

Installation Manual

Super-Rail ES, Post Distance 1.0 m (SR ES/1.0)

L1-W2-A ($W_N = 0.8$ m; $D_N = 0.7$ 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	6
8. Adjustments on site.....	7
9. Installation in curves.....	7
10. Flaring	7
11. Installation in drinking water reserves.....	8
12. Terminals.....	8
13. Transitions.....	8
14. Additional components.....	8
15. Repair.....	9
16. Reusability of parts.....	10
17. Inspection and maintenance	10
Annex I: Installation Drawings acc. to RAL-RG 620	11
Annex II: Assembly Instructions Super-Rail Eco.....	13
Annex III: Data sheet.....	15

1. General

For the assembly and installation of Super-Rail ES with a post distance of 1.0 m (SR ES/1.0), 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 S1.1-400 and drawing B1.1-103 (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 personnel¹. 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°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 the distance to the road (standard distance 0.50 m; also see section 5) can be reduced.

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 Sigma-posts.

¹ 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 classes²:

- | | |
|---|-------------------|
| - 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 ES/1.0 the system Super-Rail eco MÜF has to be installed acc. to RAL-drawing S1.3-370 and the relevant manual.

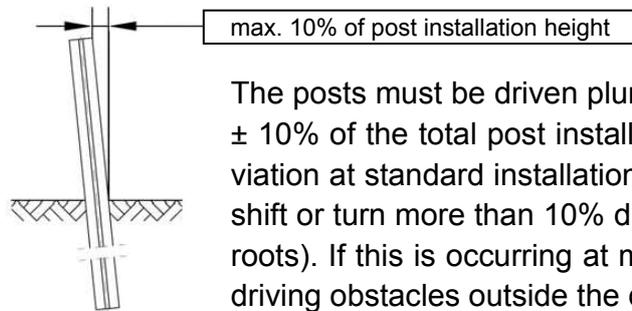
During piling, only a moderate deformation of the post heads is permissible.

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

² 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 7.0 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 for containment classes L1/H1 and $D_N = 0.5$ m for class N2, respectively). 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 this 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

An installation on strip foundations is not permissible.

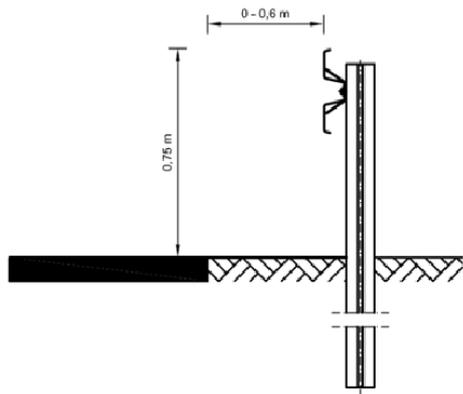
5. Installation height and limits of shoulders

The standard installation height of the system is 75 cm \pm 3 cm, 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.

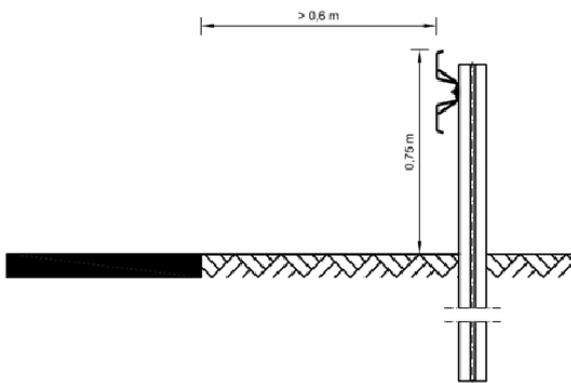
Despite the above, the height of the guardrail beam must be measured directly in front of the system in case the front edge of the guardrail beam is installed

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

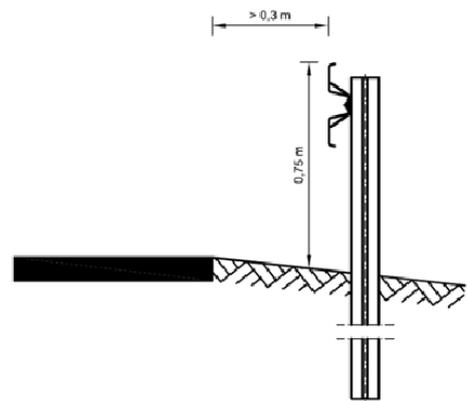
2) at a distance of a > 30 cm from the edge of the paved road edge and the verge has a transverse inclination of more than 12% (i.e. 1:8.33) (see Case C). The maximum inclination permissible is described in section 3.



