Technical Application Document

Reference Technical Assessment **3/11-684**

Only the original version in French language is valid

Injection system for fixing post-installed rebars

SPIT EPCON C8

Conforming to the European Technical Approval	**ETA-07/0189**

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Commission in Charge of Issuing Technical Assessments
(Decree of December 2, 1969)

Specialised Group no. 3

Moulded concrete and fixings

Structures, floors and other structural components

Presented for registration on

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Specialised Group no. 3 of the Commission in Charge of Issuing Technical Assessments, on March 15, 2011, examined the SPIT EPCON C8 injection system for fixing post-installed rebars, presented by SPIT Company. This document, to which is appended the Technical File prepared by the requester, sets forth the Assessment formulated by the Specialised Group. This Assessment assembles the complementary data useful for users of the system in terms of field of application, guidelines for design and implementation. As proposed, this system is capable of ensuring normal behaviour of the structures. This Assessment was formulated for applications in European France.

1. Brief definition

1.1 Brief description

This system is used for connection, by anchoring or by joint overlapping of posts-installed rebars (concrete reinforcing bars) in new structures of standard concrete with the SPIT EPCON C8 injection system in conformity with the regulations concerning concrete structures.

1.2 Marketing

For their marketing, the products covered in this Assessment are subject to the provisions of the Decree of December 24, 2004 applying to certain fixing plugs of Edict no. 92-647 of July 8, 1992 concerning the suitability for the use of building products, as modified by Edicts no. 95-1051 of September 20, 1995 and no. 2003-947 of October 3, 2003.

1.3 Identification of the components

The SPIT EPCON C8 injection system comes in cartridges of 400 ml, 450 ml or 900 ml. The product is marked in conformity with the provisions of European Technical Approval ETA-07/0189.

The products come with EC marking and are accompanied by the information specified by European Technical Approval ETA-07/0189.

2. ASSESSMENT

2.1 Accepted field of application

The field of application is limited to the construction of new works or of substantial renovations (new parts on new substrates) Class A, B or C in the sense of the PS92 Rules or Class I, II, III according to Eurocode 8, for all seismic zones.

2.2 Evaluation of the system

2.21 Conformity with the laws and rules in force and other qualities of suitability for the application

Use in seismic zone

The system can be used for building the main structural elements of buildings, given conformity with the guidelines in § 2.3 of this document and with the sizing method described in the Technical File.

Fire safety

By itself, the system cannot satisfy a criterion of fire resistance. The fire resistance requirement can however be obtained with the aid of a post-installed protection.

Heat insulation

The SPIT EPCON C8 injection system does not modify the thermal performances when compared to a traditional system with cast-in reinforcements.

Sound insulation

The SPIT EPCON C8 injection system does not modify the noise reduction coefficients when compared with a traditional system with cast-in reinforcements.

2.22 Durability - servicing

The durability of the SPIT EPCON C8 injection system is equivalent to the traditional systems used under comparable conditions.

2.23 Manufacture

The system is manufactured in the SPIT company factory. It requires permanent quality assurance operations, specific to the manufacture of fixing resins. The manufacturer makes sure that its EC conformity certificate is maintained thus making it possible to guarantee the application of its quality assurance system.

2.24 Installation

The system is installed by a trained installer under supervision on the site.

2.3 Special Technical Specification Book

2.31 Design guidelines outside any seismic zone

For a use outside any seismic zone, the SPIT EPCON C8 injection system for fixing post-installed rebars shall be designed in conformity with the instructions given in European Technical Approval ETA-07/0189 while verifying, in particular, the points mentioned in Paragraph 4.1 of the Technical File.

2.32 Design guidelines in seismic zone

When designing the structure, the engineering organisation shall take into account the specific nature of this system, providing notably for the rebars that will be transferring stresses into the structure.

The rebars for reinforced concrete shall have a specified elastic limit equal to or less than 500 MPa.

For the rebars having specified elastic limit less than 500 MPa, the calculation of the $l_{b,rqd,earthquake}$, defined in the Technical File shall be carried out using f_y=500MPa so as not to shorten the rebars' anchorage length.

The strength of the structure's concrete in seismic zone shall be C20/25 minimum and C45/55 maximum.

In the critical zones of the elements of primary structures of Class DCH structures, the post-installed rebars shall be Class C according to Table C1 of EN 1992-1-1.

The fixing in existing structures subject to a substantial renovation shall be done in the newly constructed parts exclusively.

