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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-11/0390

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

Nom commercial : **Trade name:**	**Injection System Hilti HIT-CT 1 for rebar connection**
Titulaire : **Holder of approval:**	Hilti Corporation Feldkircherstrasse 100 FL-9494 Schaan Principality of Liechtenstein
Type générique et utilisation prévue du produit de construction : **Generic type and use of construction product:**	Scellement d'armatures rapportées, diamètres 8 à 25mm, avec Système d'injection Hilti HIT-CT 1 **Post installed rebar connections diameter 8 to 25 mm made with Hilti HIT-CT 1 injection mortar.**
Validité du : au : **Validity from / to:**	**27/08/2012** **31/10/2016**
Usine de fabrication : **Manufacturing plant:**	**Hilti Plants**
Le présent Agrément technique européen contient : **This European Technical Approval contains:**	30 pages incluant 20 annexes faisant partie intégrante du document. **30 pages including 20 annexes which form an integral part of the document.**

Cet Agrément Technique Européen remplace l'Agrément ETA-11/0390 valide du 31/10/2011 au 31/10/2016

This European Technical Approval replaces ETA-11/0390 with validity from 31/10/2011 to 31/10/2016

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] and Regulation (EC) N° 1882/2003 of the European Parliament and of the Council[3] ;

   - Décret n° 92-647 du 8 juillet 1992[4] 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[5];

   - 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 Official Journal of the European Union L 284, 31 October 2003, p. 25
4 Journal officiel de la République française du 14 juillet 1992
5 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 Hilti HIT-CT 1 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 (EN 1992-1-1).

Covered are rebar anchoring systems consisting of Hilti HIT-CT 1 bonding material and the Hilti tension anchor HZA-R sizes M12, M16 and M20 or an embedded straight deformed reinforcing bar diameter, d, from 8 to 25 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 an end support/bearing of a slab or a beam 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.
- Rebar connections with the Hilti HZA-R may be used for the transmission of tensile forces in the direction of the bar axis only. The transmission of shear forces has to be ensured by appropriate measures, Figure 6, 7 and 8 in annex 3.

The Hilti HIT-CT 1anchoring systems can be used with the following limitations:

- ✓ The rebars can be placed in holes made with hammer drilling, hollow drilling Hilti TE-CD/TE-YD 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)
- ✓ According to EN 206-1 the allowable chloride content in concrete is limited to 0.40% (Cl 0,40) related to cement content.
- ✓ The rebars may be installed in dry or wet concrete, but must not be installed in flooded holes.
- ✓ 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 Hilti HIT-CT 1 injection adhesive corresponds to the drawings and provisions given in annexes 1 to 7.

The Hilti HIT-CT 1 injection adhesive is a two components system. The two components of the injection mortar are delivered in unmixed condition in foil packs of sizes 330ml or 500ml according to annex 1. Each foil pack is marked with the identifying mark “Hilti HIT-CT 1” with the production date and expiration date.

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[1]. 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.

1 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.

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 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 resin and the Hilti tension anchor HZA-R 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 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 14),
- Use of a guide device (drilling aid) for the drilling holes close to edges (if necessary)
- 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.

Hilti tension anchor HZA-R according to annexes 6 and 7 shall be designed for the welded-on reinforcement steel BSt 500S. The length of the bonded-in smooth shaft made of stainless steel may not be accounted as anchorage.

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 - respectively Hilti tension anchor HZA-R shall be greater than the maximum of $5 \cdot d_s$ and 50mm (according to Annex 5 - respectively Annex 7)

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 given in annex 8. The maximum permissible anchorage depth is given in annex 8.

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 5 in annex 8
$f_{bd} = 2.25\ \eta_1\ \eta_2\ f_{ctd}$ (according to EN 1992-1-1)
with $f_{ctd} = \alpha_{ct}\ f_{ctk,0.05} / \gamma_c$
$\alpha_{ct} = 1$ and $\gamma_c = 1.5$
η_1 coefficient relative to the quality of the bond condition and position of the rebar during concreting
$\eta_1 = 1{,}0$ (“good” bond conditions)
$\eta_1 = 0{,}7$ (all other conditions)
$\eta_2 = 1{,}0$ (for $\varnothing \leq 25$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:

$l_{b,min} = \alpha_{crack}$ x Max (0,3 $l_{b,rqd}$; 10 ϕ; 100mm) under tension

$l_{b,min} = \alpha_{crack}$ x Max (0,6 $l_{b,rqd}$; 10 ϕ; 100mm) under compression

Overlap joint

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

$l_{0,min} = \alpha_{crack}$ x Max (0,3.α_6.$l_{b,rqd}$; 15 ϕ; 200mm)

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.

Concrete class	α_{crack}
C20/25	1.0
C25/35	1.2
C30/37 to C50/60	1.4

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 anchorage length l_{bd} 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 18 and 19 for concrete C20/25. Other values can be calculated by using the above formulas.

4.3.2.5 Embedment depth for overlap joints with Hilti tension anchor HZA-R

The effective embedment depth is the same as the lap length $l_v = l_0$ (see Annex 7, Figure 12).
The total embedment depth $l_{e.ges}$ shall be determined as follows (see Annex 7, Figure 12):

$l_{e.ges} \geq l_0 + l_e$

with: l_0 = required lap length acc. to Section 4.3.2 and to EN 1992-1-1
l_e = length of the smooth shaft see also Annex 7, $l_e > c_1$

If the clear distance between overlapping rods exceeds $4 \cdot d_s$, the overlap length shall be increased by the difference between the actual clear distance and $4 \cdot d_s$.

4.3.2.6 Transverse reinforcement

The transverse reinforcement required in the zone of the rebar or of the tension anchor HZA-R 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 or tension anchor HZA-R is shown in Table 3 of Annex 8 in relation to 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.

4.4 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 respectively HZA-R shall be carried out according to the manufacturer's installation instructions and this European technical approval, annexes 1 to 19;
- The installation of post-installed rebars respectively HZA-R 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 an 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 9 to 17. 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
- hole depth,
- minimum effective anchorage depth,
- information on the installation procedure, including cleaning of the hole with the cleaning equipments, preferably by means of an illustration,
- material and property class of metal parts acc. to Annex 4 and Tables 1 and 2 of Annex 6,
- anchor component installation temperature,
- ambient temperature of the concrete during installation of the anchor,
- admissible processing time (open time) of the mortar,
- curing time until the anchor may be loaded as a function of the ambient temperature in the concrete during installation,
- maximum torque moment, where applicable (HZA-R),
- reference to any installation tool 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 +25°C.

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

The original French version is signed by

Le Directeur Technique
C. BALOCHE

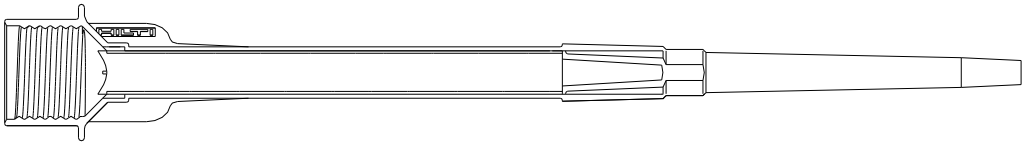
Product description and intended use

The post-installed rebar connection consists of injection mortar Hilti HIT-CT 1 and an embedded straight deformed reinforcing bar with properties of class B and C according to Annex C of EC 2 or the Hilti tension anchor HZA-R.

