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**Institut de  
Tecnologia de la Construcció  
de Catalunya**

Member of EOTA

## European Technical Approval

**ETA 13/0917**

Nombre comercial:

*Trade name:*

Titular del DITE:

*Holder of approval:*

Área genérica y uso del  
producto de construcción:

*Generic type and use of  
construction product.*

Validez:  
*Validity:*

de  
*from*  
  
hasta  
*to*

Planta de fabricación:

*Manufacturing plant:*

El presente Documento de  
Idoneidad Técnica Europeo  
contiene:

*This European Technical  
Approval contains:*

**ChemMatesEP**

**Ideal Fasteners Pty. Ltd.**

10-12 Ausco Place  
3175 – Dandenong South  
Australia

Anclaje químico con barras de acero corrugado post-instaladas de  
diámetro 8 a 32 mm con ChemMates EP

*Post-installed rebar connections diameter 8 mm to 32 mm with  
ChemMates EP injection mortar*

27.06.2013

17.06.2018

**Ideal Fasteners Pty. Ltd.**

25 páginas, incluyendo 10 anexos que forman parte del documento.

*25 pages including 10 annexes which form an integral part of the  
document.*



Organización Europea para la Idoneidad Técnica

European Organisation for Technical Approvals

## I LEGAL BASES AND GENERAL CONDITIONS

1. This European Technical Approval is issued by the Catalonia Institute of Construction Technology (ITeC) in accordance with:
  - Council Directive 89/106/EEC<sup>1</sup> of 21 December 1988 on the approximation of laws, regulations and administrative provisions of Member States relating to construction products modified by the Council Directive 93/68/EEC<sup>2</sup> and Regulation (EC) N° 1882/2003 of the European Parliament and of the Council<sup>3</sup>;
  - Real Decreto 1630/1992, de 29 de diciembre, por el que se dictan disposiciones para la libre circulación de productos de la construcción en aplicación de la Directiva 89/106/CEE<sup>4</sup>;
  - Real Decreto 1328/1995, de 28 de julio, por el que se modifican, en aplicación de la Directiva 93/68/CEE, las disposiciones para la libre circulación, aprobadas por el Real Decreto 1630/1992, de 29 de diciembre (BOE 19-8-95) y la Orden CTE/2276/2002 de 4 de septiembre;
  - Common Procedural Rules for Requesting, Preparing and the Granting of European Technical Approvals set out in the Annex to Commission Decision 94/23/EC<sup>5</sup>;
  - Guideline for European Technical Approval of *Metal Anchors for use in Concrete*, ETAG 001, Part 1: *Anchors in general*, edition 1997 (Amended November 2006), Part 5: *Bonded Anchors*, edition March 2002 (Second Amendment February 2008). TR023: *Assessment of post-installed rebar connections*, edition November 2006.
2. The Catalonia Institute of Construction Technology (ITeC) is authorised 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 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 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 the Catalonia Institute of Construction Technology (ITeC) pursuant to information by the Commission according to 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 the Catalonia Institute of Construction Technology (ITeC). 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. This European Technical Approval is issued in Spanish by the Catalonia Institute of Construction Technology (ITeC). This version corresponds fully to the version circulated in EOTA. Translations into other languages have to be designated as such.

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<sup>1</sup> Official Journal of the European Communities N° L 40, 11.2.1989, p.12.

<sup>2</sup> Official Journal of the European Communities N° L 220, 30.8.1993, p.1.

<sup>3</sup> Official Journal of the European Union N° L 284, 31.10.2003, p.1.

<sup>4</sup> Boletín Oficial del Estado n° 34 de 9 de febrero de 1993.

<sup>5</sup> 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 the construction product

ChemMates EP injection mortar is used for the connection, by anchoring or overlap connection joint, of steel reinforcing bars (rebars) in existing structures made of normal weight concrete, 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 diameter from 8 to 32 mm and ChemMates EP injection mortar are used for the post-installed rebar connections covered by this document. The rebar is placed into a drilled hole previously injected with the mortar and is anchored by the bond between the embedded element, the injection mortar and the concrete.

#### 1.2 Intended use

The post-installed rebar connections may be used in normal weight concrete of a minimum grade C12/15 and a maximum grade C50/60 according to EN 206-1. They may be used in non-carbonated concrete with the allowable chloride content of 0,40% (Cl 0,40) related to the cement content according to EN 206-1.

The post-installed rebar connections may be used under 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 post-installed rebar connections may only be carried out in the manner, which is also possible with straight deformed cast-in bars according to EN 1992-1-1, e.g. those in the following applications:

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

The post-installed rebar connections may be installed in dry or wet concrete but they must not be installed in flooded holes (use category 1 according to ETAG 001, part 5).

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 and wet diamond drilling technique.

The provisions made in this European technical approval are based on an assumed working life 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 products and methods of verification

### 2.1 Characteristics of the product

The post-installed rebar connection corresponds to the drawings and provisions given in annexes I to VIII.

ChemMates EP is a two component system. The two components of the injection mortar are delivered in unmixed condition in side-by-side coaxial cartridges of sizes 400 or 600 ml according to annex I. Each cartridge is marked with the identifying mark "ChemMates EP" with the anchorage preparation, application pictograms, cartridge use, hazard code, processing and curing time and internal code to identify the product.

The rebar shall comply with the specifications given in table IV of annex IV.

### 2.2 Methods of verification

The assessment of fitness of the post-installed 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*, edition 1997 (Amended November 2006), Part 5: *Bonded Anchors*, edition March 2002 (Second Amendment February 2008) and Technical Report n° 023: *Assessment of post-installed rebar connections*, edition November 2006.

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 EU 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

The system of attestation of conformity specified by the European Commission in decision 96/582/EC<sup>6</sup> is system 1 as described in Council Directive 89/106/EEC Annex III, and it is detailed as follows:

**System 1** for any intended uses.

**Tasks of the manufacturer:**

- Factory production control.
- Further testing of samples taken at the factory in accordance with a prescribed test plan.

**Tasks of the approved body:**

- Initial type testing of the product.
- Initial inspection of the factory and of factory production control.
- Continuous surveillance, assessment and approval of factory production control.

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<sup>6</sup> Official Journal of the European Communities N° L 254 of 08.10.1996.

## 3.2 Responsibilities

### 3.2.1 Tasks of the manufacturer

#### 3.2.1.1 Factory production control

The manufacturer shall exercise permanent internal control of production. All the elements, requirements and provisions adopted by the manufacturer shall be documented in a systematic manner in the form of written policies and procedures, including records of results performed in accordance with the *Control Plan*. This production control system shall ensure that the product is in conformity with this European Technical Approval (ETA).

Only the raw materials and materials stated in the technical documentation of this ETA may be used in the production of the products.

The factory production control shall be in accordance with the *Control Plan* relating to this ETA, which is part of the technical documentation of this European technical approval. The *Control Plan* is laid down in the context of the factory production control system operated by the manufacturer and deposited with the ITeC.<sup>7</sup>

The results of factory production control shall be recorded and evaluated in accordance with the provisions of the *Control Plan*. On request they shall be presented to the ITeC.

