strengthening solutions

Method Statement re-bar 10 & 16

27.05.2024 / V2.0 / re-fer AG

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1 Scope

This method statement supplements the product data sheet of the re-bar system. The application of the prestressed reinforcement is carried out by qualified specialist companies trained by re-fer. The specialist company ensures that all aspects of safety during application and activation (heating) are observed by the employees.

This document must be used and referred to, in combination with all other relevant product data sheets, any safety data sheets of third-party products and the respective project specifications.

2 System description

The ribbed reinforcing bars made of memory®-steel are used for structural strengthening of concrete structures in building construction and bridge building. They are fully embedded in Sika repair, sprayed, or grouted mortar and act as an active load-bearing tension element in the structure. The static design of the reinforcement system is carried out by a specialist engineer with suitable qualifications.

2.1 Limitations

This product must only be used in accordance with its intended purpose.

Local differences in some products may result in performance variations. The latest and relevant local product data sheet must be used or referenced.

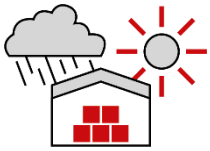
For any other specific construction / build information refer to the architect's, Engineer's or specialist contractor's details, drawings, specifications, and risk assessments.

3 Products

Brand	Description
re-bar 10, re-bar 16	The Ø10 and Ø16 ribbed re-bar made of memory®-steel is used for structural reinforcement of concrete structures (for components subjected to static or dynamic loads). re-bar is delivered pre-stretched and cut to length according to the parts list.
Sika MonoTop®-452 N	Shrinkage-compensated, class R4 repair mortar for horizontal application
Sika MonoTop®-422 PCC	Shrinkage-compensated, class R4 repair mortar for horizontal, vertical, and overhead application
Sika MonoTop®-412 N/DE, Eco, -4012	Shrinkage-compensated, class R4 wet sprayed mortar for vertical and overhead application
SikaGrout®-314 N	Shrinkage-free, class R4 precision grouting mortar for filling formwork or cut groove
Sika® FastFix-121	Cement mortar for sealing surface cracks
Sika® InjectoCem-190	Very fine cement-based crack injection mortar (after surface sealing)
SikaTop® Armatec®-110 EpoCem®	Bonding primer and corrosion protection (3-component cementitious epoxy) for re-bar and internal reinforcement
Sika® Rock Gunit BE-8	Dry-mix sprayed mortar (cementitious, alkali free) for tunneling overhead and vertically
Sika® AnchorFix®-3030	2-component epoxy high performance chemical anchoring adhesive

Detailed information on the products is provided in the corresponding product data sheets.

3.1 Material storage



The materials must be stored in unopened original packaging in a dry and cool place. With regard to the minimum and maximum storage temperature, the respective information in the product data sheets must be respected. **Products must be protected from direct sunlight!** re-bar may only be transported in its original packaging or with other adequate protection against mechanical damage and heat exposure.

4 Equipment

4.1 Tools

Standard Installation of re-bar:

Wrench (for re-bar couplers)

Binding wire

Fixing (Screw hooks, steel bar, wood wedge)

Drill

Bending device (for Ø10 and 16 mm)

Concrete cutting tool

Gas torch

Thermometer

The concrete substrate is prepared using either hydromechanical blasting or picking and sandblasting. Milling slots/grooves are cut out using conventional concrete cutters.

Appropriate processing guidelines must be followed for the application of the mortar products. An agitator, mixing container, trowels and other standard tools are required.

Activation/Heating of re-bar:

Plastic fixing elements re-bolt or re-clip

Cable ties

Electric heating device for resistive heating (only handled by re-fer technician)

4.2 Cleaning

All tools and accessories must be cleaned immediately after use (e.g. with Sika® Colma Cleaner). Cured material can only be removed mechanically.

5 Health and safety

5.1 Risk assessment

The risks to safety and health must be properly assessed and safely countered.

Any working areas on platforms and temporary structures must also provide a stable and safe area to work. All work and working procedures must be carried out fully in accordance with the relevant local health and safety legislation.