The combination of embedded anchors and post-installed rebars is not authorised because of possible problems of compatibility of shifts.

Cast-in continuity rods shall be provided to assume the shear stresses since the system is only used to assume tensile or compressive stress.

If the normal stress in a column is tensile stress, the anchorage length shall be increased by 50% over the lengths specified in EN 1992-1-1 for the part located in the critical zone,

Whenever possible, one should avoid overlapping in critical zone. In the overlapping zones, the transversal rebars shall conform to the continuity rod rule resulting from the transmission of stresses between the longitudinal bars.

The design stress in the rebar $\sigma_{sd,\ earthquake}$ shall be calculated under seismic combinations, in particular, in conformity with § 4.4 - Safety Verification of EN 1998-1-1 (Eurocode 8).

2.33 Installation guidelines

The implementation of the SPIT EPCON C8 injection system for fixing post-installed rebars shall conform to the specifications set down in European Technical Approval ETA-07/0189.

The holder of this Assessment shall propose training in the use of the injection system, in particular, for contracting firms implementing the system (distribution of the Technical Assessment, compliance with the instructions attached to it...).

Conclusions

Overall assessment

The use of the system in the proposed application field is favourably assessed.

Validity

That of European Technical Approval ETA-07/0189, that is, until September 19, 2012.

For Specialised Group no. 3
The Chairman
JP. BRIN

3. Complementary remarks from the Specialised Group

The anchorage length decided upon is the length deducted from the sizing under static conditions on the one hand and under seismic conditions on the other hand. Furthermore, the design stress in rebar $\sigma_{sd,earthquake}$ can only be determined under seismic combination and cannot be deducted simply from the sizing under static conditions.

The hole is made using the hammer drill (driven by compressed air), and the hole is cleaned using compressed air with the accessories listed in ETA 07/0189.

The structure in which the fixing is done shall be sized for earthquake and the rebar layout shall be designed for and shall be capable of assuming the stresses generated by the post-installed rebars.

Concrete bonding shall be done while roughening the joints until the aggregates protrude.

The Rapporteur of Specialised Group no. 3
Nicolas RUAUX

Technical File

prepared by the requester

A. Description

1. Nature

The SPIT EPCON C8 system is used for the connection, by anchoring or by joint overlapping, of rebars in new structures built of concrete, strength C20/25 to C45/55 (in seismic zone). The design of these fixings by post-installed rebars was carried out in conformity with ETA-07/0189 and with EN 1992-1-1: October 2005 (Eurocode 2).

2. Materials and constituent elements

2.1 EPCON C8 resin

The SPIT EPCON C8 injection system is implemented with the aid of a two-component resin. These two components come unmixed in a two-component cartridge, volume 400 ml, 450 ml or 900 ml in conformity with Annex 1 of ETA 07/0189.

2.2 Rebars

The SPIT EPCON C8 injection system is used with straight rebars, diameter 8 to 40 mm, the properties of which correspond to Annex C of EN 1992-1-1 and to EN 10080. The detailed characteristics are given in Annex 4 of ETA 07/0189.

3. Production and quality assurance

3.1 Production process

The SPIT EPCON C8 resin is manufactured in the SPIT factory of Bourg les Valence on an automated production line. The factory is ISO 9001 certified by the British Standards Institution (BSI) and ISO 14001 by the Bureau Veritas Certification.

3.2 Marking

The SPIT EPCON C8 resin is identified by marking on its packing.

The marking indicates the name of the product, the batch number, the storage life, the number of the European Technical Approval and the EC marking number.

The installation instructions are supplied for each SPIT EPCON C8 resin cartridge.

3.3 Quality assurance operations

The manufacture of the SPIT EPCON C8 resin benefits from a system of internal production quality assurance in the factory. All the requirements and guidelines adopted by the manufacturer are, in every case, covered by documents in the form of written procedures and rules. The factory is inspected by an independent body once each year as part of the EC marking review inspection audit.

4. Sizing

4.1 Sizing outside seismic zones

For use outside seismic zones, the SPIT EPCON C8 injection system for fixing post-installed rebars is to be designed in conformity with the specifications set down in European Technical Approval ETA-07/0189, verifying, in particular:

- The positioning of the pre-existing reinforcement in the part of the structure receiving the anchoring shall be ascertained on the basis of working drawings of the construction and shall be taken into account during the design of the anchoring.
- The design of the anchoring and the determination of the internal stresses shall be carried out according to EN 1992-1-1 at the same time as the design of the structure.
- The verification of the local transfer of the loads to the concrete shall be supplied.
- The verification of the transfer of the loads to be anchored in the structure shall be supplied.