The personnel involved in the production process shall be identified, sufficiently qualified and trained to operate and maintain the production equipment. Machinery and equipment shall be regularly maintained and this shall be documented. All processes and production procedures shall be recorded at regular intervals.

All testing equipment is maintained, calibrated and/or verified against measurement standards traceable to relevant international or national measurement standards.

The manufacturer shall ensure that handling, preservation and storage of test equipment is such that its accuracy and fitness for purpose is maintained. The calibration of all test equipment shall be repeated if any repair or failure occurs which could upset the calibration of the test equipment.

The manufacturer shall maintain a traceable documentation of the production process from purchasing or delivery of raw or basic raw materials up to the storage and delivery of finished products.

Products that do not comply with requirements as specified in the ETA shall be separated from the conforming products and marked as such. The manufacturer shall register non-compliant production and action(s) taken to prevent further non-conformities. External complaints shall also be documented, as well as actions taken.

#### 3.2.1.2 Testing of samples taken at the factory

The testing of samples taken at the factory shall be carried out in accordance with the *Control Plan*.

#### 3.2.1.3 Other tasks of the manufacturer

The manufacturer shall, on the basis of a contract, involve a body which is approved for the tasks referred to in section 3.1 in the field of post-installed rebar connections in order to undertake the actions laid down in section 3.2.2. For this purpose, the *Control Plan* referred to in sections 3.2.1.1 and 3.2.2 shall be handed over by the manufacturer to the approved body involved.

The manufacturer shall make a declaration of conformity, stating that the construction product is in conformity with the provisions of the ETA 13/0917 issued on 27.06.2013.

### 3.2.2 Tasks of approved bodies

The approved body shall perform the activities referred to above according to the specific conditions, in accordance with the provisions laid down in the *Control Plan* relating to this ETA.

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<sup>7</sup> The *Control Plan* is a confidential part of the European technical approval and only handed over to the approved body or bodies involved in the procedure of attestation of conformity.

The approved body shall retain the essential points of its actions referred to above and state the results obtained and conclusions drawn in a written report.

#### 3.2.2.1 Initial type testing

The verifications on which this ETA is based have been carried out on representative samples from the current production. The results of the tests performed as part of the assessment shall be used for initial type-testing (ITT) unless changes in the manufacturing procedure affect the product properties.

Any change in the manufacturing procedure which may affect the properties of the product shall be notified and the necessary type-testing revised according to the *Control Plan*.

#### 3.2.2.2 Initial inspection of factory and the factory production control

The approved body shall assess the factory production control system to check that the factory production control is in conformity with this European Technical Approval and any subsidiary information. The approved body shall ensure that the manufacturer has acceptable premises, technical equipment and competent staff to produce the product as described in this European Technical Approval.

#### 3.2.2.3 Continuous surveillance, assessment and approval of factory production control

Continuous surveillance of the factory production control is necessary to ensure continuing conformity with the ETA. It is recommended that surveillance inspections be conducted least twice per year.

#### 3.2.2.4 Certification

Once the ITT, the initial inspection and surveillance of the FPC have been performed and whether a favourable conclusion can be drawn on the basis of available information, the notified certification body shall issue an EC Certificate of product Conformity, permitting the manufacturer to issue an EC Declaration of Conformity, enabling CE Marking of the product.

In cases where the provisions of this European Technical Approval and its *Control Plan* are no longer fulfilled, the certification body shall withdraw the certificate and inform the Catalonia Institute of Construction Technology (ITeC) without delay.

### 3.3 CE marking


#### 3.3.1 General

The CE marking shall be affixed on product on a label attached to the packaging of product or on the accompanying documents. The letters "CE" shall be followed by the identification number of the approved certification body, where relevant, and be accompanied by the following additional information:

- The name and address of the ETA holder.
- The last two digits of year in which the CE marking was affixed.
- The number of the EC Certificate of Conformity for the product.
- The number of the European Technical Approval.
- The reference of ETA-Guideline 001 part 1 and 5.
- Use category 1: Installed in dry or wet concrete, but not in flooded holes.
- Service temperature range b: - 40 °C to + 80 °C.

### 3.3.2 Example of CE marking

Example of CE marking and accompanying information for ChemMates EP:

 nnnn	Letters "CE"  Identification number of notified certification body
<b>Ideal Fasteners Pty. Ltd.</b> 10-12 Ausco Place 3175 – Dandenong South Australia YY	Name and address of the ETA holder  Two last digits of year of affixing the CE marking
ETA 13/0917 ETAG 001 Parts 1 and 5 1 b	Number of European technical approval Number of guideline for European technical approval Use category Service temperature range

## 4 Assumptions under which the fitness of the product(s) for the intended use was favourably assessed

The European Technical Approval is issued for the products on the basis of agreed data/information deposited with the ITeC, which identifies the products that have been assessed and judged. Changes to the product or production processes, which could result in this deposited data and information being incorrect, should be notified to ITeC before the changes are introduced. ITeC will decide whether such changes affect the ETA and consequently the validity of the CE marking on the basis of the ETA and, if so, whether further assessment or alterations to the ETA shall be necessary.

The detailed description and conditions of the manufacturing process of ChemMates EP, and all the relevant design and installation criteria of ChemMates EP are specified in the technical documentation of the manufacturer deposited with the ITeC. The main aspects of this information are specified in the following chapters.

### 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 plant by the approved body 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.
- Use of a guide device (drilling aid) for the drilling holes close to edges (if necessary).
- Dimension for the depth of injection mortar.
- Kind of preparation of the joint between building components being connected including the diameter and 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 II and the 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 greater than the minimum of 40 mm and  $4 \cdot d_s$  (according to annex V).

#### 4.3.2 Determination of the basic anchorage depth

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

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

where:

$d_s$  = diameter of the rebar

$\sigma_{sd}$  = calculated design stress of the rebar

$f_{bd}$  = design value of bond strength according to annex III, table III.2 and III.3. 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 basic anchorage length  $\ell_{bd}$  shall be determined in accordance with EN 1992-1-1 clause 8.4.4.

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

Where  $\alpha_1$ ,  $\alpha_2$ ,  $\alpha_3$ ,  $\alpha_4$  and  $\alpha_5$  are determined in accordance with EN 1992-1-1, table 8.2:

$\alpha_1 = 1,0$  for straight rebars

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

$\alpha_3 = 1,0$  because no transverse reinforcement

$\alpha_4 = 1,0$  because no transverse reinforcement

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

With:

$\ell_{b,rqd}$  = according to clause 4.3.2

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

$\ell_{b,min} = 1,5 \cdot \max \{0,3 \cdot \ell_{b,rqd}; 10 d_s; 100 \text{ mm}\}$  under tension

$\ell_{b,min} = 1,5 \cdot \max \{0,6 \cdot \ell_{b,rqd}; 10 d_s; 100 \text{ mm}\}$  under compression

The maximum anchorage length is given in annex III, table III.1.