Injection mortar HIT-CT 1

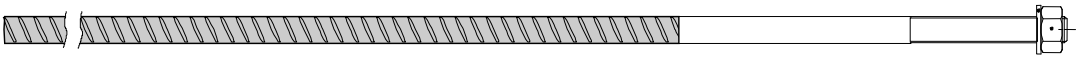
Foil pack:
330 ml and 500 ml

Static mixer



Reinforcing bar according to EC 2 (see Annex 4):

Hilti Tension anchor HZA-R (see Annex 6):



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.

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

Injection System Hilti HIT-CT 1 for rebar connection	**Annex 1** **of the European Technical Approval** **ETA - 11/0390**
Product description and intended use	

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

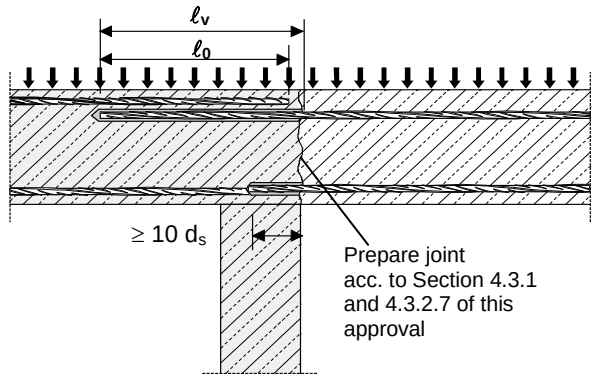


Figure 2:
Overlap joint at a foundation of a column or wall where the rebars are stressed in tension

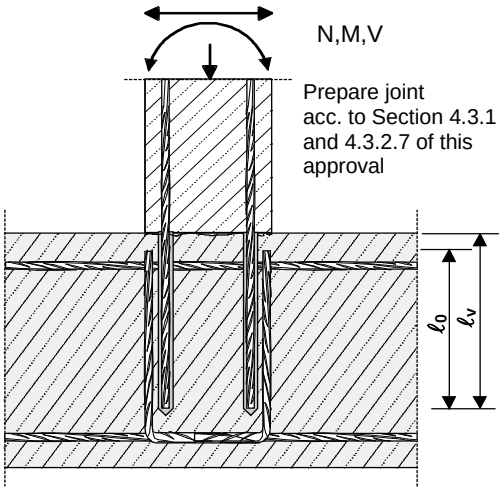


Figure 3:
End anchoring of slabs or beams, designed as simply supported

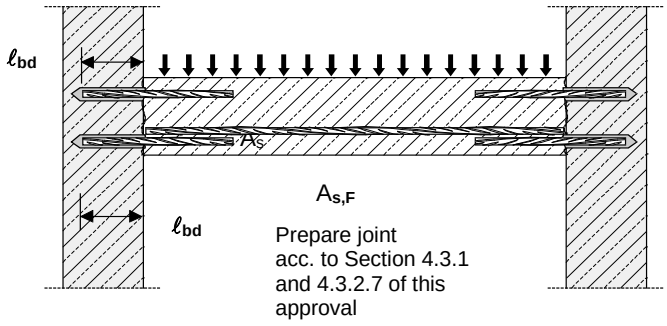


Figure 4:
Rebar connection for components stressed primarily in compression.
The rebars are stressed in compression.

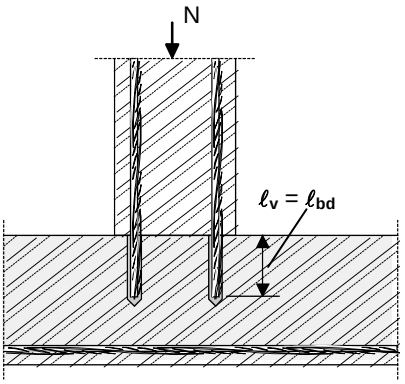
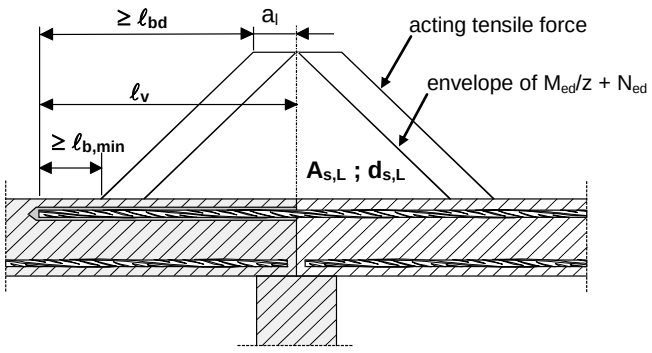


Figure 5:
Anchoring of reinforcement to cover the line of acting tensile force



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.

Description of the bonded-in rebars and overlap joints see Annex 4 and 5.

Injection System Hilti HIT-CT 1 for rebar connection	**Annex 2** **of the European Technical Approval** **ETA - 11/0390**
Examples of use for rebars	

Figure 6:
Overlap joint of a column stressed in bending to a foundation

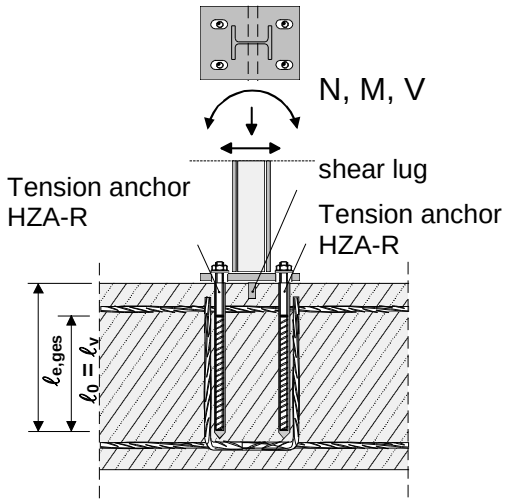


Figure 7:
Overlap joint for the anchorage of barrier posts

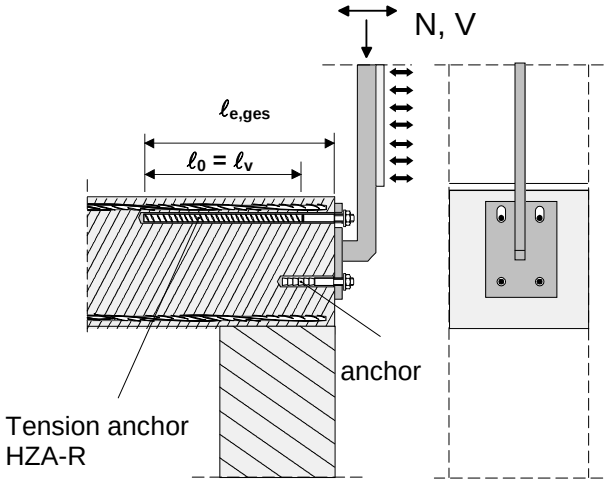
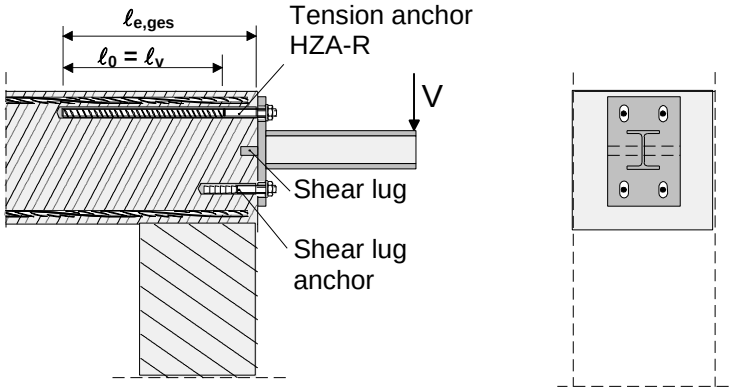


