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Autoryzowany i notyfikowany zgodnie z art.10 dyrektywy Rady z 21 grudnia 1988 r. w sprawie zbliżenia ustaw i aktów wykonawczych państw członkowskich dotyczących wyrobów budowlanych (89/106/EWG)

Członek EOTA

European Technical Approval ETA-13/0585

(English language translation – the original version is in Polish language)

Nazwa handlowa *Trade name*	**R-KEX II do kotwienia prętów zbrojeniowych** *R-KEX II for rebar connections*
Właściciel aprobaty *Holder of approval*	**RAWLPLUG S.A.** **ul. Kwidzyńska 6** **51-416 Wrocław** **Poland**
Rodzaj i przeznaczenie wyrobu *Generic type and use of construction products*	**Wklejane zakotwienia prętów zbrojeniowych o średnicach od 8 do 32 mm z zastosowaniem zaprawy iniekcyjnej** *Post-installed rebar connections of the sizes 8 to 32 mm with injection mortar*
Termin ważności **od** *from* *Valid* **do** *to*	**27. 06. 2013** **14. 06. 2018**
Zakład produkcyjny *Manufacturing plant*	**Zakład Produkcyjny nr 3** *Manufacturing Plant no. 3*
Niniejsza Europejska Aprobata Techniczna zawiera *This European Technical Approval contains*	23 strony, w tym 12 Załączników *23 pages including 12 Annexes*
Niniejsza Europejska Aprobata Techniczna zastępuje *This European Technical Approval replaces*	**ETA-13/0585 ważną od 14.06.2013 do 14.06.2018** *ETA-13/0585 with validity from 14.06.2013 to 14.06.2018*

I LEGAL BASES AND GENERAL CONDITIONS

1. This European Technical Approval is issued by Instytut Techniki Budowlanej in accordance with:
   - Council Directive 89/106/EEC of 21 December 1988 on the approximation of laws, regulations and administrative provisions of Member States relating to construction products[1], amended by the Council Directive 93/68/EEC of 22 July 1993[2];
   - ustawa z dnia 16 kwietnia 2004 r. o wyrobach budowlanych (law on construction products from 16th April 2004)[3];
   - rozporządzenie Ministra Infrastruktury z dnia 14 października 2004 r. w sprawie europejskich aprobat technicznych oraz polskich jednostek organizacyjnych upoważnionych do ich wydawania (regulation of the Ministry of Infrastructure of 14th October 2004 on the European Technical Approvals and Polish bodies entitled to issue them)[4];
   - Common Procedural Rules for Requesting, Preparing and the Granting of European Technical Approvals set out in the Annex of Commission Decision 94/23/EC[5];
   - Guideline for European Technical Approval of "*Metal anchors for use in concrete – Part 5: Bonded anchors*", ETAG 001-05;
2. Instytut Techniki Budowlanej is authorized to check whether the provisions of this European Technical Approval are met. Checking may take place in the manufacturing plant. Nevertheless, the responsibility for the conformity of the products to the European Technical Approval and for their fitness for the intended use remains with the holder of the European Technical Approval.
3. This European Technical Approval is not to be transferred to manufacturers or agents of manufacturers other than those indicated on page 1, or manufacturing plants other than those indicated on page 1 of this European Technical Approval.
4. This European Technical Approval may be withdrawn by Instytut Techniki Budowlanej, in particular after information by the Commission on the basis of Article 5(1) of Council Directive 89/106/EEC.
5. Reproduction of this European Technical Approval including transmission by electronic means shall be in full. However, partial reproduction can be made with the written consent of Instytut Techniki Budowlanej. In this case partial reproduction has to be designated as such. Texts and drawings of advertising brochures shall not contradict or misuse the European Technical Approval.
6. The European Technical Approval is issued by the approval body in its official language. This version corresponds to the version circulated within EOTA. Translations into other languages have to be designated as such.

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[1] Official Journal of the European Communities № L 40, 11.02.1989, p. 12
[2] Official Journal of the European Communities № L 220, 30.08.1993, p. 1
[3] Official Journal of Polish Republic № 92/2004, pos. 881
[4] Official Journal of Polish Republic № 237/2004, pos. 2375
[5] Official Journal of the European Communities № L 17, 20.01.1994, p. 34

II SPECIFIC CONDITIONS OF THE EUROPEAN TECHNICAL APPROVAL

1 Definition of product and intended use

1.1 Definition of product

The subject of this approval are the post-installed rebar connections, by anchoring or overlap connection joint, consisting of steel reinforcing bars (rebars) in existing structures made of normal weight concrete, using injection mortar R-KEX II in accordance with the regulations for reinforced concrete construction.

The design of the post-installed rebar connections shall be done in accordance with EN 1992-1-1 (Eurocode 2).

Reinforcing bars with diameters from 8 to 32 mm and injection mortar according to Annex 3 are used for the post-installed rebar connections covered by this ETA. The steel element is placed into a drilled hole previously injected with a mortar and is anchored by the bond between embedded steel element, injection mortar and concrete.

1.2 Intended use

The post-installed rebar connections may be used in normal weight concrete of a minimum grade C12/15 and maximum grade C50/60 according to EN 206-1. They may be used in non-carbonated concrete with the allowable chloride content of 0,20% (Cl 0.20) related to the cement content according to EN 206-1 (use category 1).

The rebar connections may be used for predominantly static loads.

Fatigue, dynamic or seismic loading of post-installed rebar connections are not covered by this ETA.

The fire resistance of the post-installed rebar connections is not covered by this ETA.