#### 4.3.4 Overlap joints

The required basic anchorage length  $\ell_0$  shall be determined in accordance with EN 1992-1-1 clause 8.7.3.

$$\ell_0 = \alpha_1 \cdot \alpha_2 \cdot \alpha_3 \cdot \alpha_5 \cdot \alpha_6 \cdot \ell_{b,rqd} \geq \ell_{0,min}$$

Where  $\alpha_1$ ,  $\alpha_2$ ,  $\alpha_3$ ,  $\alpha_5$  and  $\alpha_6$  are determined in accordance with EN 1992-1-1, table 8.2 and 8.3 with:

$\alpha_1 = 1,0$  for straight rebars

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



$\alpha_3 = 1,0$  because no transverse reinforcement

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

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

With:

$\ell_{b,rqd}$  = according to clause 4.3.2

$\ell_{0,min}$  = minimum lap length acc. to EN 1992-1-1 equations 8.11 modified with TR 023 clause 4.2.

$\ell_{0,min} = 1,5 \max \{0,3 \alpha_6 \cdot \ell_{b,rqd} ; 15 d_s ; 200 \text{ mm}\}$

The maximum anchorage length is given in annex III, table III.1.

#### 4.3.5 Embedment depth for overlap joints

The concrete cover at end-face of bonded-in rebar  $c_1$  (see annex V) must be taken into account for the calculation of the effective embedment depth of overlap joints.

$\ell_v \geq \ell_0 + c_1$

Where:

$\ell_0$  = required lap length according 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  $4\emptyset$  the lap length shall be enlarged by the difference between the clear distance and  $4\emptyset$ .

#### 4.3.6 Concrete cover

The concrete cover required for bonded-in rebar is shown in annex III, table III.1 regarding the drilling method and the hole tolerance.

Furthermore the minimum concrete cover given in EN 1992-1-1, section 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 will be designed according to EN 1992-1-1. The joints for concreting must be roughened to at least such an extent that aggregate protrude.

In case of a 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  $d_s + 60$  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 rebar can only be assumed if the anchor is installed as follows:

- 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 State in which the installation is done.
- Use of the injection system only as supplied by the manufacturer without exchanging the components of an anchor;

- Installation in accordance with the manufacturer's specifications (see annex VIII) and drawings prepared for that purpose and using the tools indicated in the annex.
- Checks before rebar installation to ensure that the strength class of the concrete in which the anchor is to be placed is in the range given and is not lower than that of the concrete to which the characteristic loads apply;
- Check of concrete being well compacted;
- Check the position of existing rebars;
- Keeping the anchorage depth as specified in the design drawings;
- Keeping the edge distance 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;
- 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 VI, VII and VIII;
- Minimum injection mortar temperature during installation shall be at least + 10 °C;
- During installation and curing of the injection mortar the temperature of the concrete must not fall below 5 °C and must not exceed + 40 °C, observing the curing time given in annex IV.

## **5 Recommendations**

### **5.1 Manufacturer's responsibilities**

It is the manufacturer's responsibility to ensure that the information on the specific conditions according to sections 1 and 2 including annexes referred to as well as sections 4 and 5 is given to those who are concerned. This information may be made by reproduction of the respective parts of the issued 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;
- Installation instructions including cleaning of the drill hole;
- Reference to any special installation equipment needed;
- Identification of the manufacturing batch;

All 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 manufacturer's instruction in dry conditions at temperatures of least + 5 °C to not more than + 25 °C.

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

On behalf of the Catalonia Institute of Construction Technology.

Barcelona, 27 June 2013



ITeC  
Institut de  
Tecnologia de la Construcció  
de Catalunya

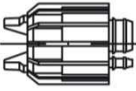
Anton Maria Checa Torres  
General Manager, ITeC

### Annex I: Product description and intended use

- Only for design of rebar connections based on EN 1992-1-1.
- Non carbonated concrete C12/15-C50/60 according to EN 206-1.
- Chloride content in concrete is limited to 0,40 % (Cl 0,40). Use category 2 according to clause 1.3 TR023.
- Reinforcement bars diameter  $\varnothing = 8 \text{ mm} - 32 \text{ mm}$  according to annex III.
- Service temperature range - 40 °C to + 80 °C. Maximum long term temperature + 50 °C, maximum short term temperature + 80 °C.
- Maximum anchorage length see annex V.
- Installation in dry or wet concrete. No installation in flooded holes.

**Injection mortar ChemMates EP coaxial cartridges**

Sealing cap



Side by Side cartridges of 400 and 600 ml

Imprint:  
Trade name – ChemMates EP Pure Epoxy  
injection mortar  
Anchorage preparation  
Application pictograms

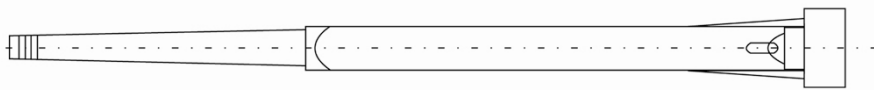
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Cartridge use  
Hazard code  
Processing and curing time  
Internal code to identify the product

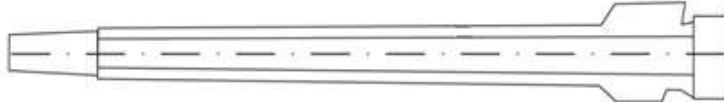
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**Static mixer**

