the right fixing

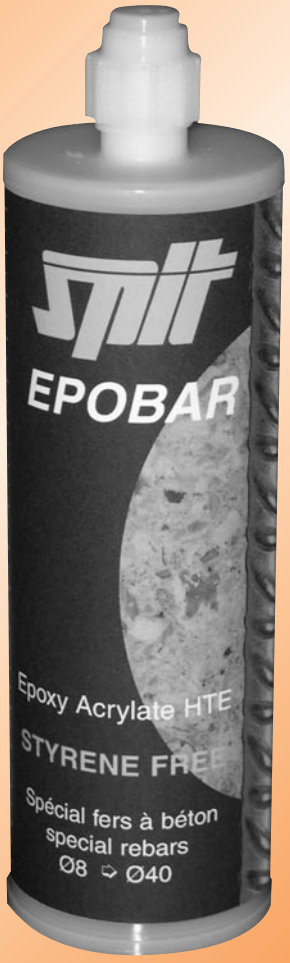
SPECIFICATION :

DE DEFINITION,

IDENTIFICATION

AND APPLICATION

SPIT EPOBAR



JUNE 2007 – VALIDITY MAY 2010

Accepted by **SOCOTEC**
under No. NX 0233

SOCOTEC

■ Concrete

The operating loads which can be applied to anchors generally depend on the mechanical properties of the base material. In the case of concrete, it is customary to refer to its compressive strength.

According to the NF EN 206-1 standard, the compressive strength of concrete is expressed in terms of a characteristic resistance defined as being the strength value below which a maximum of 5 % of the whole possible strength measurements of the specified concrete must be located.

The strength must be determined according to ISO 4012 on cubic specimens 15 x 15 x 15 cm (called $f_{ck,cube}$) or a cylindrical specimens 16 x 32 cm (called $f_{ck,cyl}$.) 28 days old, complying with ISO 1920 and manufactured and stored according to ISO 2736.

Concrete is classified according to its compressive strength which is based on the classification per strength measured on cylinders as indicated in the NF EN 206-1 standard. For information, the table below gives an equivalence between the characteristic values and average strength on cylindrical and cubic specimens in Mpa.

	Characteristic strength f_{ck}		Average strength		
Classes	Cylinder 16 x 32 cm	Cube 15 x 15 x 15 cm	Cylinder (f_{cm}) 16 x 32 cm	Cube 15 x 15 x 15 cm	Cube 20 x 20 x 20 cm
C 16/20	16	20	20	25	24
♦ C 20/25	20	25	25	31	29
C 25/30	25	30	30	37	36
♦ C 30/37	30	37	37	46	43
C 35/45	35	45	45	56	53
♦ C 40/50	40	50	50	62	59
C 45/55	45	55	55	69	65
♦ C 50/60	50	60	60	72	68

♦ *The most usual classes.*

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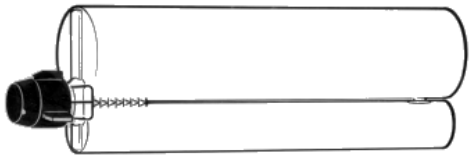
1 – THE EPOBAR RESIN

1.1 - Definition of the EPOBAR Resin

1.1.1 – SPIT EPOBAR cartridges : composition

① EPOBAR 410



② EPOBAR 910

The EPOBAR resin is composed of two components contained in a two-cylinder monoblock cartridge (these cylinders are concentric ① for EPOBAR 410 and juxtaposed ② for EPOBAR 910) :

. The large-diameter cylinder contains the VINYLESTER resin ;

. The small-diameter cylinder contains the hardener.

The table below summarizes the technical characteristic of the components:

	Density g/ml	Viscosity pas	Volume Cm^3		Net Weight g		Ignition Point
			EPOBAR 410	EPOBAR 910	EPOBAR 410	EPOBAR 910	
Vinylester resin	1.59	60	373	827	593	1315	53°C
Hardener	1.59	95	37	83	59	94	93°C
Mixture	-	-	410	910	652	1447	-

The EPOBAR resin's mechanical characteristics after polymerization :

	Polymerized EPOBAR resin
Compressive strength	80 Mpa
Young's modulus	5100 N/mm²
Shore hardness D	90

1.1.2 – Storage conditions

The cartridges must be stored at temperatures between +5°C and 35°C.

1.1.3 – Marking

The usage limit date is affixed to the cartridge in the following format : DD MM YY.

1.2 – Description of the Injection System

1.2.1 – Nozzles

The CM12L nozzle for the EPOBAR 410 cartridges :

The E910 nozzle for the EPOBAR 910 cartridges + 1 m extension :

Note : The CM12L and E910 nozzles are adapted to the EPOBAR resin in order to obtain a good mixture. The product does not accept other nozzles.