The rebar connections may only be carried out in the manner, which is also possible with reinforcing bars, e.g. those in the following applications:

- an overlapping joint with existing reinforcement in a building component (Figures 1 and 2, Annex 2),
- anchoring of the reinforcement at a slab or beam support (Figure 3, Annex 2; end support of a slab, designed as simply supported, as well as appropriate reinforcement for restraint forces),
- anchoring of reinforcement of building components stressed primarily in compression (Figure 4, Annex 2),
- anchoring of reinforcement to cover the line of acting tensile force (Figure 5, Annex 2).

The post-installed rebar connections may be installed in dry or wet concrete and it must not be installed in flooded holes.

The post-installed rebar connections may be used overhead.

The post-installed rebar connections may be used in the temperature range -40°C to +80°C (max. short term temperature +80°C and max. long term temperature +50°C).

This ETA covers anchoring in bore holes made with hammer drilling.

The provisions made in this European Technical Approval are based on an assumed intended working life of the product of 50 years. The indications given on the working life cannot be interpreted as a guarantee given by the producer or Approval Body, but are to be regarded only as a means for choosing the right products in relation to the expected economically reasonable working life of the works.

2 Characteristics of product and methods of verification

2.1 Characteristics of product

The post-installed rebar connections correspond to the drawings and provisions given in Annexes 1 to 12. The characteristic material values, dimensions and tolerances not indicated in Annexes shall correspond to the respective values laid down in the technical documentation[6] of this European Technical Approval.

Each mortar cartridge is marked with the identifying mark of the producer and with the trade name. The rebars are either delivered with the mortar cartridges or commercial standard rebars purchased separately.

The two components of the injection mortar are delivered in unmixed condition in side by side mortar cartridges in a size of 385 to 1100 ml, in accordance with Annex 4.

2.2 Methods of verification

The assessment of fitness of the post-installed rebar connections for the intended use in relation to the requirements for mechanical resistance and stability and safety in use in the sense of the Essential Requirements 1 and 4 has been made in accordance with the ETAG 001 Guideline for European Technical Approval of *"Metal anchors for use in concrete"*, Part 1: "*Anchors in general*", Part 5: "*Bonded anchors*" and EOTA Technical Report TR 023 "*Assessment of post-installed rebar connections*".

In addition to the specific clauses relating to dangerous substances contained in this European Technical Approval, there may be other requirements applicable to the products falling within its scope (e.g. transposed European legislation and national laws, regulations and administrative provisions). In order to meet the provisions of the Construction Products Directive, these requirements need also to be complied with, when and where they apply.

[6] The technical documentation of this European Technical Approval is deposited at Instytut Techniki Budowlanej and, as far as relevant for the tasks of the approved body involved in the attestation of conformity procedure, may be handed over only to the approved body involved.

3 Evaluation of Conformity and CE marking

3.1 System of attestation of conformity

The system of attestation of conformity 2 (i) (referred to as system 1) according to Council Directive 89/106/EEC Annex III laid down by the European Commission provides:

(a) Tasks of the manufacturer:

1) factory production control,
2) further testing of samples taken at the factory by the manufacturer in accordance with a prescribed test plan;

(b) Tasks of the approved body:

1) initial type-testing of the product,
2) initial inspection of factory and of factory production control,
3) continuous surveillance, assessment and approval of factory production control.

3.2 Responsibilities

3.2.1 Tasks of the manufacturer; factory production control

The manufacturer has a factory production control system and shall exercises permanent internal control of production. All the elements, requirements and provisions adopted by the manufacturer are documented in a systematic manner in the form of written policies and procedures. This production control system ensures that the product is in conformity with the European Technical Approval.

The manufacturer shall only use raw materials supplied with the relevant inspection documents as laid down in the control plan[7]. The incoming raw materials shall be subject to controls and tests by the manufacturer before acceptance. Check of incoming materials such as rebars, resin and hardeners shall include control of the inspection documents presented by suppliers (comparison with nominal values) by verifying dimensions and determining material properties.

The frequency of controls and tests conducted during production is laid down in the control plan[7] taking account of the automated manufacturing process.

The results of factory production control are recorded and evaluated. The records include at least the following information:

- designation of the product, basic material and components,
- type of control or testing,
- date of manufacture of the product and date of testing of the product or basic material or components,
- result of control and testing and, if appropriate, comparison with requirements,
- signature of person responsible for factory production control.

The records shall be presented to the approved body involved in continuous surveillance. On request, they shall be presented to Instytut Techniki Budowlanej.

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[7] The control plan has been deposited at Instytut Techniki Budowlanej and may be handed over only to the approved body involved in the attestation of conformity procedure.

Details of the extent, nature and frequency of testing and controls to be performed within the factory production control shall correspond to the control plan[7] which is part of the technical documentation of this European Technical Approval.

3.2.2 Tasks of the approved body

3.2.2.1 Initial type-testing of the product

For initial type-testing the results of the tests performed as part of the assessment for the European Technical Approval shall be used unless there are changes in the production line or plant. In such cases the necessary initial type-testing has to be agreed between the Instytut Techniki Budowlanej and the approved body involved.

3.2.2.2 Initial inspection of factory and of factory production control

The approved body shall ascertain that, in accordance with the control plan, the factory, in particular the staff and equipment, and the factory production control are suitable to ensure continuous and orderly manufacturing of the anchor according to the specifications mentioned in clause 2.1 as well as to the Annexes to this European Technical Approval.

3.2.2.3 Continuous surveillance

Continuous surveillance and assessment of factory production control have to be performed according to the control plan.

The approved body shall visit the factory at least once a year for surveillance. It has to be verified that the system of factory production control and the specified automated manufacturing process are maintained taking account of the control plan[7].

