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Autorisé et notifié conformément à l'article 10 de la directive 89/106/EEC du Conseil, du 21 décembre 1988, relative au rapprochement des dispositions législatives, réglementaires et administratives des Etats membres concernant les produits de construction.

CSTB le futur en construction

MEMBRE DE L'EOTA

European Technical Approval ETA-12/0100

(English language translation, the original version is in French language)

Nom commercial : **Trade name:**	**Injection System EPOMAX PLUS for rebar connection**
Titulaire : **Holder of approval:**	**Société SPIT** **Route de Lyon** **F-26501 BOURG-LES-VALENCE** **France**
Type générique et utilisation prévue du produit de construction : **Generic type and use of construction product:**	Scellement d'armatures rapportées, diamètres 8 à 32mm, avec Système d'injection EPOMAX PLUS **Post installed rebar connections diameter 8 to 32 mm made with EPOMAX PLUS injection mortar.**
Validité du : au : **Validity from / to:**	**07/02/2012** **04/04/2016**
Usine de fabrication : **Manufacturing plant:**	**Société SPIT Plant 2**
Le présent Agrément technique européen contient : **This European Technical Approval contains:**	21 pages incluant 12 annexes faisant partie intégrante du document. **21 pages including 12 annexes which form an integral part of the document.**

I LEGAL BASES AND GENERAL CONDITIONS

1. This European Technical Approval is issued by the Centre Scientifique et Technique du Bâtiment 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], modified by the Council Directive 93/68/EEC of 22 July 1993[2];

– Décret n° 92-647 du 8 juillet 1992[3] concernant l'aptitude à l'usage des produits de construction;

– Common Procedural Rules for Requesting, Preparing and the Granting of European Technical Approvals set out in the Annex of Commission Decision 94/23/EC[4];

– Guideline for European Technical Approval of « Metal Anchors for use in Concrete » ETAG 001, edition 1997, Part 1 « Anchors in general », Part 5 « Bonded anchors» and Technical Report for Post Installed Rebar Connections TR23.

2. The Centre Scientifique et Technique du Bâtiment is authorised to check whether the provisions of this European Technical Approval are met. Checking may take place in the manufacturing plant (for example concerning the fulfilment of assumptions made in this European Technical Approval with regard to manufacturing). Nevertheless, the responsibility for the conformity of the products with 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 manufacturer 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 the Centre Scientifique et Technique du Bâtiment pursuant to Article 5 (1) of the 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 the Centre Scientifique et Technique du Bâtiment. 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 n° L 40, 11.2.1989, p. 12

2 Official Journal of the European Communities n° L 220, 30.8.1993, p. 1

3 Journal officiel de la République française du 14 juillet 1992

4 Official Journal of the European Communities n° L 17, 20.1.1994, p. 34

II SPECIFIC CONDITIONS OF THE EUROPEAN TECHNICAL APPROVAL

1 Definition of product and intended use

1.1. Definition of product

The SPIT EPOMAX PLUS injection system is used for the connection, by anchoring or overlap joint, of reinforcing bars (rebars) in existing structures made of ordinary non-carbonated concrete C12/15 to C50/60. The design of the post-installed rebar connections is done in accordance with EN 1992-1-1: October 2005 (Eurocode 2).

Covered are rebar anchoring systems consisting of EPOMAX PLUS bonding material and an embedded straight deformed reinforcing bar diameter, d, from 8 to 32 mm with properties according to Annex C of EN 1992-1-1 and EN 10080. The classes B and C of the rebar are recommended.

1.2. Intended use

The ETA covers applications in non-carbonated concrete C 12/15 to C 50/60 (EN 206-1) only, which are also allowed with straight deformed cast-in bars according to EN 1992-1-1, e.g. those in the following applications:

- overlapping joints with existing reinforcement in a building component, Figure 1 and 2 in annex 2.
- anchoring of the reinforcement at a slab or beam support; end support/bearing of a slab designed as simply supported as well as its reinforcement for restraint forces, Figure 3 in annex 2.
- anchoring of reinforcement of building components stressed primarily in compression, Figure 4 in annex 2.
- anchoring of reinforcement to cover the line of acting tensile force, Figure 5 in annex 2.

The EPOMAX PLUS anchoring systems can be used with the following limitations:

- ✓ The rebars can be placed in holes made with hammer drilling or compress air drilling only
- ✓ The rebars may be used in the following temperature range : -40°C to +80°C (max short term temperature +80°C and max long term temperature +50°C)
- ✓ The rebars must be used only in building components dry surroundings or permanently wet surroundings according to exposure class X0 or XC1 of EN 1992-1-1.
- ✓ The rebars may be installed in dry or wet concrete, but must not be installed in flooded holes.
- ✓ The rebars may be installed overhead.
- ✓ The rebar connections may be used for predominantly static loads

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

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

The provisions made in this European Technical Approval are based on an assumed intended working life of the rebar connections of 50 years. The indications given on the working life cannot be interpreted as a guarantee given by the producer, 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 EPOMAX PLUS injection adhesive corresponds to the drawings and provisions specified in Annexes 1 to 5.

The EPOMAX PLUS injection adhesive is a two components system. The two components of the injection mortar are delivered in unmixed condition in foil packs and cartridges of sizes according to Annex 1. Each mortar cartridge is marked with the identifying mark of the producer, the trade name, the charge code, storage life, curing and processing time

2.2. Methods of verification

The assessment of fitness of the rebar connection 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 « Guideline for European Technical Approval of Metal Anchors for use in Concrete », Part 1 « Anchors in general », Part 5 « Bonded anchors » and Technical Report n° 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 UE Construction Products Directive, these requirements need also to be complied with, when and where they apply.

