

# Installation Manual

## Super-Rail Eco, Post Distance 2.0 m (SR Eco)

H2-W4-B ( $W_N = 1.3$  m;  $D_N = 0.7$  m; test length = 52 m)

Content	Page
1. General.....	1
2. Storage and handling .....	2
3. Setting up posts .....	2
4. Strip foundations .....	4
5. Installation height and limits of shoulders .....	4
6. Assembly.....	6
7. Bolting .....	7
8. Adjustments on site.....	7
9. Installation in curves.....	8
10. Flaring .....	8
11. Installation in drinking water reserves.....	8
12. Terminals.....	8
13. Transitions.....	9
14. Additional components.....	9
15. Repair.....	10
16. Reusability of parts.....	11
17. Inspection and maintenance .....	11
Annex I: Installation Drawings acc. to RAL-RG 620 .....	12
Annex II: Assembly Instructions Super-Rail Eco.....	14
Annex III: Data sheet.....	16

### 1. General

For the assembly and installation of Super-Rail Eco with a post distance of 2.0 m (SR Eco), basically the regulations of RAL-RG 620 in their current version apply. In addition, the requirements shown below have to be met precisely in order to achieve the performance of the Initial Type Test (ITT) as declared in the test reports (see data sheet in Annex III). If the requirements are not complied with during installation without consulting the manufacturer, any liability for defects of the product passes from the manufacturer to the installer.

This construction product has been tested to EN 1317. The test results were achieved under the conditions described in the test report. However, the test report scenario cannot cover all applications that may occur in practice. Therefore, this installation manual defines the boundary conditions for installation in correspondence with the state of the art as set out in German installation regulations RAL-RG 620, ZTV-PS 98 and RPS 2009. Provided that these conditions are fulfilled, the barrier system can be expected to perform effectively.

The assembly drawings of the tested product correspond to RAL-RG 620 drawing S1.1-370 and drawing B1.1-403 (bolting); see Annex I.

This construction product does not contain any toxic substances or dangerous substances that must be monitored.

For an installation in accordance with RAL-RG 620, installation teams have to be permanently supervised by qualified personnel<sup>1</sup>. Self-inspection tests as required in RAL-RG 620 must be carried out, recording the results in accordance with Annex 9 of RAL-RG 620.

In regions where the minimal outside air temperature  $T_{\min}$  in accordance with EN 1991-1-5/NA is below  $-24^{\circ}\text{C}$ , the installation requires the manufacturer's written confirmation. Within Germany, the product installation can be expected to be unaffected by the ambient temperature with the exception of repairs, see section 15.

The durability of the construction product, including the foundation structure, is guaranteed by the fact that all components are galvanized. This also applies for places with a corrosive environment such as in industrial or sea atmospheres. Information on the assessment methods and the assessment of durability are contained in RAL-RG 620 and EN ISO 1461 or EN 10346.

In case the space requirements for the working width cannot be fulfilled due to the local situation and confined space, it has to be contemplated whether a another restraint system like Super-Rail (SR) or Super-Rail VZB (SR VZB) can be considered more suitable in the specific situation.

To the beginning and end of the installed length, transitions or terminals must always be added.

## **2. Storage and handling**

All safety barrier parts have to be stored and handled properly. Manufacturer-specific requirements such as procedure instructions for storage and transport have to be observed.

The parts must be protected against dirt, corrosion and damage. Parts that are laid out for assembly must be assembled as soon as possible. Only lay out as much material at operation sections as can be installed within one day.

## **3. Setting up posts**

The soil in front of and under the safety barrier must be compacted so that it is sufficiently strong to bear the load of passenger cars.

Posts are driven into the ground with a pneumatic or hydraulic ram and a hammer head-piece for C-posts.

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<sup>1</sup> The term of "qualified personnel" applies for certified guard-rail assembly personnel or "certified skilled assembly fitters for safety barriers" according to RAL-RG 620, for instance.

The hammer of a pneumatic pile driver should have an impact energy (for single impacts) of at least 420 Nm at 6 bar. For hydraulic pile drivers, a pressure of at least 70 bar is recommended.

Before beginning the piling works, all available information must be acquired regarding utility lines (cables, pipelines, etc.) in the installation area. Instructions regarding the protection of cables as issued by the utility companies must be adhered to.

For the piling of posts, soils are subdivided into the following soil classes<sup>2</sup>:

- |   |                   |
|---|-------------------|
| - Top soil and flowing soils (e.g. sand):           | soil classes 1-2; |
| - Light, medium and hard soils:                     | soil classes 3-5; |
| - Light rock (e.g. limestone) and comparable soils: | soil class 6;     |
| - Hard rock (e.g. granite):                         | soil class 7.     |

Piling of posts in soils of classes 1 and 2 is not permitted. In case such kind of soil is present, special arrangements must be agreed on with the client. The soil may have to be substituted or strip foundations may have to be built (see section 4).

In soil classes 3-6, posts must be driven to a depth of 1.00 m. In exceptional cases (ramming obstacles) the embedment length of individual posts may be reduced. For the individual soil classes, minimum embedment lengths are:

- soil classes 3-5: 0.90 m;
- soil classes 6-7: 0.80 m;

Any reduction of the posts length is only admissible with a written approval of the client. If a reduction of the post embedment length is not advisable, special arrangements (single dug-in posts or posts with footplate, strip foundations etc.) can be agreed on with the client.