The results of continuous surveillance shall be made available on demand by the approved body to Instytut Techniki Budowlanej. In cases where the provisions of the European Technical Approval and the control plan are no longer fulfilled the conformity certificate shall be withdrawn.

3.3 CE–marking

The CE marking shall be affixed on each packaging of the injection mortar. The letters "CE" shall be accompanied by the following information:

- name and address of the holder of the approval,
- identification number of the approved body,
- last two digits of the year in which the CE marking was affixed,
- number of the EC certificate of conformity,
- number of the European Technical Approval,
- number of the guideline for the European Technical Approval.

4 Assumptions under which the fitness of the product for the intended use was favourably assessed

4.1 Manufacturing

The products are manufactured in accordance with the provisions of the European Technical Approval using the automated manufacturing process as identified during inspection of the manufacturing plant by Instytut Techniki Budowlanej and laid down in the technical documentation.

4.2 Drafting

Rebar connections must be designed in keeping with good engineering practice. Considering the loads to be anchored, design calculations and design drawings must be produced in a way they can be checked. At least the following items must be given in the design drawings:

- grade of concrete strength,
- diameter, drilling technique, concrete cover, spacing and embedment depth of the rebar,
- kind of preparation of the joint between building component being connected including the thickness of concrete layer that has to be removed.

4.3 Rebar connections design

4.3.1 General

The actual position of the reinforcement in the existing structure shall be determined on the basis of the construction documentation and taken into account when designing.

The design of the post-installed rebar connections according to Annex 2 and determination of the internal section forces to be transferred in the construction joint shall be verified in accordance with EN 1992-1-1.

The minimum clear spacing between two post-installed rebars shall be: $a = 40\ mm \geq 4 \cdot Ø$ (according to Annex 9).

4.3.2 Determination of the basic anchorage length

The required basic anchorage length $l_{b,rqd}$ shall be determined in accordance with EN 1992-1-1, clause 8.4.3:

$$l_{b,rqd} = (Ø / 4) \cdot (\sigma_{sd} / f_{bd})$$

where:

$Ø$ = diameter of the rebar

σ_{sd} = calculated design stress of the rebar

f_{bd} = design value of bond strength according to Annex 9, Table 7

in consideration of the coefficient related to the quality of bond conditions and of the coefficient related to the rebar diameter.

4.3.3 Determination of the design anchorage length

The required design anchorage length l_{bd} shall be determined in accordance with EN 1992-1-1, clause 8.4.4:

$$l_{bd} = \alpha_1 \cdot \alpha_2 \cdot \alpha_3 \cdot \alpha_4 \cdot \alpha_5 \cdot l_{b,rqd} \geq l_{b,min}$$

where: α_1, α_2, α_3, α_4, α_5 determined acc. to EN 1992-1-1, Table 8.2:

α_1 = 1,0 for straight rebars

α_2 = $0,7 \leq \alpha_2 \leq 1,0$ calculated acc. to EN 1992-1-1, Table 8.2

α_3 = 1,0 because no transverse reinforcement

α_4 = 1,0 because no transverse reinforcement

α_5 = $0,7 \leq \alpha_5 \leq 1,0$ influence of transverse pressure acc. to EN 1992-1-1, Table 8.2

with:

$l_{b,rqd}$ = according to clause 4.3.2

$l_{b,min}$ = minimum anchorage length acc. to EN 1992-1-1, equations 8.6 and 8.7 modified with TR 023, § 4.2

$l_{b,min} = \max \{0,3 \cdot l_{b,rqd}; 10 \cdot Ø; 100 \text{ mm}\}$ under tension

$l_{b,min} = \max \{0,6 \cdot l_{b,rqd}; 10 \cdot Ø; 100 \text{ mm}\}$ under compression

The maximum anchorage depth is given in Annex 9, Table 6.

4.3.4 Overlap joints

The required design anchorage length l_0 shall be determined in accordance with EN 1992-1-1, clause 8.7.3:

$$l_0 = \alpha_1 \cdot \alpha_2 \cdot \alpha_3 \cdot \alpha_5 \cdot \alpha_6 \cdot l_{b,rqd} \geq l_{0,min}$$

where: α_1, α_2, α_3, α_5, α_6 determined acc. to EN 1992-1-1, Tables 8.2 and 8.3 with:

α_1 = 1,0 for straight rebars

α_2 = $0,7 \leq \alpha_2 \leq 1,0$ calculated acc. to EN 1992-1-1, Table 8.2

α_3 = 1,0 because no transverse reinforcement

α_5 = $0,7 \leq \alpha_5 \leq 1,0$ influence of transverse pressure acc. to EN 1992-1-1, Table 8.2

α_6 = $1,0 \leq \alpha_6 \leq 1,5$ influence of percentage of lapped bars relative to the total cross-section area acc. to EN 1992-1-1, Table 8.3

with:

$l_{b,rqd}$ = according to clause 4.3.2.

$l_{0,min}$ = minimum lap length acc. to EN 1992-1-1, equation 8.11 modified with TR 023, § 4.2

$l_{0,min} = \max \{0,3 \cdot \alpha_6 \cdot l_{b,rqd}; 15 \cdot Ø; 200 \text{ mm}\}$

The maximum anchorage depth is given in Annex 9, Table 6.

4.3.5 Embedment depth for overlap joints

For the calculation of the effective embedment depth of overlap joints the concrete cover at end-face of bonded-in rebar c_1 shall be considered:

$$l_v \geq l_0 + c_1$$

where:

l_0 = required lap length acc. to clause 4.3.4 and EN 1992-1-1

c_1 = concrete cover at end-face of bonded-in rebar

If the clear distance between overlapping rebars is greater than 4·Ø the overlap length shall be enlarged by the difference between the clear distance and 4·Ø.