  The spacing between the post-installed rebars shall be no greater than $4d_s$ and 40 mm, according to European Technical Approval ETA-07/0189.

  d_s = diameter of the rebar

- The reference anchorage length $l_{b,rqd}$ necessary to transfer stress $A_s.f_{yd}$ into the rebar assuming a constant stress of f_{bd} over the length of the bar, is equal to:

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

  Where:

  d_s = diameter of the rebar

  σ_{sd} = design stress in the rebar under the design load

  f_{bd} = design value of the ultimate bond strength [according to Table 4 of Annex 10 of European Technical Approval ETA-07/0189 and noted again in Table 1 of this (TAD)].

- The design anchorage length l_{bd} shall be determined according to EN 1992-1-1, Section 8.4.3:

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

  Where:

  α_1 = 1.0 for the straight bars

  α_2 = from 0.7 to 1.0 calculated according to EN 1992-1-1. Table 8.2.

  α_3 = 1.0 when there are no transversal rebars

  α_4 = 1.0 when they are no transversal welded rebars

  α_5 = from 0.7 to 1.0 for the influence of confinement by transversal compression according to EN 1992-1-1. Table 8.2.

  $l_{b,min}$ = minimal anchorage length according to EN 1992-1-1

  = Max (0.3 $l_{b,rqd}$; 10 d_s; 100mm) Anchoring under tensile stress

  = Max (0.6 $l_{b,rqd}$; 10 d_s; 100mm) Anchoring under compressive stress

  The maximal authorised anchorage depth is given in European Technical Approval ETA-07/0189.

- The design overlap length l_0 shall be determined according to EN 1992-1-1, Section 8.7.3:

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

  Where:

  α_1 = 1.0 for the straight bars

  α_2 = from 0.7 to 1.0 calculated according to EN 1992-1-1. Table 8.2.

  α_3 = 1.0 when there are no transversal rebars

  α_5 = from 0.7 to 1.0 for the influence of confinement by transversal compression according to EN 1992-1-1.Table 8.2.

  α_6 = from 1.0 to 1.5 for the influence of the percentage of overlapped rebars compared with the total resistant section according to EN 1992-1-1 Table 8.3.

  The verified product $(\alpha_2.\alpha_3.\alpha_5) \geq 0.7$

  $l_{0,min}$ = minimal overlap length according to EN 1992-1-1

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

  The maximal authorised anchorage depth is given in European Technical Approval ETA-07/0189.

4.2 Sizing in seismic zone

For use in seismic zone, the SPIT EPCON C8 injection system for fixing post-installed rebars is to be calculated while verifying:

- The system is reserved for structures that are new or subject to a substantial renovation.
- The structure in which the fixing is to take place shall be sized for earthquake and the pre-existing reinforcement shall be known and capable of assuming the stresses generated by the post-installed rebars.
- So the study and design is to be carried out at the same time as the verification of the pre-existing reinforcement of the pre-existing structure.
- Continuity rods need to be provided to assume the shear stresses.
- The design of the anchorings of the post-installed rebars and the determination of the internal stresses shall be carried out according to EN 1992-1-1 (Eurocode 2) and EN 1998-1-1 (Eurocode 8) and, at the same time as the study and design of the structure.
- The stresses applied to the rebars, taking acceleration into account, are the responsibility of the engineering organisation. This may lead to installing more rebars or to inserting them more deeply.

- The verification of the local transfer of loads to the concrete shall be supplied.
- The verification of the transfer of the loads to be anchored in the structure shall be supplied.
- The spacing between the post-installed rebars shall be no greater than $4d_s$ and 40 mm, according to European Technical Approval ETA-07/0189.

  d_s = diameter of the rebar
- The reference anchorage length $l_{b,rqd}$ necessary to transfer stress $A_s.f_{yd}$ into the rebar assuming a constant stress of f_{bd} over the length of the bar is equal to:

  $l_{b,rqd,\ earthquake}=(d_s/4).(\sigma_{sd,earthquake}/f_{bd,earthquake})$

  Where:

  d_s = diameter of the rebar

  $\sigma_{sd,earthquake}$ = design stress in the rebar calculated in conformity with § 4.4 - Safety check of EN 1998-1-1 (Eurocode 8)

  $f_{bd,earthquake}$ = design value of the ultimate adhesive strength in seismic zone is given in Table 2 of this TAD
- The design anchorage length $l_{bd,earthquake}$ shall be determined according to the following formula:

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

  Where:

  α_1 = 1.0 for the straight bars

  α_2 = from 0.7 to 1.0 calculated according to EN 1992-1-1. Table 8.2.