Standard mixer




High flow mixer

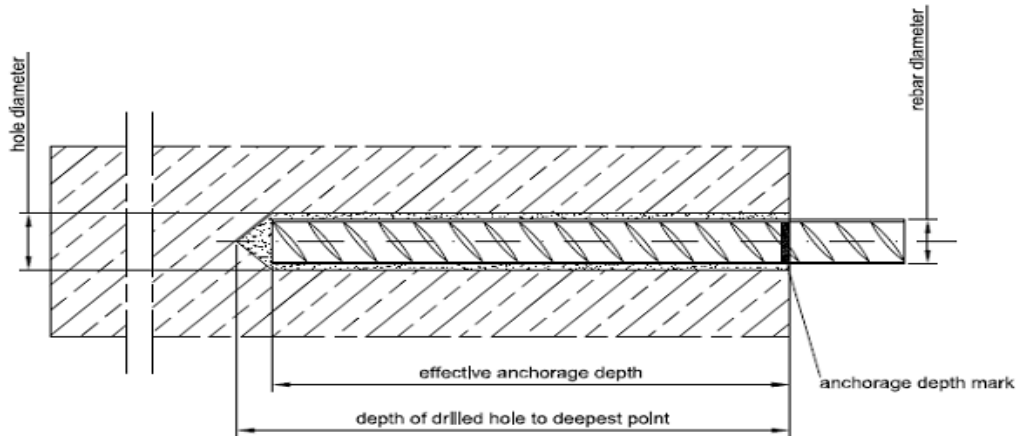


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**Reinforcing bar**



**Installed rebar**



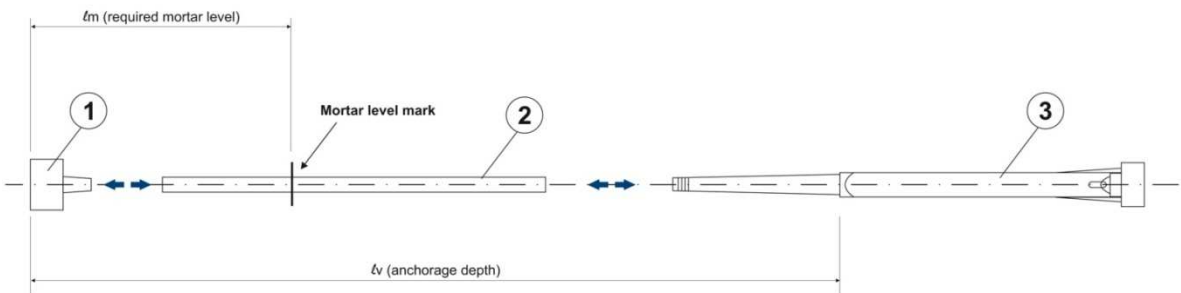
**Dispenser 400 ml and 600 ml**



**Additional tools**

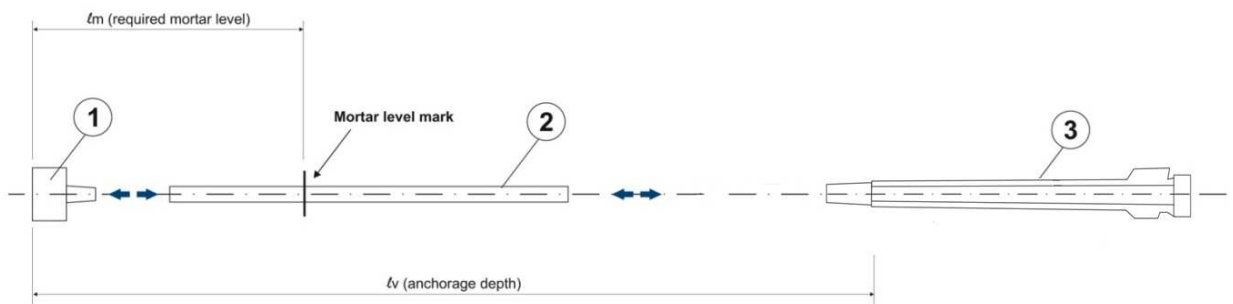
For holes with  $h_{ef} \leq 1$  m

- 1 - piston plug
- 2 - tub inner diameter 8 mm
- 3 - standard mixer

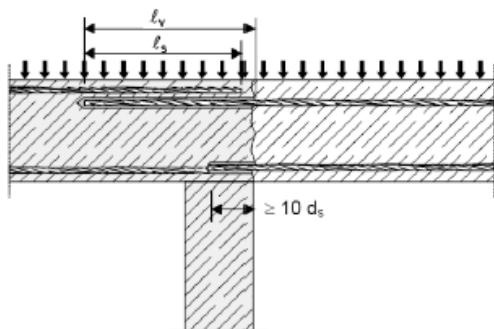


For holes with  $h_{ef} > 1$  m

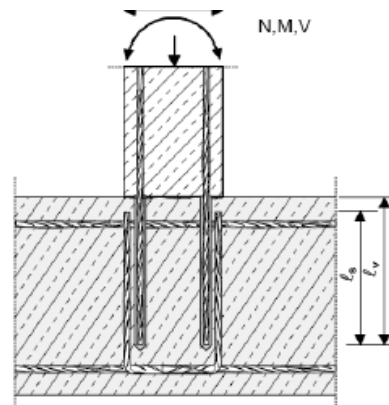
- 1 - piston plug
- 2 - tub inner diameter 16 mm
- 3 - special mixer high flow



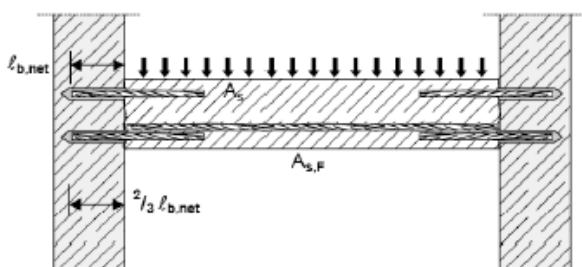
### Annex II: Examples of use for rebar



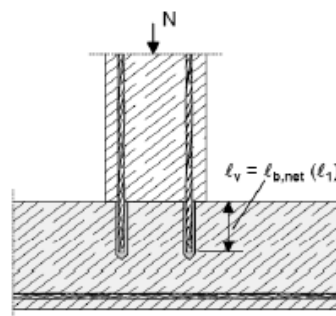
**Figure II.1:** Overlap joint for rebar connections of slabs and beams.



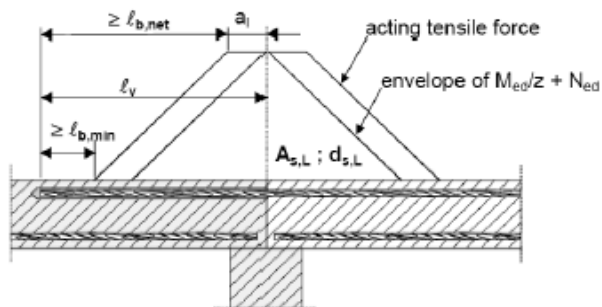
**Figure II.2:** Overlap joint at a foundation of a column or wall where the rebars are stressed in tension.



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



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



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

**Note to figures II.1 to II.5:**

In the figures no transverse reinforcement is plotted, the transverse reinforcement as required by EC2 shall be present.

The shear transfer between old and new concrete shall be designed according to EN 1992-1-1.

### Annex III: Setting depths and design values

**Table III.1:** Drill bit diameter and setting depth.

Rebar diameter (mm)		Ø 8	Ø 10	Ø 12	Ø 14	Ø 16	Ø 20	Ø 25	Ø 28	Ø 32
HD <sup>8</sup> DD <sup>9</sup>	Nominal drill hole $d_0$ [mm]	12	14	16	18	20	25	30	35	40
HD DD	Min anchorage length, $l_{b,min}$ [mm]	175	215	260	300	345	430	535	600	685
HD DD	Min lap length, $l_{0,min}$ [mm]	300	300	300	315	360	450	565	630	720
HD DD	Max anchorage depth, $l_{v,max}$ [mm]	700	900	1000	1000	1400	1800	2000	2000	2000
HD	Minimum concrete cover <sup>10</sup> , min c [mm]	72	84	96	108	114	138	150	150	150
DD	Minimum concrete cover <sup>10</sup> , min c [mm]	106	122	138	154	162	194	210	210	210

The minimum anchorage length ( $l_{b,min}$ ) and the minimum lap length ( $l_{0,min}$ ) are according to clauses 8.6 and 8.11 of EN 1992-1-1, respectively. The conditions of application of clauses 8.6 and 8.11 are: for good bond conditions ( $\alpha_6 = 1,0$ ), yield strength of reinforcement steel bars = 500 N/mm<sup>2</sup>,  $\gamma_M = 1,15$  and concrete C20/25.