3 Evaluation of Conformity and CE marking

3.1. Attestation of conformity system

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 for 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 for the approved body:

3. initial type-testing of the product,
4. initial inspection of factory and of factory production control,
5. 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 in the plant and 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 prescribed test plan[5]. The incoming raw materials shall be subject to controls and tests by the manufacturer before acceptance. Check of incoming materials shall include control of the inspection documents presented by suppliers.

The frequency of controls and tests conducted during production is laid down in the prescribed test plan taking account of the automated manufacturing process of the product.

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 and 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 inspection body during the continuous surveillance. On request, they shall be presented to the Centre Scientifique et Technique du Bâtiment.

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

3.2.2. Tasks of approved bodies

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 Centre Scientifique et Technique du Bâtiment and the approved bodies involved.

3.2.2.2. Initial inspection of factory and of factory production control

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

3.2.2.3. Continuous surveillance

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

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

The results of product certification and continuous surveillance shall be made available on demand by the certification body or inspection body, respectively, to the Centre Scientifique et Technique du

5 The prescribed test plan has been deposited at the Centre Scientifique et Technique du Bâtiment and is only made available to the approved bodies involved in the conformity attestation procedure.

Bâtiment. In cases where the provisions of the European Technical Approval and the prescribed test 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 anchors. The symbol « CE » shall be accompanied by the following information:

- name or identifying mark of the producer and manufacturing plant;
- the 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;

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

4.1. Manufacturing

The EPOMAX PLUS resin is manufactured in accordance with the provisions of the European Technical Approval using the automated manufacturing process as identified during inspection of the plant by the Centre Scientifique et Technique du Bâtiment and the approved body and laid down in the technical documentation.
Changes to the product or production process, which could result in this deposited data/information being incorrect, should be notified to the Centre Scientifique et Technique du Bâtiment before the changes are introduced. The Centre Scientifique et Technique du Bâtiment will decide whether or not such changes affect the approval and consequently the validity of the CE marking on the basis of the approval and if so whether further assessment or alterations to the approval shall be necessary.

4.2. Drafting

Rebar connection must be designed in keeping with good engineering practice. Allowing for the loads to be anchored, design calculations and design drawings must be produced which can be checked. At least the following must be given in the design drawings:

- Concrete strength.
- Diameter, drilling technique, concrete cover, spacing and anchorage depth of the rebars.
- Dimension for the depth of adhesive (dispensing amount to be marked on the mixer extension as per Annex 9.
- Kind of preparation of the joint between building component being connected.

4.3. Rebar connection design as per EN 1992-1-1

4.3.1. General points

The actual position of the reinforcement in the existing building component must be determined on the basis of the construction documentation and allowed for when drafting.

The transfer of internal section forces in the joint must be verified in accordance to EN 1992-1-1 when a new building component is being connected. The transfer of shear forces between new and old concrete shall be designed according to EN 1992-1-1. The joints for concreting must be roughened to at least such an extent that aggregate protrude.

The design of rebar connections and determination of the internal section forces to be transferred in the construction joint shall be in keeping with the EN 1992-1-1.

Verification of immediate local force transfer to the concrete has been provided.

Verification of the transfer of the loads to be anchored to the building component must be provided.

The spacing between post installed rebars shall be equal or greater than the maximum of $4d_s$ and 40mm (according to Annex 4)

4.3.2. Determination of anchorage depth.

4.3.2.1. General points

The design anchorage length l_{bd} must be determined according to EN 1992-1-1, section 8.4.3.

The anchorage depths and overlap lengths must not be less than the minimum values that are given in Annex 5. The maximum permissible anchorage depth is given in Annex 5.

4.3.2.2. Calculation of the basic anchorage length $l_{b,rqd}$

The basic anchorage length $l_{b,rqd}$, for anchoring the force $A_s.f_{yd}$ in the rebar assuming constant bond stress equal to f_{bd} follows from:

$l_{b,rqd}=(\phi/4).(\sigma_{sd}/f_{bd})$ where: ϕ = diameter of the rebar

σ_{sd} = calculated stress in the rebar under the design action

f_{bd} =design value of the bond strength according to table 4 in Annex 5

$f_{bd} = 2.25\ \eta_1\ \eta_2\ f_{ctd}$ (according to EN 1992-1-1)

with $f_{ctd} = \alpha_{ct}\ f_{ctk,0.05} / \gamma_c$ and $\alpha_{ct} = 1$ and $\gamma_c = 1.5$

η_1 coefficient relative to the quality of the bond condition and position of the rebar during concreting

η_1 = 1,0 (“good” bond conditions)

η_1 = 0,7 (all other conditions)

η_2 = 1,0 (for $\varnothing \leq 32$mm)

4.3.2.3. Calculation of the minimum anchorage length $l_{b,min}$

Anchoring rebar

In the case of anchoring rebar, the minimum anchorage length $l_{b,min}$ must be determined as follow:

For anchoring rebar in tension
$l_{b,min}$ = Max (0,3 $l_{b,rqd}$; 10 ϕ; 100mm) (EN 1992-1-1, Equation 8.6)

For anchoring rebar under compression
$l_{b,min}$ = Max (0,6 $l_{b,rqd}$; 10 ϕ; 100mm) (EN 1992-1-1, Equation 8.7)

Overlap joint

In the case of overlap joint, the minimum anchorage length $l_{0,min}$ must be determined as follow:

$l_{0,min}$ = Max (0,3.α_6.$l_{b,rqd}$; 15 ϕ; 200mm) (EN 1992-1-1 Equation 8.11)

where $\alpha_6 = (\rho_1/25)^{0.5} \leq 1.5$ ρ_1 is the percentage of reinforcement lapped within 0.65 l_0 from the centre of the length considered.