Case A

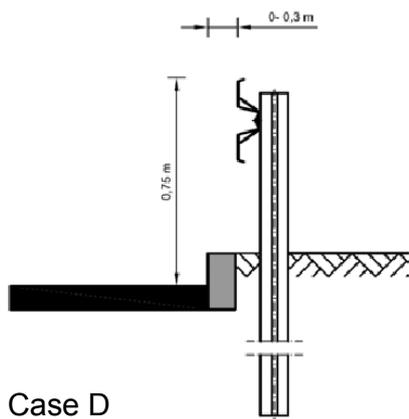


Case B

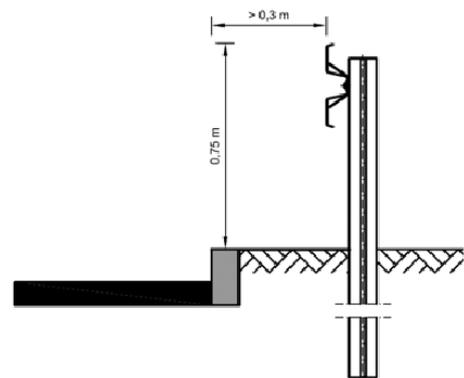


Case C

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:



Case D



Case E

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).

As a rule, the standard post spacing of 1.0 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 one post may be left out with approval of the client.

The distance between two posts must never exceed 2.0 m. In case of further piling problems, special measures (e.g. single dug-in posts) 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 beams must be hand-tight. This corresponds to a torque of 17 Nm minimum.

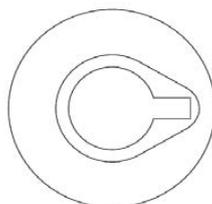
The bolts M 16x27, connecting the guardrail beams at their joints, must be tightened with a torque of at least 70 Nm.

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 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.

Radii of more than 30 m can be achieved without pre-bent guardrail beams.

For Radii ≤ 25 m, the reinforcement beams also have to be pre-bent in the same extent as the guardrail beams. Reinforcement beam for Radii ≤ 10 m are also available without punched joint holes, as drilling is required here in any case.

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 posts.

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

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

The system must not be installed, if the piling of posts would impair the aquifer or its sealing membrane.

12. Terminals

As a rule, the regular 12-m-terminal in accordance with RAL-RG 620, drawing S4.1-110 is to be installed. 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 ES/1.0:

a) by means of a transition element:

- SR ES/1.33
- ESP+ W1

b) by means of an untested, modified transition:

- ESP/4.0 (multiple transition consisting of 8 m SR ES/1.33, 4 m SR ES/2.0 and 4 m ESP/2.0)
- ESP/2.0 (multiple transition consisting of 8 m SR ES/1.33 and 4 m SR ES/2.0)
- ESP+/2.0 (multiple transition consisting of 8 m SR ES/1.33 and 4 m SR ES/2.0)
- EDSP/2.0 (multiple transition consisting of 8 m SR ES/1.33 and a construction acc. to drawing S3.1-127 of RAL GR-620)

Connecting any other safety barriers requires the written approval of the manufacturer³.

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.
- Gliding protection for pedestrians and cyclists (RAL GR-620 drawing S5.1-301)

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

³ 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.

Due to the structural design, the system can be climbed over without additional climb-over aids.

15. Repair

In case of any permanent (plastic) deformation, the system does not provide sufficient residual protection against break-through anymore.

All system parts showing a permanent (plastic) deformation must be replaced.

Guardrail sections up to 30 cm that have become out of line may be re-aligned if parts are not permanently deformed.

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: $2.00 \text{ m} + 2.07 \text{ m} = 4.07 \text{ m}$). 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 com-

pletely 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.