In case the piling time exceeds 4 minutes and the top of the post is deformed or damaged, or the post deviates significantly, the installation methods as for soil class 7 (drilling; see below) apply.

In soil class 7 and if the soil contains slag, the posts must always be inserted into bore holes. In these cases, the embedment length of the posts may be reduced to 0.80 m. The system can only be installed in soils of class 7, if the solid rock is covered by a 20-cm-layer (min.) of verge material. The bore holes must be filled with sand before the posts are driven into the filled hole. The minimum diameter for the holes is 15 cm.

On paved surfaces (bituminous or concrete paving, e.g. asphalt), instead of SR Eco the system Super-Rail eco MÜF has to be installed acc. to RAL-drawing S1.3-370 and the relevant manual.

During piling, only a moderate deformation of the post heads is permissible.

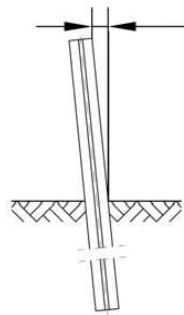
Since even a single stone may be a piling obstacle, the following procedure must be followed depending upon the required piling times: in case that the piling time exceeds 4 minutes (driving obstacles outside the defined soil classes, e.g. highly compacted soil with

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<sup>2</sup> A suitable definition of soil classes is given in DIN 18300, e.g.

bigger stones) but the piling progresses continuously, then the driving procedure for soil class 6 applies. In case the piling progress stops within the 4 minutes window (e.g. if the post hits a concrete foundation), the procedure for soil class 7 applies with the difference that a shortening of the posts is only permissible up to a minimum embedment length of 90 cm.

Single obstacles (e.g. big stones) that are found at a depth of less than 50 cm are to be removed.



The posts must be driven plumb-vertically. Deviations are permissible up to  $\pm 10\%$  of the total post installation height above ground (that is 8.9 cm deviation at standard installation height). In some cases, individual posts may shift or turn more than 10% due to driving obstacles in the soil (e.g. stones, roots). If this is occurring at more than 20% of the posts, the provisions for driving obstacles outside the defined soil classes apply (see above).

The inclination of the verge at the location where the system is installed should not exceed 12%. In justified exceptional cases and with written approval by the client, the ground inclination may be up to 1:3.

At descending slopes, it must be made sure that between the front of the system and the theoretical crown of slope, there is left a space that at least equals the dynamic deflection of the system ( $D_N = 0.7$  m). If the system has to be erected closer to the slope edge, a system with less dynamic deflection should be preferred. To go below that limit is only permissible in exceptional cases and when special arrangements (e.g. reduction of the post distance, suitably designed concrete foundations or slope improvements) are being agreed on with the client. In such a case, the use of longer posts alone would be not enough to compensate the lack of anchor ground in rear of the system.

#### 4. Strip foundations

In exceptional cases, the system may have to be installed on strip foundations. In these cases, instead of SR Eco the system Super-Rail Eco Bw has to be installed acc. to RAL-drawing S1.2-370 and the relevant manual. RAL-RG 620, chapter 1, paragraphs 5.7.11 and 5.7.12 also apply.

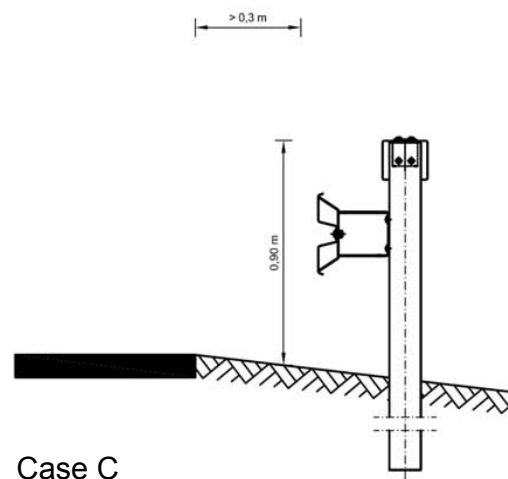
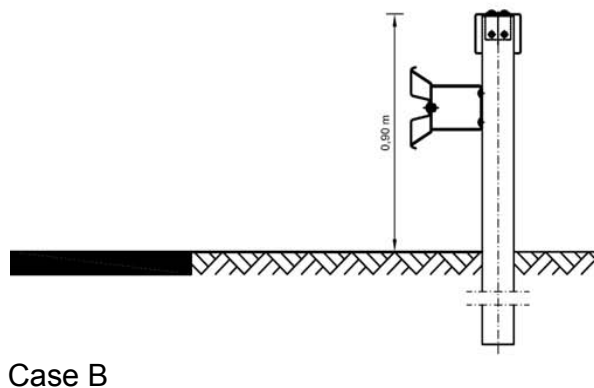
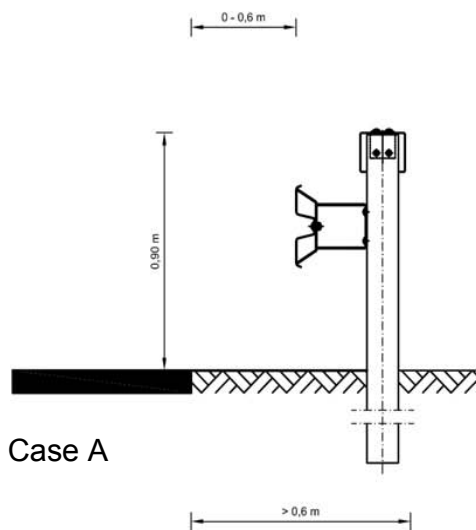
#### 5. Installation height and limits of shoulders

The standard installation heights of the system are 90 cm  $\pm 3$  cm for the upper box beams and 70 cm  $\pm 3$  cm for the guardrail beams, measured from the road surface to the top of the beam (see Case A). The standard installation distance between the front end of the system and the road edge is 50 cm.