4.3.2.4. Calculation of the design anchorage length l_{bd}

Anchoring rebar

In the case of anchoring rebar, the design anchorage length l_{bd} must be determined as follow:

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

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

Overlap joint

In the case of overlap joint, the design lap length l_0 must be determined as follow:

$$l_0 = \alpha_1\ \alpha_2\ \alpha_3\ \alpha_4\ \alpha_5\ \alpha_6\ l_{b,rqd} \geq l_{0,min}$$

where α_1, α_2, α_3, α_4, α_5, α_6 determined according to, EN 1992-1-1.Table 8.2 and 8.3

α_1	Influence of the shape of the rebar	α_1=1 for straight rebar
α_2	Influence of the concrete cover	$0.7 \leq \alpha_2 \leq 1.0$ calculated according to EN 1992-1-1 Table 8.2
α_3	Influence of the confinement by transverse reinforcement not welded to main reinforcement	α_3=1 because no transverse reinforcement
α_4	Influence of the confinement by welded transverse reinforcement	α_4=1 because no transverse reinforcement
α_5	Influence of the confinement by transverse pressure	$0.7 \leq \alpha_5 \leq 1.0$
α_6	Influence of the overlapping length	$1.0 \leq \alpha_6 \leq 1.5$

Nota: Examples of calculations are published in annexes 11 and 12 for concrete C20/25. Other values can be calculated by using the above formulas.

4.3.2.6. Transverse reinforcement

The transverse reinforcement required in the zone of the rebar connection must fulfil the requirement of EN 1992-1-1, section 8.7.4.

4.3.2.7 Connection joint

In case of a connection being made between new and existing concrete where the surface layer of the existing concrete is carbonated, the layer should be removed in the area of the new reinforcing bar (with a diameter ds + 60mm) prior to the installation of the new bar.
The foregoing may be neglected if building components are new and not carbonated.

4.3.2.8 Additional provisions

The concrete cover required for bonded-in rebars is shown in Annex 5, Table 2, in relation to the drilling method.
Furthermore the minimum concrete cover given in EN 1992-1-1, Section 4.4.1.2 shall be observed.

4.4. Installation

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

- The installation of the post installed rebars shall be carried out according to the manufacturer's installation instructions and this European technical approval, annexes 6 to 9
- The installation of post-installed rebars shall be done only by suitable trained installer and under supervision on site. The conditions under which an installer may be considered as suitable trained and the conditions for supervision on site are up to the Member States in which the installation is done.
- Use of the system only as supplied by the manufacturer without exchanging the components of a system;
- Checks before placing the rebar to ensure that the strength class of the concrete in which the rebar is to be placed is in the range;

- The surface of the joint between new and existing concrete should be prepared (roughing, keying, according to the envisaged intended use according to EN 1992-1-1;
- Check of concrete being well compacted, e.g. without significant voids;
- Keeping the anchorage depth as specified in the design drawings;
- Keeping of the concrete cover and spacing as specified in the design drawings;
- The drilling and cleaning of the hole and the installation shall be performed only with the equipment as specified by the manufacturer given in annexes 6 to 10. It shall be ensured that this equipment is available on site and is used;
- Positioning of the drill holes without damaging the reinforcement;
- In case of aborted drill hole: the drill hole shall be filled with mortar;
- The post installed rebar connection must not be installed in flooded holes;
- Rebar installation ensuring the specified embedment depth, that is the appropriate depth marking of the rebar not exceeding the concrete surface.

4.5. Responsibility of the manufacturer

It is the manufacturer's responsibility to ensure that the information on the specific conditions according to 1 and 2 including Annexes referred to in § 4.3. 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,
- rebar diameter,
- admissible service temperature range,
- curing time of the bonding material depending on the installation temperature,
- information on the installation procedure, including cleaning of the hole, preferably by means of an illustration,
- reference to any special installation equipment needed,
- identification of the manufacturing batch.

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

5 Recommendations concerning packaging, transport and storage.

Each cartridge of resin is marked with the identifying mark of the producer, the trade name, the charge code, storage life, curing and processing time.

The cartridges of resin shall be protected against sun radiation and shall be stored according to the manufacturer's installation instructions in dry conditions at temperatures of at least +5°C to not more than +20°C to achieve the maximum shelf life.

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

The original French version is signed by

Le Directeur Technique
C. BALOCHE

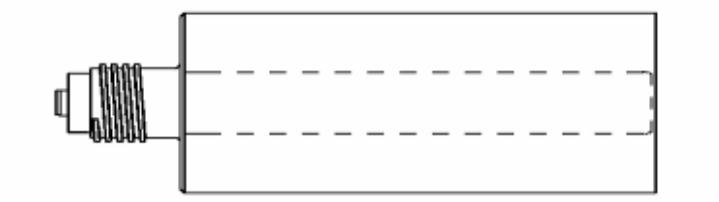
Product description and intended use

The post-installed rebar connection consists of injection mortar EPOMAX PLUS and an embedded straight deformed reinforcing bar with properties of class B and C according to Annex C of EC2.

Mortar cartridges:

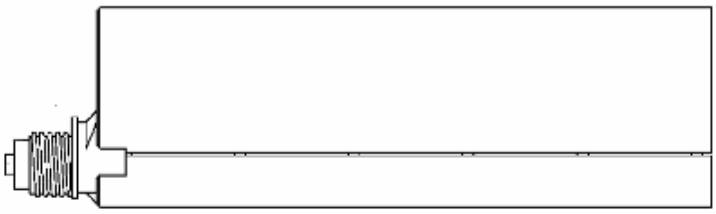
Coaxial cartridge:

C-CN/150-10/EPOMAX PLUS
C-CN/330-10/EPOMAX PLUS
C-CN/380-10/EPOMAX PLUS
C-CN/400-10/EPOMAX PLUS
C-CN/410-10/EPOMAX PLUS
(150 ml / 330 ml / 380 m / 400 ml / 410ml)



Side by side cartridge

S-CN/345-10/EPOMAX PLUS
S-CN/825-10/EPOMAX PLUS
(345 ml / 825ml)