5.2 Personal protection

Ensuring safety at work!

Safety shoes, gloves and other suitable skin protection must be always worn. It is strongly recommended to use new or clean disposable protective clothing during the preparation and application of the material. Heat-resistant protective gloves should be worn during the heating process.

As mortar products can cause skin irritation, protective gloves must always be worn when handling them. Always apply protective cream to hands and unprotected skin before starting work. Suitable eye protection must always be worn during handling, mixing and installation of the products. Carrying an eye wash with you at all times is recommended.

Always wash hands with suitable soap and clean water after handling the products and before eating food, smoking, going to the toilet and after finishing work.

The work area must be well ventilated, and workers should take regular breaks in the fresh air to avoid health problems. Dust produced when drilling concrete can be dangerous. A vacuum cleaner can be used. Always wear a dust mask or respirator when drilling concrete. The concrete dust must not be inhaled.

For high-pressure water or sand blasting, etc., specially trained applicators must be consulted, and the corresponding safety regulations must be observed.

For detailed health and safety information, refer to the relevant safety data sheet of the third-party product.

5.3 First aid

If the mortar products meet the eyes or mucous membranes, glasses must be taken off or contact lenses removed and the eyes rinsed with clean, warm water for 10 - 15 minutes and then a doctor must be consulted. For detailed health and safety information, see the corresponding safety data sheet of the third-party product.

5.4 Waste disposal

Do not empty any surplus material into drainage or water systems; dispose of all waste materials and packaging responsibly through licensed waste disposal facilities or contractors, fully in accordance with local legislation and the authorities' requirements. Also avoid any chemical materials run-off into soil or into waterways, drains or sewers.

Any waste must be disposed of in accordance with local legislation.

6 Preparations

6.1 Preliminary tests

Preliminary tests must be carried out before the reinforcement is carried out. The substrate must be load-bearing. The minimum requirements regarding compressive strength and adhesive tensile strength (≥1.5 N/mm2) of the concrete must be met.

The concrete must be older than 28 days (depending on curing conditions, type of concrete, etc.).

In addition, all space conditions must be checked regarding installation and critical, smoke developing materials are to be removed prior to the heating process. After the preliminary tests, the application is carried out according to the following application procedures.

6.2 Screwing/coupling of re-bar

re-bar is delivered with couplers. On site, the bars can be joined together thanks to the splicing system and cut to length according to the parts list. The screw couplers show female pieces with internal threads and male pieces with external threads. Protective caps and plugs are attached as thread protection, which must be removed beforehand [Figure 6.1].

Before screwing them together, the coupler's threads are cleaned (no water, concrete, mortar, dust, or particles), visually checked that the threads have no damage and are treated with neutral lubricant. The counterparts are carefully aligned and turned on the first pitches by hand [Figure 6.2]. Proper tightening of the coupler system is achieved when the ring gap and the distance sleeve are closed [Figure 6.3 and 6.4]. This can be achieved using two wrench (a torque wrench is not required). Excessive tightening (e.g. using a hammer) is prohibited. Connections can be checked by visual inspection.


Figure 6.1

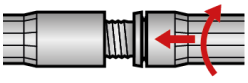


Figure 6.2

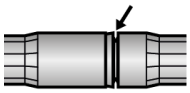


Figure 6.3

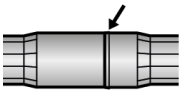


Figure 6.4

7 Application in Sika repair or sprayed mortar

7.1 Substrate preparation and fixation

The minimum required roughness of the concrete base must be observed for the mortar bond [Figure 7.1]. The concrete grains must be exposed in order to achieve a roughness of (usually) 1/4 to 1/3 of the maximum grain diameter (concrete) or one maximum grain diameter (mortar). The concrete contact surface is roughened hydromechanically. Mechanical roughening with a pointed hammer is an alternative [Figure 7.2]. The top layer of concrete is removed from the substrate in layers over the entire surface. This ensures that the grains of the concrete are not broken. In a second step, the entire surface is sandblasted. This removes any remaining loose grains and roughens the surface. The surface must be dust-free.