4.3.6 Concrete cover

The concrete cover required for bonded-in rebars is shown in Annex 9.

Furthermore the minimum concrete cover given in EN 1992-1-1, clause 4.4.1.2 shall be observed.

4.3.7 Transverse reinforcement

The requirements of transverse reinforcement in the area of the post-installed rebar connection shall comply with EN 1992-1-1, clause 8.7.4.

4.3.8 Connection joint

The transfer of shear forces between new concrete and existing structure shall be designed according to EN 1992-1-1. The joints for concreting shall be roughened to at least such an extent that aggregate protrude.

In the case of carbonated surface of the existing concrete structure the carbonated layer shall be removed in the area of the post-installed rebar connection with a diameter of Ø + 60 mm prior to the installation of the new rebar.

The depth of concrete to be removed shall correspond to at least the minimum concrete cover for the respective environmental conditions in accordance with EN 1992-1-1.

The foregoing may be neglected if building components are new and not carbonated and if building components are in dry conditions.

4.4 Installation

The fitness for use of the post-installed rebars can only be assumed if the rebar is installed as follows:

- installation of the post-installed rebars shall be done only by suitable trained installer and under supervision on the site; the condition under which an installer may be considered as suitable trained and the condition for supervision on site are up to the Member States in which the installation is done,
- use of the injection system only as supplied by the manufacturer without changing the components,
- installation in accordance with the manufacturer's specifications and drawings using the tools indicated in the technical documentation of this European Technical Approval,
- check before rebar installation to ensure that the strength class of the concrete in which the post-installed rebar connection is to be placed is in the range given and is not lower than that of the concrete to which the characteristics loads apply,
- check of concrete being well compacted, e.g. without significant voids,
- check the position of the existing rebars,
- keeping the anchorage depth as specified in the design drawings,
- keeping the concrete cover and spacing as specified in the design drawings,
- positioning of the drill holes without damaging the reinforcement,

- in case of aborted drill hole: the drill hole shall be filled with mortar,
- rebar installation ensuring the specified embedment depth, that is the appropriate depth marking of the rebar not exceeding the concrete surface,
- clearing the hole of drilling dust by blowing and brushing operations acc. to Annex 7; before brushing checking whether the brush diameter according to Annex 5 is sufficient,
- mortar injection by using the equipment including the special mixing nozzle (mixer) shown in Annex 5; discarding the first swings of mortar of each new cartridge until an homogeneous color is achieved; taking from the manufacturer instruction the admissible processing time (open time) of a cartridge as a function of the ambient temperature of the concrete; filling the drill hole uniformly from the drill hole bottom, in order to avoid entrapment of air; removing the special mixing nozzle slowly bit by bit during pressing-out; filling the drill hole with a quantity of the injection mortar corresponding to 2/3 of the drill hole depth; inserting immediately the rebar, slowly and with a slight twisting motion, removing excess of injection mortar around the rod; observing the loading (curing) time according to Annex 3, Table 3 until the rebar may be loaded,
- mortar component installation temperature shall be at least +5°C,
- during installation and curing of the injection mortar the temperature of the concrete must not be less than temperature given in Annex 3, observing the curing time.

5 Indications to the manufacturer

5.1 Manufacturer's responsibility

It is the manufacturer's responsibility to ensure that the information on the specific conditions according to clause 1 and 2 including Annexes referred to clause 4 is given to those who are concerned. This information may be made by reproduction of the respective parts of the European Technical Approval. In addition all installation data shall be shown clearly on the package and/or on an enclosed instruction sheet, preferably using illustration(s).

The minimum data required are:

- drill bit diameter,
- diameter of rebar,
- admissible service temperature range,
- curing time of the injection mortar depending on the installation temperature,
- information on the installation procedure, including cleaning of the drill hole, preferably by means of an illustration,
- reference to any special installation equipment needed,
- identification of the manufacturing batch.

All the data shall be presented in a clear and explicit form.

5.2 Recommendations on packaging, transport and storage

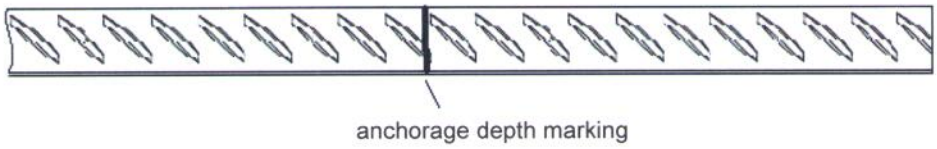
The mortar cartridges shall be protected against sun radiation and shall be stored according to the manufacturer's instructions in dry conditions at temperatures of at least +5°C to not more than +25°C.

Mortar cartridges with expired shelf life must no longer be used.

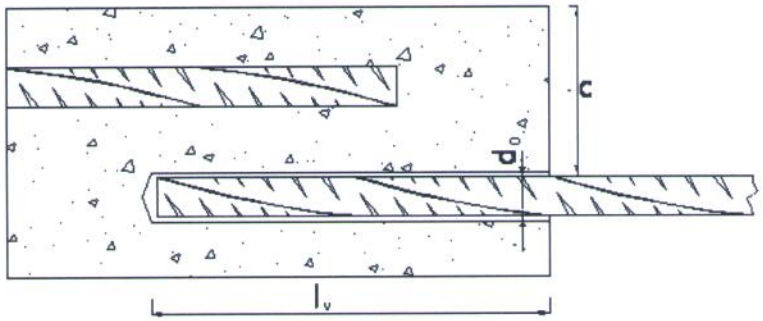
On behalf of Instytut Techniki Budowlanej

Jan Bobrowicz
Director of ITB

Reinforcing bars (rebars) Ø8 to Ø32 according to Eurocode 2 (Annex 3, Table 1)



anchorage depth marking



Covered are post-installed rebar connections in non-carbonated concrete C12/15 to C50/60 (acc. to EN 206-1) on the assumption only that the design of post-installed rebar connections is done in accordance to EN 1992-1-1 (Eurocode 2).