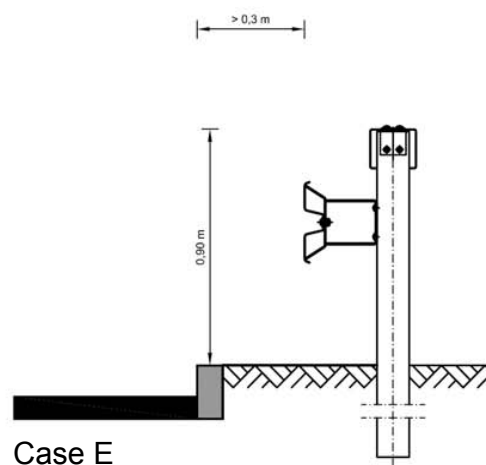
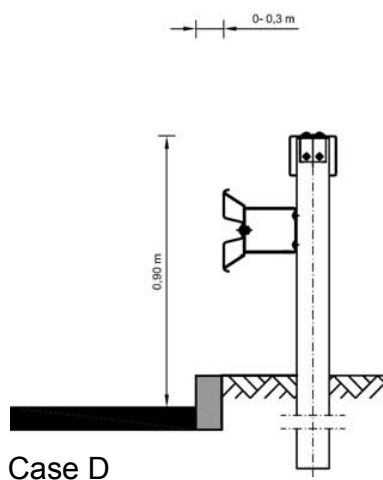
Despite the above, the height of the guardrail beam must be measured directly in front of the system in case the front edge of the guardrail beam is installed

1) at a distance of a  $> 60$  cm from the edge of the paved road edge (see Case B) or

2) at a distance of a  $> 30$  cm from the edge of the paved road edge and the verge has a transverse inclination of more than 12% (i.e. 1:8.33) (see Case C). The maximum inclination permissible is described in section 3.



Kerbs with a level difference of more than 7.5 cm should be avoided, level differences of more than 20 cm are not permissible. If kerbs with a maximum height of 20 cm cannot be removed, one of the following solutions should be chosen in consultation with the client:



If possible the system should be placed so that the front edge of the guardrail beam is aligned with the front edge of the kerb. In case the distance from the front edge of the kerb is not more than 30 cm (Case D), the installation height is measured from the carriageway

surface. In case the distance from the front edge of the kerb is > 30 cm (Case E) the height of the guardrail and box beams is to be measured from the top edge of the kerb.

Any other installation heights are only permissible in justified and locally limited exceptions. The written approval of the client is required in these cases.

## 6. Assembly

Only parts that have been manufactured or supplied by a RAL-supplier are permitted.

The construction product does not include any components that have been preassembled at the factory and no pre-stressed parts.

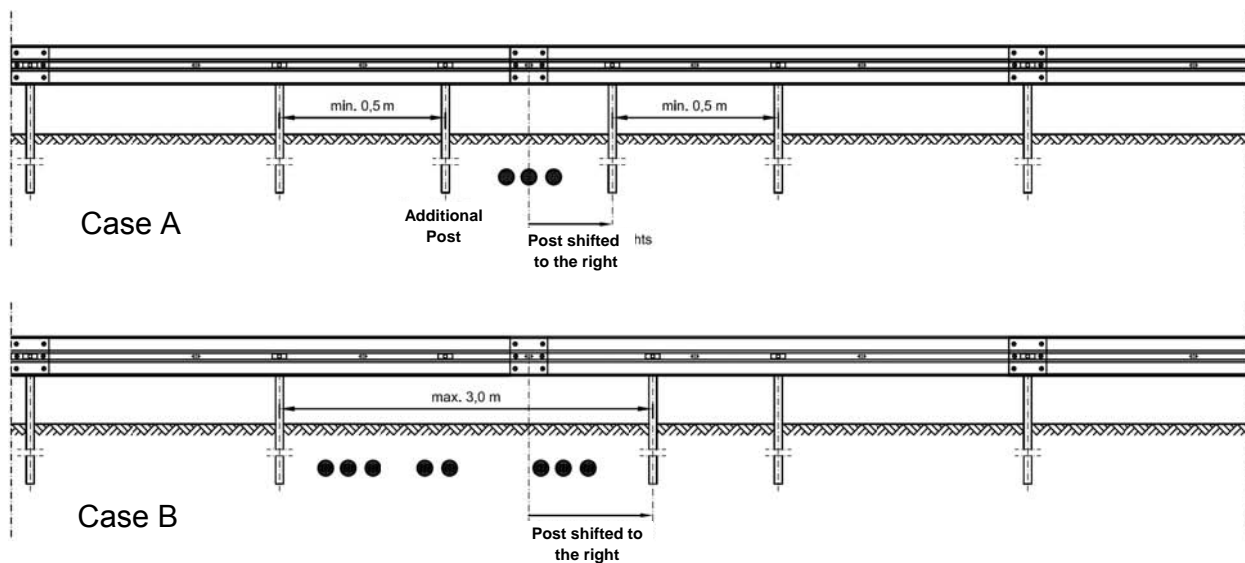
The guardrail beams must overlap in the traffic direction. The posts are to be installed with their closed sides towards the traffic (see Assembly Instructions in Annex II).