Only use excavation equipment that does not shatter the concrete surface (breaking of grains / microcracks in the base) [Figure 7.4].


Figure 7.1


Figure 7.2

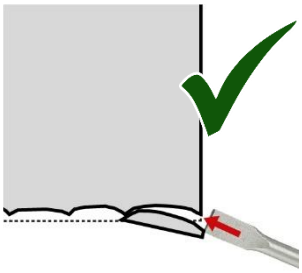


Figure 7.3


Figure 7.4

Any damaged concrete or concrete contaminated with chlorides must be removed mechanically (note: hydromechanical removal may lead to salts being pressed even deeper into the structure). Corroded internal reinforcements [Figure 7.5] must be cleaned in accordance with standard regulations. The minimum required roughness depths and information on pre-wetting/cleaning can be found in the Sika mortar product data sheets and the locally applicable standards.

re-bar are fixed to the concrete substrate. Metal screw hooks [example: Figure 7.6], bent reinforcement bars or situational timber constructions as formwork are suitable for this purpose. Plastics for fixing, construction foam and chemicals are prohibited (can lead to aggressive decomposition products when heated). The brackets are fixed at intervals of around 1-2 metres in order to align the bars on the structure. For large spans, alignment is carried out using a laser or alignment line.


Figure 7.5


Figure 7.6

7.2 End anchoring on both sides

Anchoring via mortar bond

The re-bar reinforcements are mortared in the end areas. For floor applications, Sika MonoTop®-452 N reprofiling mortar is used [Figure 7.7]. Sika MonoTop®-422 PCC is also suitable for sloping/vertical applications. For overhead applications, Sika MonoTop®-412 N/DE, Eco, -4012 spray mortar is used [Figure 7.8]. Any formwork needs to be established with wooden elements. **The use of construction foam, polystyrol or other chemical components is prohibited.**

Figure 7.7

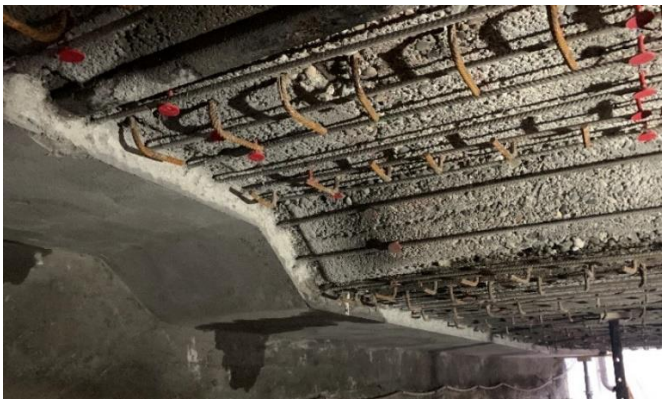


Figure 7.8

Anchoring with end hooks

End hooks on re-bar can be used to apply force at specific points. Ideally, the end hooks are bent directly on site with a hand bending device (easy handling / high adaptability to the object) [Figure 7.9 and 7.10]. The concrete is pre-drilled [Figure 7.11] and the drilling hole is blown out and cleaned in order to grout/glue the end hooks in it. For this purpose, the anchor adhesive Sika® AnchorFix®-3030 [Figure 7.12] is used (dry drilling hole) or the grout SikaGrout®-314 N (pre-wetting the drilling hole) [Figure 7.14]. The re-bars are also embedded in mortar outside the hole over a length of 100 mm. This serves as heat protection for any bonding and as a support bed for the bar [Figure 7.13/.15].