Figure 8:
Overlap joint for the anchorage of cantilever members



Note to Figure 6 to 8:

In the figures no transverse reinforcement is plotted. The transverse reinforcement as required by EN 1992-1-1 shall be present.

Only tension forces in the direction of the bar axis may be transmitted by the tension anchor HZA-R.

The tension force must be transferred via an overlap joint to the reinforcement in the building part.

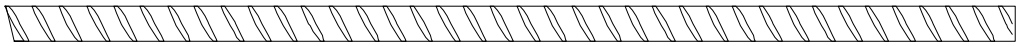
The transmission of the shear load shall be ensured by appropriate additional measures, e.g. by shear lugs or by anchors with a European technical approval (ETA).

In the anchor plate, the holes for the tension anchor shall be executed as elongated holes with the axis in the direction of the shear force.

Description of anchorages and overlap joints see Annex 6 and 7.

Injection System Hilti HIT-CT 1 for rebar connection	**Annex 3** **of the European Technical Approval** **ETA - 11/0390**
Examples of use for tension anchor HZA-R	

Figure 9: 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; 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:

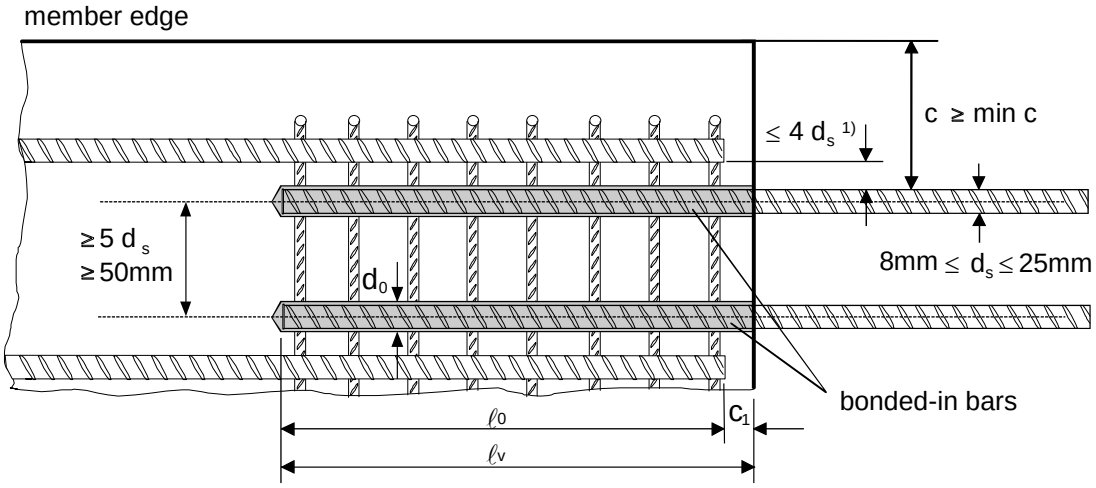
Product form		**Bars and de-coiled rods**	
Class		B	C
Characteristic yield strength f_{yk} or $f_{0,2k}$ (MPa)		400 to 600	
Minimum value of k = $(f_t/f_y)_k$		≥ 1,08	≥ 1,15 < 1,35
Characteristic strain at maximum force, ε_{uk} (%)		≥ 5,0	≥ 7,5
Bendability		Bend / Rebend test	
Maximum deviation from 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	

Rip height h:

The maximum outer rebar diameter over the rips shall be:
nominal diameter of the bar d + 2∗h (h ≤ 0,07∗d)

Injection System Hilti HIT-CT 1 for rebar connection	**Annex 4** **of the European Technical Approval** **ETA - 11/0390**
Reinforcing bar “rebar” according to EC2	

Figure 10: 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 10:

- 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 8 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 Table 7 to Table 9

Injection System Hilti HIT-CT 1 for rebar connection	**Annex 5**
General design rules of construction **spacing and edge distance for bonded-in rebars**	**of the European Technical Approval** **ETA - 11/0390**

Figure 11: Tension anchor HZA-R

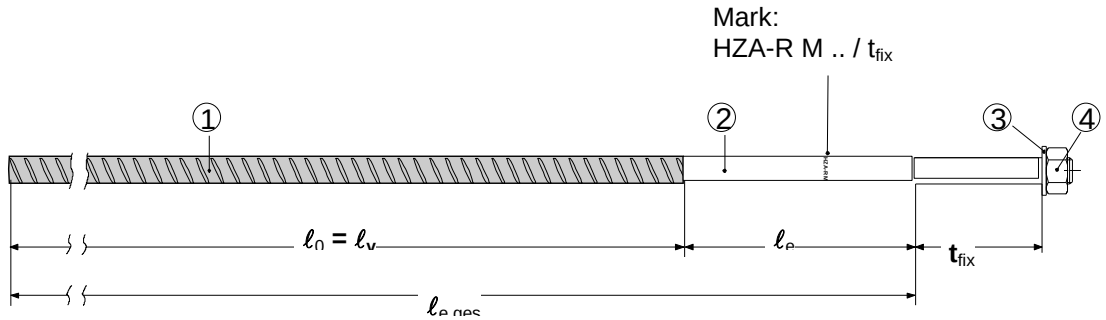


Table 1: Tension anchor HZA-R materials

Part	Designation	Material
1	BSt 500 S	not galvanised reinforcement steel acc. DIN 488
2	Round steel smooth with thread	Stainless steel 1.4404, 1.4571 EN 10088
3	Washer	
4	Hex nut	Stainless steel 1.4401, 1.4571 EN 10088 Strength class 80, EN ISO 3506

