

# Product data sheet re-bar

«for statically and dynamically loaded elements»



## Product data

### Post-strengthening of structures

Ø10 or Ø16 mm ribbed re-bar is end anchored in Sika repair mortar. After sufficient cure of the end anchorage, the re-bar is activated with a gas burner. Finally, the remaining free length is also embedded in mortar. The installed and bonded re-bar acts as an internal prestressing. re-bar 10 U-profiles (stirrups) are embedded in Sika repair mortar and activated using electric current.

Product	Cross-section	Max. tensile stress*	Max. tensile force*	Elongation at break
re-bar 10	89.9 mm <sup>2</sup>	520 N/mm <sup>2</sup>	<b>46.7 kN</b>	30 %
re-bar 16	211.2 mm <sup>2</sup>	520 N/mm <sup>2</sup>	<b>109.8 kN</b>	30 %

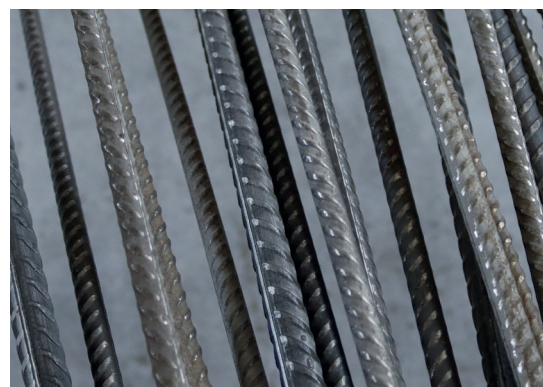
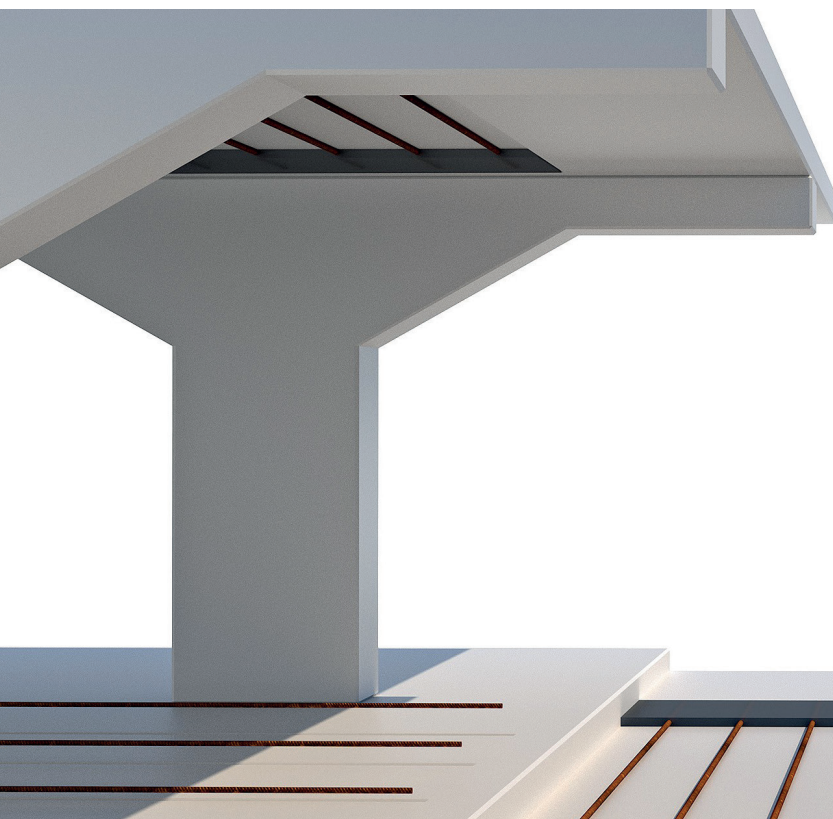
\* Design value reduced by safety factor

Product	Heating temperature	Prestressing	Prestressing force	Relaxation
re-bar 10 – bars	Gas 300 - 350 °C	400 N/mm <sup>2</sup>	<b>36.0 kN</b>	15 % t <sub>∞</sub>
re-bar 10 – U-profiles	Electricity 200 °C	350 N/mm <sup>2</sup>	<b>2 x 31.5 kN = 63 kN</b>	15 % t <sub>∞</sub>
re-bar 16 – bars	Gas 300 - 350 °C	320 N/mm <sup>2</sup>	<b>67.6 kN</b>	15 % t <sub>∞</sub>

### In concrete for new construction (concealed downstand beam)

In new concrete structures, re-bar 16 is used analog to traditional reinforcement. Activation is performed by resistive heating with electric current applied before the concrete formwork is removed.