**Table III.2:** Design values of the ultimate bond resistance  $f_{bd}$  according to EN 1992-1-1 for hammer drilling method.

Rebar $d_s$ [mm]	Ultimate bond resistance $f_{bd}$ according to EN 1992-1-1 Hammer drilling								
	C12/15	C16/20	C20/25	C25/30	C30/37	C35/45	C40/50	C45/55	C50/60
Ø 8 - 28	1,6	2,0	2,3	2,7	3,0	3,4	3,7	4,0	4,3
Ø 32	1,6	2,0	2,3	2,7	3,0	3,4	3,4	3,7	4,0

The values given in the table are valid for "good bond conditions" as described on EN 1992-1-1. For all other conditions multiply the value by 0,7.

**Table III.3:** Design values of the ultimate bond resistance  $f_{bd}$  according to EN 1992-1-1 for diamond drilling method (wet cutting system).

Rebar $d_s$ [mm]	Ultimate bond resistance $f_{bd}$ according to EN 1992-1-1. Diamond drilling								
	C12/15	C16/20	C20/25	C25/30	C30/37	C35/45	C40/50	C45/55	C50/60
Ø 8-16	1,6	2,0	2,3	2,7	3,0	3,4	3,7	4,0	4,3
Ø 20	1,6	2,0	2,3	2,7	3,0	3,4	3,7	4,0	4,0
Ø 25	1,6	2,0	2,3	2,7	3,0	3,4	3,4	3,7	4,0
Ø 28	1,6	2,0	2,3	2,7	2,7	3,0	3,0	3,4	3,4
Ø 32	1,6	2,0	2,0	2,3	2,3	2,3	2,7	2,7	2,7

The values given in the table are valid for "good bond conditions" as described on EN 1992-1-1. For all other conditions multiply the value by 0,7.

<sup>8</sup> HD: Hammer drilling.

<sup>9</sup> DD: Diamond drilling.

<sup>10</sup> The minimum concrete cover is equal to  $c_{min} = 30 + 0,06 \cdot l_v \geq 2\phi$  for Hammer drilling and  $c_{min} = 50 + 0,08 \cdot l_v$  for Diamond drilling. It should also be defined according to EN 1992-1-1.

## Annex IV: Materials and curing time

**Table IV.1:** Reinforcing bar according to EN 1992-1-1. Abstract of EN 1992-1-1 annex C, tables C.1 and C.2N. Properties of reinforcement.

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

Rib height of the bar shall be in the range  $0,05 \cdot d \leq h \leq 0,07 \cdot d$ .  
(d: nominal diameter of the bar; h: Rib height of the bar).

**Table IV.2:** Injection mortar.

Product	Composition
ChemMates EP: 2 components injection mortar catalyzed 1:1 in volume.	Bonding agent: Pure epoxy resin

**Table IV.3:** Minimum curing time<sup>11</sup>.

Concrete temperature <sup>12</sup>	Maximum processing time (min)	Minimum curing time (h)	
		Dry	Wet
5 °C	60	33	50
10 °C	50	24	36
20 °C	30	6	9
30 °C	15	4	6
40 °C	8	3	4

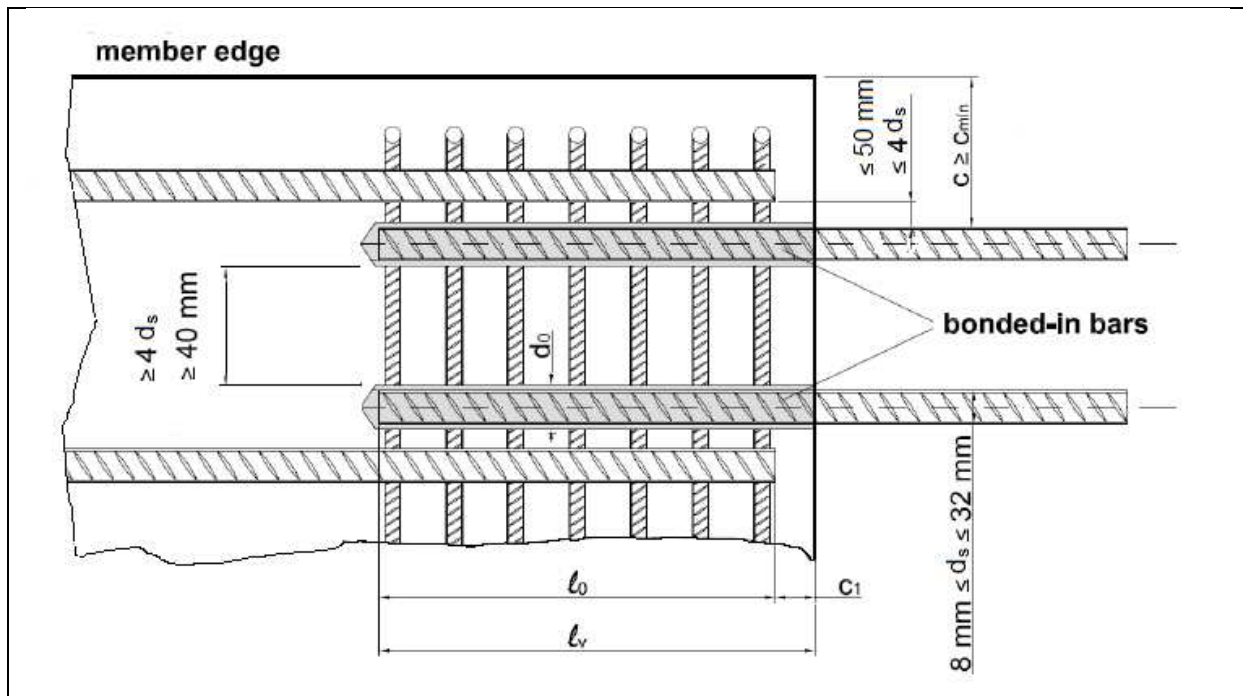
<sup>11</sup> The minimum time from the end of the mixing to the time when the anchor may be torqued or loaded (whichever is longer).

<sup>12</sup> Minimum mortar temperature for injection is + 10 °C.



## Annex V: Spacing and edge distance: general rules

Figure V.I: General rules for post-installed rebar connections.



**c:** concrete cover of bonded-in bar.

**c<sub>1</sub>:** concrete cover at end-face of bonded-in rebar.

**min c:** minimum concrete cover according to annex III.

**d<sub>s</sub>:** diameter of post-installed rebar.

**l<sub>0</sub>:** lap length; in accordance with section 4.3.4 of this document.

**l<sub>v</sub>:** anchorage length; in accordance with section 4.3.5 of this document.

**d<sub>0</sub>:** nominal drill bit diameter according to annex III.

Note: the provision of sufficient transverse reinforcement according to section 4.3.7 of this document must be verified.