1.2.2 – Injection guns

injection tool 380-410 code 77151
for concentric cartridges vol. 410 ml

injection tool 910 code 063750
for coaxial cartridges vol. 910 ml

These guns consist of a frame and a mechanical system made of steel, a highly ergonomically designed 18 / 1 ratio handle for the 410 gun and 26 / 1 ratio handle for the 910 gun.

The guns benefit from a double guidance.

The blocking tab at the rear allows instantaneously eliminating the resin pressure.

1.2.3 – Cleaning brushes

- 10 / 16 / 25 / 30 mm dia. cleaning brush
- 320 mm extension
- 300 mm handle

2 – OPERATING PRINCIPLE

The EPOBAR resin used for the fixing of steel reinforcements in concrete is an injectable resin inserted in the drill hole (~50 % volume) using an injection tool and its nozzle. Thus, by passing through the nozzle, the 2 constituents of the cartridge (vinylester resin + hardener) are mixed to cause a chemical reaction which is going to allow the EPOBAR resin to progressively harden.

Once the resin is injected, the steel rebar is inserted in the drill hole down to the effective anchoring depth. The resin is thus going to be spread around the steel reinforcement and the fixture is then going to adhere to the concrete walls. (see table §7.2 for the installation and complete curing time).

3 – THE APPLICATION FIELD

This Specification applies to the use of the EPOBAR resin in both reinforced or non-reinforced concrete in a floor, wall or ceiling position.

This Specification is intended for the use of the EPOBAR resin in the fixing of steel reinforcements in concrete whose characteristic strength on a 28-day old sample is a minimum 20 Mpa**. The concrete can be dry or wet.**

The EPOBAR resin can be used in cracked or hollow concrete and in other solid building materials, but the values in this Specification cannot be used. Please consult us to define the specific tests to be performed accordingly.

4 – EPOBAR RESIN PERFORMANCES : TENSILE TESTS ON REBARS

4.1 – Tensile Tests on Rebars

Pull out tests in a dry and wet environment according to the NFP 18-831 standard allowed validating the use of the EPOBAR resin for the fixing of reinforcements.

On the other hand, creep tests on wet concrete were carried out according to the test methodology of the NFP18-836 standard, and satisfied the criteria of the NFP18-822 standard. (see § 5.3.1).

4.2 – Minimum Anchoring Depths Guaranteeing the failure of Steel rebar

The minimum anchoring depths were experimentally determined in order to obtain a minimum failure load according to the NFA 35016 standard. The minimum drill hole diameters were determined in order to obtain a free introduction of the steel rebars into the drilled hole.

The table below gives the results obtained for the failure of the steel rebar Fe E500 (mm) (confined tests).

Steel rebar ∅	8	10	12	14	16	20	25	32	40
Drill hole ∅	10 - 12	12 - 15	15 - 18	18 - 20	20 - 24	25 - 28	30 - 32	40	50
Anchoring depth (mm) for $f_{ck} \geq 20$ Mpa	60	80	100	110	130	160	190	250	250
Failure load (daN) for $f_{ck} \geq 20$ Mpa	3030	4850	6985	9000	12700	18500	19070	50000	65957
Conventional elasticity limit (daN)	2515	3925	5650	7700	10050	15700	24550	40200	62850

The anchoring depths specified above allow judging the resin's performances, but cannot be used for the design of the anchoring. The dimensioning rules defined in §6 have to be applied.

4.3 – Bonding strength

The **characteristic bonding strength** was determined from all the tests performed at a reduced depth, allowing to obtain a bond failure (~6 x Østeel-bar) in a concrete of the C20/25 class.

Its value is **17.85 N/mm²** for steel bar diameters varying from 8 to 40 mm.

4.4 – Behaviour in a wet concrete

The test results presented below highlight the fact that the EPOBAR resin is hardly sensitive to wet drilling conditions

Test conditions	Steel rebar Ø mm	Drill hole Ø mm	Anchoring depth mm	Failure load (daN) for $f_{ck} \geq 20$ Mpa	Conventional elasticity limit daN
Wet	12	15	120	7370	5650

The results obtained demonstrate that we obtain the failure rebar for the steel bar having a anchoring length equal to 10 x $Ø_{steel\text{-}bar}$ in a wet environment. These drilling conditions in a wet environment therefore remain acceptable in order to apply the dimensioning rules of the BAEL.