Installation in dry or wet concrete, it must not be installed in flooded holes. Overhead installation is allowable.

Use category 1: post-installed rebar connections in concrete CI 0,20 (acc. to EN 206-1)

Temperature range: -40°C to +80°C (max. short term temperature +80°C and max. long term temperature +50°C).

R-KEX II for rebar connections	**Annex 1** of European Technical Approval ETA-13/0585
Product description and intended use	

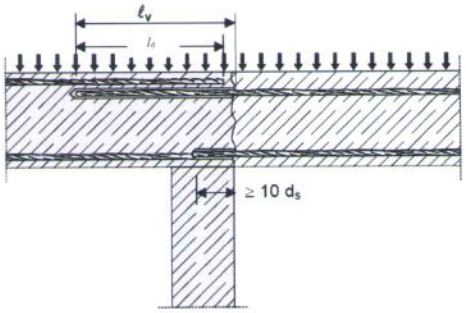


Figure 1: Overlap joint for rebar connections of slabs and beams

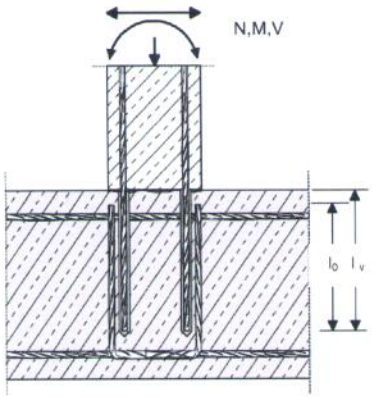


Figure 2: Overlap joint at a foundation of a column or wall where the rebars are stressed in tension

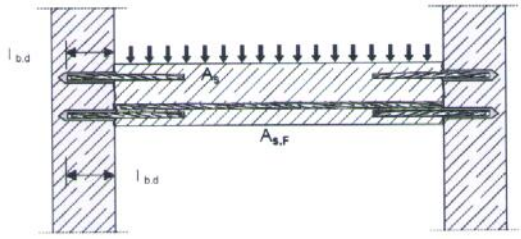


Figure 3: End anchoring of slabs or beams, designed as simply supported

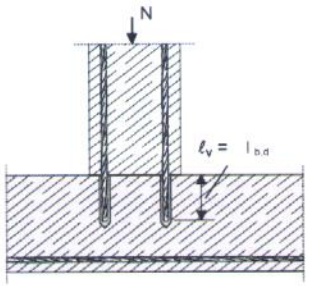


Figure 4: Rebar connection for components stressed primarily in compression. The rebars are stressed in compression

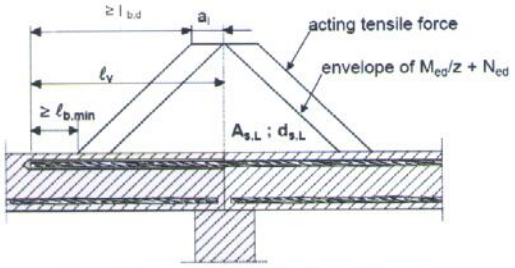


Figure 5: Anchoring of reinforcement to cover the line of acting tensile force

Note to Figure 1 to 5:

In the Figures no transverse reinforcement is plotted, the transverse reinforcement as required by EC 2 shall be present.

The shear transfer between old and new concrete shall be designed according to EC 2.

R-KEX II for rebar connections	**Annex 2** of European Technical Approval ETA-13/0585
Examples of use for rebars	

Table 1: Rebars according to EN 1992-1-1, Annex C, Tables C.1 and C.2N

Product form		**Bars and de-coiled rods**	
Class		B	C
Characteristic yield strength f_{yk} or $f_{0,2k}$ [N/mm^2]		400 to 600	
Minimum value of $k = (f_t / f_y)_k$		≥ 1,08	≥ 1,15 < 1,35
Characteristic strain at maximum force, ε_{uk} [%]		≥ 5,0	≥ 7,5
Bendability		Bend / Rebend test	
Maximum deviation from nominal mass (individual bar), [%]	Nominal bar size [mm] ≤ 8 > 8	 ± 6,0 ± 4,5	
Bond: minimum relative rib area, $f_{R,min}$	Nominal bar size [mm] 8 to 12 > 12	 0,040 0,056	

Rib height h: The rib height h shall be: $0,05 \cdot Ø \leq h \leq 0,07 \cdot Ø$; Ø = nominal bar diameter

Table 2: Injection mortar

Product	**Composition**
R-KEX II	Injection mortar: epoxy system with fillers

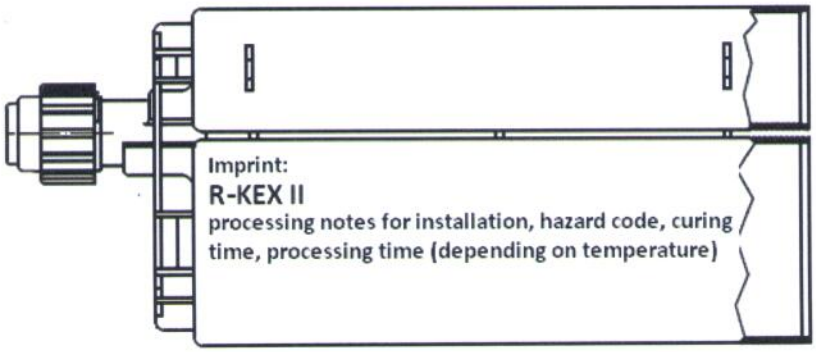
Table 3: Open time and curing time

Mortar temperature	**Concrete temperature**	**Open time [minutes]**	**Minimum curing time[1)] [minutes]**
5°C	5°C	150	2880
10°C	10°C	120	1080
20°C	20°C	35	480
25°C	30°C	12	300