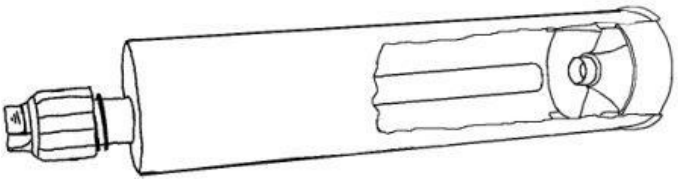
Two part foil capsules within a single component cartridge :

CIC/150/EPOMAX PLUS
CIC/300/EPOMAX PLUS
CIC/380/EPOMAX PLUS
CIC/550/EPOMAX PLUS

(150ml / 300 ml / 380 ml / 550 ml)

PLR/280-10/EPOMAX PLUS

(280 ml)



Reinforcing bar according to EC2 (see Annex 3):

- Covered are post-installed rebar connections in non-carbonated concrete on the assumption only that the design of post-installed rebar connections is done in accordance to EC2.
- Installation in dry or wet concrete, it must not be installed in flooded holes.
- Overhead installation is permissible
- The post-installed rebar connections can be used only in dry surroundings or permanently wet surroundings according to exposure class X0 or XC1 of EC2
- Temperature range: -40°C to +80°C (maximum long term temperature +50 C and maximum short term temperature +80 C)

Injection System EPOMAX PLUS for rebar connection	**Annex 1** **of the European Technical Approval** **ETA - 12/0100**
Product description and intended use	

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

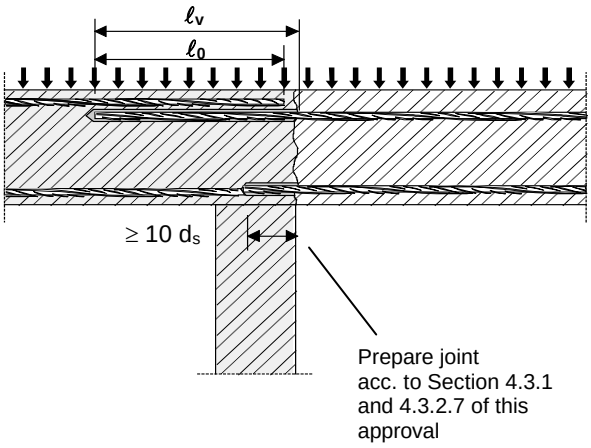


Figure 2: Overlap joint at a foundation of a column or wall where the rebars are stressed in tension

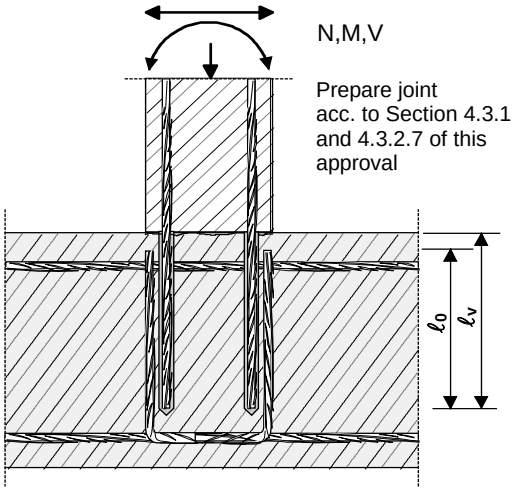


Figure 3: End anchoring of slabs or beams, designed as simply supported

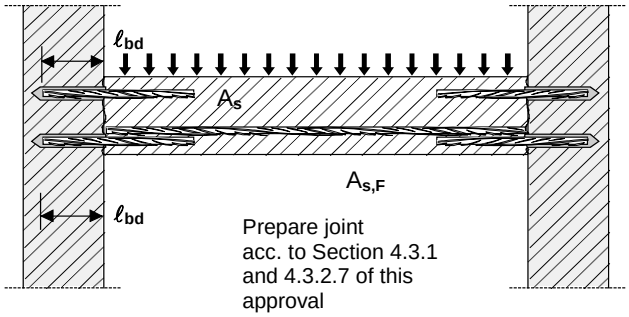


Figure 4: Rebar connection for components stressed primarily in compression. The rebars are stressed in compression.

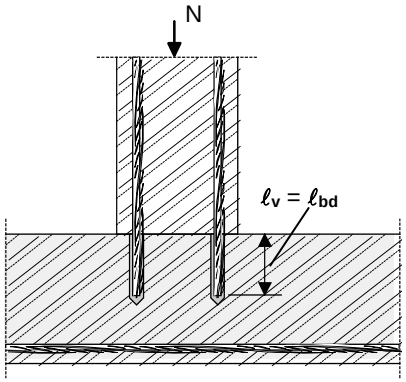
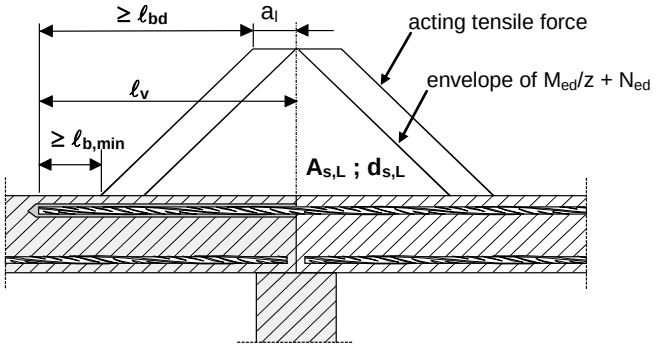


Figure 5: Anchoring of reinforcement to cover the line of acting tensile force



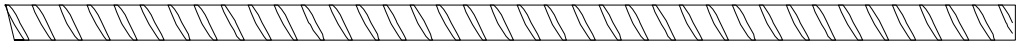
Note to Figure 1 to 5:

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.