Product	Heating temperature	Prestress	Prestressing force	Relaxation
re-bar 16 - with end hooks for electrical connection	Electricity 200 °C	250 N/mm <sup>2</sup>	<b>52.8 kN</b>	15 % t <sub>∞</sub>



**Material:**  
memory®-steel is similar to a 1.4003 alloy according to DIN EN 10088 (corrosion resistance class I).

**Storage/transport:**  
re-bar needs to be stored and transported in a dry and safe environment. The material must be protected from direct sunlight and temperatures above +40°C.

## Information

### Condition of the substrate

The concrete substrate must be able to transfer the load and must have a compression strength of  $>25 \text{ N/mm}^2$  (C20/25 acc. to EN 206-1). Damaged or chloride-contaminated concrete is removed by hydromechanical jetting or by mechanical picking and sandblasting. The substrate needs to be roughened, cleaned, and wetted according to available specifications in the data sheet of the mortar supplier. A minimal tensile adhesion strength of the concrete substrate of  $1.5 \text{ N/mm}^2$  is required (EN 1542). When re-bar is applied in grooves, information concerning geometry are to be found in the current re-fer brochure.

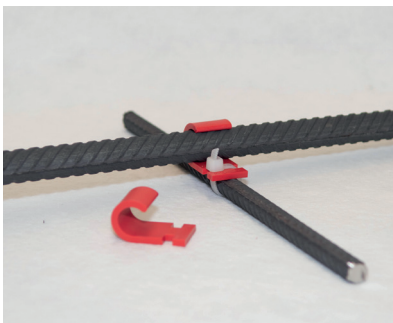
In case of insufficient strength of the concrete substrate alternative doweling systems can be applied to deliver additional anchorage resistance. The additional strengthening layer can also be applied together with steel stirrups to improve the bond and to transfer the forces to the compression zone.

## Application / Activation of re-bar

Information on the handling and the installation of our products can be found in the current re-fer brochure.

### Application for post-strengthening

re-bar is mounted in grooves or directly on the substrate. re-fer delivers the plastic holders re-clip (attach to existing reinforcement) and re-bolt (pin on concrete) for fixation. These plastic holders are installed every 1.00 m and will isolate re-bar from the conventional reinforcement (contact corrosion and isolation for electrical heating).



re-clip



re-bolt

memory®-steel has been tested in systems with Sika sprayed, concrete repair and grouting mortars. re-fer provides no guarantee if other mortars and products are used in combination with memory®-steel. Mortars must be approved for the structural repair of concrete under continuous load.

When applying re-bar on concave elements, attention should be paid to the straightening of re-bar activated by gas.

### Application in new construction

re-bar is placed directly with the conventional reinforcement. The engineer controls the strengthened sections and authorises the concreting. The electrical isolation between reinforcement and re-bar is essential. For this purpose, the plastic holders re-clip are suitable.

### Application in tunnelling

Prefabricated Sika shotcrete mortars tested in systems with re-bar are available for tunnelling.

## Activation/prestressing of re-bar

re-bar is heated with a gas burner. Heating is performed up to a temperature of 300-350 °C and in sections with a length of around 1.00 m. If plastic holders are installed, they serve to control the sectional heating and drip off when burned. A second person monitors the temperature progression. Another possibility is the activation by electric resistive heating (up to 200°C). Contact between re-bar and the internal reinforcement or other conductive parts must be prevented.

Required power supply: either **2-times** port 3x400 V, CEE 32A, 400 V, 5-poles  
or **1-time** port 3x400 V, CEE 63A, 400 V, 5-poles

All necessary processing materials and equipment can be purchased from re-fer. Upon request, re-fer offers on-site instructions by an application technician on a rental basis.