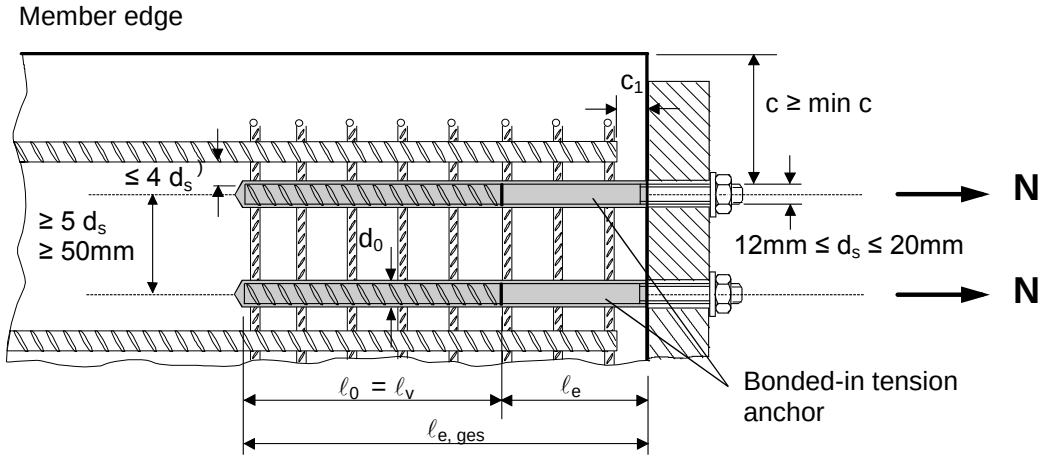
Table 2: Tension anchor HZA-R dimensions

Size		HZA-R M12 / t_{fix}	HZA-R M16 / t_{fix}	HZA-R M20 / t_{fix}
Thread diameter	[mm]	12	16	20
Width across nut flats SW	[mm]	19	24	30
Effective embedment depth $\ell_v \leq$ [1)]	[mm]	800	1000	1300
Length of smooth shaft $\ell_e \geq$	[mm]	100	100	100
Max torque moment T_{max}	[Nm]	60	100	150
Minimum thickness of fixture t_{fix}	[mm]	5	5	5
Maximum thickness of fixture t_{fix}	[mm]	400	400	400

[1)] May be shortened according to static calculation.

Injection System Hilti HIT-CT 1 for rebar connection	**Annex 6**
Hilti tension anchor HZA-R **Dimension and materials**	**of the European Technical Approval** **ETA - 11/0390**

Figure 12: General design rules for the Hilti tension anchor HZA-R



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

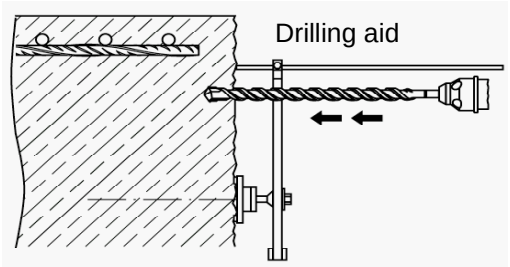
The following applies to Figure 12:

- With the tension anchor HZA-R, only tensile forces in the direction of the bar axis may be transmitted.
- 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 8 of this approval
d_s	diameter of bonded-in bar
ℓ_0	lap length
ℓ_v	effective embedment depth
ℓ_e	Length of the smooth shaft; $\ell_e \geq 100$ mm
$\ell_{e,ges}$	Embedment depth
d_0	nominal drill bit diameter, see Table 7 to Table 9

Injection System Hilti HIT-CT 1 for rebar connection	**Annex 7**
General design rules of construction, spacing and edge distance for Hilti tension anchor HZA-R	**of the European Technical Approval ETA - 11/0390**

Table 3: Minimum concrete cover min c [1)] of the bonded-in rebar or tension anchor HZA-R depending on drilling method and drilling tolerance



Drilling method	Bar diameter d_s	Without drilling aid	With drilling aid
Hammer drilling **(HD) / (HDB)**	≤ 24 mm	30mm + 0,06 $\ell_v \geq$ 2 d_s	30mm + 0,02 $\ell_v \geq$ 2 d_s
	25 mm	40mm + 0,06 $\ell_v \geq$ 2 d_s	40mm + 0,02 $\ell_v \geq$ 2 d_s
Compressed air drilling **(CA)**	≤ 24 mm	50mm + 0,08 ℓ_v	50mm + 0,02 ℓ_v
	25 mm	60mm + 0,08 ℓ_v	60mm + 0,02 ℓ_v

1) See Figures 10 and 12 (Annex 5 and 7). The minimum concrete cover according to EN 1992-1-1 must be observed

Table 4: Minimum anchorage length[1)] and lap splice length for C20/25 to C50/60 for good bond conditions and maximum installation length l_{max}

Rebar		Drilling method **HD, CA**						
Ø d_s	$f_{y,k}$	$l_{b,min}$ [mm]			$l_{0,min}$ [mm]			l_{max}
[mm]	[N/mm²]	C20/25	C25/30 [2)]	C30/37-C50/60 [3)]	C20/25	C25/30 [2)]	C30/37-C50/60 [3)]	[mm]
8	500	113	120	140	200	240	280	700
10	500	142	145	152	200	240	280	700
12	500	170	174	183	200	240	280	700
14	500	199	203	213	210	252	294	700
16	500	227	232	244	240	288	336	700
18	500	255	261	274	270	324	378	500
20	500	284	290	305	300	360	420	500
22	500	312	319	335	330	396	462	500
24	500	340	348	365	360	432	-	500
25	500	355	363	381	375	450	-	500

1) according to EN 1992-1-1: $l_{b,min}$ (8.6) and $l_{0,min}$ (8.11) with maximum yield stress for rebar BSt 500S, with γ_M = 1,15 and α_6 = 1,0
2) according TR 023, Section 4.2 an increasing factor 1,2 for C25/30 is included
3) according TR 023, Section 4.2 an increasing factor 1,4 for C30/37 to C50/60 is included

Table 5: Design values of the 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 25 mm	1,6	2,0	2,3	2,7	3,0	3,0	3,0	3,0	3,0

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 Hilti HIT-CT 1 for rebar connection	**Annex 8**
Minimum concrete cover min c, minimum anchorage and lap splice length, maximum installation length **Design bond resistance**	**of the European Technical Approval** **ETA - 11/0390**

Safety Regulations:

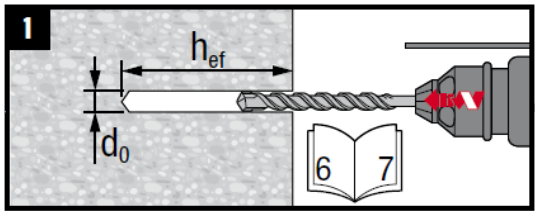
Review the Material Safety Data Sheet (MSDS) before use for proper and safe handling!

Wear well-fitting protective goggles and protective gloves when working with Hilti HIT-CT 1.

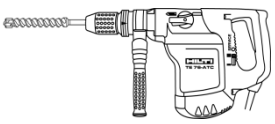
Important: Observe the Instructions for Use provided with each foil pack.