	Bending radius:	Min. lenght of hooks:	Diameter of drilling hole:
re-bar 10	approx. 40 mm	150 mm	≥14 mm
re-bar 16	approx. 50 mm	150 mm	≥20 mm

Figure 7.9

Figure 7.10

Figure 7.11


Figure 7.12


Figure 7.13


Figure 7.14

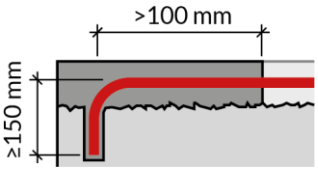


Figure 7.15

Anchoring for T-beams/girders

For T-beams or girders, U-profiles made of normal reinforcing steel can be used in the anchoring zone [Figure 7.16 to 7.18]. The stirrups enclose the re-bars, are anchored in the compression zone of the beam, and are embedded in mortar (sprayed mortar Sika MonoTop®-412 N/DE, Eco, -4012 or SikaGrout®-314 N). For T-beams, two holes are drilled in the top slab. The stirrups are glued into the holes with Sika® AnchorFix®-3030 anchor adhesive. It is also possible to bend the stirrups completely around the beam to create a confinement.


Figure 7.16


Figure 7.17

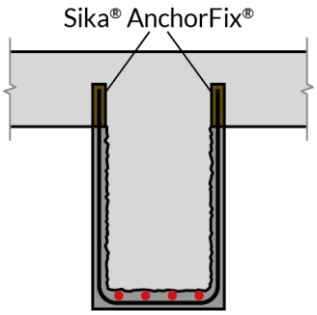


Figure 7.18

This is a very robust type of anchoring. It is also possible to bend the stirrups completely around the beam to create a confinement. If an additional shear reinforcement is required, prestressed re-bar 10 U-profiles can be used for the same purpose. Durable and complete strengthening solutions are realisable with these combinations [Figure 7.19].

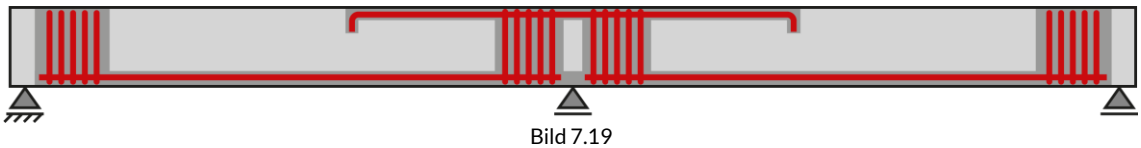


Bild 7.19

7.3 Activation of prestressing and finish

Before heating, hence activating the prestressing, the mortar of the anchorage must be cured. A compressive strength of >35 N/mm^2 is required. Mortar after-treatments according to corresponding product data sheets. For overhead applications, the plastic fixings should be removed prior to heating.

Activation of the re-bars with the gas burner is carried out in stages of approx. 0.5 m length at 300°C [Fig. 7.20]. The process must be accompanied by a second person who checks and records the temperature. A suitable infrared thermometer or one with a K-connection and surface probe with a corresponding temperature range is used for the control [Figure 7.21]. If screw couplings are used on re-bar, they must not be directly flamed/heated.

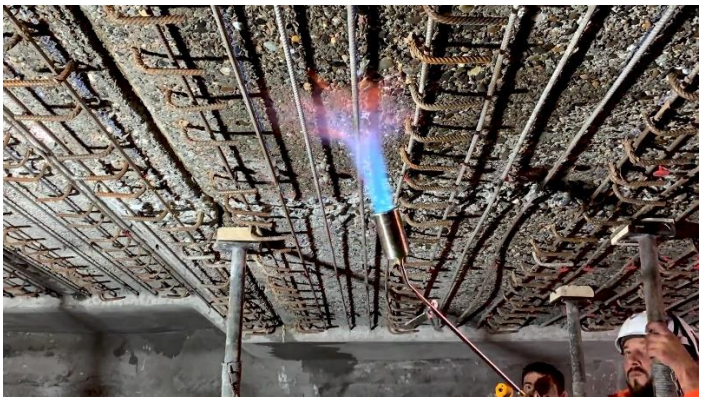


Figure 7.20

Figure 7.21

Note: The end zones of re-bar, respectively the anchorages, are temporarily secured (e.g. by supports) to prevent them from falling down in case of break-out. When using the anchor adhesive Sika AnchorFix®-3030, the adhesive must not be directly flamed/heated. This is protected against heat with a proper mortar cover.