## End anchorage for plate/slab

### In Sika repair and sprayed mortar

re-bar is anchored at both ends to transfer the prestressing force. After the activation, also the middle section is embedded in mortar. The anchorage length for the prestressing process is calculated as follows. Five re-bar ( $P_0 = 67.6$  kN) per meter are examined as an example. A tensile adhesion strength of 1.5 N/mm<sup>2</sup> is considered for the force transmission (concrete with compression strength of 25 N/mm<sup>2</sup>). re-fer recommends reducing the anchorage resistance by a safety factor of 1.5.

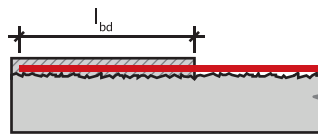
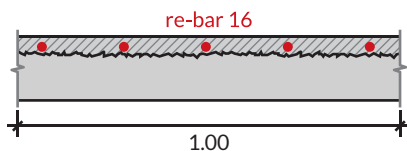
Calculation example for 5 x re-bar 16:

Total prestressing force per meter:

$$5 \times P_0 = 5 \times 67.6 \text{ kN} = 338.0 \text{ kN}$$

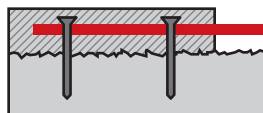
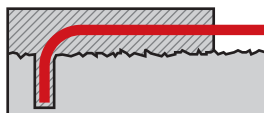
Necessary anchorage length:

$$338.0 \text{ kN} / (1'000 \text{ mm} \times l_{bd} \times 1.5 \text{ N/mm}^2) \times 1.5 \rightarrow l_{bd} \approx 35 \text{ cm}$$



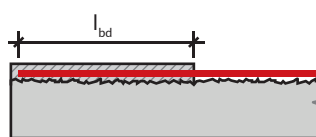
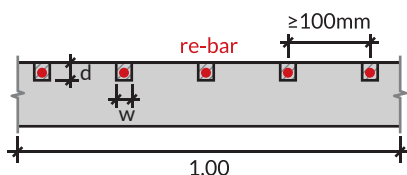
Specifications concerning minimal spacing between bars, constructional details etc. are given in local standards.

Solutions with hooks or conventional shear connectors at the anchoring zone are possible for insufficient shear bonding (very low concrete quality, cracks, limited space etc.).



### In cut grooves with Sika grouting mortar

The anchorage length for the prestressing force of re-bar in grooves refer to pull-out tests at Empa (Swiss Federal Laboratories for Materials Science and Technology) Switzerland. The results are reduced by a safety factor of 1.5. The minimal axial spacing of the grooves is 100 mm. The solutions with Sika repair and sprayed mortar applied on the entire surface shall be used in case of smaller spacings



The following values can be used for re-bar in cut grooves:

Product	Width w of groove	Depth d of groove	Design anchorage length l <sub>bd</sub>
re-bar 10	25 mm	25 mm**	400 mm*
re-bar 16	30 mm	30 mm**	600 mm*

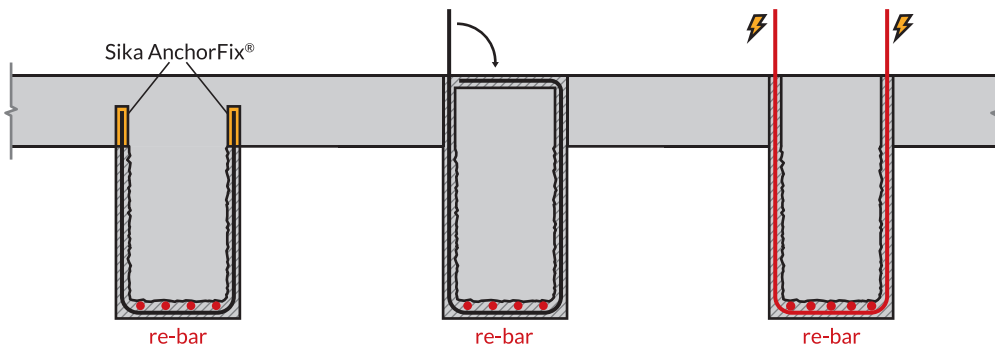
\*reduced by safety factor of 1.5

The corresponding research report (2021-003/SNSF 200021\_175998 / English) is available on request. It is possible to reduce the anchoring length for concretes of higher qualities. The re-fer engineering support will gladly help. \*\*Groove depths and corresponding mortar covers should be increased, if necessary, to comply with national standards and reach project-specific requirements on corrosion- or fire protection.

