ETA-Danmark A/S
Kollegievej 6
DK-2920 Charlottenlund
Tel. +45 72 24 59 00
Fax +45 72 24 59 04
Internet ww.etadanmark.dk

Authorised and notified according to Article 29 of the Regulation (EU) No 305/2011 of the European Parliament and of the Council of 9 March 2011

MEMBER OF EOTA

European Technical Assessment ETA-12/0254 of 10/04/2014

I General Part

Technical Assessment Body issuing the ETA and designated according to Article 29 of the Regulation (EU) No 305/2011: ETA-Danmark A/S

Trade name of the construction product:	SWE01 Sinto ST-EE for rebar connections
Product family to which the above construction product belongs:	Post-installed rebar connections of the sizes 8 to 32 mm with SWE01 Sinto ST-EE injection mortar
Manufacturer:	Tecfi SpA Strada Statale Appia, Km. 193 IT-81050 Pastorano (CE) Tel. +39 823 88 33 38 Fax +39 823 88 32 60 Internet www.tecfi.it
Manufacturing plant:	Tecfi SpA Manufacturing Plant I
This European Technical Assessment contains:	25 pages including 20 annexes which form an integral part of the document
This European Technical Assessment is issued in accordance with Regulation (EU) No 305/2011, on the basis of:	Guideline for European Technical Approval (ETAG) No. 001 Metal Anchors for use in concrete, Part 5 – Bonded anchors, April 2013, used as European Assessment Document (EAD).
This version replaces:	The ETA with the same number issued on 2012-06-06 and expiry on 2016-09-15

Translations of this European Technical Assessment in other languages shall fully correspond to the original issued document and should be identified as such.

Communication of this European Technical Assessment, including transmission by electronic means, shall be in full (except the confidential Annexes referred to above). However, partial reproduction may be made, with the written consent of the issuing Technical Assessment Body. Any partial reproduction has to be identified as such.

II SPECIFIC PART OF THE EUROPEAN TECHNICAL ASSESSMENT

1 Technical description of product and intended use

Technical description of the product
The subject of this assessment are the post-installed connections, by anchoring or overlap connection joint consisting of steel reinforcing bars (rebars) in existing structures made of normal weight concrete, using injection mortar SWE01 Sinto ST-EE in accordance with the regulations for reinforced concrete construction. The design of the post-installed rebar connections shall be done in accordance with EN 1992-1-1 (Eurocode 2).

Reinforcing bars with diameters from 8 to 32 mm and SWE01 Sinto ST-EE injection mortar according to Annex A3 are used for the post-installed rebar connections covered by this ETA. The steel element is placed into a drilled hole previously injected with a mortar and is anchored by the bond between embedded element, injection mortar and concrete.

The characteristic material values, dimensions and tolerances of the anchors not indicated in Annexes shall correspond to the respective values laid down in the technical documentation[1] of this European Technical Assessment.

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

The SWE01 Sinto ST-EE injection mortar is delivered in mortar cartridges in a difference sizes in accordance with Annex A4.

For the installed anchor see Figure given in Annex A2. The intended use specifications of the product are detailed in the Annex B1.

2 Specification of the intended use in accordance with the applicable EAD

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

The rebar connections may be used for predominantly static loads.

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

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

The rebar connections may only be carried out in the manner, which is also possible with reinforcing bars, e.g. those in the following applications:
- an overlapping joint with existing reinforcement in a building component (Figures 1 and 2, Annex A1),
- anchoring of the reinforcement at a slab or beam support (Figure 3, Annex A1; end support of a slab, designed as simply supported, as well as appropriate reinforcement for restraint forces),
- anchoring of reinforcement of building components stressed primarily in compression (Figure 4, Annex A1),
- anchoring of reinforcement to cover the line of acting tensile force (Figure 5, Annex A1).

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

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

This ETA covers anchoring in bore holes made with hammer drilling and diamond drilling technique (wet and dry cutting system).

The performances given in Section 3 are only valid if the anchor is used in compliance with the specifications and conditions given in Annex B1 to B12

The provisions made in this European Technical Assessment are based on an assumed intended working life of the anchor of 50 years.

The indications given on the working life cannot be interpreted as a guarantee given by the producer or Assessment Body, but are to be regarded only as a means for choosing the right products in relation to the expected economically reasonable working life of the works.

1 The technical documentation of this European Technical Assessment is deposited at ETA-Danmark and, as far as relevant for the tasks of the Notified bodies involved in the attestation of conformity procedure, is handed over to the notified bodies.

3 Performance of the product and references to the methods used for its assessment

3.1 Characteristics of product

Mechanical resistance and stability (BWR1):
The essential characteristics are detailed in the Annex from C1 to C3.

Safety in case of fire (BWR2):
The essential characteristics are detailed in the Annex C1.

Hygiene, health and the environment (BWR3):
Regarding the dangerous substances contained in this European Technical Assessment, there may be other requirements applicable to the products falling within its scope (e.g. transposed European legislation and national laws, regulations and administrative provisions). In order to meet the provisions of the Construction Products Regulation, these requirements need also to be complied with, when and where they apply.

Safety in use (BWR4):
For basic requirement Safety in use the same criteria are valid for Basic Requirement Mechanical resistance and stability (BWR1).

Sustainable use of natural resources (BWR7)
No performance determined

Other Basic Requirements are not relevant.

3.2 Methods of assessment

The assessment of fitness of the anchor for the intended use in relation to the requirements for mechanical resistance and stability and safety in use in the sense of the Basic 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 » and Part 5 « Bonded anchors », and EOTA Technical Report 023 “Assessment of post-installed rebar connections”.

4 Assessment and verification of constancy of performance (AVCP)

4.1 AVCP system

According to the decision 96/582/EC of the European Commission, the system(s) of assessment and verification of constancy of performance (see Annex V to Regulation (EU) No 305/2011) is 1.

5 Technical details necessary for the implementation of the AVCP system, as foreseen in the applicable EAD

Technical details necessary for the implementation of the AVCP system are laid down in the control plan deposited at ETA-Danmark

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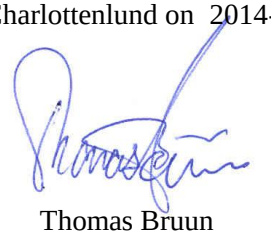