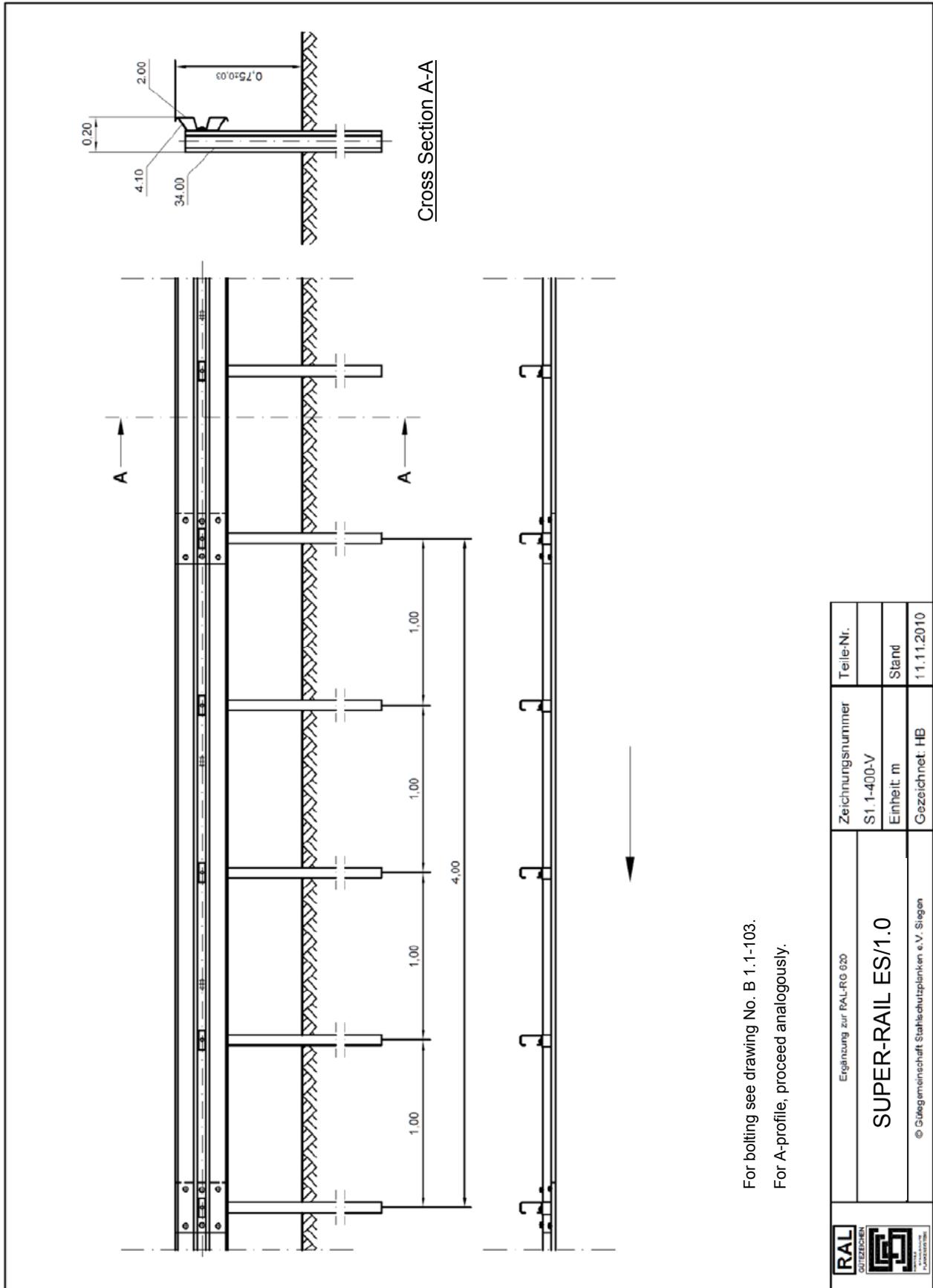
Fixing material (bolts, nuts, washers) that has been used before must not be used again. Only new fixing material must be used. For repairing damage caused by accidents new material must be used exclusively.

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.