## End anchorage for beam

### In Sika repair and sprayed mortar

Limited beam widths often make it difficult to anchor the prestressing force of re-bar. Vertical stirrups (conventional reinforcing steel) can be used to increase the shear bond between the new mortar layer and old concrete. These prevent a detaching of the mortar layer and need to be anchored in the concrete compression zone of the beam. Therefore, the stirrups can be adhesively bonded in drillholes in the web/slab with Sika AnchorFix®, or overlapped on top creating a closed profile. Prestressed re-bar 10 U-stirrups enable a stress reduction in the existing shear reinforcement. The active, vertical compression of the double shear U-profile increases the shear bond of the mortar layer.



Calculation example for re-bar 16 ( $P_0 = 67.6.0 \text{ kN}$ ), with stirrup (steel B500B) and safety factor of 1.5:

Necessary stirrup cross-section (in double shear / slack applied):  $A_s = 67.6.0 \text{ kN} \times 1.5 / (2 \times 435 \text{ N/mm}^2) = 116 \text{ mm}^2$   
This is equivalent to a U-profile Ø12 mm for each re-bar 16 tension bar.

With this approach, the longitudinal elongation of the stirrup is limited to around 0.2%. Hence, the stirrup prevents an uplift over the roughed connection plane (no slipping of the grains in the mortar).

re-fer proposes the following supplementary elements for insufficient contact surface:

Tension bar to be anchored	Thin beam (low strengthening level)	Wide beam (high strengthening level)
re-bar 10 (prestressed)	min. <b>1 x Ø10 mm stirrup</b> (steel B500B, applied loosely)	min. <b>1 x re-bar 10</b> U-stirrup (prestressed)
re-bar 16 (prestressed)	min. <b>1 x Ø12 mm stirrup</b> (steel B500B, applied loosely)	min. <b>2 x re-bar 10</b> U-stirrup (prestressed)

## Fire protection

The minimal dimensions of structural concrete parts, concrete cover and constructional specifications of local standards must be met. An additional fire protection is then dispensable.

## Additional corrosion protection

If there is a future risk of contamination of the concrete or concrete replacement mortar with chlorides (for example in bridge constructions), it is recommended to coat memory®-steel with the corrosion protection SikaTop® Armatec®-110 EpoCem®. The coating is applied after activation with gas burner and at the same time serves as a bonding agent.

## Tested Sika products



Tested Sika products in combination with re-bar		
<b>Sika® FastFix-121</b>	Cement mortar	for sealing surface cracks
<b>SikaGrout®-314 N</b>	Shrinkage-free, Class R4 precision grouting mortar	for filling formwork or cut groove
<b>Sika® InjectoCem-190</b>	Very fine cement-based crack injection mortar	crack injection after surface sealing
<b>Sika MonoTop®-412 N/DE, Eco, -4012</b>	Shrinkage-compensated, Class R4 wet sprayed mortar	for vertical and overhead surface
<b>Sika MonoTop®-422 PCC</b>	Shrinkage-compensated, Class R4 repair mortar	for horizontal, vertical and overhead surface
<b>Sika MonoTop®-452 N</b>	Shrinkage-compensated, Class R4 repair mortar	for horizontal surface
<b>Sika MonoTop®-910 N/Eco, -1010</b>	Reinforcement corrosion protection and bond coat	for joint plane of new mortar layer
<b>Sika® Rock Gunit BE-8</b>	Dry sprayed mortar (cementitious, alkali free)	for tunneling application vertical/overhead
<b>Sika® AnchorFix®-3030</b>	2-component epoxy adhesive	supplied in «cartridge» for anchorage fixings
<b>SikaTop® Armatec®-110 EpoCem®</b>	Anti-corrosion coating/bonding agent (3-comp., water-based epoxy resin)	for re-bar and existing reinforcement

memory®-steel has been tested in systems with Sika sprayed, repair and grouting mortars. re-fer gives no guarantee if other mortars and products are used in combination with memory®-steel.

## Notes

All technical values in this product data sheet are subject to the re-fer quality assurance. Current measured values may deviate from the product specifications. For design purpose, re-fer provides engineering support and advice. For further information please visit us at [www.re-fer.eu](http://www.re-fer.eu) (references, technical data sheets, brochure, tender texts, test reports and publications can be downloaded or are available upon request) or contact our technical service directly.

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