Thomas Bruun
Managing Director, ETA-Danmark

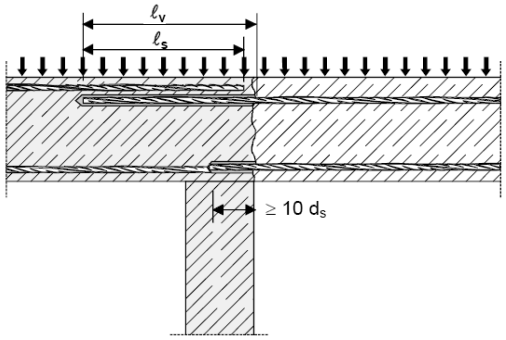


Figure 1: Overlap joint for rebar connections of slabs and beams

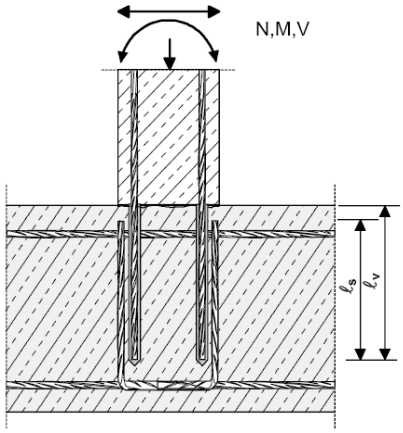


Figure 2: Overlap joint at a foundation of a column or wall where the rebars are stressed in tension

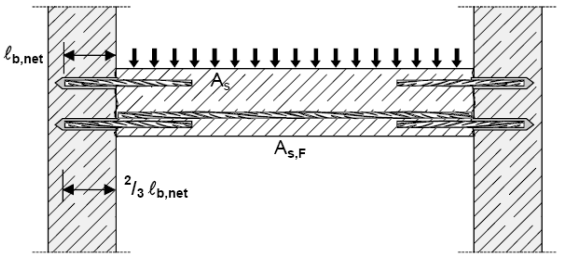


Figure 3: End anchoring of slabs or beams, designed as simply supported

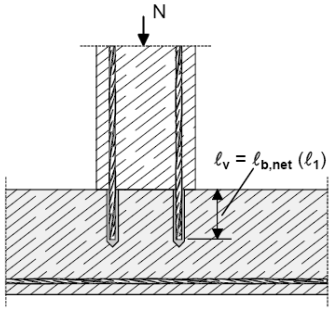


Figure 4: Rebar connection for components stressed primarily in compression. The rebars are stressed in compression

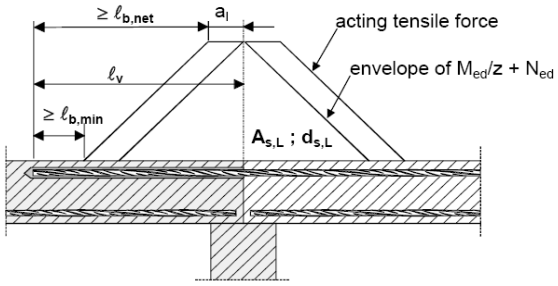


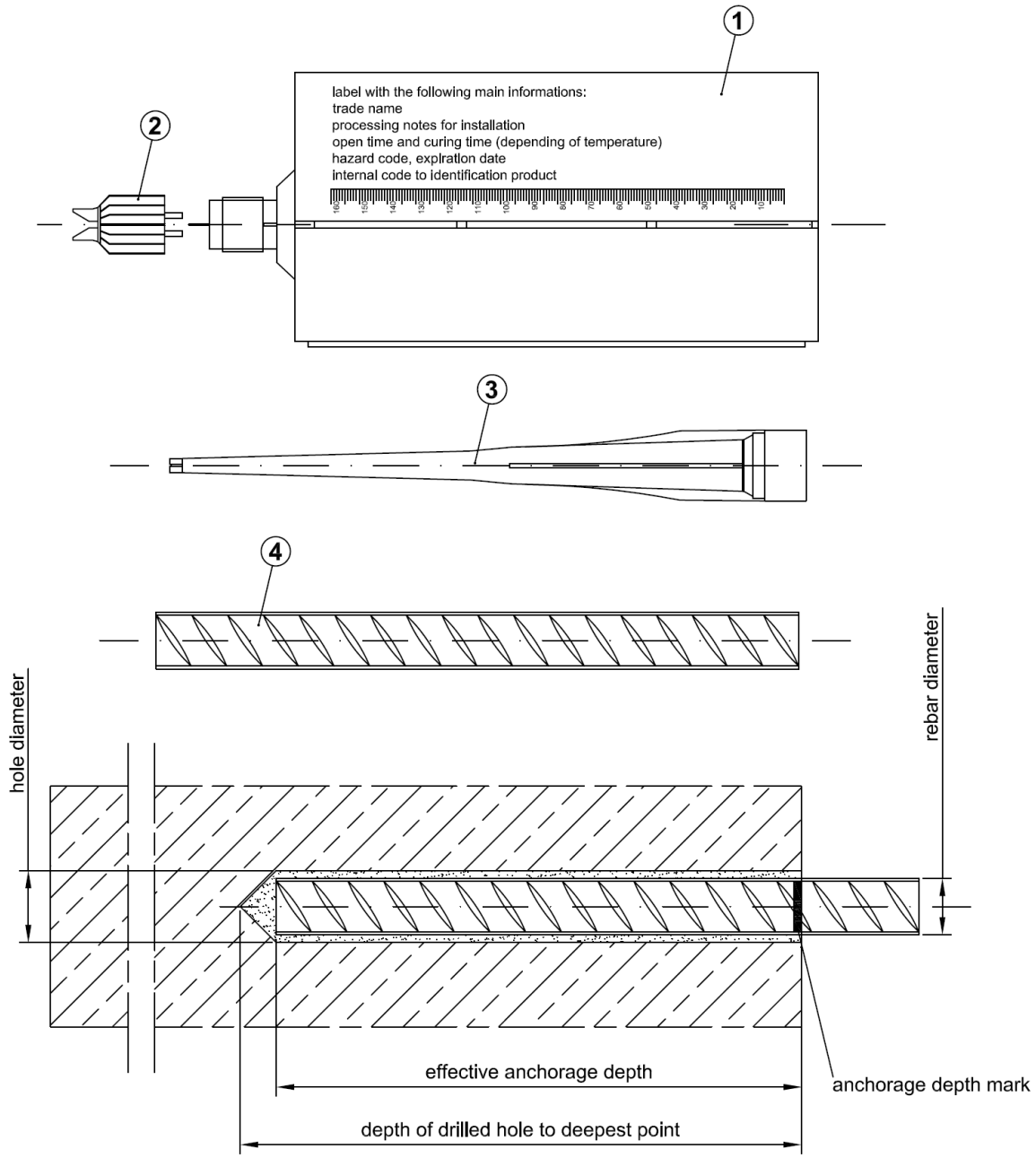
Figure 5: Anchoring of reinforcement to cover the line of acting tensile force

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.