Injection System EPOMAX PLUS for rebar connection	**Annex 2** **of the European Technical Approval** **ETA - 12/0100**
Examples of use for rebars	

Figure 6: Reinforcing bar “rebar” according to EC2



Refer to EOTA TR 023:
This Technical Report covers post-installed rebar connections in non-carbonated concrete under the assumption only that the design of post-installed rebar connections is done in accordance with EN 1992-1-1.

Covered are rebar anchoring systems consisting of bonding material and an embedded straight deformed reinforcing bar with properties according to Annex C of EN 1992-1-1; the classes B and C of the rebar are recommended.

Refer to EN 1992-1-1 Annex C Table C.1 and C.2N Properties of reinforcement:

Table 1: Rebar Properties

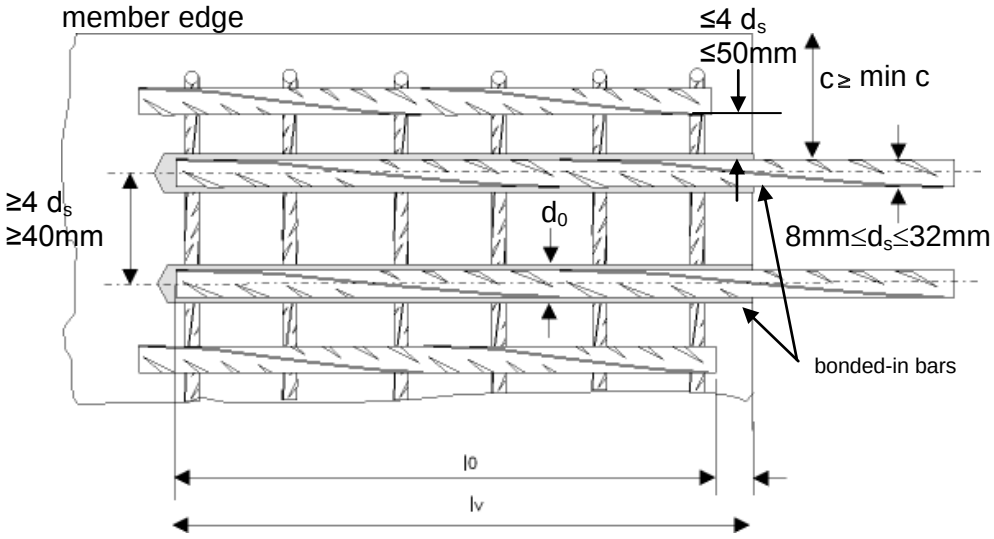
Product form		**Bars and de-coiled rods**	
Class		B	C
Characteristic yield strength f_{yk} or $f_{0,2k}$ (MPa)		400 to 600	
Minimum value of $k = (f_t/f_y)_k$		≥ 1,08	≥ 1,15 < 1,35
Characteristic strain at maximum force, ε_{uk} (%)		≥ 5,0	≥ 7,5
Bendability		Bend / Rebend test	
Maximum deviation from nominal mass (individual bar or wire) (%)	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 maximum outer rebar diameter over the ribs shall be:
nominal diameter of the bar d + 0.2∗d

Injection System EPOMAX PLUS for rebar connection	**Annex 3** **of the European Technical Approval** **ETA - 12/0100**
Reinforcing bar “rebar” according to EC2	

Figure 7: General design rules of construction for bonded-in rebars



1) If the clear distance between lapped bars exceeds $4d_s$, then the lap length shall be increased by the difference between the clear bar distance and $4d_s$.

The following applies to Figure 7:

- ℓ_v or. ℓ_0 are in accordance with section 4.3.2 of the approval
- The provision of sufficient transverse reinforcement according to section 4.3.2.6 of this approval must be verified.

c concrete cover of bonded-in bar
c_1 concrete cover at end-face of bonded-in bar
min c minimum concrete cover acc. Annex 5 of this approval
d_s diameter of bonded-in bar
ℓ_0 lap length
ℓ_v effective embedment depth
d_0 nominal drill bit diameter, see Annex 7

Injection System EPOMAX PLUS for rebar connection	**Annex 4**
General design rules of construction, spacing and edge distance for bonded-in rebars	**of the European Technical Approval** **ETA - 12/0100**

Table 2: Minimum concrete cover min c of the bonded-in rebar depending on drilling method

Drilling method	Without drilling aid
Hammer drilling	30mm + 0,06 $\ell_v \geq 2\ d_s$
Compressed air drilling	50mm + 0,08 ℓ_v

Table 3: Minimum anchorage length and lap splice length for C20/25 and maximum installation length l_{max} for good bond conditions

Rebar		$l_{b,min}$ [mm]	$l_{0,min}$ [mm]	l_{max} [mm]
Ø d_s	$f_{y,k}$ [N/mm²]			
8 mm	500	113	200	400
10 mm	500	142	200	500
12 mm	500	170	200	600
14 mm	500	198	210	700
16 mm	500	227	240	800
20 mm	500	284	300	1000
25 mm	500	354	375	1000
28 mm	500	397	420	1000
32 mm	500	454	480	1000

1) According EN 1992-1-1: $l_{b,min}$ (8.6) and $l_{0,min}$ (8.11) with maximum yield strength for rebar BSt 500S, γ_M = 1,15 and α_6 = 1,0

Table 4: Design values of the ultimate bond resistance f_{bd} [1)] in N/mm² for all drilling methods for good bond conditions

Rebar-Ø	Concrete class								
d_s	C12/15	C16/20	C20/25	C25/30	C30/37	C35/45	C40/50	C45/55	C50/60
8 to 14 mm	1.6	2.0	2.3	2.7	3.0	3.4	3.7	4.0	4.3
16 mm									4.0
20 mm							3.4		
25 to 32 mm					2.7				

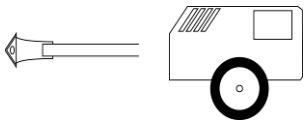
1) Tabulated values for f_{bd} are valid for good bond conditions according to EN 1992-1-1. For all other bond conditions multiply the values for f_{bd} by 0.7.