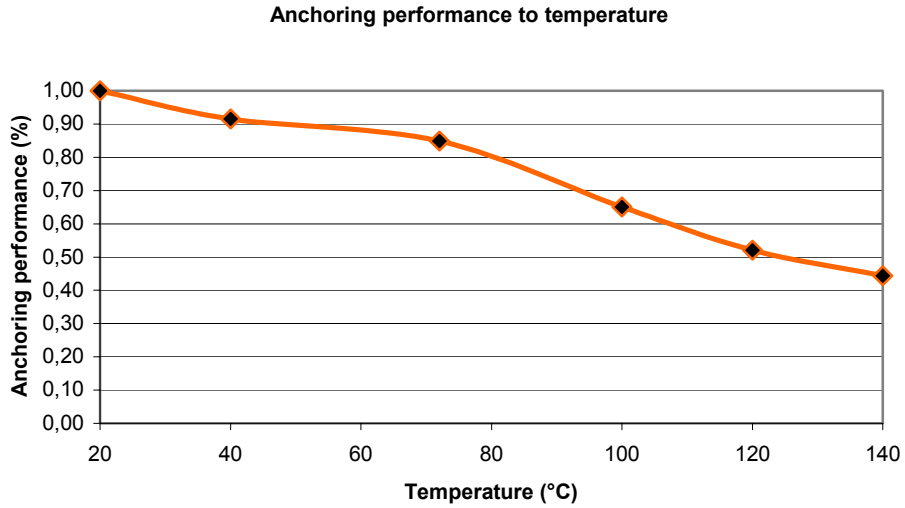
The EPOBAR resin is waterproof and adapted for a usage in a wet environment.

Note : In compliance with the procedure defined in the Guideline for European Technical Approval (ETAG), Part 5, untitled "Bonded anchors", the concrete was saturated with water by flooding the drill hole for 8 hours such that the water infiltrated the concrete. For the wet test, the water is swept out of the hole.

5 – CONDITIONS FOR USING SPIT EPOBAR RESIN

5.1 - EPOBAR Resin's Resistance to Temperature

Temperature tests were carried out from 20°C up to 140°C according to the requirements of the ETAG Guide, Part 5 untitled "Bonded anchors" (March 2001 Edition). For the various tested temperatures, pull out tests were conducted after the anchoring had been exposed in an oven at a constant temperature for 24 hours. The influence of the temperature is represented by the following graph :



5.2 – Behaviour in water

Tests in a wet environment such as defined in the ETA Guide, Part 5 untitled "Bonded anchors" (March 2001 Edition) were carried out (see §4.4). The results obtained revealed an excellent behaviour by the resin on wet supports. The dimensioning rules according to the BAEL in §6 are applicable.

5.3 – Behaviour under a Long-Term Load

5.3.1 – Reference tests according to the NFP 18 836 standard

Creep tests in an humid base material were conducted in compliance with the NFP 18836 standard. The SPIT EPOBAR resin exhibited an excellent behaviour since small displacements with stability over time were observed and a residual load having attained the failure of the steel rebar. The results obtained were compliant with the criteria of the NFP 18822 standard (NF marking requirements).

5.3.2 – Resistance to long-term loading at + 50°C

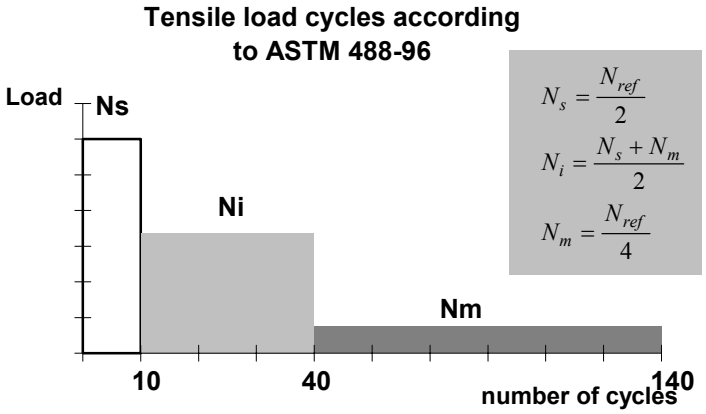
Creep tests were carried out in an oven at a temperature of 50°C for 2 months. The SPIT EPOBAR resin exhibited an excellent behaviour since small displacements between 0.7 and 0.95 mm with stabilization over time were observed and a residual load greater than the reference value was obtained. The test results obtained allow guaranteeing the dimensioning rules specified in §6.

5.4 – Behaviour to pulsating loads

Tests with pulsating loads were carried out for the EPOBAR sealing of M10 sizes. The sealing was subjected to 10^5 load cycles ; these load variations did not have any effect on the ″pin″.

5.5 – Seismic behaviour

The EPOBAR resin's behaviour to earthquakes was checked based on the test standard ASTM 488-96. The test procedure consists of applying 140 load cycles at a frequency of 2 Hz in order to simulate seismic stress forces. The following tensile cycles were applied to the anchoring in an uncracked C20/25 concrete :



Tests were carried out on a 12 mm dia. steel bar.