Drill hole

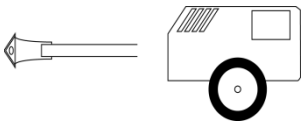
Note: Before drilling, remove Carbonized Concrete; Clean contact areas (see section 4.3.2.7 in ETA)



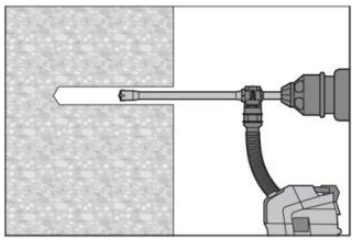
Drill hole to the required embedment depth using a hammer-drill with carbide drill bit set in rotation hammer mode, a compressed air drill.



a) Hammer drill (HD) (see Table 7)

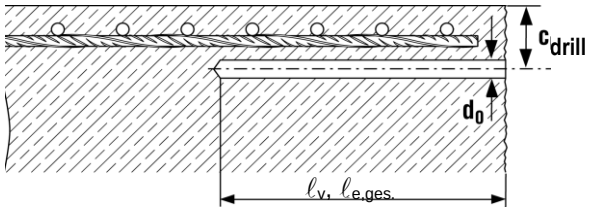


b) Compressed air drill (CA) (see Table 9)



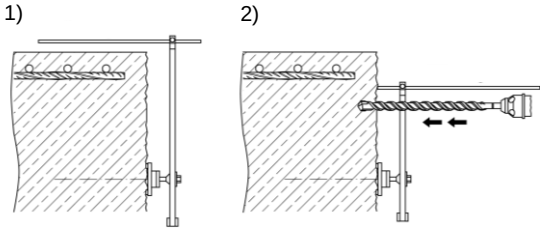
or drill hole to the required embedment depth with an appropriately sized Hilti TE-CD or TE-YD hollow drill bit (HDB) (see Table 8) with Hilti vacuum attachment. This drilling method properly cleans the borehole and removes dust while drilling. After drilling is complete, proceed to the “Rebar preparation and foil pack preparation” step in the instructions for use.

Splicing applications:



Measure and control concrete cover c
$c_{drill} = c + d_s/2$
Drill parallel to surface edge and to existing rebar
Where applicable use Hilti drilling aid HIT-BH.

Drilling aid



Example: HIT-BH

For holes ℓ_b > 20 cm use drilling aid (see Table 3).
Three different options can be considered:

A) Hilti drilling aid HIT-BH
B) Slat or spirit level
C) Visual check

Injection System Hilti HIT-CT 1 for rebar connection	**Annex 9**
Installation instruction I **Drill hole**	**of the European Technical Approval** **ETA - 11/0390**

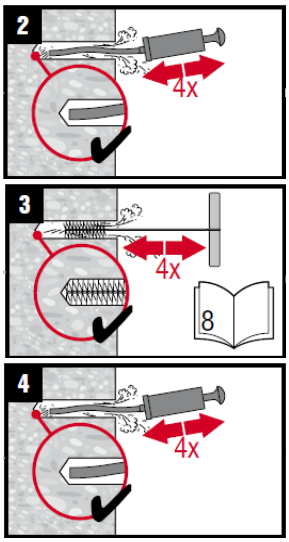
Clean hole	The borehole must be free of dust, debris, water, ice, oil, grease and other contaminants prior to mortar injection. Inadequate borehole cleaning = poor load values.

Automatic Cleaning (AC)

Automatic Cleaning (AC):

Cleaning is performed during hollow drilling (HDB) with Hilti TE-CD and TE-YD drilling system including vacuum cleaner.

Manual cleaning (MC)



Manual cleaning is permitted for hammer drilled boreholes up to hole diameters $d_0 \leq 20$mm and depths ℓ_v resp. $\ell_{e,ges.} \leq 10xd_s$.

Blowing
4 strokes with Hilti blow-out pump from the back of the hole until return air stream is free of noticeable dust.

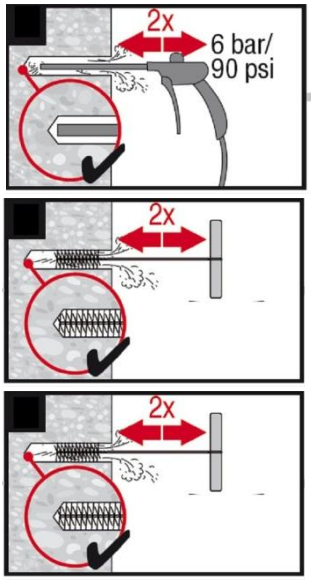
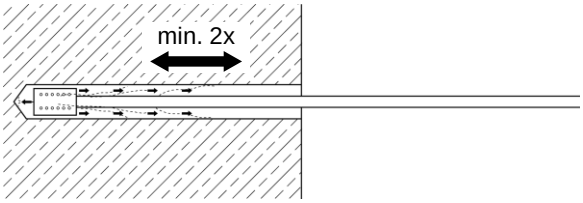
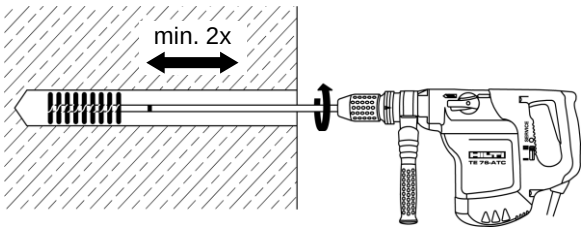
Brushing
4 times with the specified brush size (brush diameter ≥ borehole diameter d_0) by inserting the round steel wire brush to the back of the hole with a twisting motion. The brush shall produce natural resistance as it enters the anchor hole. If this is not the case, please use a new brush or a brush with a larger diameter.

Blowing
4 strokes with Hilti blow-out pump from the back of the hole until return air stream is free of noticeable dust.

Manual Cleaning (MC):

Hilti hand pump is recommended for blowing out boreholes with diameters $d_0 \leq 20$mm and borehole depth $h_0 \leq 10d_s$.

Injection System Hilti HIT-CT 1 for rebar connection	**Annex 10**
Installation instruction II **Clean bore hole – Automatic (AC) / Manual cleaning (MC)**	**of the European Technical Approval** **ETA - 11/0390**

Compressed air cleaning (CAC):	Just before setting an rebar the hole must be cleaned of dust and debris by one of the two cleaning methods described below:
	**Blowing** 2 times from the back of the hole with oil-free compressed air (min. 6 bar at 100 litres per minute (LPM)) until return air stream is free of noticeable dust. **Brushing** 2 times with the specified brush size (brush Ø larger than borehole Ø) by inserting the round steel 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. **Blowing** 2 times again with compressed air until return air stream is free of noticeable dust.
	**Deep Boreholes – Blowing** For boreholes deeper than 250mm use the appropriate air nozzle Hilti HIT-DL (see Table 7 or Table 9).
	**Deep boreholes – brushing** For boreholes deeper than 250mm use machine brushing and brush extensions HIT-RBS. Screw the round steel brush HIT-RB in one end of the brush extension(s) HIT-RBS, so that the overall length of the brush is sufficient to reach the base of the borehole. Attach the other end of the extension to the TE-C/TE-Y chuck.

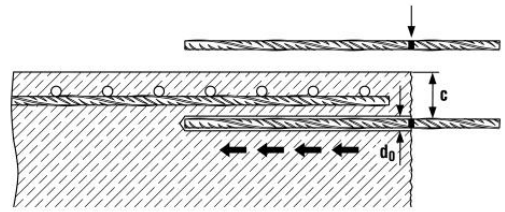
	**Compressed air cleaning (CAC):** Air nozzle with an orifice opening of minimum 3,5mm in diameter recommended for blowing out with compressed air (min. 6 bar at 6 m³/h).