Injection System EPOMAX PLUS for rebar connection	**Annex 5**
Minimum concrete cover min c, minimum anchorage and lap splice length, maximum installation length and design values of the ultimate bond resistance	**of the European Technical Approval** **ETA - 12/0100**

Drilling the hole

Drill hole to the required embedment depth using a hammer-drill with carbide drill bit set in rotation hammer mode, or a compressed air drill.

Rotary hammer drilling



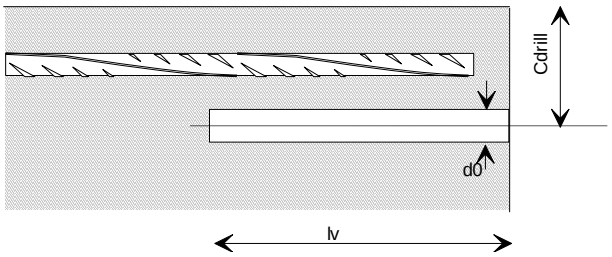
Compressed air drill

Water in the hole is not permitted

Table 5: Drilling diameter and maximum anchorage length

Rebar diameter d_{nom} [1)] [mm]	Nominal drilling diameter d_{cut} [mm]	Max Permissible anchorage depth l_v [mm]
8	12 (10)	400
10	14 (12)	500
12	16	600
14	18	700
16	20	800
20	25	1000
25	32	1000
28	35	1000
32	40	1000

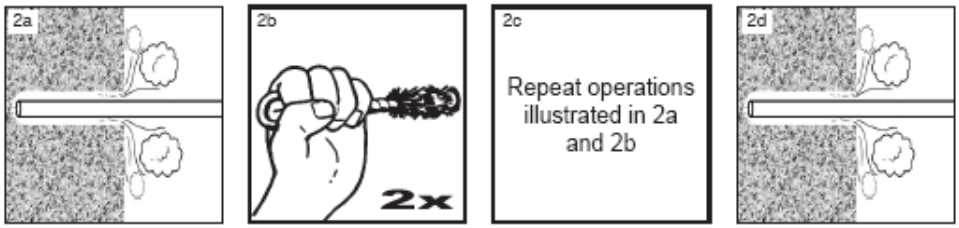
1) The maximum outer rebar diameter over the ribs shall be:
nominal diameter of the bar d_{nom} + 0,20 d_{nom}



- Observe concrete coverage, c, as per setting plan and table 3.
- Drill parallel to the edge

Cleaning the hole

The borehole must be free of dust, debris, water, ice, oil, grease and other contaminants prior to mortar injection.



Use the brush with the required extensions and a source of clean compressed air. For holes of 400mm or less deep, a blow pump may be used

Operation 1. Blowing 1 time from the back of the hole with oil-free compressed air (min. 6 bar) until return air stream is free of noticeable dust.

Operation 2. Brushing 2 times with the specified brush size (brush Ø ≥ borehole Ø) 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 or a brush with a larger diameter.

Operation 3. Repeat operation 1 and 2.

Operation 4. Blowing 1 time again with compressed air until return air stream is free of noticeable dust.

sizes		Ø8	Ø10	Ø12	Ø14	Ø16	Ø20	Ø25	Ø28	Ø32
Drill hole diameter d_0	[mm]	12 (10)	14 (12)	16	18	20	25	32	35	40
Brushes head diameter	[mm]	14	14	19	22	22	29	40	40	42
Brushes head length	[mm]	75								

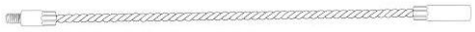
If required use additional accessories and extensions for air nozzle and brush to reach back of hole.

Max. hole depth	Brush / extension configuration	Part
250mm	Standard brush	(a)
550mm	Brush head unit + handle unit	(b) + (c)
850mm	Brush head unit + extension piece + handle unit	(b) + (d) +(c)
1150mm	Brush head unit + 2x (ext. piece) + handle unit	(b) + (d) + (d) +(c)

Part (a)

Part (b)

Part (c)

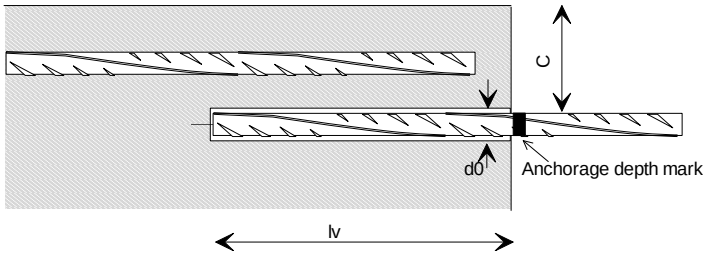


Part (d)

Injection System EPOMAX PLUS for rebar connection	**Annex 7**
Installation instruction II **Cleaning the hole**	**of the European Technical Approval** **ETA - 12/0100**

Mortar injection

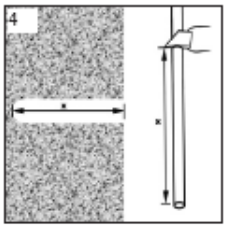
If the hole collects water after the initial cleaning, this water must be removed before injecting the resin.



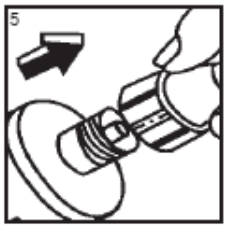
Before use, make sure the rebar is dry and free of oil or other residue.

Mark the embedment depth on the rebar (e.g. with tape) → ℓ_v

Insert Rebar in borehole, to verify hole and setting depth ℓ_v



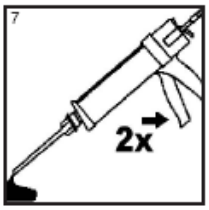
Cut the extenstion tube (if used) to the depth of the hole.