The standard's requirements were achieved :

- No anchoring failure during the load cycles ;
- Stabilized displacements ;
- Failure load equal to the reference value after application of the cycles

5.6 – Electric Conductibility

Electric conductibility tests were carried out in the LCIE laboratory in compliance with the IEC standards 60243-1 and 60093 :

- Volume resistivity at 23°C – 50% RH : ***2.8 x 10^{14} Ωm***
- Relative permittivity at 23°C – 50% RH – 50 Hz / 1000 Hz / 10^6 Hz ***: 4***
- Dielectric strength at 23°C – 50% RH – 50 Hz : ***10.1 kN/mm*** determined from a 3 mm thick sample.

5.7 - Resistance of SPIT EPOBAR resin to Chemical Agents

Chemical resistance was determined by exposing the resin samples to an attack by various substances. The samples resistance was determined by a visual inspection and classified into 3 states (resistant, sensitive, non resistant).

The various tested substances and the resistance of the SPIT EPOBAR mortar are given in **Appendix 1**.

5.8 - Resistance of the SPIT EPOBAR resin in specific atmospheres

Mortar endurance tests in different environments were carried out according to the ATE Guide, Part 5 untitled "Bonding anchors" (March 2001 Edition) in order to check the influence of these environments on the adherence force's resistance. The following environments were tested :

. Immersed in a high alkalinity solution (pH = 13.2) for 2000 hours ;

. Sulfurous atmosphere for 80 cycles alternating 8 hours in a sulfur dioxide atmosphere and 16 hours in a laboratory environment. The sulfur dioxide atmosphere corresponds to the introduction of 0.67% in SO_2 in an atmosphere at 40°C – 100 % RH ; therefore, sulphuric acid is created when in contact with the resin.

The results obtained for these endurance tests allowed guaranteeing the mortar's adherence resistance was not adversely affected by each of the atmospheres.

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6 – DESIGN OF WORKS

6.1 – Mechanical Characteristics of rebars

The mechanical characteristics of the high adhesion rebars are defined in the NFA 35-016 and NFA 35-017 standards .

Nominal steel bar ∅		**8**	**10**	**12**	**14**	**16**	**20**	**25**	**32**	**40**
Sections (cm²)		0.503	0.785	1.13	1.54	2.01	3.14	4.91	8.04	12.57
Min. resistances to failure (daN)	Fe E400	2113	3297	4746	6468	8442	13188	20622	33768	52794
	Fe E500	2590	4043	5820	7931	10352	16171	25287	41406	64736
Ultimate limit load (daN)	**Fe E500**	**2185**	**3415**	**4917**	**6693**	**8742**	**13659**	**21343**	**34956**	**54636**

6.2 – Anchoring Depth calculation

Considering the hypothesis proved during the tests that the ultimate bonding strength of resin with versus concrete is at least equal to the one of high adhesion rebar in concrete, we can apply the formulas given in the BAEL to determine the anchoring depth **ls** (mm), which can be given by the equality :

$$A_s \cdot f_{yk} = \Pi \cdot d_0 \cdot ls \cdot \tau_{su}$$ Equation ❶ according to the BAEL (page 44)

A_s : Nominal cross section of rebar in mm²

f_{yk} : Elastic limit of rebar in N/mm²

d_0 : Drill hole diameter for the $\varnothing_{steel\text{-}bar}$ considered (mm)

τ_{su} : Adhesive strength [$=0{,}6 \cdot \Psi_s^2 \cdot f_{tj}(N/mm^2)$]

Ψ_s : Fixing coefficient taken equal to 1 for plain rounds and 1.5 for high adhesion rebars.

f_{tj} : Characteristic tensile strength of concrete in N/mm².

Concrete class	$f_{ck,cyl}$ (Mpa)	f_{tj} (N/mm²)
C20/25	20	1.8
C25/30	25	2.1
C30/37	30	2.4
C35/45	35	2.7
C40/50	40	3.0
C45/55	45	3.3

The ultimate limit load for rebar is $\frac{A_s \cdot f_{yk}}{\gamma_s}$ where γ_s : safety factor = 1.15.

Equation ❶ becomes :

Ultimate limit load (N) = $$\Pi \cdot d_0 \cdot Ls \cdot 0{,}6 \cdot \Psi_s^{\,2} \cdot f_{tj} \cdot \frac{1}{\gamma_s} = \frac{\Pi \cdot 0{,}6 \cdot 1{,}5^2 \cdot f_{tj}}{1{,}15} \cdot d_0 \cdot Ls$$

Ultimate limit load (N) = $3{,}69 \cdot f_{tj} . d_0 \cdot Ls$

Limit of this formula :

- The maximum anchoring depth will be limited to 900 mm.
- An installation reduced to 10 x $\varnothing_{steel\text{-}bar}$ is possible for a reduced ultimate load of the rebar in compliance with the BAEL.

6.3 – Dimensioning tables of anchoring for Concrete According to the BAEL Rules

These tables indicate the values obtained from the application of the formula determined in §6.2 taking into account the limit of use.