The box beam joints must be placed with lateral off-set to the right of the guardrail beam joints (see Assembly Instructions in Annex II) – the off-set is 1.10 m at the right side of the carriageway and 0.90 m at the left side of the carriageway.

As a rule, a 2.0 m post spacing must not be exceeded. Where a post cannot be installed in the place intended, e.g. due to a shaft or a crossing utility line, this post have to be shifted. As this necessarily leads to a post distance of more than 2.0 m, an additional post must be applied (see Case A).

Where the piling obstacle is so wide that the additional post would have to be positioned closer than 0.5 m to the next regular post, the additional post may be omitted as an exception (Case B), provided that the distance between two posts does not exceed 3.0 m.

This and all other special measures in that concern (e.g. single dug-in posts or concrete foundations) have to be agreed on with the client.



More details regarding the assembly of the system are provided by the Assembly Instructions in Annex II.

## 7. Bolting

Only bolts that have been manufactured or supplied by a RAL-supplier are permitted.

The bolts have to sit vertically in their holes and must be fixed properly (see Assembly Instructions in Annex II).

The bolts M 10x45 connecting the posts and the fastening angle must be hand-tight. This corresponds to a torque of 17 Nm minimum.

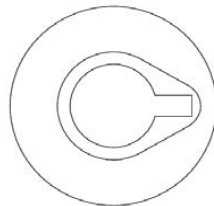
All other bolts (M 16x27 connecting the guardrail beams at their joints, M 16x30 at the butt joints of the box beams as well as M 16x45 connecting the deformation brackets with the beams and posts) must be tightened with a torque of at least 70 Nm.

It is recommended to use an impact wrench that can be adjusted for the required torque (max. 500 Nm).

The tools required for fixing the bolts are wrench sockets or wrenches in the following sizes:

- for M16 AF 24 mm;
- for M10 AF 17 mm or AF 16 mm (depending upon bolt standard)

When bolting the beam joints, it has to be ensured that the nib of the button-head screw is located at the centre of the drop hole (see sketch below).



Only hot-dip galvanized bolts must be used. The strength grades of 4.6 or 8.8 respectively must be strictly adhered to.

Reuse of bolting materials is not permissible.

## 8. Adjustments on site

The following applies where posts or longitudinal elements need to be shortened:

- Use a saw or cutting-off machine and deburr cut edges
- Drill holes properly
- Observe hole diameters and spacing as per the specifications of the relevant RAL-RG 620 drawing
- Protect cut edges and drilled holes against corrosion by using zinc dust coating (in acc. w. EN ISO 1461)

Thermal processing such as welding or flame-cutting are not permissible.

## 9. Installation in curves

Guardrail beams must be installed tension- and stress-free. In bends with a radius of  $< 30$  m pre-bent beams (so-called radius-beams) must be used. Radius-beams are available in various lengths staggered in steps of 2.5 m:

25 m – 22.5 m – 20 m – 17.5 m – 15 m – 12.5 m – 10 m – 7.5 m – 5 m – 2.5 m.

The difference between inside and outside bends must be taken into account. For outside bends, convex radius beams must be used while in inside bends concave radius beams are to be installed. Guardrail beams must not be bent on site or upon installation with such force that they are permanently deformed.

When installing radius beams ensure that the overlap at joints does not have any gaps. It is recommended to first tighten the bolts at the joints and then to fix the beams at the deformation brackets.

Holes must not be widened, e.g. by means of broaching.

The following box beams are to be used in curves:

- Radius  $> 100$  m: 4-meter box beam
- Radius  $> 50$  m: 2-meter box beam
- Radius  $> 35$  m: 1.33-meter box beam

## 10. Flaring

Flaring with an inclination of 1:20 (1:12 in exceptional cases) is permitted.

In case a guardrail section begins at a rising slope, it may be turned sideways and terminated in the cut slope. Post distances, fixing and terminal pieces must be executed as for the tested terminal. Installation heights as given in section 5 must be adhered to.

In the area of the flare, the ground in front of and under the systems must be compacted so that it is sufficiently strong to bear the load of passenger cars (also see section 3). Ditches must not be traversed.

## 11. Installation in drinking water reserves

If the piling of posts would impair the aquifer or its sealing membrane, the system must be erected on a strip foundation (see section 4).

## 12. Terminals

As a rule, the regular 12-m-terminal in accordance with RAL-RG 620, drawing S4.1-120 is to be installed. The terminals are to be connected to the system by a transition to EDSP (Flextra SR Eco-EDSP acc. to drawing S3.1-370 of RAL RG 620) and an additional run of EDSP/2.0 of at least 4.0 m length.

In exceptional cases, a 4 m short terminal may be installed, provided that in public traffic areas it is not installed in traffic direction (e.g. at junctions with tracks through fields).