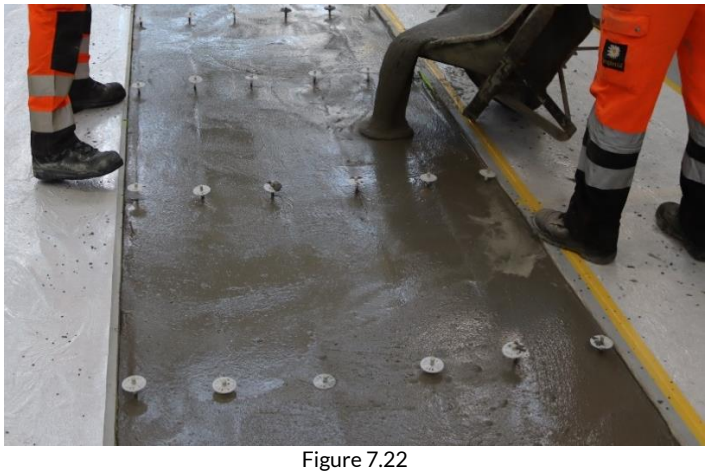


Figure 7.22

Figure 7.23

After heating and cooling re-bar, the open residual area is also mortared [Figure 7.22 and 7.23]. The same mortar products as for the corresponding end anchorages are to be used. re-bar shows its load-bearing effect immediately after activation and cooling down.

8 Application in cut grooves

8.1 Substrate preparation and fixation

The concrete base is cut to the required groove depth with a hand tool or a concrete cutter [Figure 8.1]. Any material remaining in the slot is broken out and removed [Figure 8.2]. The concrete slots are to be cleaned dust-free and wetted. Specifications for the minimal groove geometries are given in the product data sheet. The bars are then temporarily fixed in the slot [Figure 8.3]. Simple wooden wedges, pipe clamps are suitable for this.


Figure 8.1


Figure 8.2

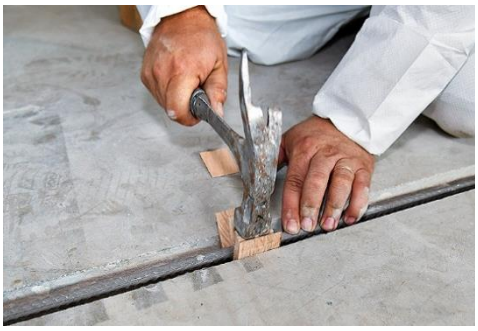


Figure 8.3

8.2 End anchoring on both sides

The end areas of re-bar are sealed off (wooden formwork) and then grouted with SikaGrout®-314 N grout [Figure 8.4]. **The use of construction foam, polystyrol or other chemical components is prohibited.**


Figure 8.4

8.3 Activation of prestressing and finish

Heating/activation and grouting of the centre area of re-bar is to be done according to chapter 7.3.

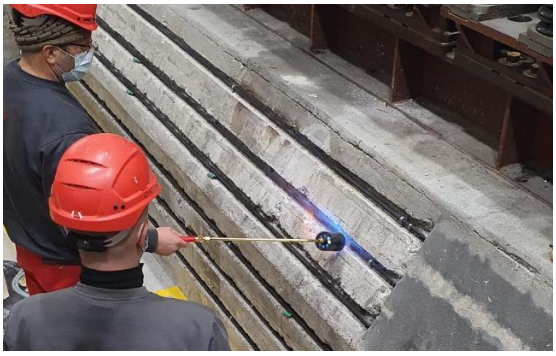


Figure 8.5


Figure 8.6


Figure 8.7

9 Application of active shear strengthening

9.1 Substrate preparation and fixation

For partially damaged shear beams with cracks in the concrete, a crack injection can be made beforehand. For this purpose, a surface sealing with Sika® FastFix-121 is applied and the cracks are injected with the injection material Sika® InjectoCem-190 [Figure 9.1].