  α_3 = 1.0 even in the presence of transversal rebars

  α_4 = 1.0 when there are no transversal welded rebars

  α_5 = from 0.7 to 1.0 for the influence of confinement by transversal compression according to EN 1992-1-1. Table 8.2.

  The verified product $(\alpha_2.\alpha_3.\alpha_5) \geq 0.7$

  $l_{b,min,earthquake}$ = minimal anchorage length

  $l_{b,min,earthquake}$ = Max (0.3 $l_{b,rqd,earthquake}$; 10 d_s; 100mm) Anchoring under tensile stress

  = Max (0.6 $l_{b,rqd,earthquake}$; 10 d_s; 100mm) Anchoring under compressed stress

  The maximal authorised anchorage depth is given in European Technical Approval ETA-07/0189.
- The design overlapping length l_{bd} shall be determined according to EN 1992-1-1, Section 8.4.3:

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

  Where:

  α_1 = 1.0 for the straight bars

  α_2 = from 0.7 to 1.0 calculated according to EN 1992-1-1. Table 8.2.

  α_3 = 1.0 even in the presence of transversal rebars

  α_5 = from 0.7 to 1.0 for the influence of confinement by transversal compression according to EN 1992-1-1.Table 8.2.

  α_6 = from 1.0 to 1.5 for the influence of the percentage of overlapped rebars compared with the total resistant section according to EN 1992-1-1 Table 8.3.

  $l_{0,min,earthquake}$ = minimal overlap length

  $l_{0,min,earthquake}$ = Max ($0.3.\alpha_6.l_{b,rqd,earthquake}$; 15 ϕ; 200mm)

  The maximal authorised anchorage depth is given in European Technical Approval ETA-07/0189.

  If the normal stress in a column is a tensile stress, the anchorage lengths shall be increased by 50% over the lengths specified in EN 1992-1-1 for the part located within the critical zone.

A table of pre-calculated values is given in Table 3 of this Technical Application Document (TAD).

5. Installation

5.1 Phasing the work on the site

The sizing decision in seismic zones is taken by the main contractor / contracting authority and they delegate this to the engineering organisation.

The engineering organisation calculates the stresses applied to the rebars (taking into account the applicable acceleration according to the zone) and determine the anchorage length of the rebars by applying the formulae given in this TAD. It may contact the SPIT Company for help in sizing.

The engineering organisation makes sure that the structures are capable of assuming the stresses and that the continuity rods are properly specified.

The technical inspection body validates the study and design before the rebars are installed.

5.2 Installation procedure

The SPIT EPCON C8 injection system for fixing post-installed rebars is to be carried out in conformity with the installation instructions issued by the manufacturer and with Annexes 5 to 9 of ETA 07/0189.

The drilling is to be done using a hammer drill (driven by compressed air) and the hole is to be cleaned with compressed air with the accessories listed in ETA 07/0189.

5.3 Implementing the system

The installation of the post-installed rebars is done by a trained installer under supervision on the site.

The SPIT technicians provide that training on the site or in the International SPIT Fixing Centre of BOURG les VALENCE (Drôme).

Each person trained receives an attestation of presence at the injection resin user course.

The training programme includes:

- Basic rules for using the resin (storage of cartridges, storage life, temperature and use safety …)
- Preparation for the embedment (boring, cleaning…)
- Resin injection (method of injection and use of accessories).

5.4 Points to be verified for correct installation

Table 4 of this TAD gives the list of items to be verified to make sure of a correct installation for the rebar fixing in seismic zones and outside seismic zones.

B. Experimental results

As part of the issuing of ETA 07/0189, the SPIT EPCON C8 system has been the subject of CSTB Test Reports no. EEM10 26024032, no. EEM 08 26014862 and no. ER 552 06 1016 (COFRAC[1] accredited laboratory under no. 1-0301). These tests were carried out in conformity with European Technical Guide ETAG001 + Technical Report TR023 relative to the fixing of post-installed rebars and to the American Guide AC308 (Acceptance Criteria for Post-Installed Adhesive Anchors in Concrete Element) for the part concerning the seismic tests.