### 13. Transitions

The following safety barriers may be connected to SR Eco:

a) by means of a transition element:

- SR Eco Bw (RAL-RG 620, drawing S3.1-373)
- SR Eco MÜF (equivalent to RAL-RG 620, drawing S3.2-373)
- SR Eco doppelt ((RAL-RG 620, drawing S3.1-331)
- SR (RAL-RG 620, drawing S3.1-322)
- SRL (RAL-RG 620, drawing S3.1-351)
- SRL Bw (RAL-RG 620, drawing S3.2-351)
- SR Bw (RAL-RG 620, drawing S3.2-322)
- SR VZB (RAL-RG 620, drawing S3.1-322)

b) by means of a tested transition:

- EDSP/2.0 (Flextra SR-EDSP, RAL-RG 620, drawing S3.1-320)
- Concrete Wall, Step or New Jersey (Flextra SR-C, RAL-RG 620, drawings S3.1-325/326)

c) by means of an untested, modified transition:

- EDSP/1.33 (Flextra SR-EDSP, RAL-RG 620, drawing S3.1-320)
- EDSP/1.33 Bw (RAL-RG 620, drawing S3.2-321)
- SR+ (RAL-RG 620, drawing S3.1-316)
- SR+ Bw (RAL-RG 620, drawing S3.1-316)

Connecting any other safety barriers requires the written approval of the manufacturer<sup>3</sup>.

### 14. Additional components

The following additional components may be mounted to the system:

- Guiding posts fixed to the post.
- Guiding posts fixed to the beam joint. In that case, the bolt with nib M 16 x 27 as specified in the drawing is to be substituted by a button head bolt M 16 x 45.
- Guardrail beam reflectors fixed to the beam at the centre holes using button head screws.

Due to the structural design, the system can be climbed over by pedestrians. In justified exceptional cases, a rear-side climb-over aid may be installed with the written consent of the client.

Any installation of an additional component (e.g. top rails, anti-dazzle protection, traffic signs) requires the written consent of the manufacturer. These additional components can only be installed if changes to the system's behaviour are ruled out and this is certified by a

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<sup>3</sup> Transitions that are permitted in Germany are listed in the "Einsatzfreigabeliste" issued by BASt (Bundesanstalt für Straßenwesen - Federal Road Research Laboratory).

notified body. The fixing instructions for the respective additional component have to be followed.

Traffic signs may be installed within the working width, if they are designed to be run over or sheared off.

## 15. Repair

As a general rule, all system parts showing a permanent (plastic) deformation must be replaced.

If only a guardrail beam or a deformation tube are deformed after an impact, the system still provides sufficient residual protection against break-through.

In case damaged components are being replaced, special care must be taken regarding the joints between damaged and undamaged beams. The beams remaining after dismantling must not be damaged by the use of angle grinders, mandrels or hammers.

Due to temperature-related changes of length or major deflection after heavy collisions, the hole patterns of the beam joints may no longer match when connecting new beams to the remaining barrier. If the longitudinal deviation of the hole axes does not exceed 5 cm, the beams can usually be adjusted by loosening the bolts at several joints and retightening them after adjustment. If that is not, the following procedure is to be applied:

If repair work is carried out at very low temperatures, the new beams tend to be too short. In that case, the installation length between the post axes is greater than 4.00 m (e.g. 4.07 m), or, in other words, the beams overlap by less than 30 cm. This would be not permissible, so that two fitting beam pieces must be cut for achieving the needed length > 4.00 m. (for our example: 2.00 m + 2.07 m = 4.07 m). An additional post is not required.

At high temperatures or in the case of major deflection, the overlap of the bars is usually greater than 30 cm. In that case, fitting pieces are not necessary, but new holes need to be drilled. However, this is only permitted where the distance between the outer edges of the new and of the existing boreholes is greater than 2.5 cm.

Generally, both the use of fitting pieces and the drilling of new boreholes should be avoided, even if this means further effort due to dismantling and re-installing of the adjoining barrier.

Widened holes around posts in the verge must be re-compacted so that the posts newly driven are sufficiently fixed in the ground. Multiple damages at the same spot can make it necessary to completely refill the verge or to install additional posts. Please consult the client regarding these works.

After finishing installation works at roads already in operation (e.g. in case of repair), surplus materials have to be removed completely, so that the road is ready for operation. In case that the works are interrupted for several hours, the barrier ends must be left completely screwed and furnished with a fully-fixed temporary slope-down terminal (lowering angle, one beam, head piece - lying on the ground).

## 16. Reusability of parts

Used barrier parts (including butt plates, connecting plates and others) may be re-used for retrofitting and/or conversions, provided that:

- the parts do not have any visible deformation and/or damage (e.g. torn open, widened or burned out holes);
- structural parts have a residual zinc layer of  $\geq 30 \mu\text{m}$  (pre-galvanised steel:  $\geq 15 \mu\text{m}$ );
- the manufacturer's mark and the test period mark are still visible on components which require marking.