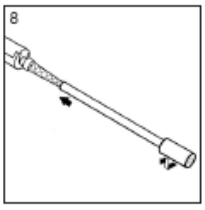
Remove the screw cap from the cartridge.

- **Check Expiration date**: See imprint on cartridge. Do not use an expired product.
- **Cartridge temperature**: Must be between +5°C and +40°C when in use.
- **Base material temperature at time of installation**: Must be between -5°C and +40°C.
- **Instructions for transport and storage**: Keep in a cool, dry and dark place at +5˚C to +20˚C to achieve maximum shelf life.
- **Review the MSDS before use.**

Attach the mixer nozzle, and place the cartridge in the applicator gun

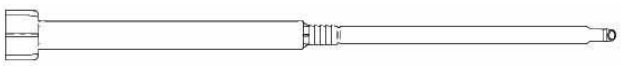


Dispense the first part to waste, until an even colour is achieved.

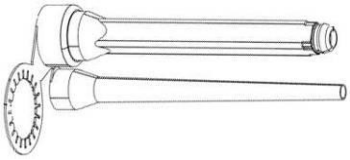


Push the extension tube onto the end of the mixer nozzle, and (for bars 16mm dia. or more) fit the correct resin stopper to the other end.

Mixer nozzle KW



Mixer nozzle TB



Mixer nozzle RM

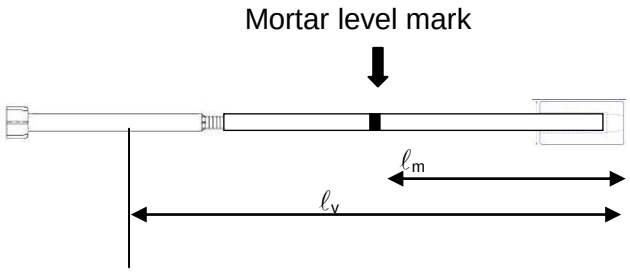
Resin stopper

Mixer nozzle TB is recommended for holes depth greater than 400 mm

Injection System EPOMAX PLUS for rebar connection	**Annex 8** **of the European Technical Approval** **ETA - 12/0100**
Installation instruction III **Mortar injection**	

Extension hose for deep holes	Bar size (mm)								
	8	10	12	14	16	20	25	28	32
Hole dia (mm)	12 (10)	14 (12)	16	18	20	25	32	35	40
Extension hose o.d. (mm)	9		14						
Resin stopper o.d. (mm)	-	-	-	-	18	22	30	30	36

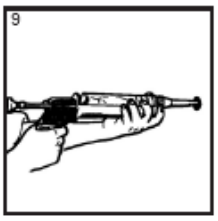
Inserting the rebar



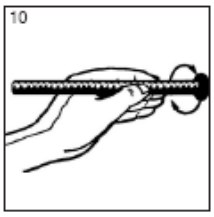
Mark the required mortar level ℓ_m and embedment depth ℓ_v with tape or marker on the injection extension.

Quick estimation: $\ell_m = 1/2 \cdot \ell_v$

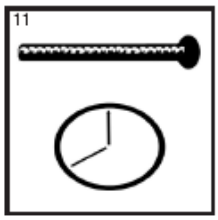
Continue injection until the mortar level mark ℓ_m becomes visible.



Insert the resin stopper / tube to the far end of the hole and inject the resin, allowing the tube to be pushed out as the hole fills.



Immediately insert the rebar, slowly and with a slight twisting motion. Remove excess resin from around the mouth of the hole before it sets.



Leave the rebar undisturbed until the cure time has elapsed.

Ambient temperature	Processing time
Minimum cartridge temperature +5°C	
5° to 10 °C	8 mn
10° to 20°C	4 mn
20° to 35°C	1 mn
35° to 40°C	45 sec

Base material temperature	Curing time
-5° to 0°C	24 h
0° to 5°C	180 mn
5° to 10°C	100 mn
10° to 20°C	70 mn
20° to 35°C	40 mn
35° to 40°C	35 mn

Injection System EPOMAX PLUS for rebar connection	**Annex 9** **of the European Technical Approval** **ETA - 12/0100**
Installation instruction IV **Inserting the rebar**	

Dispensers

Cartridge sizes	Manual dispensers	Cartridge sizes	Manual dispensers
C-CN 380-10 C-CN 400-10 C-CN 410-10	 Manual Dispenser A	S-CN 345-10 S-CN 350-10	 Manual Dispenser B
CIC 150 CIC 300 CIC380 CIC 550	 Manual Dispenser C	CIC 150 CIC 300 CIC 380 PLR 280-10	 Manual Dispenser D
C-CN 150-10 C-CN 330-10	 Manual Dispenser E	S-CN 825-10	 Manual Dispenser F

Cartridge sizes	Pneumatic dispenser
S-CN 825-10	

Values for pre-calculation of anchoring with EPOMAX PLUS injection system

Examples for the anchorage length[1)] for rebars ($f_{y,k}$ = 500 N/mm²) in C20/25 (f_{bd} = 2,3 N/mm²)