Injection System Hilti HIT-CT 1 for rebar connection

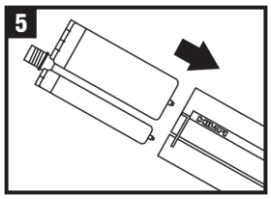
Installation instruction III
Clean bore hole - Compressed air cleaning (CAC)

Annex 11
of the European Technical Approval
ETA - 11/0390

Rebar preparation and foil pack preparation



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 resp. $\ell_{e,ges}$
Insert Rebar in borehole to verify hole and setting depth ℓ_v resp. $\ell_{e,ges}$



Insert foil pack into the foil pack holder.
Observe the Instruction for Use of the dispenser
Check foil pack holder for proper function.
Put foil pack into foil pack holder.
Do not use damaged foil packs / holders.

Static Mixer HIT-RE-M

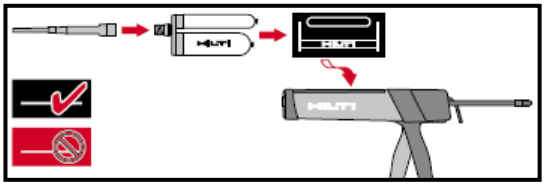
Hilti HIT-CT 1 (foil pack 330ml and 500ml)

Check Expiration date
Foil pack temperature: +5°C to +40°C
Base material temperature: -5°C to +40°C

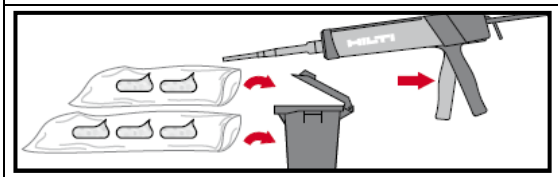
Manual dispenser:
HIT-MD 2000 / HIT-HDM 330 (330ml)
HIT-MD 2500 / HIT-HDM 500 (330/500ml)

or Electric dispenser:
HIT-ED 3500 (330/500ml)
HIT-ED 3500-A (330/500ml)
HIT-HDE 500 (330/500ml)

or Pneumatic dispenser:
HIT-P3000HY (330ml)
Hilti HIT-P3500F (330/500ml)



Tightly attach Hilti mixing nozzle to foil pack manifold. Do not modify the mixing nozzle.
Insert foil pack into the foil pack holder.
Observe the Instruction for Use of the dispenser Check foil pack holder for proper function. Put foil pack into foil pack holder. Do not use damaged foil packs / holders.
Insert foil pack holder with foil pack into dispenser.
Push release trigger, retract plunger and insert foil pack holder with foil pack into the appropriate Hilti dispenser.



330ml 2 trigger pulls
500ml 3 trigger pulls

Discard initial mortar.
The foil pack opens automatically as dispensing is initiated. Depending on the size of the foil pack an initial amount of mortar has to be discarded.
After changing a mixing nozzle, the first few trigger pulls must be discarded as described above. For each new foil pack a new mixing nozzle must be used.

Injection System Hilti HIT-CT 1 for rebar connection

Installation instruction IV
Rebar preparation and foil pack preparation

Annex 12

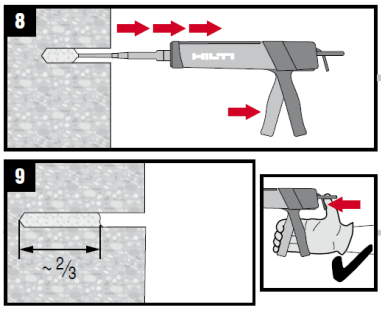
of the European Technical Approval

ETA - 11/0390

Inject mortar into borehole

Forming air pockets shall be avoided.

Injection method for borehole depth ≤ 250 mm:

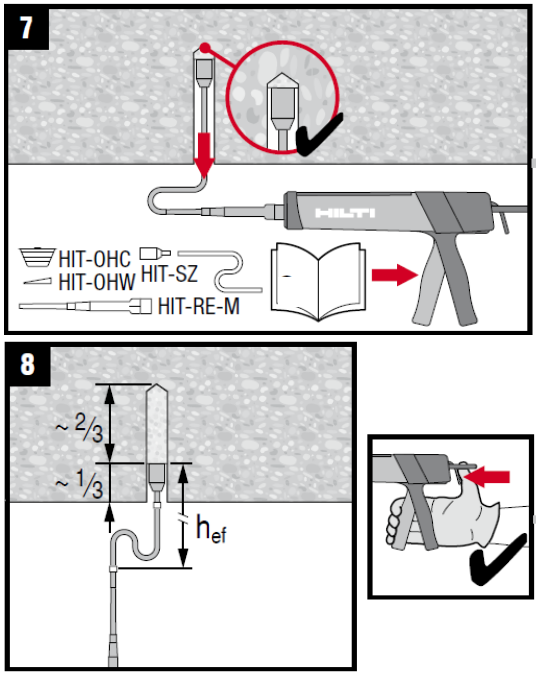


Inject the mortar from the back of the hole towards the front and slowly withdraw the mixing nozzle step by step after each trigger pull.

Fill holes approximately 2/3 full, or as required to ensure that the annular gap between the rebar and the concrete is completely filled with adhesive over the embedment length.

After injecting, depressurize the dispenser by pressing the release trigger. This will prevent further mortar discharge from the mixing nozzle.

Injection method for borehole depth > 250 mm or overhead applications:

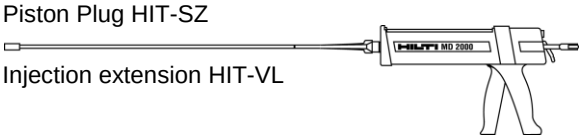


Assemble mixing nozzle, extension(s) and piston plug HIT-SZ (see Table 7 or Table 9).

Piston plug HIT-SZ — Injection extension HIT-VL

Piston Plug HIT-SZ

Injection extension HIT-VL



For combinations of several injection extensions use coupler HIT-VL K. A substitution of the injection extension for a plastic hose or a combination of both is permitted.

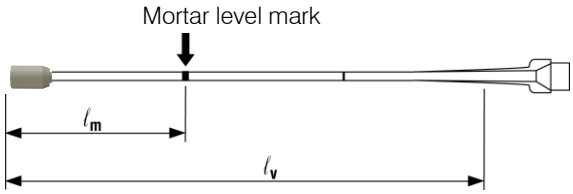
Insert piston plug to back of the hole. Begin injection allowing the pressure of the injected adhesive mortar to push the piston plug towards the front of the hole.

Fill holes approximately 2/3 full, or as required to ensure that the annular gap between the rebar and the concrete is completely filled with adhesive over the embedment length.

After injecting, depressurize the dispenser by pressing the release trigger. This will prevent further mortar discharge from the mixing nozzle.

For maximum embedment depth, see Table 7 to Table 9.

Injection System Hilti HIT-CT 1 for rebar connection	Annex 13
Installation instruction V Mortar injection	of the European Technical Approval ETA - 11/0390



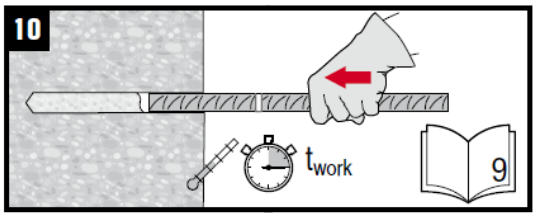
Mark the required mortar level ℓm and embedment depth ℓ_b resp. $\ell_{e,ges}$ with tape or marker on the injection extension.
Estimation: ℓ_m = 1/3 · ℓ_v resp. ℓ_m = 1/3 · $\ell_{e,ges}$

When using a piston plug HIT-SZ continue injection until the mortar level mark ℓ_m becomes visible.