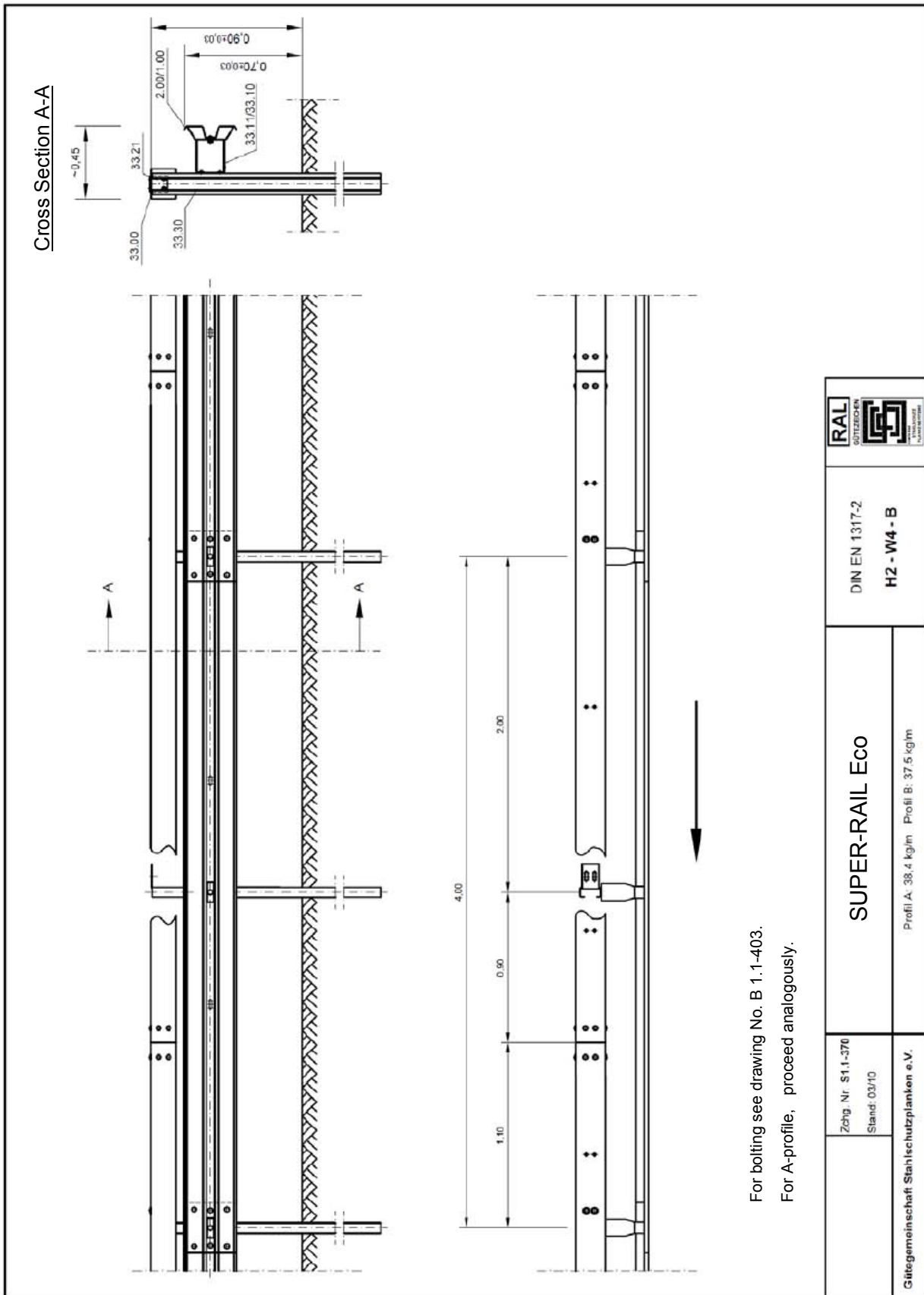
Reused barrier parts with a minimum residual zinc layer of  $55 \mu\text{m}$  (pre-galvanised steel with coating ZA300:  $\geq 17 \mu\text{m}$ ; with coating Z600 or ZA600:  $\geq 32 \mu\text{m}$ ) can be expected to have the same durability as new parts.

Fixing material (bolts, nuts, washers) that has been used before must not be used again. Only new fixing material must be used. For repairing damage caused by accidents new material must be used exclusively.

Components that cannot be used any more must be destroyed (e.g. by cutting off parts or dividing it) and recycled. The same applies for removed fixing material.

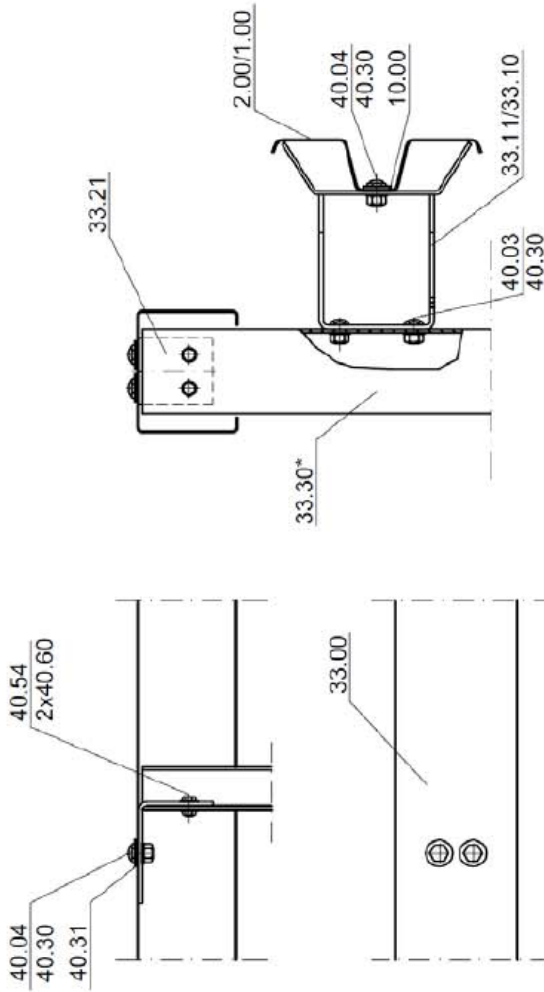
## 17. Inspection and maintenance

There are no specific requirements with regard to inspection and maintenance.