They give the anchoring depth and the number of HA Fe E500 rebar anchoring with a EPOBAR 410 cartridge for the maximum possible ultimate limit load of the rebar or an ultimate limit load below the maximum ultimate load.

The ultimate loads in the tables below represent the calculation resistances to the Ultimate Limit State for the combinations of basic actions (non accidental).

6.3.1 - SPIT EPOBAR Resin - C20/25 Class Concrete (f_{ck} = 20 Mpa)

Steel bar Ø (mm)	Drill hole Ø d_0 (mm)	Anchorage length Ls (mm)	Ultimate limit load (daN)	No. of sealings for a 410 ml cartridge *
8	10	80	531	*145*
		160	1063	*73*
		250	1661	*46*
		330	**2185**	*35*
	12	80	638	*65*
		145	1156	*36*
		210	1674	*25*
		275	**2185**	*19*
10	12	100	797	*95*
		210	1674	*45*
		320	2551	*30*
		430	**3415**	*22*
	14	100	930	*44*
		190	1767	*23*
		280	2604	*16*
		365	**3415**	*12*
12	15	120	1196	*43*
		245	2441	*21*
		365	3636	*14*
		495	**4917**	*10*
	18	120	1435	*19*
		215	2570	*11*
		310	3706	*7*
		410	**4917**	*6*
14	18	140	1674	*23*
		280	3348	*12*
		420	5021	*7.8*
		560	**6693**	*5.8*
	20	140	1860	*15*
		260	3454	*7.9*
		380	5048	*5.4*
		505	**6693**	*4.1*
16	20	160	2125	*18*
		285	3786	*10.2*
		530	7041	*5.5*
		660	**8742**	*4.4*
	24	160	2551	*8.2*
		290	4623	*4.5*
		420	6695	*3.1*
		548	**8742**	*2.4*
20	25	200	3321	*9.3*
		405	6725	*4.6*
		610	10129	*3.0*
		822	**13659**	*2.3*
	28	200	3720	*5.4*
		380	7067	*2.9*
		560	10415	*1.9*
		734	**13659**	*1.5*
25	30	250	4982	*6.1*
		465	9266	*3.3*
		680	13550	*2.2*
		900	**17933**	*1.7*
	32	250	5314	*4.2*
		465	9883	*2.3*
		680	14453	*1.5*
		900	**19129**	***1.2***
32	40	320	8502	*2.3*
		510	13550	*1.4*
		700	18598	*1.0*
		900	**23911**	***0.8***
40	50	400	12487	*1.7*
		565	17638	*1.2*
		730	22789	*0.9*
		900	**28096**	***0.8***

* : with 20% loss

6.3.2 - SPIT EPOBAR Resin - C25/30 Class Concrete (f_{ck} = 25 Mpa)

Steel bar Ø (mm)	Drill hole Ø d_0 (mm)	Anchorage length Ls (mm)	Ultimate limit load (daN)	No. of sealings for a 410 ml cartridge *
8	10	80	620	*145*
		150	1162	*77*
		215	1666	*54*
		282	**2185**	*41*
	12	80	744	*65*
		130	1209	*40*
		180	1674	*29*
		235	**2185**	*22*
10	12	100	930	*95*
		190	1767	*50*
		280	2604	*34*
		367	**3415**	*26*
	14	100	1085	*44*
		170	1844	*26*
		245	2658	*18*
		315	**3415**	*14*
12	15	**120**	1395	*43*
		220	2557	*23*
		320	3720	*16*
		423	**4917**	*12*
	18	120	1674	*19*
		200	2790	*12*
		275	3836	*8*
		352	**4917**	*7*
14	18	140	1953	*23*
		250	3487	*13*
		365	5091	*8.9*
		480	**6693**	*6.8*
	20	140	2170	*15*
		240	3720	*8.5*
		330	5114	*6.2*
		432	**6693**	*4.7*
16	20	160	2480	*18*
		300	4649	*9.7*
		430	6664	*6.7*
		564	**8742**	*5.1*
	24	160	2976	*8.2*
		260	4835	*5.0*
		360	6695	*3.6*
		470	**8742**	*2.8*
20	25	200	3875	*9.3*
		370	7168	*5.0*
		535	10364	*3.5*
		705	**13659**	*2.6*
	28	200	4339	*5.4*
		340	7377	*3.2*
		485	10523	*2.2*
		630	**13659**	*1.7*
25	30	250	5812	*6.1*
		465	10810	*3.3*
		680	15808	*2.2*
		900	**20922**	*1.7*
	32	250	6199	*4.2*
		450	11159	*2.3*
		650	16118	*1.6*
		861	**21343**	*1.2*
32	40	320	9919	*2.3*
		510	15808	*1.4*
		700	21697	*1.0*
		900	**27896**	***0.8***
40	50	400	14568	*1.7*
		565	20577	*1.2*
		730	26587	*0.9*
		900	**32778**	***0.8***