C. References

The SPIT EPCON C8 system, described in this Technical File, has been installed in Europe as follows:

- France –Axe Littoral Project in Marseille – 200 Epcon C8 cartridges
- France – Project of reinforcement of highway bridge A7 in Valence – Vinci Group – 500 Epcon C8 cartridges
- France – High Speed Train station parking project in Aix en Provence – 100 Epcon C8 cartridges
- France – Museum of Confluences in Lyons – 1000 Epcon C8 cartridges
- France – Panorama of dômes in Clermont-Ferrand – 200 Epcon C8 cartridges France –Nice Hospital – 300 Epcon C8 cartridges
- Belgium –BELLIARD renovation project in Brussels– Epcon C8 cartridges

[1] COFRAC – Comité Français d'Accréditation *(French Accreditation Committee)*

Description of the product and specified application

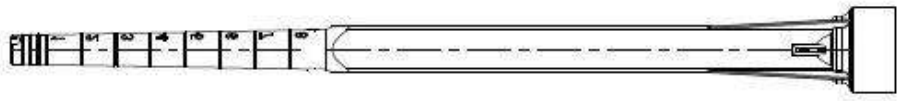
This installation of concrete rebars is a SPIT EPCON C8 injection system plus a straight rebar, the properties of which correspond to Classes B and C, in conformity with Annex C of Eurocode 2 (EC2).

SPIT EPCON C8 injection system:

Marking:
EPCON C8
Batch number
Storage life

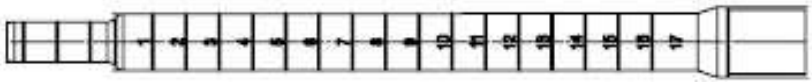
Cartridge:
400 ml, 450 ml and 900 ml

Mixing nozzle:



Standard 400-450-900

High flow rate



Nozzle reducer

Rebar in conformity with EC2:

The installation of rebars in a non-carbonated concrete on the basis of a sizing in conformity with EC2 is covered.
Installation is possible in dry or wet concrete. There should be no installation in a flooded hole
Temperature range: -40° C to +80° C
(Maximal long term temperature +50° C and maximal short term temperature +80° C)

Design bond strength

Table 1: Design values of the ultimate bond stress f_{bd} in N/mm² outside seismic zone

Hammer drill (driven by compressed air) according to EC 2 for good bonding conditions
(for other bonding conditions, multiply the values by 0.7)

Rebar Ø	Concrete class						
d_s	C20/25	C25/30	C30/37	C35/45	C40/50	C45/55	C50/60
8 mm	2.3	2.7	3.0	3.4	3.7	4.0	4.3
10 mm	2.3	2.7	3.0	3.4	3.7	4.0	4.3
12 mm	2.3	2.7	3.0	3.4	3.7	4.0	4.3
14 mm	2.3	2.7	3.0	3.4	3.7	4.0	4.3
16 mm	2.3	2.7	3.0	3.4	3.7	4.0	4.3
20 mm	2.3	2.7	3.0	3.4	3.7	4.0	4.3
25 mm	2.3	2.7	3.0	3.4	3.7	4.0	4.3
32 mm	2.3	2.7	3.0	3.4	3.7	4.0	4.3
36 mm	2.3	2.7	3.0	3.4	3.7	4.0	4.3
40 mm	2.3	2.7	3.0	3.4	3.7	4.0	4.3

Table 2: Design values of the ultimate bond stress $f_{bd,earthquake}$ in N/mm² in seismic zone

Hammer drill (driven by compressed air) according to EC 2 for good bonding conditions
(for other bonding conditions, multiply the values by 0.7)

Rebar Ø	Concrete class					
d_s	C20/25	C25/30	C30/37	C35/45	C40/50	C45/55
8 mm	2.3	2.7	3.0	3.0	3.0	3.0
10 mm	2.3	2.7	3.0	3.0	3.0	3.0
12 mm	2.3	2.7	3.0	3.0	3.0	3.0
14 mm	2.3	2.7	3.0	3.0	3.0	3.0
16 mm	2.3	2.7	3.0	3.0	3.0	3.0
20 mm	2.3	2.7	3.0	3.0	3.0	3.0
25 mm	2.3	2.7	3.0	3.0	3.0	3.0
32 mm	2.3	2.7	3.0	3.0	3.0	3.0
36 mm	2.3	2.7	3.0	3.4	3.4	3.4
40 mm	2.3	2.7	3.0	3.4	3.4	3.4