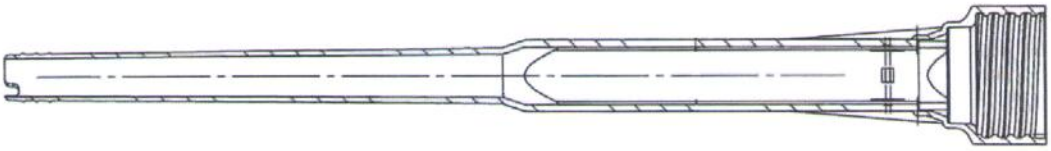
[1)] curing time shall be doubled for wet concrete

R-KEX II for rebar connections	**Annex 3** of European Technical Approval ETA-13/0585
Materials, curing and open time	

Side by side cartridge - 385 to 1100 ml



Mixer for cartrige



Mixer extension

*Variable length from 300mm up to 1000mm.

R-KEX II for rebar connections	**Annex 4** of European Technical Approval ETA-13/0585
Cartridge type and sizes	

Air gun

Brushes

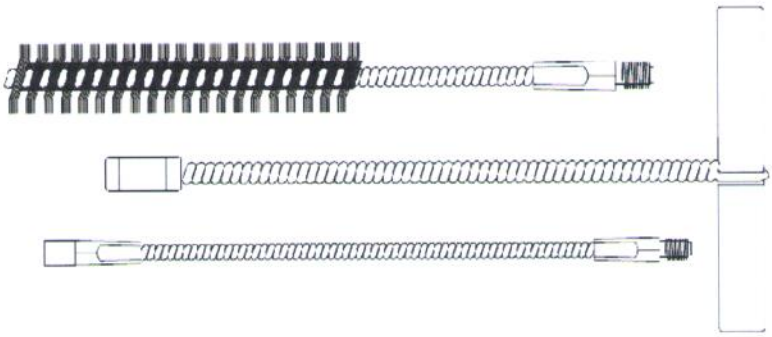


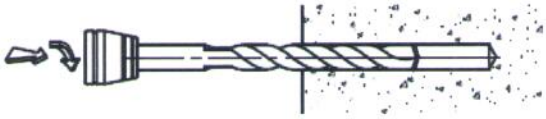
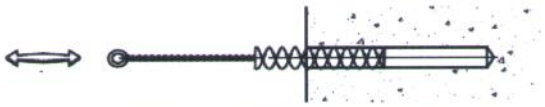
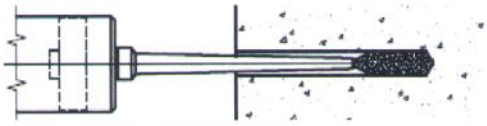
Table 4: Brushes for cleaning the drilled holes

Rebar diameter [mm]		**Ø8**	**Ø10**	**Ø12**	**Ø14**	**Ø16**	**Ø20**	**Ø25**	**Ø28**	**Ø32**
Type of the brush		with steel wires								
Brush head diameter	**[mm]**	14	16	18	20	22	27	32	37	42
Brush head length	**[mm]**	80						100		

R-KEX II for rebar connections	**Annex 5** of European Technical Approval ETA-13/0585
Tools for installation (1)	

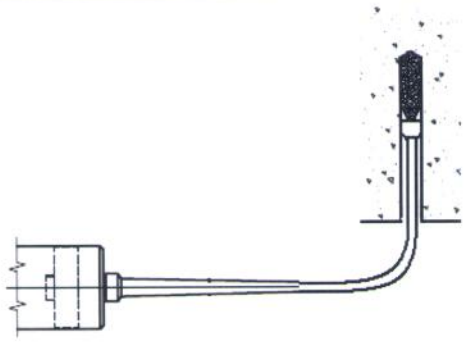
Table 5: Tools for installation

Pumps (guns)	Cartridge size	Intended use
 Manual gun	385 ml	up to 300 mm anchorage depth
 Manual gun	385 ml	up to 300 mm anchorage depth
 Pneumatic gun	385 to 1100 ml	up to 2500 mm anchorage depth

	Drill a hole to the required diameter and depth using a rotary hammer drilling machine.
	Blow the hole at least 2 times using compressed air (minimum 6 bar) until dust is evacuated.
	Brush the hole 2 times with the specified brush size (acc. to Annex 5) by inserting the brush to the back of the hole in a twisting motion. The brush shall produce natural resistance as it enters the anchor hole. If this is not the case, please use a new brush with a larger diameter.
	Blow the hole at least 2 times using compressed air (minimum 6 bar) until dust is evacuated.
	Brush the hole 2 times with the specified brush size (acc. to Annex 5) by inserting the brush to the back of the hole in a twisting motion.
	Blow the hole at least 2 times using compressed air (minimum 6 bar) until dust is evacuated.
	Insert the mixing nozzle to the far end of the hole and inject the mortar, slowly withdrawing the nozzle as the hole is filled to 2/3 of its' depth.
	Drive the rebar into the hole.
	Leave the fixing undisturbed until the curing time elapses.

R-KEX II for rebar connections	**Annex 7** of European Technical Approval ETA-13/0585
Installation procedure (hammer drilling)	

In addition to standard installation procedure (Annex 7), for overhead installation, follow the procedure given below.