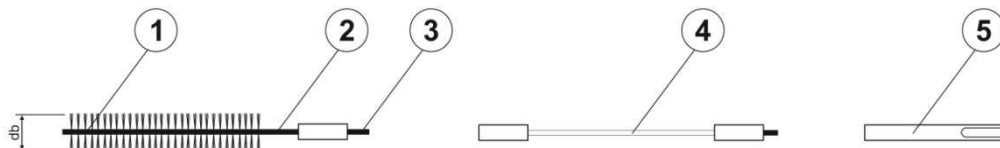
## Annex VI: Cleaning tools

### Cleaning pump (compressed air)

The hole is cleaned by using a mechanical air system with an air gun  $\varnothing$  3,5 mm, oil free compressed air and minimum pressure of 6 bar at 6 m<sup>3</sup>/h flow rate.



### Standard brush (mechanical brush)



1. Steel bristles
2. Steel stem
3. Threaded connection for drilling tool extension
4. Extension special brush
5. Drilling tool connection (SDS connection)

**Table VI:** Standard brush diameter.

Rebar diameter			$\varnothing$ 8	$\varnothing$ 10	$\varnothing$ 12	$\varnothing$ 14	$\varnothing$ 16	$\varnothing$ 20	$\varnothing$ 25	$\varnothing$ 28	$\varnothing$ 32
$d_0$	Nominal drill hole	[mm]	12	14	16	18	20	25	30	35	40
$d_b$	Brush diameter	[mm]	14	16	19	20	22	22	32	37	44

## Annex VII: Tools for injection

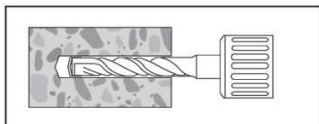
In order to avoid the creation of voids, a mixer extension will be used for holes deeper than the mixer. For holes with a nominal drill hole higher than 14 mm a high flow mixer and a mixer extension with higher diameter will be used.

- Choose the piston plug with the same diameter of the drilled hole.
- Choose the additional tools for injection according :

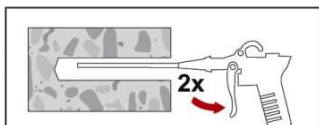
Concrete temperature [°C]	Rebar from 8 mm to 14 mm				Rebar from 16 mm to 32 mm			
	ChemMates EP temperature [°C]	Pressure [bar]	Tools for injection	$h_{ef}$ maximum [mm]	ChemMates EP temperature [°C]	Pressure [bar]	Tools for injection	$h_{ef}$ maximum [mm]
5	10	8	Standard mixer + tub inner Ø 8 + piston plug	1.000	10	8	Mixer high flow + tub inner Ø 16 + piston plug	2.000
10	10	8		1.000	10	8		2.000
15	15	7		1.000	15	7		2.000
20	20	7		1.000	20	7		2.000
25	25	7		1.000	25	7		2.000
30	30	6		1.000	30	6		2.000
35	35	6		1.000	35	6		2.000
40	40	6		1.000	40	6		2.000

- Assemble the mixer with the mixer extension and with the injection plug.
- Mark in the system the required mortar level, 2/3 of the drill hole depth.
- Insert the assembled system in the bottom of the hole and start injecting.
- Allow the pressure of the injected mortar to push the injection plug to the front of the hole.
- Fill the hole until the mortar level mark becomes visible.
- Once the injection is finished press the release trigger in order to depressurize the dispenser, this will prevent more mortar discharge from the mixing nozzle and will avoid forming voids.

## Annex VIII: Installation instructions

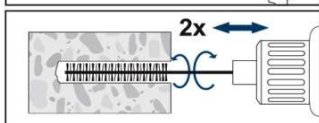


1- Drill the hole with the correct diameter and depth according to Annex III using diamond core drilling system or rotary percussive machine. Check the perpendicularity of the hole during the drilling operation.



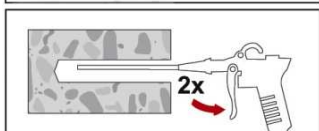
2- Clean the hole (compressed air and mechanical brush):

2.a - For rotary percussive machine, clean the hole from drilling dust, core fragments, oil, water, grease and other contaminants prior to mortar injection.

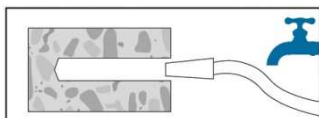


The hole shall be cleaned by at least:

1. 4 blowing operations, 5 seconds for single operation with compressed air, from the bottom of the hole;
2. 4 brushing operations, before brushing, clean the brush and check if the brush diameter is according to annex VI. Starting from the top of the hole moving downwards to the bottom of the hole, then move upwards to the top of the hole;
3. 4 blowing operations, 5 seconds for single operation with compressed air, from the bottom of the hole;

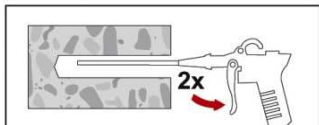
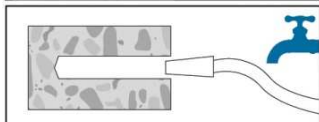
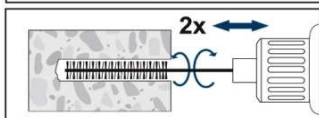


or

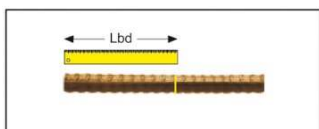


2.b- For diamond core drilling with a wet cutting system:

1. Flush the drill hole with tap water, starting from the bottom, until clean water gets out of the drill hole;
2. 2 brushing operations, before brushing clean the brush and check if the brush diameter is according to annex VI. Starting from the top of the hole moving downwards to the bottom of the hole, then move upwards to the top of the hole;
3. Flush again the drill hole with tap water, starting from the bottom, until clean water gets out of the drill hole;
4. Blow 2 times the hole, from the bottom of the hole, with oil free compressed air, until no dust is evacuated;



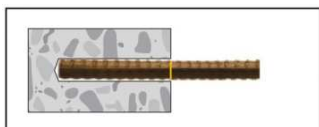
For cleaning tools see annex VI.



3- Injection (pneumatic injection pump preferably):

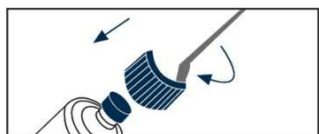
The rebar must be free of dirt, grease, oil or other contaminants.

The position of the anchorage length shall be marked on the rebar. Then insert the rebar in the empty hole in order to verify the correct hole depth.



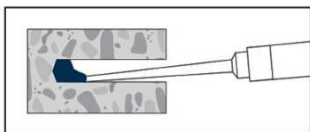
If additional mixer extension is required, check that the length is appropriate to the drill hole depth. See annex VII.

If additional piston plug is required, check that its diameter is the same than the drilled hole diameter. See annex VII.