Rebar Ø	$\alpha_1=\alpha_2=\alpha_3=\alpha_4=\alpha_5=1,0$			α_2 **or** α_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	113 *	6.56	6 (4) **	113 *	9.37	6 (4) **
	170	9.83	10 (7) **	150	12.39	8 (6) **
	240	13.87	14 (9) **	180	14.86	10 (7) **
	310	17.92	18 (12) **	220	18.17	12 (9) **
	378	21.85	21 (15) **	265	21.85	15 (10) **
10	142 *	10.24	11 (8) **	142 *	14.63	11 (8) **
	220	15.90	17 (12) **	180	18.58	14 (10) **
	300	21.68	23 (17) **	230	23.74	18 (13) **
	380	27.46	29 (21) **	280	28.90	22 (16) **
	473	34.15	36 (27) **	331	34.15	25 (19) **
12	170 *	14.75	17	170 *	21.07	17
	260	22.54	26	220	27.25	22
	360	31.21	36	280	34.68	28
	460	39.89	46	340	42.12	34
	567	49.17	57	397	49.17	40
14	198 *	20.08	25	198 *	28.68	25
	310	31.36	39	260	37.57	33
	430	43.50	55	330	47.69	42
	540	54.63	69	390	56.36	50
	662	66.93	84	463	66.93	59
16	227 *	26.23	36	227 *	37.46	36
	350	40.46	55	300	49.55	47
	490	56.65	77	370	61.11	58
	620	71.68	97	450	74.32	71
	756	87.42	119	529	87.42	83
20	284 *	40.98	70	284 *	58.54	70
	440	63.59	108	370	76.39	91
	610	88.15	150	470	97.03	115
	770	111.28	189	560	115.61	137
	945	136.59	232	662	136.59	162
25	354 *	64.03	143	354 *	91.47	143
	510	92.13	205	470	121.29	189
	670	121.03	269	590	152.26	237
	830	149.93	334	700	180.64	281
	1000	180.64	402	827	213.42	333
28	397 *	80.32	191	397 *	114.74	191
	540	109.25	260	520	150.29	250
	690	139.60	332	660	190.76	317
	840	169.95	404	790	228.33	380
	1000	202.32	481	926	267.72	446
32	454 *	104.90	285	454 *	149.86	285
	590	136.42	371	590	194.89	371
	720	166.48	452	720	237.83	452
	860	198.85	540	860	284.07	540
	1000	231.22	628	1000	330.32	628

1) Tabulated maximum tension loads are valid for good bond conditions according to EN 1992-1-1. For all other bond conditions the values for tension loads must be multiplied by 0.7.

* Values correspond to the minimum anchorage length $l_{b,min}$

** Values correspond to minimum hole diameter

Injection System EPOMAX PLUS for rebar connection	**Annex 11** **of the European Technical Approval** **ETA - 12/0100**
Pre-calculated values for the anchorage length Example for rebars ($f_{y,k}$ = 500 N/mm²) in C20/25 (f_{bd} = 2,3 N/mm²)	

Values for pre-calculation of lap splice lengths with EPOMAX PLUS injection system
Examples for the lap splice length[1)] for rebars ($f_{y,k}$ = 500 N/mm²) in C20/25 (f_{bd} = 2,3 N/mm²)

Rebar Ø	$\alpha_1=\alpha_2=\alpha_3=\alpha_4=\alpha_5=\alpha_6=1,0$			α_2 **or** α_5= 0,7 **and** $\alpha_1=\alpha_3=\alpha_4=\alpha_6$= 1,0		
	Lap splice length l_0	Tension load	Mortar volume V	Lap splice length l_0	Tension load	Mortar volume V
[mm]	[mm]	[kN]	[ml]	[mm]	[kN]	[ml]
8	200 *	11.56	11 (8) **	200 *	16.52	11 (8) **
	240	13.87	14 (9) **	210	17.34	12 (8) **
	280	16.19	16 (11) **	230	18.99	13 (9) **
	330	19.08	19 (13) **	240	19.82	14 (9) **
	378	21.85	21 (15) **	265	21.85	15 (10) **
10	200 *	14.45	15 (11) **	200 *	20.64	15 (11) **
	260	18.79	20 (15) **	230	23.74	18 (13) **
	330	23.84	25 (19) **	260	26.84	20 (15) **
	400	28.90	31 (23) **	290	29.93	22 (16) **
	473	34.15	36 (27) **	331	34.15	25 (19) **
12	200 *	17.34	20	200 *	24.77	20
	290	25.15	29	240	29.73	24
	380	32.95	38	290	35.92	29
	470	40.75	47	340	42.12	34
	567	49.17	57	397	49.17	40
14	210 *	21.24	27	210 *	30.35	27
	320	32.37	41	270	39.02	34
	430	43.50	55	330	47.69	42
	540	54.63	69	390	56.36	50
	662	66.93	84	463	66.93	59
16	240 *	27.75	38	240 *	39.64	38
	360	41.62	57	310	51.20	49
	490	56.65	77	380	62.76	60
	620	71.68	97	450	74.32	71
	756	87.42	119	529	87.42	83
20	300 *	43.35	74	300 *	61.93	74
	460	66.48	113	390	80.51	96
	620	89.60	152	480	99.09	118
	780	112.72	191	570	117.68	140
	945	136.59	232	662	136.59	162
25	375 *	67.74	151	375 *	96.77	151
	530	95.74	213	480	123.87	193
	680	122.84	273	600	154.84	241
	840	151.74	338	710	183.22	286
	1000	180.64	402	827	213.42	333
28	420 *	75.87	202	420 *	121.39	202
	560	101.16	269	540	156.07	260
	710	128.26	342	670	193.65	322
	850	153.55	409	790	228.33	380
	1000	180.64	481	926	267.72	446
32	480 *	110.99	302	480 *	158.55	302
	610	141.04	383	610	201.49	383
	740	171.10	465	740	244.43	465
	870	201.16	547	870	287.37	547
	1000	231.22	628	1000	330.32	628

1) Tabulated maximum tension loads are valid for good bond conditions according to EN 1992-1-1. For all other bond conditions the values for tension loads must be multiplied by 0.7.

* Value corresponding to the minimum anchorage length $l_{0,min}$

** Values correspond to min. hole diameter

Injection System EPOMAX PLUS for rebar connection	**Annex 12** **of the European Technical Approval** **ETA - 12/0100**
Pre-calculated values for the lap splice length Example for rebars ($f_{y,k}$ = 500 N/mm²) in C20/25 (f_{bd} = 2,3 N/mm²)	