* : with 20% loss

6.3.3 - SPIT EPOBAR Resin - C30/37 Class Concrete (f_{ck} = 30 Mpa)

Steel bar Ø (mm)	Drill hole Ø d_0 (mm)	Anchorage length Ls (mm)	Ultimate limit load (daN)	No. of sealings for a 410 ml cartridge *
8	10	80	708	*145*
		135	1196	*86*
		190	1683	*61*
		247	**2185**	*47*
	12	80	850	*65*
		120	1275	*44*
		160	1700	*33*
		205	**2185**	*25*
10	12	100	1063	*95*
		170	1807	*56*
		250	2657	*38*
		321	**3415**	*30*
	14	100	1240	*44*
		160	1984	*27*
		215	2666	*20*
		275	**3415**	*16*
12	15	**120**	1594	*43*
		200	2657	*26*
		285	3786	*18*
		370	**4917**	*14*
	18	120	1913	*19*
		180	2869	*13*
		245	3905	*9*
		308	**4917**	*8*
14	18	140	2232	*23*
		230	3666	*14*
		325	5181	*10.0*
		420	**6693**	*7.8*
	20	140	2480	*15*
		220	3897	*9.3*
		300	5314	*6.8*
		377	**6693**	*5.4*
16	20	160	2834	*18*
		270	4782	*10.7*
		380	6731	*7.6*
		493	**8742**	*5.9*
	24	160	3401	*8.2*
		245	5207	*5.3*
		330	7014	*4.0*
		411	**8742**	*3.2*
20	25	200	4428	*9.3*
		340	7528	*5.5*
		480	10627	*3.9*
		617	**13659**	*3.0*
	28	200	4959	*5.4*
		315	7811	*3.5*
		430	10663	*2.5*
		550	**13659**	*2.0*
25	30	250	6642	*6.1*
		430	11424	*3.5*
		620	16472	*2.4*
		803	**21343**	*1.9*
	32	250	7085	*4.2*
		420	11902	*2.5*
		585	16578	*1.8*
		753	**21343**	*1.4*
32	40	320	11336	*2.3*
		510	18066	*1.4*
		700	24797	*1.0*
		900	**31882**	*0.8*
40	50	400	16649	*1.7*
		565	23517	*1.2*
		730	30385	*0.9*
		900	**37461**	*0.8*

* : with 20% loss

6.3.4 - SPIT EPOBAR Resin - C35/45 Class Concrete (f_{ck} = 35 Mpa)

Steel bar Ø (mm)	Drill hole Ø d_0 (mm)	Anchorage length Ls (mm)	Ultimate limit load (daN)	No. of sealings for a 410 ml cartridge *
8	10	80	797	*145*
		125	1245	*93*
		170	1694	*68*
		219	**2185**	*53*
	12	80	956	*65*
		115	1375	*45*
		150	1793	*35*
		183	**2185**	*29*
10	12	100	1196	*95*
		160	1913	*59*
		220	2630	*43*
		285	**3415**	*33*
	14	100	1395	*44*
		150	2092	*29*
		195	2720	*22*
		245	**3415**	*18*
12	15	120	1793	*43*
		190	2839	*27*
		260	3886	*20*
		329	**4917**	*16*
	18	120	2152	*19*
		170	3049	*14*
		225	4035	*10*
		275	**4917**	*8*
14	18	140	2511	*23*
		215	3856	*15*
		300	5380	*10.9*
		373	**6693**	*8.7*
	20	140	2790	*15*
		205	4085	*10.0*
		270	5380	*7.6*
		336	**6693**	*6.1*
16	20	160	3188	*18*
		250	4982	*11.6*
		345	6874	*8.4*
		439	**8742**	*6.6*
	24	160	3826	*8.2*
		230	5500	*5.7*
		300	7173	*4.4*
		366	**8742**	*3.6*
20	25	200	4982	*9.3*
		315	7846	*5.9*
		430	10710	*4.3*
		548	**13659**	*3.4*
	28	200	5579	*5.4*
		295	8229	*3.7*
		400	11159	*2.7*
		490	**13659**	*2.2*
25	30	250	7472	*6.1*
		405	12105	*3.7*
		560	16738	*2.7*
		714	**21343**	*2.1*
	32	250	7970	*4.2*
		390	12434	*2.7*
		530	16897	*2.0*
		669	**21343**	*1.6*
32	40	320	12753	*2.3*
		505	20125	*1.4*
		690	27498	*1.1*
		877	**34968**	***0.8***
40	50	400	18730	*1.7*
		565	26457	*1.2*
		730	34183	*0.9*
		900	**42143**	***0.8***

* : with 20% loss

6.3.5 - SPIT EPOBAR Resin - C40/50 Class Concrete (f_{ck} = 40 Mpa)