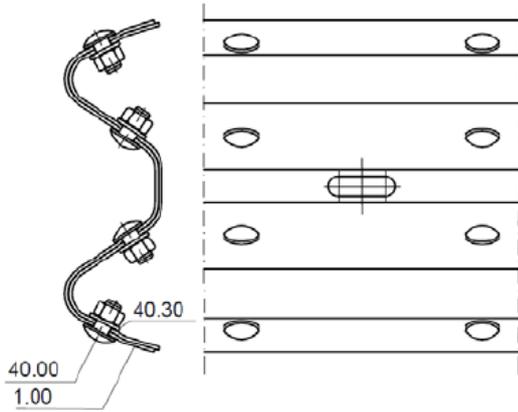
Annex I: Installation Drawings acc. to RAL-RG 620



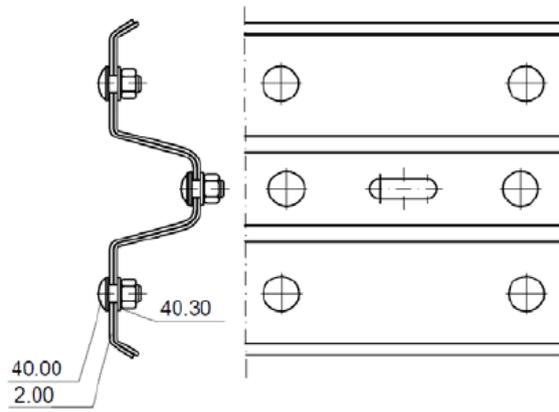
For bolting see drawing No. B 1.1-103.
For A-profile, proceed analogously.

	Ergänzung zur RAL-RG 620		Teile-Nr.
	SUPER-RAIL ES/1.0		Stand
© Gütegemeinschaft Stahlchutzplanken e.V. Siegen		Zeichnungsnummer S1.1-400-V	11.11.2010
		Einheit: m	
		Gezeichnet: HB	

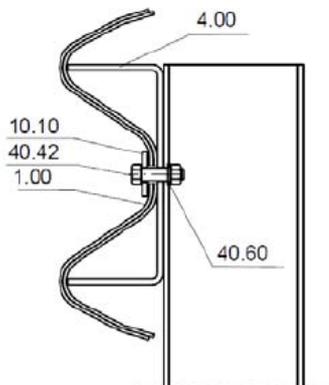
Screwing Beam Joints A-Profile



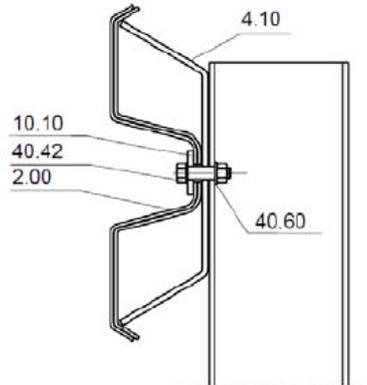
Screwing Beam Joints B-Profile



Screwing Posts A-Profile

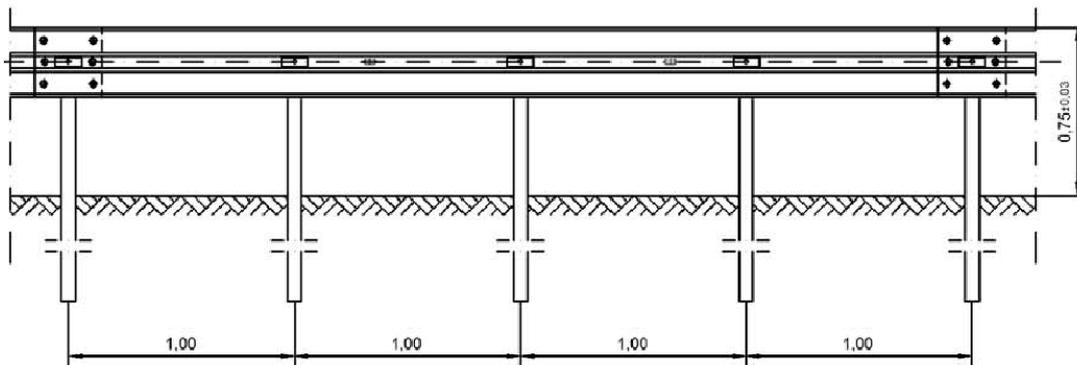


Screwing Posts B-Profile



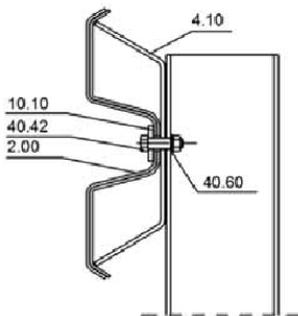
	Ergänzung zur RAL-RG 620		Zeichnungsnummer	Teile-Nr.
	SUPER-RAIL ES Screwing Details		B1.1-103	
			Einheit:	Stand
	© Gütegemeinschaft Stahlenschutzplanken e.V. Siegen		Gezeichnet: HB	11.11.2010