SWE01 SINTO ST-EE for post-installed rebar connection	**Annex A1** of European Technical Assessment ETA-12/0254
Use of the product	



① **Cartridge**
② **Sealing cap**
③ **Mixer**
④ **Rebar - Reinforced bar**

SWE01 SINTO ST-EE for post-installed rebar connection	**Annex A2** of European Technical Assessment ETA-12/0254
Product description	

Table A1: Rebar according to EN 1992-1-1, Annex C, Tables C.1 and C.2

Product form		**Bars and de-coiled rods**	
Class		B	C
Characteristic yield strength f_{yk} or $f_{0,2k}$ [N/mm^2]		400 to 600	
Minimum value of $k = (f_t / f_y)_k$		≥ 1,08	≥ 1,15 < 1,35
Characteristic strain at minimum force, ε_{uk} [%]		≥ 5,0	≥ 7,5
Bendability		Bend / Rebend test	
Maximum deviation from nominal mass (individual bar), [%]	Nominal bar size [mm] ≤ 8 > 8	 ± 6.0 ± 4.5	
Bond: Minimum relative rib area, $f_{R,min}$	Nominal bar size [mm] 8 to 12 > 12	 0,040 0,056	

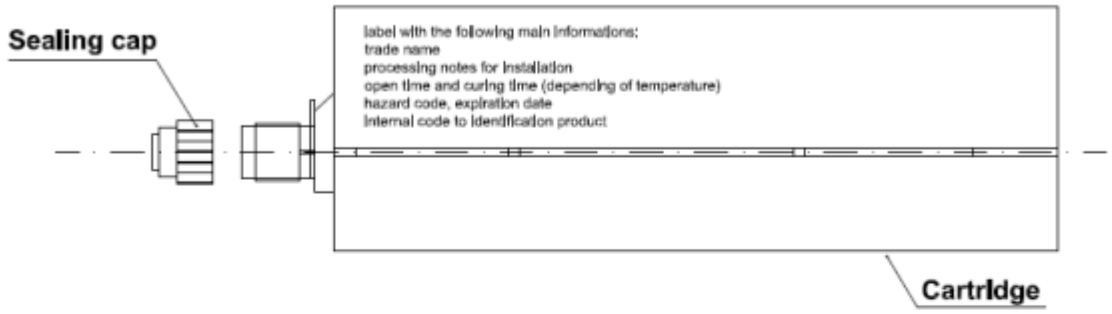
Rib height h: The rib height h should be: $0,05 \cdot Ø \leq h \leq 0,07 \cdot Ø$

Ø = nominal bar diameter

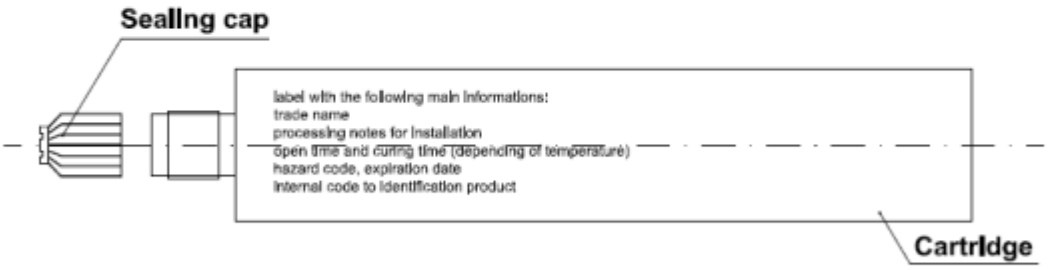
Table A2: Injection mortar

Product	**Composition**
SWE01 SINTO ST-EE **two components injection mortar**	Additive: quartz Bonding agent: epoxy resin

Cartridge from 400 to 900 ml - syde by syde cartridge



Cartridge 265 ml - peeler cartridge



MIXER - the mixer is suitable for each type of cartridge

1) Variable length from 380 mm up to 1000 mm

SWE01 SINTO ST-EE for post-installed rebar connection	**Annex A4** of European Technical Assessment ETA-12/0254
Cartridge types and sizes	

Specification of intended use

Anchorages subject to:

- Static and quasi-static loads.

Base materials:

- Reinforced or unreinforced normal weight concrete of strength class C12/15 at minimum to C50/60 at maximum according to EN 206-1.
- Maximum chloride content of 0,40% (CL 0,40) related to the cement content according to EN 206-1.
- Non-carbonated concrete.

  Note: In case of a carbonated surface of the existing concrete structure the carbonate layer shall be removed in the area of the post-installed rebar connection with a diameter of ds + 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 according to EN 1992-1-1. The above may be neglected if building components are new and not carbonated and if building components are in dry conditions.

Temperature range:

- - The anchors 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).

Use conditions (Environmental conditions):

- Structures subject to dry internal conditions.
- Structures subject to external atmospheric exposure including industrial and marine environment).
- Structures subject to permanently damp internal conditions if no particular aggressive conditions exist.

  Note: Particular aggressive conditions are e.g. permanent, alternating immersion in seawater or the splash zone of seawater, chloride atmosphere of indoor swimming pools or atmosphere with extreme chemical pollution (e.g. in desulphurization plants or road tunnels where de-icing materials are used).

Design:

- Anchorages are designed under the responsibility of an engineer experienced in anchorages and concrete work.
- Verifiable calculation notes and drawings are prepared taking into account of the forces to be transmitted.
- Design according to EN 1992-1-1 and Annex B2.
- 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.

Installation:

- Dry or wet concrete (use category 1).
- It must not be installed in flooded holes.
- Overhead installation is permissible.
- Hole drilling by hammer drill and diamond drilling machine (dry and wet cutting system).
- Installation of the post-installed rebars shall be done only by suitable trained installer and under supervision on the site.
- Check the position of the existing rebars (if the position of existing rebars in not known it shall be determined using a rebar detector suitable for this purpose as well as on the basis of the construction documentation and then marked on the building component for the overlap joint).

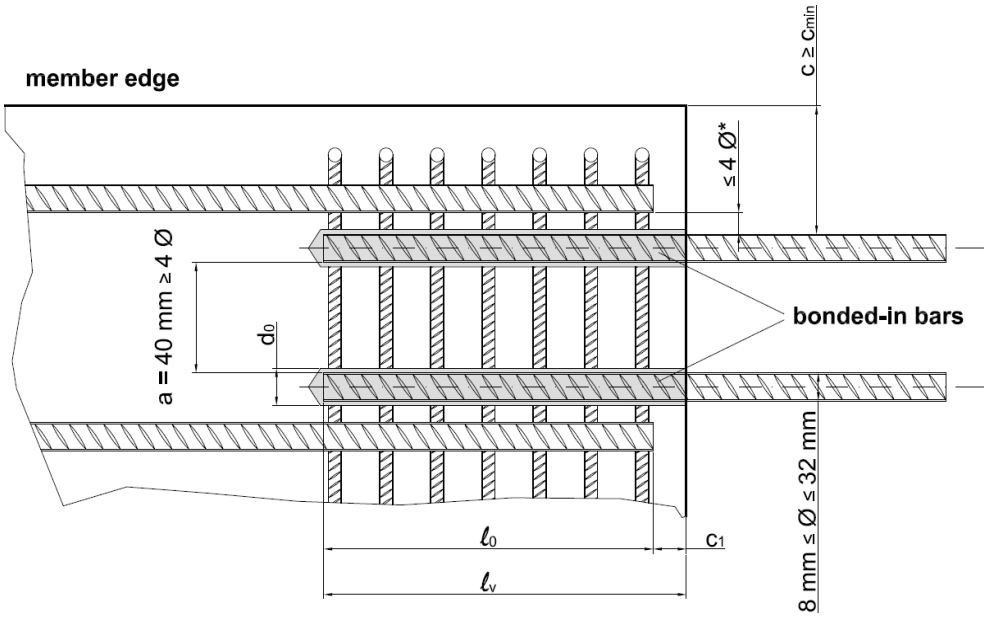
SWE01 SINTO ST-EE for post-installed rebar connection	**Annex B1** of European Technical Assessment ETA-12/0254
Intended use - Specification	

General design rules of construction for post-installed rebars

Only tension forces in the axis of the rebar may be transmitted.