Steel bar Ø (mm)	Drill hole Ø d_0 (mm)	Anchorage length Ls (mm)	Ultimate limit load (daN)	No. of sealings for a 410 ml cartridge *
8	10	80	886	*145*
		120	1328	*97*
		160	1771	*73*
		197	**2185**	*59*
	12	80	1063	*65*
		110	1461	*47*
		135	1793	*39*
		164	**2185**	*32*
10	12	100	1328	*95*
		150	1993	*63*
		205	2723	*46*
		257	**3415**	*37*
	14	100	1550	*44*
		140	2170	*31*
		180	2790	*24*
		220	**3415**	*20*
12	15	120	1993	*43*
		180	2989	*29*
		240	3985	*21*
		296	**4917**	*17*
	18	120	2391	*19*
		160	3188	*15*
		200	3985	*12*
		246	**4917**	*9*
14	18	140	2790	*23*
		205	4085	*16*
		270	5380	*12.1*
		336	**6693**	*9.7*
	20	140	3100	*15*
		195	4317	*10.5*
		250	5535	*8.2*
		302	**6693**	*6.8*
16	20	160	3542	*18*
		240	5314	*12.1*
		315	6974	*9.2*
		395	**8742**	*7.3*
	24	160	4251	*8.2*
		215	5712	*6.1*
		270	7173	*4.8*
		329	**8742**	*4.0*
20	25	200	5535	*9.3*
		300	8303	*6.2*
		395	10932	*4.7*
		493	**13659**	*3.8*
	28	200	6199	*5.4*
		280	8679	*3.9*
		360	11159	*3.0*
		440	**13659**	*2.5*
25	30	250	8303	*6.1*
		380	12620	*4.0*
		510	16937	*3.0*
		642	**21343**	*2.4*
	32	250	8856	*4.2*
		365	12930	*2.9*
		485	17181	*2.2*
		602	**21343**	*1.7*
32	40	320	14170	*2.3*
		475	21033	*1.5*
		630	27896	*1.2*
		790	**34968**	*0.9*
40	50	400	20812	*1.7*
		565	29396	*1.2*
		730	37981	*0.9*
		900	**46826**	*0.8*

* : with 20% loss

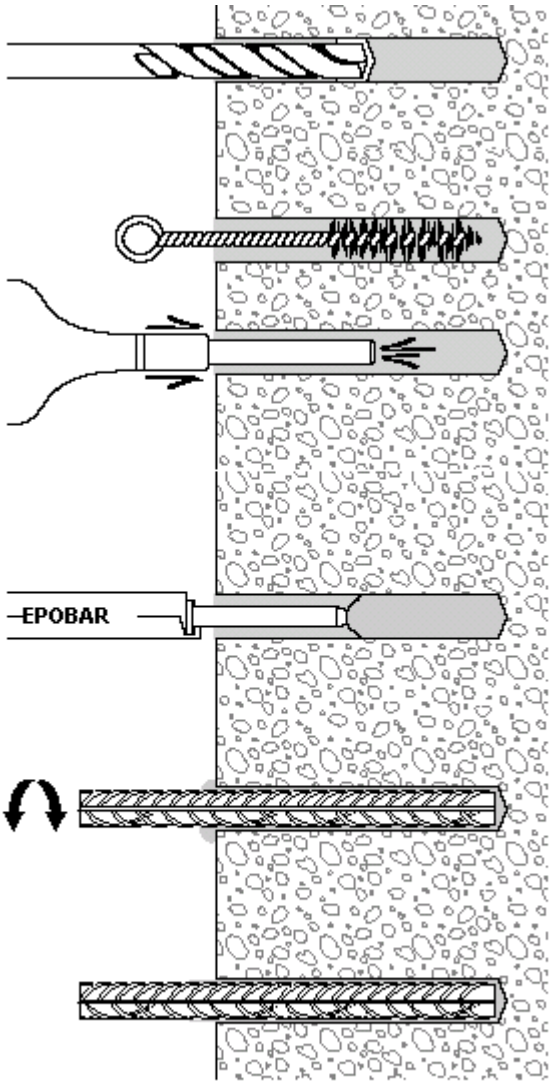
6.3.6 - SPIT EPOBAR Resin - C45/55 Class Concrete (f_{ck} = 45 Mpa)