	1. Inject from the bottom of the hole. Maintain this position during the injection phase. 2. Inject the product about 2/3 of the hole depth. During the injection maintain this position to assure the correct installation.
	3. Remove the injection plug. Insert immediately the rebar (turn the rebar during the insertion).
	4. To avoid the slipping of the rebar during the open time of the product (due to the rebar own weight) use a temporary interlocking element.

R-KEX II for rebar connections	**Annex 8** of European Technical Approval ETA-13/0585
Overhead installation procedure	

Table 6: Installation parameters

Rebar diameter [mm]	Ø8	Ø10	Ø12	Ø14	Ø16	Ø20	Ø25	Ø28	Ø32
Drill bit diameter d_0 [mm]	12	14	16	18	20	25	30	35	40
Brush diameter [mm]	14	16	18	20	22	27	32	37	42
Minimum anchorage length $l_{b,min}$ [mm]	115	145	170	200	230	285	355	400	455
Minimum anchorage length: overlap joint $l_{o,min}$ [mm]	200	200	200	210	240	300	375	420	480
Maximum anchorage depth $l_{v,max}$ [mm]	700	900	1100	1300	1400	1800	2200	2500	2500

Minimum anchorage length for anchoring rebar: $l_{b,min} = \max \{0,3 \cdot l_{b,rqd}; 10 \cdot Ø; 100 \text{ mm}\}$

Minimum lap length for overlap joint: $l_{0,min} = \max \{0,3 \cdot \alpha_6 \cdot l_{b,rqd}; 15 \cdot Ø; 200 \text{ mm}\}$

Table 7: Design values of the ultimate bond resistance f_{bd} according to EN 1992-1-1 (for hammer drilling)

Rebar diameter [mm]	Ultimate bond resistance f_{bd} [1] [N/mm²]								
	C12/15	C16/20	C20/25	C25/30	C30/37	C35/45	C40/50	C45/55	C50/60
Ø8	1,60	2,00	2,30	2,70	3,00	3,40	3,70	4,00	4,00
Ø10	1,60	2,00	2,30	2,70	3,00	3,40	3,70	4,00	4,00
Ø12	1,60	2,00	2,30	2,70	3,00	3,40	3,70	4,00	4,00
Ø14	1,60	2,00	2,30	2,70	3,00	3,40	3,70	4,00	4,00
Ø16	1,60	2,00	2,30	2,70	3,00	3,40	3,70	4,00	4,00
Ø20	1,60	2,00	2,30	2,70	3,00	3,40	3,70	3,70	3,70
Ø25	1,60	2,00	2,30	2,70	3,00	3,40	3,70	3,70	3,70
Ø28	1,60	2,00	2,30	2,70	3,00	3,40	3,40	3,40	3,40
Ø32	1,60	2,00	2,30	2,70	3,00	3,00	3,00	3,00	3,00

[1] Values given in Table 7 are valid for "good bond conditions" according to EN 1992-1-1. For all other conditions the values shall be multiplied by 0,7.

Minimum concrete cover: $c_{min} = 30 \text{ mm} + 0,06 \cdot l_v \geq 2 \cdot Ø$

Minimum clear spacing between two post-installed rebars: $a = 40 \text{ mm} \geq 4 \cdot Ø$

R-KEX II for rebar connections	**Annex 9** of European Technical Approval ETA-13/0585
Installation parameters	

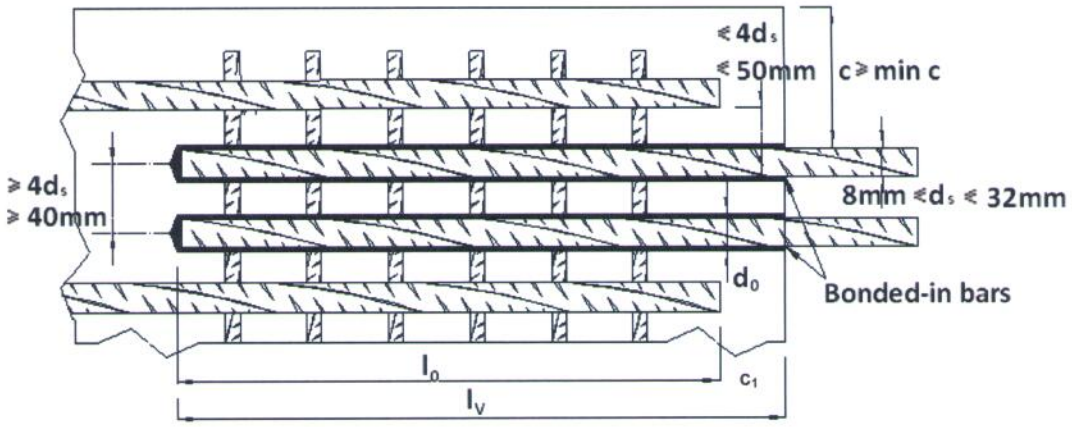


Figure 6: General rules of construction for bonded-in rebars

If the clear distance between overlapping rebars is greater than 4Ø the overlap length shall be enlarged by the difference between the clear distance and 4Ø.

l_0 – required lap length acc. to clause 4.3.4 and EN 1992-1-1
l_v – effective embedment depth
c – concrete cover of bonded-in rebar
c_{min} (min c) – minimum concrete cover acc. to Annex 9
c_1 – concrete cover at end-face of bonded-in rebar
d_0 – drill bit diameter acc. to Annex 9
d_s – rebar diameter (Ø)

R-KEX II for rebar connections	**Annex 10** of European Technical Approval ETA-13/0585
General rules of construction, spacing and edge distance	