The transfer of shear forces between new concrete and existing structure shall be designed additionally according to EN 1992-1-1.

The joints for concreting must be roughened to at least such an extended that aggregate protrude.



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

l_0 – lap length acc. to EN 1992-1-1, clause 8.7.3
l_v – effective embedment depth; $l_v \geq l_0 + c_1$
c – concrete cover of post-installed rebar
c_{min} – minimum concrete cover acc. to Annex B3 and EN 1992-1-1, clause 4.4.1.2.
c_1 – concrete cover at end-face of existing rebar
d_0 – nominal drill bit diameter acc. to Annex B3
Ø – rebar diameter (ds)

SWE01 SINTO ST-EE for post-installed rebar connection	**Annex B2**
Intended use. General construction rules for post-installed rebars	of European Technical Assessment ETA-12/0254

Table B1: Drill bit diameter and setting depth[1)]

Rebar diameter [mm]		**Ø8**	**Ø10**	**Ø12**	**Ø14**	**Ø16**	**Ø20**	**Ø25**	**Ø28**	**Ø32**
HD[2)] DD[3)]	**Nominal drill hole d_0 [mm]**	12	14	16	18	20	25	30	35	40
HD[2)] DD[3)]	**Min anchorage depth $l_{b,min}$ [mm]**	115	145	170	200	230	285	355	400	455
HD[2)] DD[3)]	**Min overlap joint depth $l_{0,min}$ [mm]**	200	200	200	210	240	300	375	420	480
HD[2)] DD[3)]	**Max anchorage depth $l_{v,max}$ [mm]**	700	900	1100	1300	1400	1800	2200	2500	2500

1) According to EN 1992-1-1 modified with TR023: $l_{b,min}$ (8.6) and $l_{0,min}$ (8.11) with maximum yield stress for rebar BSt 500S, $\gamma_M = 1{,}15$, $\alpha_6 = 1{,}0$, concrete C20/25 with $f_{bd} = 2{,}30$ N/mm^2 and good bond condition.
2) HD: hammer drilling method.
3) DD: diamond drilling method (dry and wet cutting system).

Minimum concrete cover (see Annex B2):

$c_{min} = 30 \text{ mm} + 0{,}06 \cdot l_v \geq 2 \cdot Ø$ for $Ø < 25$ mm

$c_{min} = 40 \text{ mm} + 0{,}06 \cdot l_v \geq 2 \cdot Ø$ for $Ø \geq 25$ mm

The minimum concrete cover according to EN 1992-1-1 shall be observed.

Minimum clear spacing between two post-installed rebars:

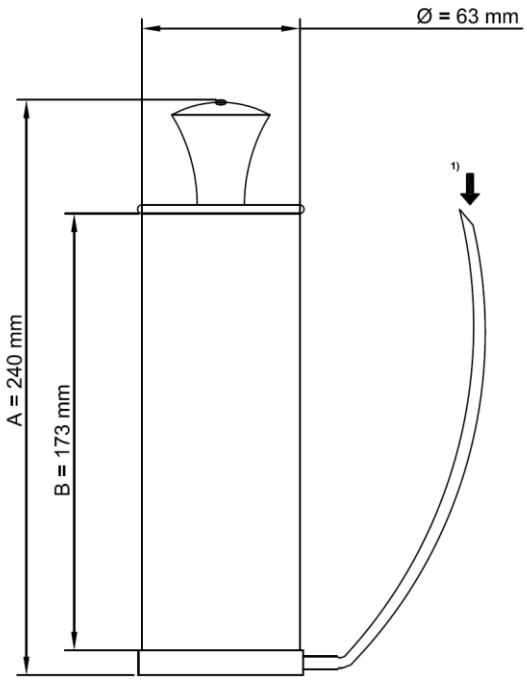
$a = 40 \text{ mm} \geq 4 \cdot Ø$

Table B2: Minimum curing time[1)]

Concrete temperature	Processing time	Minimum curing time[3)]
0°C[2)]	3 h 20 min	54 h
5°C[2)]	2 h 30 min	41 h
10°C	1 h 40 min	28 h
15°C	1 h 10 min	22 h
20°C	50 min	16 h
25°C	30 min	14 h
30°C	20 min	12 h

1) The minimum time from the end of the mixing to the time when the anchor may be torque or loaded (whichever is longer).
2) Minimum resin temperature recommended, for injection between 5°C and 0°C, equal to 10°C.
3) Minimum curing time for dry and wet conditions.
4) Maximum resin temperature for maximum anchorage length equal to 24 °C.

Manual blower pump: nominal dimensions



It is possible to use the mixer extensior with the manual blower pump.

However it is possible to blow the hole using the mechanical air system (compressed air) also with the mixer estension

1)

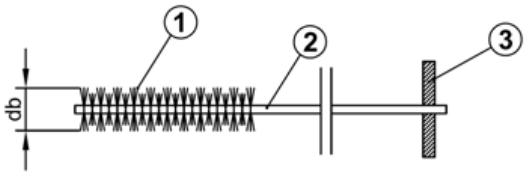
Suitable min pressure 6 bar at 6 m³/h
Oil-free compressed air
Recommended air gun with an orifice opening of minimum 3.5 mm in diameter

1) Position to insert the mixer extension

Mixer extension (from 380 mm to 1000 mm) with nominal diameter equal to 8 mm
For the hole with depth grater 1000 mm up to 2500 mm it is possible use the special mixer extension (see Annex B7) for blower operation.