The concrete surface in the area to be reinforced is roughened [Figure 9.2] and cleaned (see also chapter 7.1). re-bar 10 U-profiles enclose the concrete beam or are anchored in the concrete pressure zone [Figure 9.3]. re-bolt plastic dowels are used to fix the U-profiles and for electrical insulation to the internal reinforcement.


Figure 9.1


Figure 9.2


Figure 9.3

Holes are drilled in the concrete flange or ceiling slab and the bars are pulled through. The drilled hole is grouted with SikaGrout®-314 N. Any type of formwork or separation/closure needs to be executed with wooden elements. **The use of construction foam or other chemical products is prohibited**. After activation, the overlapping re-bar 10 can be folded down and grouted to create a stirrup connection [Figure 9.4]. Alternatively, the U-stirrups are anchored with Sika® AnchorFix®-3030 [Figures 9.5 and 9.6]. For this purpose, the concrete is predrilled until the bars can be anchored in the compression zone. Another option is activation with a gas burner as shown in the figure [Figure 9.6 or 9.7]; in this case, no plastic fixations but metal fasteners are used.

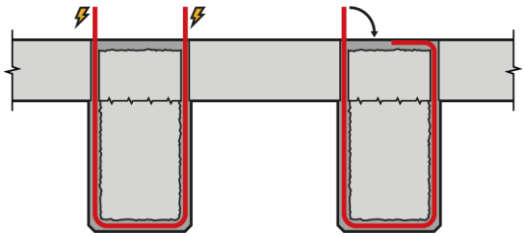


Figure 9.4

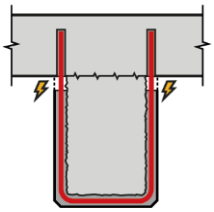


Figure 9.5

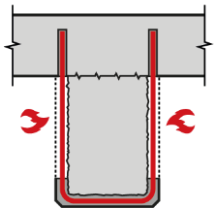


Figure 9.6

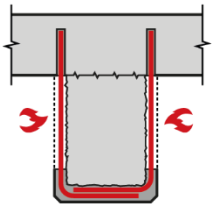


Figure 9.7

Note: Due to the manufacturing process, tolerances in geometry of the U-profiles/stirrups (e.g. exact axial distance) need to be taken into account for the installation on site. If very precise lengths are required, for example when using shear reinforcements in cut grooves, other solutions can be applied. L-profiles with an overlap are possible for the heating with gas torch [Figure 9.7].

9.2 Mortaring

The reinforcement area can either be wet sprayed with Sika MonoTop®-412 Eco/-4012 or grouted with wooden formwork and SikaGrout®-314 N grout. Mortar after-treatments according to the corresponding product data sheets. Subsequent activation can be carried out after the mortar has hardened (minimum compressive strength of >35 N/mm^2).

9.3 Activation of prestressing and finish

The activation of the U-profiles is done with electrical resistance heating. The power clamps are connected to the free length of the bars [Fig. 9.4, 9.5 and 9.8]. Activation is carried out up to a maximum of 200°C. To finish, the stirrups are folded down and mortared in [Figure 9.9 and 9.10]. The temperature control can be made with mortared-in thermal connections. Another possibility is activation with the gas burner as shown in the figure [Figure 9.6 or 9.7].


Figure 9.8


Figure 9.9


Figure 9.10

Required power connection for el. Resistance heating:
either 2 x connection 3x400 V, CEE 32A, 400V, 5-pole
or 1 x connection 3x400 V, CEE 63A, 400V, 5-pole

In case of activation with gas torch [Figure 9.11] and its related installation, procedure according to the previous chapter are to be followed.