Precise formula for optimum mortar volume:

$$\ell_m = \ell_v \text{ resp. } \ell_{e,ges} \times \left((1{,}2 \times \frac{d_s^2}{d_0^2} - 0{,}2) \right) \text{ [mm]}$$

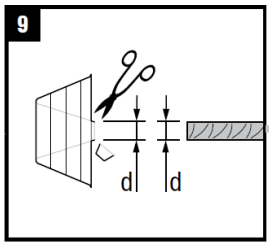
Insert rebar

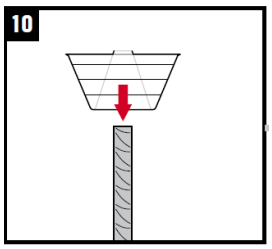


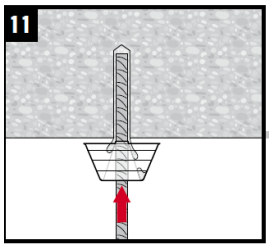
Insert the rebar into borehole until the embedment mark is at the concrete surface level.

Proper installation:
Excess mortar flows out of the borehole after the rebar has been fully inserted until the embedment mark.

Observe the gel time "t_{work}", which varies according to temperature of base material (see Table 6).
Do not disturb the rebar once the working time "t_{work}" has elapsed till "t_{cure}".



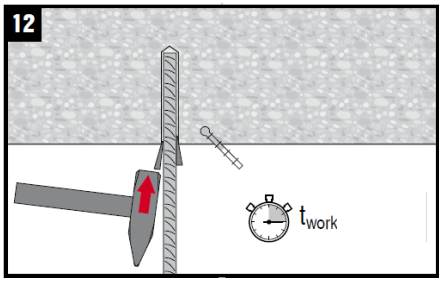




Overhead application:
During insertion of the rebar mortar might flow out of the bore hole. For collection of the flowing mortar HIT-OHC may be used.

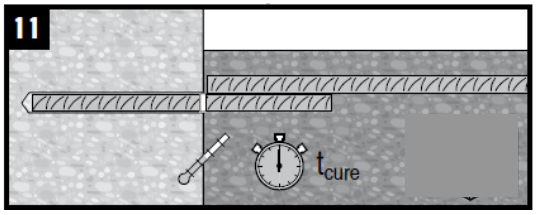
HIT-OHC

Injection System Hilti HIT-CT 1 for rebar connection	**Annex 14**
Installation instruction VI **Insert rebar**	**of the European Technical Approval** **ETA - 11/0390**



Overhead application:
Support the rebar and secure it from falling till mortar started to harden, e.g. using HIT-OHW

HIT-OHW



Full load may be applied only after the curing time "t_{cure}" has elapsed (see Table 6).

Table 6: Working time, curing time [1)]

Base material temperature	Working time "t_{gel}"	Curing time "t_{cure}"
-5 °C ≤ $T_{base\ material}$ ≤ 0°C	60 min	6 h
0 °C ≤ $T_{base\ material}$ ≤ 5°C	40 min	3 h
5 °C ≤ $T_{base\ material}$ ≤ 10°C	25 min	2 h
10 °C ≤ $T_{base\ material}$ ≤ 20°C	10 min	90 min
20 °C ≤ $T_{base\ material}$ ≤ 30°C	4 min	75 min
30 °C ≤ $T_{base\ material}$ ≤ 40 °C	2 min	60 min

[1)] The curing time data are valid for dry anchorage base only.
In water saturated anchorage base the curing times must be doubled.

Injection System Hilti HIT-CT 1 for rebar connection	**Annex 15**
Installation instruction VII **Working and curing time**	**of the European Technical Approval** **ETA - 11/0390**

Table 7: Installation tools for hammer-drilled holes

Hammer-drill (HD)

Rebar -Ø d_{nom} [mm]	Drill bit d_0 [mm]	Steel brush HIT-RB	Air Nozzle HIT-DL	Piston plug HIT-SZ	Extension HIT-VL	Maximum embedment depth [1) 2)] l_v or $l_{e,ges}$ [mm]
8	10	10	-	-	HIT-DL 10/0,8 or HIT-DL V10/1	250
	12	12	12	12		700
10	12	12	12	12		250
	14	14	14	14		700
12	14	14	14	14		250
	16	16	16	16		700
14	18	18	18	18	HIT-DL 16/0,8 or HIT-DL B and/or HIT-VL 16/0,7 and/or HIT-VL 16 [3)]	700
16	20	20	20	20		700
18	22	22	22	22		500
20	25	25	25	25		500
22	28	28	28	28		500
24	32	32	32	32		500
25	32	32	32	32		500

1) with manual dispensers: HIT-MD 2000, HIT-MD 2500, HIT-BD 2000, HIT-HDM 330, HIT-HDM 500
or electric dispensers: HIT-ED 3500, HIT-ED 3500-A, HIT-HDE 500
or pneumatic dispensers: HIT-P 3000 HY, HIT-P 3500

2) Remark: Injection of mortar at low temperatures is easier and faster when the mortar is heated up slowly to 20°C

3) Assemble extension HIT-VL 16/0.7 with coupler HIT-DL K for deeper anchor holes.

Table 8: Installation tools with use of hollow drill bit (HDB)


Hollow-drill bit (HDB)

Rebar -Ø  d_{nom} [mm]	Drill bit  d_0 [mm]	Piston plug  HIT-SZ	Extension  HIT-VL	Maximum embedment depth [1) 2)] l_v or $l_{e,ges}$ [mm]
8	12	12	HIT-DL 10/0,8 or HIT-DL V10/1	400
10	12	12		250
	14	14		400
12	14	14		250
	16	16		400
14	18	18	HIT-DL 16/0,8 or HIT-DL B and/or HIT-VL 16/0,7 and/or HIT-VL 16 [3)]	400
16	20	20		400
18	22	22		400
20	25	25		400
22	28	28		400
24	32	32		400
25	32	32		400

1) with manual dispensers: HIT-MD 2000, HIT-MD 2500, HIT-BD 2000, HIT-HDM 330, HIT-HDM 500
or electric dispensers: HIT-ED 3500, HIT-ED 3500-A, HIT-HDE 500
or pneumatic dispensers: HIT-P 3000 HY, HIT-P 3500 F

2) Remark: Injection of mortar at low temperatures is easier and faster when the mortar is heated up slowly to 20°C

3) Assemble extension HIT-VL 16/0.7 with coupler HIT-DL K for deeper anchor holes.