SWE01 SINTO ST-EE for post-installed rebar connection	**Annex B5** of European Technical Assessment ETA-12/0254
Cleaning tools (1)	

Standard brush

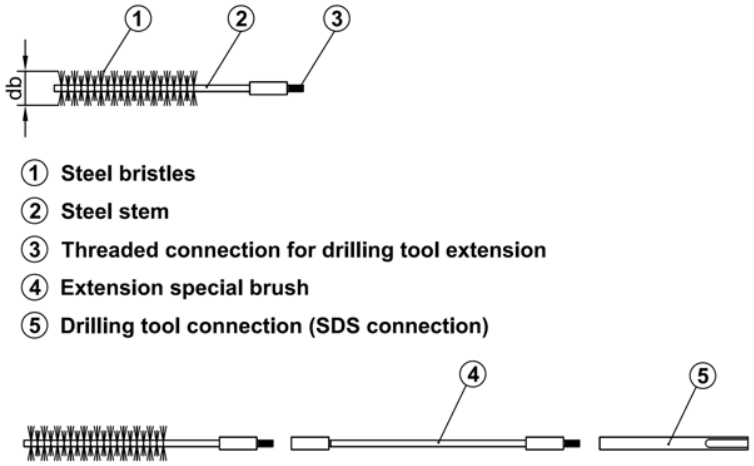


① Steel bristles
② Steel stem
③ Wood handle

Table 7: Standard brush diameter

Rebar diameter - Ø			Ø8	Ø10	Ø12	Ø14	Ø16
d_0	Nominal drill hole	[mm]	12	14	18	18	20
d_b	Brush diameter	[mm]	14	16	20	20	22

Special brush

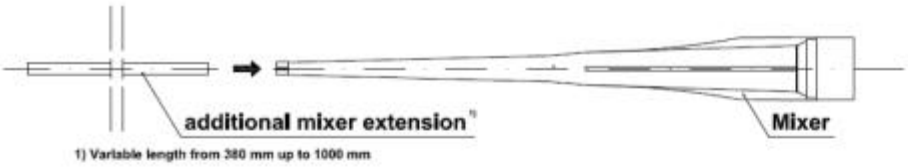


① Steel bristles
② Steel stem
③ Threaded connection for drilling tool extension
④ Extension special brush
⑤ Drilling tool connection (SDS connection)

Table 8: Special brush diameter (mechanical brush)

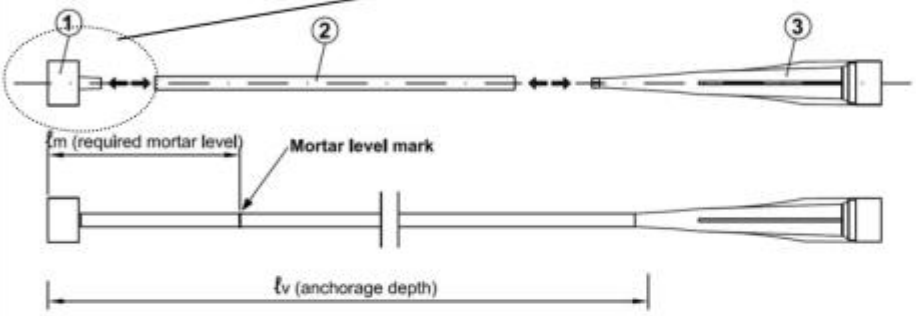
Rebar diameter - Ø			Ø8	Ø10	Ø12	Ø14	Ø16	Ø20	Ø25	Ø28	Ø32
d_0	Nominal drill hole	[mm]	12	14	16	18	20	25	30	35	40
d_b	Brush diameter	[mm]	14	16	18	20	22	27	32	37	42

Use the mixer extension (assembled on the standard mixer) for the injection up to 300 mm if necessary.

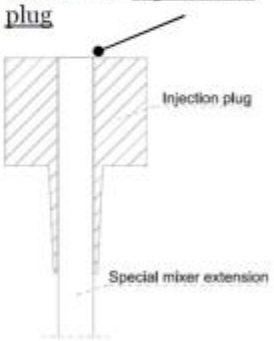


Use this system for special conditions:

Tools for installation in special condition



Insert the special mixer extension in the inner diameter of the injection plug up to reach the top of the plug



① Injection plug (nominal diameter according to the nominal diameter of drilled hole)

② Special mixer extension (variable length with nominal diameter 10 mm)

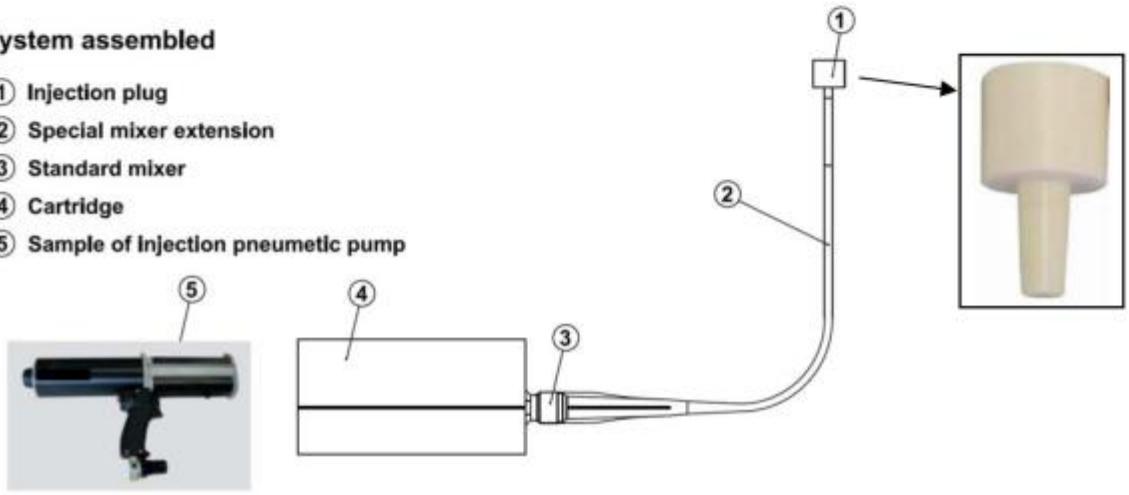
Mark the required mortar level ℓ_m and embedment depth ℓ_v with tape or marker on the injection extension. Quick estimation: $\ell_m = 1/3 \cdot \ell_v$
Continue injection until the mortar level mark ℓ_m becomes visible.

③ Standard mixer (suitable for all size of cartirge)

These tools allow the application in special conditions:
- installation with anchorage depth greater than 300 mm
- overhead installation.
For these applications is recommanded the use of the injection pneumatic pump.

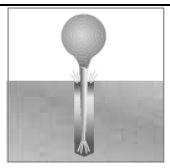
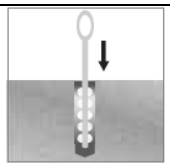
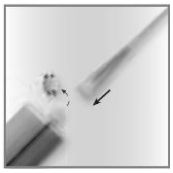
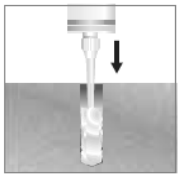
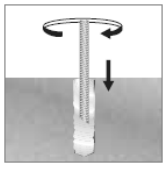
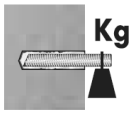
System assembled