Annex II: Assembly Instructions Super-Rail ES



Pieces per 4 m:

6/8 pcs.	40.00	Bolt, button head, M 16x27, 4.6 incl. nut
6/8 pcs.	40.30	Washer 18
4 pcs.	40.42	Bolt, hexhead, M 10x45, 4.6 incl. nut
4 pcs.	40.60	Washer 11
4 pcs.	10.10	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: 1.74 m (34.00)

Post distance: 1.0 m

Post height: 0.70 m
 tolerance ± 3 cm

Distance posts to road edge =
 Distance system to road edge +10 cm



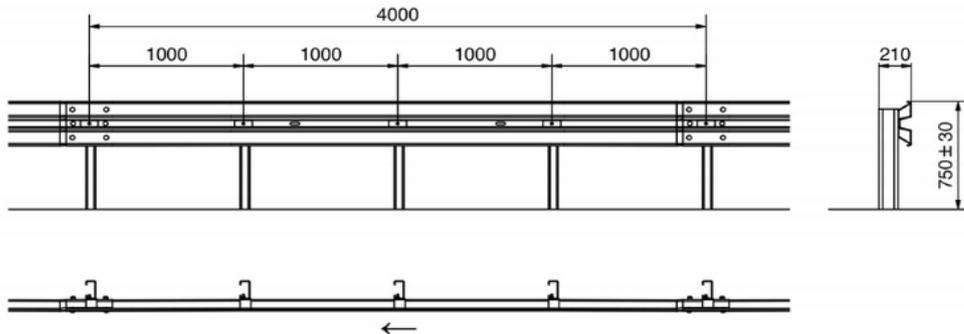
Bracket (4.00 or 4.10. resp.)

Butt Plate M 10 (10.10) and
 1 pc. bolt hexhead 10x45, 4.6
 incl. nut (40.42) with
 washer 18 (40.30) under nut

	<p>6 or 8 pcs. bolt, button head, M 16x27, 4.6 incl. nut (40.00) and Washer 11 (40.60) under nut</p>
<p>← Joints to overlap in direction of traffic</p>	

Annex III: Data sheet

	Super-Rail ES 1.00	Dated: 10.12.2014
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Die einseitige geramte Stahlschutzeinrichtung besteht aus korrosionsgeschützt ausgeführten Bauteilen nach RAL-RG 620. Die Längen der Holme und Pfosten bestimmen das Format eines Elementes. Das System ist gekennzeichnet durch seine 4 m langen Holme und einen Pfostenabstand von 1.00 m. Die Schutzplankenholme überlappen, sind mit mehrfachen Schraubenverbindungen untereinander fixiert und zusammen mit Stützbügeln an den Pfosten verschraubt.

<i>Systemname</i>	Super-Rail ES 1.00
<i>EG Konformitätszertifikat</i>	0052-CPR-2011
<i>Initial Type Tests</i>	TB11: X53.06.K08 (TÜV Süd GmbH, 2011) TB32: X53.07.K08 (TÜV Süd GmbH, 2011) TB42: X53.05.K08 (TÜV Süd GmbH, 2011)
<i>Charakteristisches Material</i>	Stahl S235 JR
<i>Systembreite</i>	0.20 m
<i>Systemhöhe (ab Oberkante Fahrbahn)</i>	0.75 m
<i>Systemlänge (Einzelelement)</i>	4.00 m
<i>Gewicht pro Meter</i>	30.8 kg (A) / 29.8 kg (B)
<i>Aufbaulänge</i>	40 m
<i>Geprüfte Einbaumethode</i>	gerammt

Leistung gem. EN 1317	
Aufhaltstufe	N2 / H1 / L1
Arbeitsbreite (W_N)	W2 (0.8 m)
Anprallheftigkeitsstufe ("ASI")	A
Dynamische Durchbiegung (D_N)	0.5 m / 0.7 m / 0.7 m
Fahrzeugeindringung (VI_N)	VI 5 (H1/L1)
Beständigkeit Schneeräumung	NPD (Keine Leistung festgelegt)

N° 2013019