Table 9: Installation tools for compressed air-drilled holes

 **Compressed air drill (CA)**						
Rebar -Ø  d_{nom} [mm]	Drill bit  d_0 [mm]	Steel brush  HIT-RB	Piston plug  HIT-SZ	Air Nozzle  HIT-DL	Extension  HIT-VL	Maximum embedment depth [1) 2)] l_v or $l_{e,ges}$ [mm]
12	17	18	18	18	HIT-DL 16/0,8 or HIT-DL B and/or HIT-VL 16/0,7 and/or HIT-VL 16 [3)]	700
14	18	18	18	18		700
16	20	20	20	20		700
18	22	22	22	22		500
20	25	25	25	25		500
22	28	28	28	28		500
24	32	32	32	32		500
25	32	32	32	32		500

1) with manual dispensers: HIT-MD 2000, HIT-MD 2500, HIT-BD 2000, HIT-HDM 330, HIT-HDM 500
or electric dispensers: HIT-ED 3500, HIT-ED 3500-A, HIT-HDE 500
or pneumatic dispensers: HIT-P 3000 HY, HIT-P 3500 F

2) Remark: Injection of mortar at low temperatures is easier and faster when the mortar is heated up slowly to 20°C

3) Assemble extension HIT-VL 16/0.7 with coupler HIT-DL K for deeper anchor holes.

Values for pre-calculation of anchorage length with Hilti HIT-CT 1

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

Rebar Ø	$\alpha_1 = \alpha_2 = \alpha_3 = \alpha_4 = \alpha_5 = 1,0$			α_2 **or** $\alpha_5 = 0,7$ $\alpha_1 = \alpha_3 = \alpha_4 = 1,0$		
	Anchorage length l_{bd}	Tension load N_{Rd}	Mortar volume V [2]	Anchorage length l_{bd}	Tension load N_{Rd}	Mortar volume V [2]
[mm]	[mm]	[kN]	[ml]	[mm]	[kN]	[ml]
8	113	6,5	9 (4)	113	9,3	9 (4)
	200	11,6	15 (7)	160	13,2	12 (5)
	290	16,8	22	210	17,3	16 (7)
	379	**21,9**	29	**265**	**21,9**	20
10	142	10,3	13 (6)	142	14,7	13 (6)
	250	18,1	23 (10)	200	20,6	18 (8)
	360	26,0	33	270	27,9	24
	472	**34,1**	43	**330**	**34,1**	30
12	170	14,7	18 (8)	170	21,1	18 (8)
	300	26,0	32	250	31,0	26 (12)
	430	37,3	45	320	39,6	34
	567	**49,2**	60	**397**	**49,2**	42
14	199	20,1	24	199	28,8	24
	350	35,4	42	290	41,9	35
	510	51,6	62	380	54,9	46
	661	**66,9**	80	**463**	**66,9**	56
16	227	26,2	31	227	37,5	31
	380	43,9	52	330	54,5	45
	540	62,4	73	430	71,0	58
	700	**80,9**	95	**529**	**87,4**	72
18	255	33,2	38	255	47,4	38
	400	52,0	60	370	68,7	56
	550	71,5	83	480	89,2	72
	700	**91,0**	106	**595**	**110,6**	90
20	284	41,0	60	284	58,6	60
	360	52,0	76	360	74,3	76
	430	62,1	91	430	88,8	91
	500	**72,3**	106	**500**	**103,2**	106
22	312	49,6	88	312	70,9	88
	370	58,8	105	370	84,0	105
	440	69,9	124	440	99,9	124
	500	**79,5**	141	**500**	**113,5**	141
24	340	59,0	144	340	84,2	144
	390	67,6	165	390	96,6	165
	450	78,0	190	450	111,5	190
	500	**86,7**	211	**500**	**123,9**	211
25	355	64,1	133	355	91,6	133
	400	72,3	150	400	103,2	150
	450	81,3	169	450	116,1	169
	500	**90,3**	188	**500**	**129,0**	188

[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.

[2] The volume V of mortar can be estimated using the equation $V = 1,2 \cdot (d_0^2 - d^2) \cdot \pi \cdot l_{bd} / 4$; values in (brackets) correspond to min. hole diameter

Injection System Hilti HIT-CT 1 for rebar connection

Pre-calculated values for anchorage length

Example: rebar (f_{yk} =500 MPa), concrete C20/25 (f_{bd} =2.3 MPa)

Annex 19

of the European Technical Approval

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Values for pre-calculation of lap splice length with Hilti HIT-CT 1

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

Rebar Ø	$\alpha_1 = \alpha_2 = \alpha_3 = \alpha_4 = \alpha_5 = 1{,}0$			α_2 **or** $\alpha_5 = 0{,}7$ $\alpha_1 = \alpha_3 = \alpha_4 = 1{,}0$		
	Anchorage length l_{bd}	Tension load N_{Rd}	Mortar volume V [2]	Anchorage length l_{bd}	Tension load N_{Rd}	Mortar volume V [2]
[mm]	[mm]	[kN]	[ml]	[mm]	[kN]	[ml]
8	200	11,6	9 (4)	200	16,5	15 (7)
	260	15,0	15 (7)	220	18,2	17 (7)
	320	18,5	22	240	19,8	18 (8)
	379	**21,9**	29	**265**	**21,9**	20
10	200	14,5	13 (6)	200	20,6	18 (8)
	290	21,0	23 (10)	240	24,8	22 (10)
	380	27,5	33	290	29,9	26
	472	**34,1**	43	**330**	**34,1**	30
12	200	17,3	18 (8)	200	24,8	21 (10)
	320	27,7	32	270	33,4	29
	440	38,2	45	330	40,9	35
	567	**49,2**	60	**397**	**49,2**	42
14	210	21,2	24	210	30,3	25
	360	36,4	42	290	41,9	35
	510	51,6	62	380	54,9	46
	661	**66,9**	80	**463**	**66,9**	56
16	240	27,7	31	240	39,6	33
	390	45,1	52	340	56,2	46
	550	63,6	73	430	71,0	58
	700	**80,9**	95	**529**	**87,4**	72
18	270	35,1	38	270	50,2	41
	410	53,3	60	380	70,6	57
	560	72,8	83	490	91,0	74
	700	**91,0**	106	**595**	**110,6**	90
20	300	43,4	60	300	61,9	64
	370	53,5	76	370	76,4	78
	430	62,1	91	430	88,8	91
	500	**72,3**	106	**500**	**103,2**	106
22	330	52,5	88	330	74,9	93
	390	62,0	105	390	88,6	110
	440	69,9	124	440	99,9	124
	500	**79,5**	141	**500**	**113,5**	141
24	340	59,0	144	360	89,2	152
	360	62,4	165	410	101,6	173
	450	78,0	190	450	111,5	190
	500	**86,7**	211	**500**	**123,9**	211
25	375	67,7	133	375	96,8	141
	420	75,9	150	420	108,4	158
	460	83,1	169	460	118,7	173
	500	**90,3**	188	**500**	**129,0**	188

[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.

[2] The volume V of mortar can be estimated using the equation $V = 1{,}2 \cdot (d_0^2 - d^2) \cdot \pi \cdot l_{bd} / 4$; values in (brackets) correspond to min. hole diameter

Injection System Hilti HIT-CT 1 for rebar connection

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of the European Technical Approval
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Pre-calculated values for lap splice length
Example: rebar (f_{yk} =500 MPa), concrete C20/25 (f_{bd} =2.3 MPa)