Table 8: Design values for anchoring rebar connections (C20/25; f_{yk}= 500 N/mm^2; f_{bd} = 2,3 N/mm^2)

Rebar diameter	$\alpha_1 = \alpha_2 = \alpha_3 = \alpha_4 = \alpha_5 = 1,0$			α_2 or $\alpha_5 = 0,7$; $\alpha_1 = \alpha_3 = \alpha_4 = 1,0$		
	Anchorage length l_{bd}	Tension load	Mortar volume V	Anchorage length l_{bd}	Tension load	Mortar volume V
[mm]	[mm]	[kN]	[ml]	[mm]	[kN]	[ml]
8	115	6,6	9	115	9,5	9
	200	11,6	15	200	16,5	15
	280	16,2	21	220	18,2	17
	360	20,8	27	240	19,8	18
	380	21,9	29	265	21,9	20
10	145	10,5	13	145	15,0	13
	200	14,5	18	200	20,6	18
	300	21,7	27	300	31,0	27
	400	28,9	36	315	32,5	29
	475	34,1	43	330	34,1	30
12	170	14,7	18	170	21,1	18
	240	20,8	25	240	29,7	25
	360	31,2	38	360	44,6	38
	480	41,6	51	375	46,5	40
	500	43,4	53	390	48,3	41
	570	49,1	60	400	49,1	42
14	200	20,2	24	200	28,9	24
	280	28,3	34	280	40,5	34
	420	42,5	51	420	60,7	51
	560	56,6	68	440	63,6	53
	665	67,0	80	465	67,0	56
16	230	26,6	31	230	38,0	31
	320	37,0	43	320	52,9	43
	480	55,5	65	480	79,3	65
	640	74,0	87	500	82,6	68
	760	87,4	103	530	87,4	72
20	285	41,2	60	285	58,8	60
	400	57,8	85	400	82,6	85
	600	86,7	127	600	123,9	127
	800	115,6	170	630	130,1	134
	945	136,5	200	662	136,5	140
25	355	64,1	92	355	91,6	92
	500	90,3	130	500	129,0	130
	750	135,5	194	750	193,5	194
	1180	213,5	444	830	213,3	215
28	400	80,9	166	400	115,6	166
	600	121,4	249	600	173,4	249
	840	169,9	349	840	242,8	349
	1325	267,8	550	930	267,7	387
32	455	105,2	247	455	150,3	247
	685	158,4	372	685	226,3	372
	700	161,9	380	700	231,2	380
	1510	307,4	821	1060	349,7	575

The given values are valid for "good bond condition" according to EN 1992-1-1. For all other conditions the values shall be multiplied by 0,7.
The volume of mortar can be calculated using the equation: $V = 1,2 \cdot (d_0^2 - d^2) \cdot \pi \cdot l_{bd} / 4$

R-KEX II for rebar connections	**Annex 11** of European Technical Approval ETA-13/0585
Design values for anchoring connections	

Table 9: Design values for overlap joint connections (C20/25; f_{yk}= 500 N/mm^2; f_{bd} = 2,3 N/mm^2)

Rebar diameter	$\alpha_1 = \alpha_2 = \alpha_3 = \alpha_4 = \alpha_5 = \alpha_6 = 1{,}0$			α_2 or $\alpha_5 = 0{,}7$; $\alpha_1 = \alpha_3 = \alpha_4 = \alpha_6 = 1{,}0$		
	Lap length l_0	Tension load	Mortar volume V	Lap length l_0	Tension load	Mortar volume V
[mm]	[mm]	[kN]	[ml]	[mm]	[kN]	[ml]
8	200	11,6	15	200	16,5	15
	280	16,2	21	220	18,2	17
	360	20,8	27	240	19,8	18
	380	21,9	29	265	21,9	20
10	200	14,5	18	200	20,6	18
	300	21,7	27	300	31,0	27
	400	28,9	36	315	32,5	29
	475	34,1	43	330	34,1	30
12	200	17,3	21	200	24,8	21
	240	20,8	25	240	29,7	25
	360	31,2	38	360	44,6	38
	480	41,6	51	375	46,5	40
	500	43,4	53	390	48,3	41
	570	49,1	60	400	49,1	42
14	210	21,2	25	210	30,3	25
	280	28,3	34	280	40,5	34
	420	42,5	51	420	60,7	51
	560	56,6	68	440	63,6	53
	665	67,0	80	465	67,0	56
16	240	27,7	33	240	39,6	33
	320	37,0	43	320	52,9	43
	480	55,5	65	480	79,3	65
	640	74,0	87	500	82,6	68
	760	87,4	103	530	87,4	72
20	300	43,3	64	300	61,9	64
	400	57,8	85	400	82,6	85
	600	86,7	127	600	123,9	127
	800	115,6	170	630	130,1	134
	945	136,5	200	662	136,5	140
25	375	67,7	97	375	96,8	97
	500	90,3	130	500	129,0	130
	750	135,5	194	750	193,5	194
	1180	2132,4	444	830	213,3	215
28	420	85,0	175	420	121,4	175
	630	127,5	262	630	182,1	262
	840	169,9	349	840	242,8	349
	1325	267,8	550	930	267,7	387
32	480	111,0	261	480	158,6	261
	720	166,5	391	720	237,8	391
	900	208,1	489	900	297,3	489
	1510	349,5	821	1060	349,5	575

The given values are valid for "good bond condition" according to EN 1992-1-1. For all other conditions the values shall be multiplied by 0,7.
The volume of mortar can be calculated using the equation: $V = 1{,}2 \cdot (d_0^2 - d^2) \cdot \pi \cdot l_{bd} / 4$