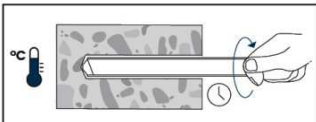
Unscrew the front cup of the cartridge, screw it on the mixer and insert the cartridge in the gun.

For the mortar injection pump details, see annex VII.



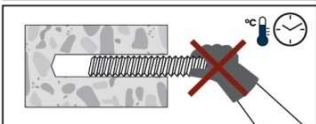
Before starting to use a new cartridge, discard the first swings until a homogeneous colour is achieved.

Fill the drilled hole uniformly starting from the drilled hole bottom, in order to avoid entrapment of air, remove the mixer slowly bit by bit during pressing-out.



Fill the drill hole with a quantity of the injection mortar corresponding to 2/3 of the drill hole depth.

Immediately insert the rebar, marked according to the proper anchorage depth, slowly and with a slight twisting motion.



Excessive injection mortar must come out of the drill hole, otherwise pull out rebar.

Remove excess of injection mortar around the rebar, if necessary, support the rebar and secure it from falling until mortar starts to harden.

Wait the curing time according to annex IV. Don't move or load the anchor until is fully cured.

## Annex IX: Design values for anchoring connection

Values for pre-calculation of anchoring with ChemMates EP injection mortar.  
Examples for anchorage length<sup>1)</sup> for rebars ( $f_{y,k} = 500 \text{ N/mm}^2$ ) on concrete C20/25 ( $f_{bd}$  according to table III.2 from Annex III). Values for **hammer drilling (HD)** perforation technique.

Rebar $\varnothing$	$\alpha_1 = \alpha_2 = \alpha_3 = \alpha_4 = \alpha_5 = 1,0$			$\alpha_1 = \alpha_3 = \alpha_4 = 1,0 \alpha_2 \text{ or } \alpha_5 = 0,7$		
	Anchorage length $l_{bd}$	Tension load	Mortar volume $V^2)$	Anchorage length $l_{bd}$	Tension load	Mortar volume $V^2)$
[mm]	[mm]	[kN]	[m]	[mm]	[kN]	[m]
8	175	10,12	13	175	10,12	13
	225	13,01	17	195	11,27	15
	275	15,90	21	215	12,43	16
	325	18,79	25	235	13,58	18
	378	21,85	29	265	15,30	20
10	215	15,54	19	215	15,54	19
	280	20,23	25	245	17,70	22
	345	24,93	31	275	19,87	25
	410	29,63	37	305	22,04	28
	473	34,15	43	331	23,90	30
12	260	22,54	27	260	22,54	27
	335	29,05	35	290	25,15	31
	410	35,55	43	320	27,75	34
	485	42,05	51	350	30,35	37
	567	49,17	60	397	34,42	42
14	300	30,35	36	300	30,35	36
	390	39,45	47	340	34,39	41
	480	48,56	58	380	38,44	46
	570	57,66	69	420	42,49	51
	662	66,93	80	463	46,85	56
16	345	39,89	47	345	39,89	47
	445	51,45	60	390	45,09	53
	545	63,01	74	435	50,29	59
	645	74,57	88	480	55,49	65
	756	87,42	103	529	61,19	72
20	430	62,14	91	430	62,14	91
	560	80,93	119	490	70,81	104
	690	99,71	146	550	79,48	117
	820	118,50	174	610	88,15	129
	945	136,59	200	662	95,61	140
25	535	96,64	139	535	96,64	139
	695	125,55	180	605	109,29	157
	855	154,45	222	675	121,93	175
	1015	183,35	263	745	134,58	193
	1181	213,42	306	827	149,40	214
28	600	121,39	249	600	121,39	249
	780	157,81	324	680	137,58	283
	960	194,23	399	760	153,76	316
	1140	230,64	474	840	169,95	349
	1323	267,72	550	926	187,40	385
32	685	158,39	372	685	158,39	372
	890	205,79	483	775	179,20	421
	1095	253,19	594	865	200,01	470
	1300	300,59	706	955	220,82	518
	1512	349,67	821	1059	244,77	575

1) Minimum anchorage length, see table III.1. The design value is valid for good bond conditions according to EN 1992-1-1. For all other bond conditions the values for tension load must be multiplied by 0,7.

2) The mortar value V can be estimated using the equation  $V = 1,2 \cdot l_{bd} \cdot \pi \cdot (d_0^2 - d_s^2) / 4$  with the nominal hole diameter.

Values for pre-calculation of anchoring with ChemMates EP injection mortar.  
Examples for anchorage length<sup>1)</sup> for rebars ( $f_{y,k} = 500 \text{ N/mm}^2$ ) on concrete C20/25 ( $f_{bd}$  according table III.3 from Annex III). Values for **diamond drilling (DD)** perforation technique.

Rebar $\varnothing$	$\alpha_1 = \alpha_2 = \alpha_3 = \alpha_4 = \alpha_5 = 1,0$			$\alpha_1 = \alpha_3 = \alpha_4 = 1,0 \alpha_2 \text{ or } \alpha_5 = 0,7$		
	Anchorage length $l_{bd}$	Tension load	Mortar volume $V^{2)}$	Anchorage length $l_{bd}$	Tension load	Mortar volume $V^{2)}$
[mm]	[mm]	[kN]	[ml]	[mm]	[kN]	[ml]
8	175	10,12	13	175	10,12	13
	225	13,01	17	195	11,27	15
	275	15,90	21	215	12,43	16
	325	18,79	25	235	13,58	18
	378	21,85	29	265	15,30	20
10	215	15,54	19	215	15,54	19
	280	20,23	25	245	17,70	22
	345	24,93	31	275	19,87	25
	410	29,63	37	305	22,04	28
	473	34,15	43	331	23,90	30
12	260	22,54	27	260	22,54	27
	335	29,05	35	290	25,15	31
	410	35,55	43	320	27,75	34
	485	42,05	51	350	30,35	37
	567	49,17	60	397	34,42	42
14	300	30,35	36	300	30,35	36
	390	39,45	47	340	34,39	41
	480	48,56	58	380	38,44	46
	570	57,66	69	420	42,49	51
	662	66,93	80	463	46,85	56
16	345	39,89	47	345	39,89	47
	445	51,45	60	390	45,09	53
	545	63,01	74	435	50,29	59
	645	74,57	88	480	55,49	65
	756	87,42	103	529	61,19	72
20	430	62,14	91	430	62,14	91
	560	80,93	119	490	70,81	104
	690	99,71	146	550	79,48	117
	820	118,50	174	610	88,15	129
	945	136,59	200	662	95,61	140
25	535	96,64	139	535	96,64	139
	695	125,55	180	605	109,29	157
	855	154,45	222	675	121,93	175
	1015	183,35	263	745	134,58	193
	1181	213,42	306	827	149,40	214
28	600	121,39	249	600	121,39	249
	780	157,81	324	680	137,58	283
	960	194,23	399	760	153,76	316
	1140	230,64	474	840	169,95	349
	1323	267,72	550	926	187,40	385
32	685	137,73	372	685	137,73	372
	890	178,95	483	775	155,82	421
	1095	220,16	594	865	173,92	470
	1300	261,38	706	955	192,01	518
	1739	349,67	944	1217	244,77	661

1) Minimum anchorage length, see table III.1. The design value is valid for good bond conditions according to EN 1992-1-1. For all other bond conditions the values for tension load must be multiplied by 0,7.