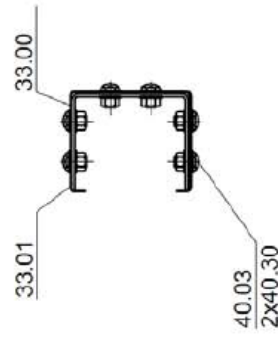
S1.1-370

Screwing Details Posts

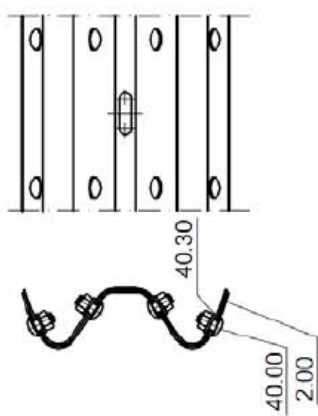


\* For Super-Rail Eco Bw 33.40 or 33.41, resp.

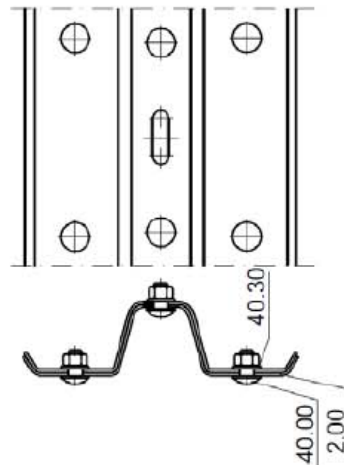
Crosssection A-A



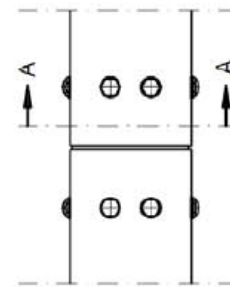
Screwing Beam Joints A-Profile



Screwing Beam Joints B-Profile

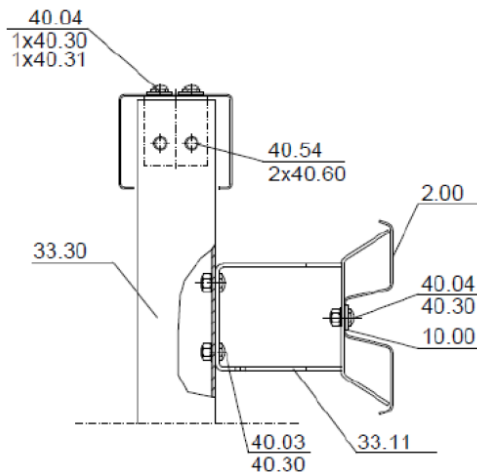
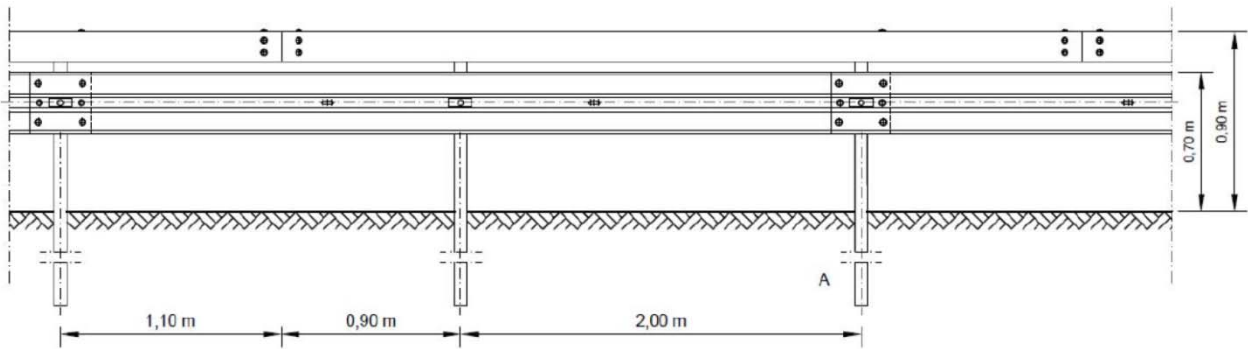


Screwing Box Beam Joints



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	SUPER-RAIL Eco Bolting Details	
Zchg. Nr. B1.1-403 Stand: 03/10		
Gütegemeinschaft Stahlenschutzplanken e.V.		

## Annex II: Assembly Instructions Super-Rail Eco



### Pieces per 4 m:

6/8 pcs.	40.00	Bolt, button head, M 16x27, 4.6 incl. nut
16 pcs.	40.03	Bolt, button head, M 16x30, 8.8 incl. nut
6 pcs.	40.04	Bolt, button head, M 16x45, 8.8 incl. nut
4 pcs.	40.54	Bolt, hexhead, M 10x45, 8.8 incl. nut
40/42 pcs.	40.30	Washer 18
4 pcs.	40.31	Washer 40/18/4
4 pcs.	40.60	Washer 11
2 pcs.	10.00	Butt Plate M16

### Locking torque:

Bolt M 10: finger-tight  
 Bolt M 16: 70 Nm, max. 140 Nm  
 Mount A and B Profile analogously



Post C-125: 2.0 m (33.30)

Post distance: 2.0 m

Post height: 0.89 m  
 tolerance  $\pm 3$  cm

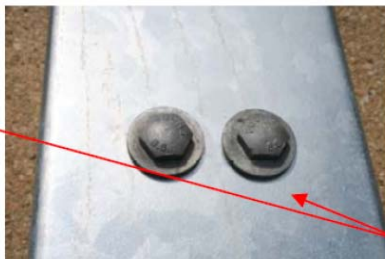
Distance posts to road edge =  
 Distance system to road edge +30 cm