Pre-calculated values

Table 3: Pre-calculated values for an anchorage depth of a SPIT EPCON C8 post-installed rebar in seismic zone

Examples for C20/25, good bonding conditions, conventional elastic limit of the rebar 500 N/mm² in hammer drilling for all drilling methods

Diameter of the deformed steel rod	Drilling diameter	Load applied on the rod under accidental seismic condition	Anchorage length	Necessary volume	Load applied on the rod under accidental seismic condition	Anchorage length	Necessary volume
mm	mm	daN	mm	ml	daN	mm	ml
		Every α = 1			One of the α = 0.7		
8	10	754	130	10	1 077	130	10
		1 156	200	15	1 404	170	13
		1 619	280	21	1 734	210	16
		2 023	350	26	2 147	260	20
		2 513	435	33	2 513	304	23
10	12	1 178	163	15	1 683	163	15
		1 806	250	23	2 168	210	19
		2 529	350	32	2 787	270	24
		3 179	440	40	3 303	320	29
		3 927	543	49	3 927	380	34
12	15	1 696	196	21	2 424	196	21
		2 601	300	32	3 221	260	27
		3 642	420	44	3 964	320	34
		4 596	530	56	4 831	390	41
		5 655	652	69	5 655	457	48
14	18	2 309	228	28	3 299	228	28
		3 642	360	43	4 335	300	36
		4 957	490	59	5 492	380	46
		6 272	620	75	6 503	450	54
		7 697	761	92	7 697	533	64
16	20	3 016	261	35	4 308	261	35
		4 740	410	56	5 615	340	46
		6 474	560	76	7 102	430	58
		8 208	710	96	8 588	520	71
		10 053	870	118	10 053	609	83
20	25	4 712	326	69	6 732	326	69
		7 370	510	108	8 877	430	91
		10 116	700	148	11 148	540	115
		12 862	890	189	13 419	650	138
		15 708	1087	230	15 708	761	161
25	30	7 363	408	153	10 519	408	153
		11 561	640	241	13 935	540	203
		15 896	880	331	17 290	670	252
		20 232	1120	421	20 903	810	305
		24 544	1359	511	24 544	951	358
32	40	10 405	450	244	14 864	450	244
		16 417	710	385	19 819	600	326
		22 428	970	527	24 774	750	407
		28 440	1230	668	29 728	900	489
		34 683	1500	814	34 683	1050	570
40	50	13 006	450	604	18 580	450	604
		20 521	710	954	24 774	600	806
		28 036	970	1 303	30 967	750	1 007
		35 550	1230	1 652	37 161	900	1 209
		43 354	1500	2 015	43 354	1050	1 410

NOTE: The necessary resin volume can be estimated with the equation: $V = 1.2.(do^2-d^2).\pi.l_{bd}/4$.

Table 4: Points to be verified for a correct installation

A certain number of parameters cannot be inspected after the fact. It is recommended that they be inspected before the injection of the resin. If this is not possible, the following table gives recommendations concerning inspection after the fact.

Elements to be verified	**Type of verification**	**Prerequisite**
1. Recommended anchorage depth	Information available on the worksite	A sizing by an engineering organisation is mandatory and shall be remitted to the jobsite.
2. Correspondence between the diameter of the rod and the diameter of the drilled hole	Geometrical	According to table below

Nominal diameter of the deformed steel rod	**d_s (mm)**	8	10	12	14	16	20	25	32	40
Drilling diameter of the hammer drill	**(mm)**	10	12	15	18	20	25	30	40	50

3. Quantity of resin injected	The resin is to overflow the hole	
4. Verification of the availability of tools and accessories for installation and cleaning	Drill bits appropriate to the drilling diameter and to the anchorage depth Compressed air, blowing nozzle and metal wire brush of appropriate diameter Nozzle for injection	Diameter of the deformed steel rod, of the hole and anchorage depth Cleaning with compressed air mandatory

Diameter of the deformed steel rod	**Diameter of the drilled hole**	**Round metal wire brush**	**Blowing nozzle**	**Nozzle for injection** (for injection length >350mm)	
d_s (mm)	**(mm)**				
8	10				
10	12				
12	14				
14	18				
16	20				
20	25				
25	32				
32	40				
40	55				

5. Resin	Storage life (if any cartridges remain)	