2) The mortar value V can be estimated using the equation  $V = 1,2 \cdot l_{bd} \cdot \pi \cdot (d_0^2 - d_s^2) / 4$  with the nominal hole diameter.

## Annex X: Design values for overlap joint connection

Values for pre-calculation of lap lengths with ChemMates EP injection mortar.

Examples for lap length<sup>1)</sup> for rebars ( $f_{y,k} = 500 \text{ N/mm}^2$ ) on concrete C20/25 ( $f_{bd}$  according table III.2 from Annex III). Values for **hammer drilling (HD)** perforation technique.

Rebar $\varnothing$	$\alpha_1 = \alpha_2 = \alpha_3 = \alpha_5 = \alpha_6 = 1,0$			$\alpha_1 = \alpha_3 = \alpha_6 = 1,0; \alpha_2 \text{ or } \alpha_5 = 0,7$		
	Lap length $l_0$	Tension load	Mortar volume $V^2)$	Lap length $l_0$	Tension load	Mortar volume $V^2)$
[mm]	[mm]	[kN]	[ml]	[mm]	[kN]	[ml]
8	300	17,34	23	300	17,34	23
	320	18,50	24	--	--	--
	340	19,65	26	--	--	--
	360	20,81	27	--	--	--
	378	21,85	29	265	15,30	20
10	300	21,68	27	300	21,68	27
	340	24,57	31	305	22,04	28
	380	27,46	34	310	22,40	28
	420	30,35	38	315	22,76	29
	473	0,00	43	331	23,90	30
12	300	26,01	32	300	26,01	32
	365	31,65	39	325	28,18	34
	430	37,28	45	350	30,35	37
	495	42,92	52	375	32,52	40
	567	49,17	60	397	34,42	42
14	315	31,87	38	315	31,87	38
	400	40,46	48	350	35,41	42
	485	49,06	59	385	38,95	46
	570	57,66	69	420	42,49	51
	662	66,93	80	463	46,85	56
16	360	41,62	49	360	41,62	49
	460	53,18	62	400	46,24	54
	560	64,74	76	440	50,87	60
	660	76,30	90	480	55,49	65
	756	87,42	103	529	61,19	72
20	450	65,03	95	450	65,03	95
	575	83,10	122	500	72,26	106
	700	101,16	148	550	79,48	117
	825	119,22	175	600	86,71	127
	945	136,59	200	662	95,61	140
25	565	102,06	146	565	102,06	146
	720	130,06	187	630	113,80	163
	875	158,06	227	695	125,55	180
	1030	186,06	267	760	137,29	197
	1181	213,42	306	827	149,40	214
28	630	127,46	262	630	127,46	262
	800	161,85	333	705	142,63	293
	970	196,25	403	780	157,81	324
	1140	230,64	474	855	172,98	355
	1323	267,72	550	926	187,40	385
32	720	166,48	391	720	166,48	391
	920	212,72	499	805	186,13	437
	1120	258,97	608	890	205,79	483
	1320	305,21	717	975	225,44	529
	1512	349,67	821	1059	244,77	575

<sup>1)</sup> Minimum lap length, see table III.1. The design value is valid for good bond conditions according to EN 1992-1-1. For all other bond conditions the values for tension load must be multiplied by 0,7.

<sup>2)</sup> The mortar value V can be estimated using the equation  $V = 1,2 \cdot l_{bd} \cdot \pi \cdot (d_0^2 - d_s^2) / 4$  with the nominal hole diameter.



Values for pre-calculation of lap lengths with ChemMates EP injection mortar.

Examples for lap length<sup>1)</sup> for rebars ( $f_{y,k} = 500 \text{ N/mm}^2$ ) on concrete C20/25 ( $f_{bd}$  according table III.3 from Annex III). Values for **diamond drilling (DD)** perforation technique.

Rebar $\varnothing$	$\alpha_1 = \alpha_2 = \alpha_3 = \alpha_5 = \alpha_6 = 1,0$			$\alpha_1 = \alpha_3 = \alpha_6 = 1,0; \alpha_2 \text{ or } \alpha_5 = 0,7$		
	Lap length $l_0$	Tension load	Mortar volume $V^{2)}$	Lap length $l_0$	Tension load	Mortar volume $V^{2)}$
[mm]	[mm]	[kN]	[ml]	[mm]	[kN]	[ml]
8	300	17,34	23	300	17,34	23
	320	18,50	24	--	--	--
	340	19,65	26	--	--	--
	360	20,81	27	--	--	--
	378	21,85	29	265	15,30	20
10	300	21,68	27	300	21,68	27
	340	24,57	31	305	22,04	28
	380	27,46	34	310	22,40	28
	420	30,35	38	315	22,76	29
	473	0,00	43	331	23,90	30
12	300	26,01	32	300	26,01	32
	365	31,65	39	325	28,18	34
	430	37,28	45	350	30,35	37
	495	42,92	52	375	32,52	40
	567	49,17	60	397	34,42	42
14	315	31,87	38	315	31,87	38
	400	40,46	48	350	35,41	42
	485	49,06	59	385	38,95	46
	570	57,66	69	420	42,49	51
	662	66,93	80	463	46,85	56
16	360	41,62	49	360	41,62	49
	460	53,18	62	400	46,24	54
	560	64,74	76	440	50,87	60
	660	76,30	90	480	55,49	65
	756	87,42	103	529	61,19	72
20	450	65,03	95	450	65,03	95
	575	83,10	122	500	72,26	106
	700	101,16	148	550	79,48	117
	825	119,22	175	600	86,71	127
	945	136,59	200	662	95,61	140
25	565	102,06	146	565	102,06	146
	720	130,06	187	630	113,80	163
	875	158,06	227	695	125,55	180
	1030	186,06	267	760	137,29	197
	1181	213,42	306	827	149,40	214
28	630	127,46	262	630	127,46	262
	800	161,85	333	705	142,63	293
	970	196,25	403	780	157,81	324
	1140	230,64	474	855	172,98	355
	1323	267,72	550	926	187,40	385
32	720	166,48	391	720	166,48	391
	970	224,28	527	845	195,38	459
	1220	282,09	662	970	224,28	527
	1470	339,90	798	1095	253,19	594
	1739	402,12	944	1217	281,49	661

<sup>1)</sup> Minimum lap length, see table III.1. The design value is valid for good bond conditions according to EN 1992-1-1. For all other bond conditions the values for tension load must be multiplied by 0,7.

<sup>2)</sup> The mortar value V can be estimated using the equation  $V = 1,2 \cdot l_{bd} \cdot \pi \cdot (d_0^2 - d_s^2) / 4$  with the nominal hole diameter.