Figure 9.11

10 Additional notes

10.1 Activation with electrical resistance heating

For special applications, re-bar can be completely embedded in mortar directly from the beginning. After complete hardening of the concrete/mortar, it can be heated/activated with electrical resistance heating. The power clamps are connected at concrete openings or on end hooks of re-bar, which stick out of the concrete [Fig. 10.1, 10.2]. Activation takes place up to a maximum of 200°C. The plastic holders prevent current from being introduced into the internal reinforcement. The temperature control is made with mortared-in thermal connections [Figure 10.3]. Finally, the extending bars are cut off with the cutting disc [Figure 10.4].


Figure 10.1


Figure 10.2


Figure 10.3

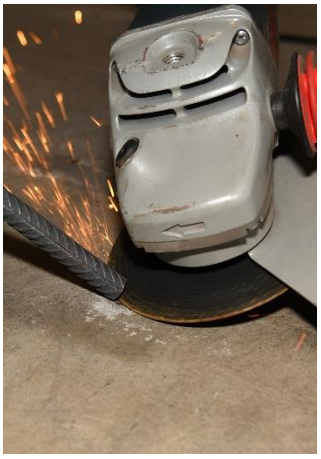


Figure 10.4

10.2 Additional corrosion protection

The Sika mortar layer provides an additional alkali deposit and protects re-bar as well as the internal reinforcement. If there is a risk of (future) contamination of the concrete or concrete replacement mortar with chlorides (for example in bridge construction) or in case of constant moisture, it is recommended to adjust the concrete cover. Additionally, re-bar can be coated with the slight corrosion protection SikaTop® Armatec®-110 EpoCem®. The coating (by hand or sprayed) is applied after heating/activation and serves as a bonding agent. The corresponding product data sheet must be consulted.

11 Inspections and tests

Visual inspection and documentation of the installation and the heating temperatures is required at all stages. Preliminary examinations of the concrete compressive strength are to be made according to Chap. 6. For a follow-up check of the prestressing force, re-fer's technical service can be contacted. A special testing device is used to calculate, based on the crossbow principle for prestressing strands, the prevailing force in the re-bar via the expansion path and the measured lifting force. The test must be carried out before the final grouting.

12 Appendix

12.1 On-site checklists

The lists below are suggestions that need to be adapted to local needs.

For the application of re-bar:

▪ Safety helmet	▪ Drill
▪ Protective googles	▪ Drill bits
▪ Dust mask	▪ Heating device gas
▪ Hearing protection	▪ Binding wire or zip ties
▪ Protective gloves	▪ Temperature sensor
▪ Elements for fixation	▪ re-bar reinforcement

Additionally, for the application of Sika mortar products:

▪ Mixing container	▪ Formwork material
▪ Agitator / mixing paddle	▪ Stripping rod
▪ Trowels	▪ Brush
▪ Spray gun	▪ Glue gun
▪ Bagged Sika mortars	▪ Cartridges of Sika anchor adhesive

	Yes	No
Has the concrete quality been checked in advance?		
Have the necessary preparations of the subbase been made?		
Can the planned type of heating be used?		
Are the necessary electrical power supplies available?		
Can geometric requirements for the construction be met?		
Are there any deviations or changes to the engineer's specifications?		
Are there any obstacles or problems?		
If so, please describe and explain in more detail:		

13 Legal note

The information, and - in particular - the recommendations relating to the application and end-use of re-fer products, are given in good faith based on re-fer's current knowledge and experience of the products when properly stored, handled, and applied under normal conditions in accordance with re-fer's recommendations. In practice, the differences in materials, substrates and actual site conditions are such that no warranty in respect of merchantability or of fitness for a particular purpose, nor any liability arising out of any legal relationship whatsoever, can be inferred either from this information, or from any written recommendations, or from any other advice offered. The user of the product must test the products suitability for the intended application and purpose. re-fer reserves the right to change the properties of its products. The proprietary rights of third parties must be observed. All orders are accepted subject to our current terms of sale and delivery. Users must always refer to the most recent issue of the local product data sheet for the product concerned, copies of which will be supplied on request.

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