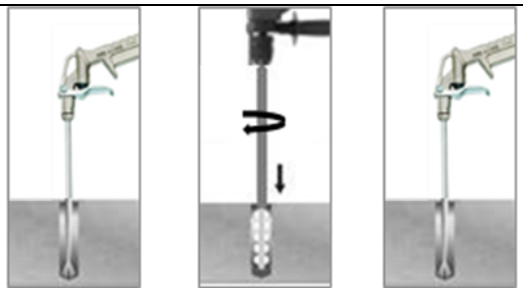
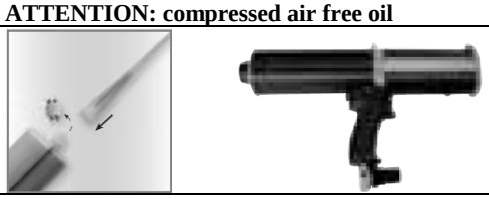
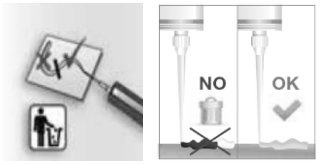
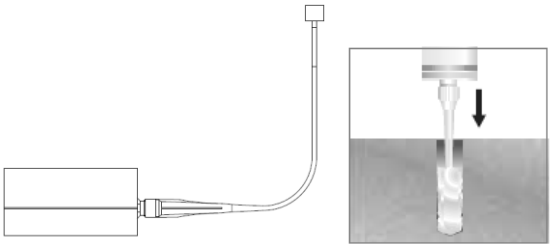
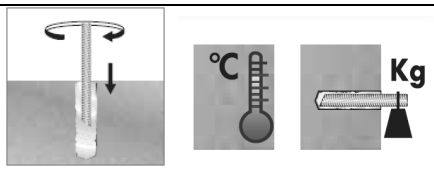
① Injection plug
② Special mixer extension
③ Standard mixer
④ Cartridge
⑤ Sample of injection pneumetic pump

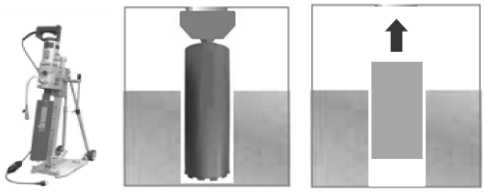
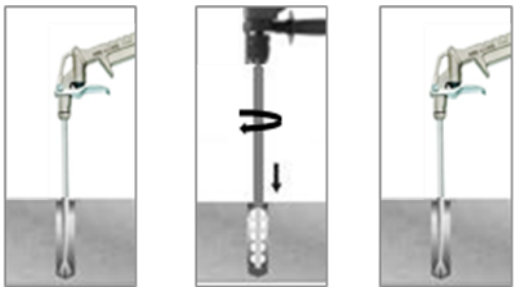


SWE01 SINTO ST-EE for post-installed rebar connection	**Annex B7** of European Technical Assessment ETA-12/0254
Tools for injection (1)	

Resin injection pump details		
Pump example	**Size cartridge**	**Type**
	900 ml	Pneumatic
	from 450 ml to 480 ml	Pneumatic
	400 ml	Pneumatic
	from 450 ml to 480 ml	Manual (up to 300 mm anchorage depth)
	400 ml	Manual (up to 300 mm anchorage depth)
	265 ml	Manual (up to 300 mm anchorage depth)

1		Drill the hole with the correct diameter and depth using a rotary percussive machine. Check the perpendicularity of the hole during the drilling operation.
2	   **4x Blower Manual Pump** **4x Standard Brush** **4x Blower Manual Pump** **if necessary use a mixer extension for the blower operation (see Annex B7)**	Clean the hole from drilling dust: the hole shall be cleaned by at least 4 blowing operations, by at least 4 brushing operations followed again by at least 4 blowing operations; before brushing clean the brush and check (see Annex B6, standard brush) if the brush diameter is sufficient. For the blower tools see Annex B5.
3		Unscrew the front cup, screw on the mixer and insert the cartridge in the gun.
4	 	Before starting to use the cartridge, eject a first part of the product, being sure that the two components are completely mixed. The complete mixing is reached only after that the product, obtained by mixing the two components, comes out from the mixer with an uniform color.
5	 **if necessary use a mixer extension for the injection (see Annex B7)**	Fill the drilled hole uniformly starting from the drilled hole bottom, in order to avoid entrapment of the air; remove the mixer slowly bit by bit during pressing-out; filling the drill hole with a quantity of the injection mortar corresponding to 2/3 of the drill hole depth.
6	   **ATTENTION: Use the rods dry and free oil and other contaminants**	Insert immediately the rod, marked according to the proper anchorage depth, slowly and with a slight twisting motion, removing excess of injection mortar around the rod. Observe the processing time according Annex B4. Wait the curing time according Annex B4.

1		Drill the hole with the correct diameter and depth using a rotary percussive machine. Check the perpendicularity of the hole during the drilling operation.
2	 **4 x 5 seconds** **4x** **4 x 5 seconds** **ATTENTION: compressed air free oil**	Clean the hole from drilling dust: the hole shall be cleaned by at least 4 blowing operations (5 seconds for single operation) with compressed air, by at least 4 brushing operations with special brush followed again by at least 4 blowing operations (5 seconds for single operation) with compressed air. Before brushing clean the brush and check (see Annex B6, special brush) if the brush diameter is sufficient. For the blower tools see the Annex B5.
3		Unscrew the front cup of the cartridges, screw on the mixer and insert the cartridge in the proper pneumatic-pump.
4		Before starting to use the cartridge, eject a first part of the product, being sure that the two components are completely mixed. The complete mixing is reached only after that the product, obtained by mixing the two components, comes out from the mixer with an uniform color.
5		Before starting the injection, assemble the system according to Annex B7. After that, fill the drilled hole uniformly from the drilled hole bottom, in order to avoid entrapment of the air; remove the special mixer extension with injection plug slowly bit by bit during pressing-out; filling the drill hole with a quantity of the injection mortar corresponding to 2/3 of the drill hole depth. Procedure for overhead application is detailed in Annex B12.
6	 **ATTENTION: Use the rods dry and free oil and other contaminants**	Insert immediately the rod, marked according to the proper anchorage depth, slowly and with a slight twisting motion, removing excess of injection mortar around the rod. Observe the processing time according Annex B4. Wait the curing time according Annex B4.