**Fastening angle**  
 (Part No. 33.21)

**Connection to post:**

2 pcs. Hexhead bolt M 10x45,  
**Grade 8.8** incl. nut (40.54),  
 and 4 washers 11 (40.60), one under each bolt head and one under each nut



**Connection to box beam:**

2 pcs. Button head bolt M 16x45, 8.8 incl. nut (40.04), each with one washer 40/18/4 (40.31) under bolt head and one washer 18 (40.30), under nut

		<p><b>Box beam (33.00)</b> to be put to post from above</p> <p><b>Connection to butt joint (33.01):</b> 12 pcs. button head bolt M16x30, 8.8 incl. nut (40.03) and 12 pcs. washers 11 (40.60), one under each bolt head and one under each nut</p>
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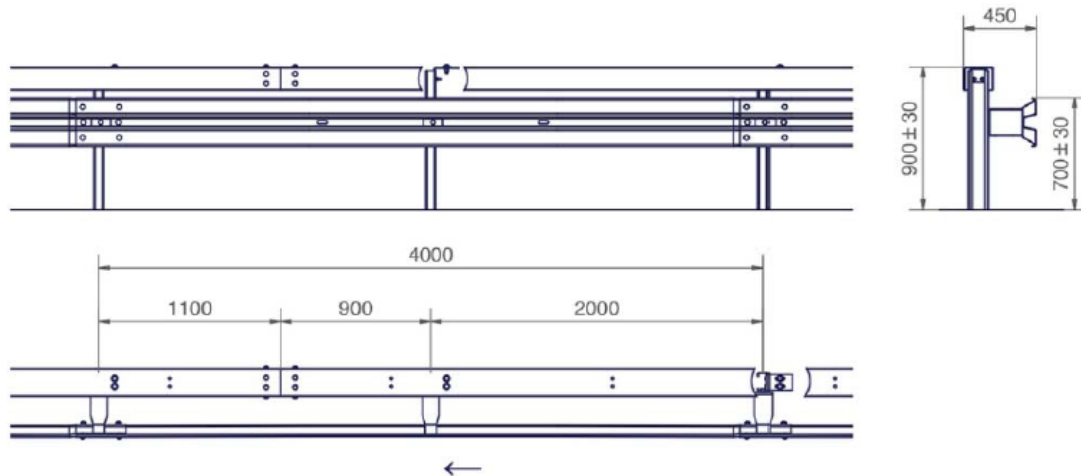
		<p>Box beam joints to be placed with lateral off-set to guardrail beam joints.</p> <p>Right side of the carriageway: 1.10 m off-set</p> <p>Left side of the carriageway: 0.90 m off-set</p> <p>Off-set of box beam <b>to the right</b> of guardrail beam.</p>
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		<p>Deformation Bracket (33.10/33.11)</p> <p><b>Connection to post:</b> 2 pcs. button head bolt M16x30, 8.8 incl. nut (40.03) and 2 pcs. washers 18 (40.30) under nuts</p> <p>Jog to bottom.</p>

		<p>Guardrail beam (01.00/02.00)</p> <p><b>B-Profile:</b> 6 pcs. button head bolt with nib M16x27, 4.6 incl. nut (40.00) and 6 pcs. washers 18 (40.30) under nuts</p> <p><b>A-Profile:</b> 8 pcs. button head bolt with nib M16x27, 4.6 incl. nut (40.00) and 8 pcs. washers 18 (40.30) under nuts</p> <p>Fishplates (10.00) and button head bolt M16x45, 8.8 incl. nut (40.04) and washer 18 (40.30) under nuts</p>
<p>Joints to overlap in direction of traffic</p>		

## Annex III: Data sheet

	<b>Super-Rail Eco</b>	Dated: 18.12.2013
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The single-sided vehicle restraint system for installation on driven posts is comprised of galvanised components acc. to RAL-RG 620. The lengths of the beams and posts as well as the dimensions of the deformation brackets are determining the shape of each segment. The system is characterised by its beams of 4 m length and a post spacing of 2.00 m. The open box beams are fixed to the posts by fastening angles. The open box beams are connected by butt joint connectors positioned inside of the beams. The joints of the guardrail beams overlap in direction of traffic. They are connected to each other by multiple screwings and connected to the posts by deformation brackets.

<i>System Name</i>	Super-Rail Eco
<i>EG Certificate of Conformity</i>	0009-CPD-2011
<i>Initial Type Tests</i>	TB11: PSG 60 TB51: PSG 59
<i>Typic Material</i>	Steel
<i>System Width</i>	0.45 m
<i>System Height (form Road Surface)</i>	0.90 m
<i>System Length (Unit)</i>	4.00 m
<i>Weight per m of System Length</i>	38.5 kg (A) / 37.5 kg (B)
<i>Installation Length</i>	52 m
<i>Tested Installing Method</i>	driven posts

<b>Performance acc. to EN 1317</b>	
<b>Containment Level</b>	<b>H2</b>
<b>Working Width (<math>W_m</math>)</b>	<b>W4 (1.3 m)</b>
<b>Impact Severity Level</b>	<b>B</b>
<b>Dynamic Deflection (<math>D_m</math>)</b>	<b>0.7 m</b>
<b>Vehicle Intrusion (<math>VI_N</math>)</b>	<b>No performance determined (NPD)</b>

Nº 2013022