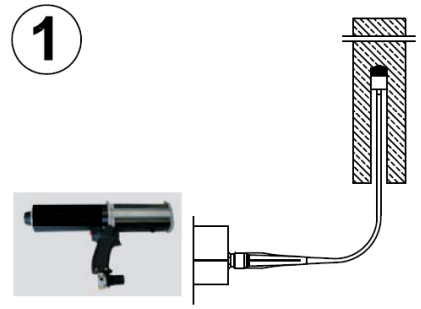
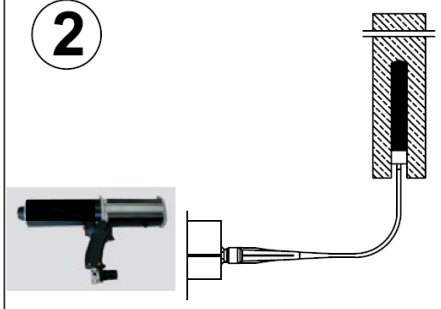
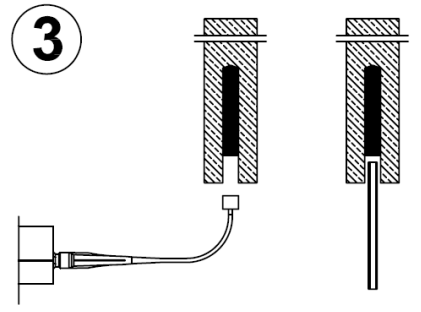
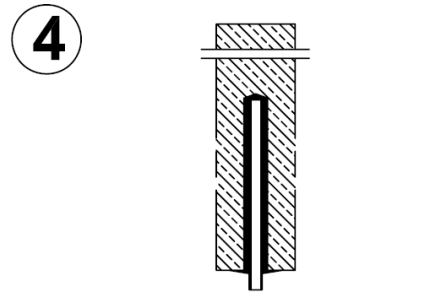
1		Drill the hole with the correct diameter and depth using a core drill machine. Check the perpendicularity of the hole during the drilling operation. Remove completely the core from the hole.
	After operation 1, if the diamond drilling machine used has a dry cutting system to proceed with the installation procedure according to the point 2. Instead if it is used a wet cutting system before of the point 2 the following operation must be done: - flush hole 2 times by inserting a water hose to the back of the hole until water runs clear; - brush 2 times with the proper special brush. Before brushing clean the brush and check (see Annex B6, special brush) if the brush diameter is sufficient; - flush again 2 times until water runs clear; - remove all standing water completely (using for example vacuum system or compressed air free oil).	
2	 **4 x 5 seconds** **6x** **4 x 5 seconds** **ATTENTION: compressed air free oil**	Clean the hole from drilling dust: the hole shall be cleaned by at least 4 blowing operations (5 seconds for single operation) with compressed air, by at least 4 brushing operations with special brush followed again by at least 4 blowing operations (5 seconds for single operation) with compressed air. Before brushing clean the brush and check (see Annex B6, special brush) if the brush diameter is sufficient. For the blower tools see the Annex B5.

After the operation above, to follow the operations from 3 to 6 on the previous Annex B9 and B10 in function of the depth of the hole.

SWE01 SINTO ST-EE for post-installed rebar connection	**Annex B11** of European Technical Assessment ETA-12/0254
Procedure with diamond drilling (wet and dry) for all depths	

Overhead installation procedure

In addition to standard procedure, for overhead installation, following the below procedure

	**1 - Start injection** **Inject from the bottom of the hole. Maintain this position during the injection phase.**
	**2 - Injection phase** **Inject the product about 2/3 of the hole depth.** **During the injection maintain this position to assure the correct installation**
	**3 - End injection** **Remove the injection plug.** **Insert immediately the rod (turn the rod during the insertion).**
	**4 - End installation** **To avoid the slipping of the rod during the open time of the product (due to the rod own weigth) use a temporary interlocking element (for ex. wedge of wood)**

SWE01 SINTO ST-EE for post-installed rebar connection	**Annex B12** of European Technical Assessment ETA-12/0254
Overhead application	

Table C1: Design values of the ultimate bond resistance f_{bd} according to EN 1992-1-1

ESSENTIAL CHARACTERISTICS	PERFORMANCE								
*** Design bond strength f_{bd} according to EN 1992-1-1 [N/mm^2] for perforation with hammer drilling machine**	**C12/15**	**C16/20**	**20/25**	**C25/30**	**C30/37**	**C35/45**	**C40/50**	**C45/55**	**C50/60**
da Ø8 a Ø28	1,60	2,00	2,30	2,70	3,00	3,40	3,70	4,00	4,30
Ø32	1,60	2,00	2,30	2,70	3,00	3,40	3,70	4,00	4,00
*** Design bond strength f_{bd} according to EN 1992-1-1 [N/mm^2] for perforation with diamond drilling machine (dry and wet cutting system)**	**C12/15**	**C16/20**	**20/25**	**C25/30**	**C30/37**	**C35/45**	**C40/50**	**C45/55**	**C50/60**
da Ø8 a Ø25	1,60	2,00	2,30	2,70	3,00	3,40	3,70	4,00	4,30
Ø28	1,60	2,00	2,30	2,70	3,00	3,40	3,70	3,70	3,70
Ø32	1,60	2,00	2,30	2,70	3,00	3,00	3,00	3,00	3,00

*** Values valid only for good bond condition according to EN 1992-1-1.**
For other bond conditions multiply the values for 0,7

Table C2: Resistance to fire

HARMONIZED TECHNICAL SPECIFICATION: ETAG 001 PART 1 PARAGRAPH 5.2.2 AND TECHNICAL REPORT TR020	
ESSENTIAL CHARACTERISTICS	**PERFORMANCE**
Resistance to fire	NPD

Table C3: Reaction to fire

HARMONIZED TECHNICAL SPECIFICATION: ETAG 001 PART 1 PARAGRAPH 5.2.1	
ESSENTIAL CHARACTERISTICS	**PERFORMANCE**
Reaction to fire	In the final application the thickness of the mortar layer is about 1 to 2 mm and most of the mortar is material classified class A1 according to EC Decision 96/603/EC. Therefore it may be assumed that the bonding material (synthetic mortar or a mixture of synthetic mortar and cementitious mortar) in connection with the metal anchor in the end use application do not make any contribution to fire growth or to the fully developed fire and they have no influence to the smoke hazard.

Values for pre-calculation of anchoring
Examples for anchorage length [1] for rebars ($f_{y,k}$ = 500 N/mm^2) on concrete C20/25 (f_{bd} = 2,3 N/mm^2)
Values for hammer drilling (HD) and diamond drilling (DD) perforation technique

Rebar Ø	Tensile load for Bst 500	$\alpha_1 = \alpha_2 = \alpha_3 = \alpha_4 = \alpha_5 = 1,0$			$\alpha_1 = \alpha_3 = \alpha_4 = 1,0$ and α_2 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]	[kN]	[mm]	[kN]	[ml]	[mm]	[kN]	[ml]
8	21,85	**115**	**6,65**	**8,50**	**115**	**9,50**	**8,50**
		180	10,40	13,31	180	14,86	13,31
		250	14,45	18,48	200	16,52	14,78
		320	18,50	23,65	220	18,17	16,26
		378	**21,85**	**27,95**	**265**	**21,85**	**19,56**
10	34,15	**145**	**10,48**	**12,86**	**145**	**14,97**	**12,86**
		230	16,62	20,40	230	23,74	20,40
		310	22,40	27,50	260	26,84	23,06
		390	28,18	34,59	290	29,93	25,72
		473	**34,15**	**41,92**	**331**	**34,15**	**29,34**
12	49,17	**170**	**14,74**	**17,59**	**170**	**21,06**	**17,59**
		270	23,41	27,94	270	33,44	27,94
		370	32,08	38,29	300	37,16	31,05
		470	40,75	48,64	330	40,88	34,15
		567	**49,17**	**58,69**	**397**	**49,17**	**41,08**
14	66,93	**200**	**20,23**	**23,65**	**200**	**28,90**	**23,65**
		320	32,37	37,85	320	46,24	37,85
		440	44,51	52,04	360	52,02	42,58
		560	56,65	66,23	400	57,81	47,31
		662	**66,93**	**78,25**	**463**	**66,93**	**54,78**
16	87,42	**230**	**26,59**	**30,60**	**230**	**37,99**	**30,60**
		360	41,62	47,90	360	59,46	47,90
		490	56,65	65,20	400	66,06	53,22
		620	71,68	82,49	440	72,67	58,54
		756	**87,42**	**100,61**	**529**	**87,42**	**70,43**
20	136,59	**285**	**41,19**	**59,25**	**285**	**58,84**	**59,25**
		450	65,03	93,55	450	92,90	93,55
		620	89,60	128,90	500	103,22	103,95
		790	114,17	164,24	550	113,55	114,34
		945	**136,59**	**196,50**	**662**	**136,59**	**137,55**
25	213,42	**355**	**64,13**	**90,21**	**355**	**91,61**	**90,21**
		560	101,16	142,30	560	144,51	142,30
		770	139,09	195,66	750	193,54	190,57
		980	177,03	249,02	800	206,45	203,28
		1181	**213,42**	**300,21**	**827**	**213,42**	**210,15**
28	267,72	**400**	**80,93**	**162,99**	**400**	**115,61**	**162,99**
		630	127,46	256,71	700	202,32	285,24
		860	173,99	350,44	800	231,22	325,99
		1090	220,53	444,16	900	260,12	366,73
		1323	**267,72**	**539,20**	**926**	**267,72**	**377,44**
32	349,67	**455**	**105,21**	**242,16**	**455**	**150,29**	**242,16**
		720	166,48	383,20	760	251,04	404,49
		980	226,60	521,58	840	277,47	447,07
		1240	286,71	659,96	920	303,89	489,64
		1512	**349,67**	**804,87**	**1059**	**349,67**	**563,41**

1) Tabulated maximum tension loads are valid for good bond condition according to EN 1992-1-1.
For all other bond condition the values for tension load must be multiplied by 0,7
2) The mortar volume V can be estimated using the equation: $V = l_b \pi (d_0^2 - d^2)/(4x0,85)$ with the nominal hole diameter

Values for pre-calculation of lap splice lengths
Examples for the lap splice length [1] for rebars ($f_{y,k}$ = 500 N/mm^2) on concrete C20/25 (f_{bd} = 2,3 N/mm^2)
Values for hammer drilling (HD) and diamond drilling (DD) perforation technique

Rebar Ø	Tensile load for Bst 500	$\alpha_1 = \alpha_2 = \alpha_3 = \alpha_5 = \alpha_6 = 1{,}0$			$\alpha_1 = \alpha_3 = \alpha_6 = 1{,}0$ and α_2 or $\alpha_5 = 0{,}7$		
		Lap splice length l_0	Tension load	Mortar volume V [2]	Lap splice length l_0	Tension load	Mortar volume V [2]
[mm]	[kN]	[mm]	[kN]	[ml]	[mm]	[kN]	[ml]
8	21,85	**200**	**11,56**	**14,78**	**200**	**16,52**	**14,78**
		240	13,87	17,74	240	19,82	17,74
		280	16,19	20,70	**265**	**21,85**	**19,56**
		320	18,50	23,65	-	-	-
		378	**21,85**	**27,95**	-	-	-
10	34,15	**200**	**14,45**	**17,74**	**200**	**20,64**	**17,74**
		270	19,51	23,95	235	24,26	20,85
		340	24,57	30,16	270	27,87	23,95
		410	29,63	36,37	305	31,48	27,05
		473	**34,15**	**41,92**	**331**	**34,15**	**29,34**
12	49,17	**200**	**17,34**	**20,70**	**200**	**24,77**	**20,70**
		290	25,15	30,01	250	30,97	25,87
		380	32,95	39,33	300	37,16	31,05
		470	40,75	48,64	350	43,35	36,22
		567	**49,17**	**58,69**	**397**	**49,17**	**41,08**
14	66,93	**210**	**21,24**	**24,84**	**210**	**30,35**	**24,84**
		320	32,37	37,85	270	39,02	31,93
		430	43,50	50,86	330	47,69	39,03
		540	54,63	63,87	390	56,36	46,13
		662	**66,93**	**78,25**	**463**	**66,93**	**54,78**
16	87,42	**240**	**27,75**	**31,93**	**240**	**39,64**	**31,93**
		370	42,78	49,23	310	51,20	41,25
		500	57,81	66,53	380	62,76	50,56
		630	72,83	83,83	450	74,32	59,88
		756	**87,42**	**100,61**	**529**	**87,42**	**70,43**
20	136,59	**300**	**43,35**	**62,37**	**300**	**61,93**	**62,37**
		460	66,48	95,63	390	80,51	81,08
		620	89,60	128,90	480	99,09	99,79
		780	112,72	162,16	570	117,68	118,50
		945	**136,59**	**196,50**	**662**	**136,59**	**137,55**
25	213,42	**375**	**67,74**	**95,29**	**375**	**96,77**	**95,29**
		580	104,77	147,38	670	172,90	170,25
		780	140,90	198,20	780	201,29	198,20
		980	177,03	249,02	800	206,45	203,28
		1181	**213,42**	**300,21**	**827**	**213,42**	**210,14**
28	267,72	**420**	**84,97**	**171,14**	**420**	**121,39**	**171,14**
		650	131,51	264,86	720	208,10	293,39
		880	178,04	358,59	810	234,11	330,06
		1110	224,57	452,31	900	260,12	366,73
		1323	**267,72**	**539,20**	**926**	**267,72**	**377,44**
32	349,67	**480**	**110,99**	**255,47**	**480**	**158,55**	**255,47**
		740	171,10	393,84	740	244,43	393,84
		1000	231,22	532,22	1000	330,32	532,22
		1260	291,34	670,60	1260	349,67	670,60
		1512	**349,67**	**804,87**	**1059**	**349,67**	**563,41**

1) Tabulated maximum tension loads are valid for good bond condition according to EN 1992-1-1.
For all other bond condition the values for tension load must be multiplied by 0,7
2) The mortar volume V can be estimated using the equation: $V = l_0 \pi (d_0^2 - d^2)/(4x0{,}85)$ with the nominal hole diameter

TERMINOLOGY AND SYMBOLS	
Ø	Nominal diameter of the reinforced bar
d_0	Drill hole diameter
lv	Setting depth
a	Minimum clear spacing between two post-installed rebar
C_{min}	Minimum concrete cover
$l_{b,min}$	Minimum anchorage length
$l_{0,min}$	Minimum overlap joint length
$l_{b,rqd}$	Required basic anchorage length
NPD	No declared performance