Steel bar Ø (mm)	Drill hole Ø d_0 (mm)	Anchorage length Ls (mm)	Ultimate limit load (daN)	No. of sealings for a 410 ml cartridge *
8	10	80	974	*145*
		110	1339	*105*
		145	1766	*80*
		179	**2185**	*65*
	12	80	1169	*65*
		100	1461	*52*
		125	1827	*42*
		149	**2185**	*35*
10	12	100	1461	*95*
		145	2119	*65*
		190	2776	*50*
		234	**3415**	*41*
	14	100	1705	*44*
		130	2216	*33*
		165	2813	*26*
		200	**3415**	*22*
12	15	**120**	2192	*43*
		170	3105	*30*
		220	4018	*23*
		269	**4917**	*19*
	18	120	2630	*19*
		150	3288	*15*
		190	4165	*12*
		224	**4917**	*10*
14	18	140	3069	*23*
		195	4274	*17*
		250	5480	*13.1*
		305	**6693**	*10.7*
	20	140	3410	*15*
		185	4505	*11.1*
		230	5601	*8.9*
		275	**6693**	*7.4*
16	20	160	3897	*18*
		225	5480	*12.9*
		290	7063	*10.0*
		359	**8742**	*8.1*
	24	160	4676	*8.2*
		205	5991	*6.4*
		250	7306	*5.2*
		299	**8742**	*4.4*
20	25	200	6089	*9.3*
		280	8524	*6.6*
		365	11112	*5.1*
		448	**13659**	*4.1*
	28	200	6819	*5.4*
		265	9035	*4.1*
		330	11252	*3.3*
		400	**13659**	*2.7*
25	30	250	9133	*6.1*
		360	13151	*4.2*
		470	17170	*3.2*
		584	**21343**	*2.6*
	32	250	9742	*4.2*
		350	13638	*3.0*
		450	17535	*2.3*
		548	**21343**	*1.9*
32	40	320	15587	*2.3*
		450	21919	*1.6*
		585	28494	*1.2*
		720	**34968**	*1.0*
40	50	400	22893	*1.7*
		565	32336	*1.2*
		730	41779	*0.9*
		900	**51509**	*0.8*

* : with 20% loss

7 – CONDITIONS OF USE

7.1 – Installation



Drill a hole according to the diameter selected in the dimensioning tables of anchoring.
Remark : A hole can also be drilled with a diamond bit.

Clean the drilled hole with a metal cleaning brush.

Blow the dust out of the drilled hole.
The drilled hole may also be cleaned with pressurized water.

Inject from the bottom of the hole, progressively moving back until 50 % or more.

For an installation in a ceiling, we recommend using a washer at the nozzle end or an extension to guarantee a good filling in the drilled hole bottom.

Insert the rebar by hand in a twisting motion until the end of the hole is reached. The rod must be clean and free from oil and grease.

Check that the hole is well filled (no air bubbles present). An excess amount of the mixture must appear at the end of the anchoring.

Wait until resin to harden before applying the load (see table §7.2)

7.2 – Curing time before loading

The curing rate is dependent on the ambient temperature :

Ambient temperature (°C)	Maximum installing time (min)	Wait time before loading (min)
40	2	50 min.
30	4.5	65 min.
20	6.5	110 min.
10	10	3 h 10 min.
5	17	4 h 10 min
0	26	5 h 15 min.
- 5	35	6 h 20 min.

8 – PRODUCTION AND QUALITY ASSURANCE

The EPOBAR resin is manufactured according to a control plan targeted at ensuring a regularity in quality.

This control plan concerns the materials used, the cartridge filling and the products terminated. In addition, tests are systematically carried out in our laboratories.

It is registered, as well as the production drawings, at SOCOTEC, which can check at any moment that the plan is being applied. Each cartridge has an identification marking to allow a traceability back to the production batch.

Furthermore, we are responsible for informing SOCOTEC of any change involving the EPOBAR resin system.

An external control is conferred to SOCOTEC.

9 - VALIDITY

This approval granted by SOCOTEC is valid from the date of issue of this document until May 31, 2010.

APPENDIX 1 :

Chemical Substances	Concentration %	Resistance
Ethyl acetate	100	(-)
Acetone	10	(+)
Acetone	100	(-)
Acetic acid	50-75	(o)
Acetic acid	0-50	(+)
Hydrochloric acid	37	(-)
Hydrochloric acid	25	(o)
Hydrochloric acid	15	(+)
Hydrochloric acid and organic compounds		(-)
Citric acid	0-100	(+)
Formic acid	50	(-)
Formic acid	10	(+)
Lactic acid	0-100	(+)
Nitric acid	2-15	(o)
Nitric acid	50	(-)
Phosphoric acid	80	(+)
Concentrated phosphoric acid	100	(+)
Phosphoric acid, vapor and condensed		(+)
Sulfuric acid	71-75	(o)
Sulfuric acid	0-70	(+)
Sulfuric acid	Fumes	(+)
Sulfuric acid	76-93	(-)
Sulfuric acid / Phosphoric acid	10:20	(+)
Benzyl alcohol	0-100	(-)
Ethyl alcohol (Ethanol)	50	(-)
Ethyl alcohol (Ethanol)	10	(o)
Ammoniac, dry gas	0-100	(-)
Ammoniac, liquified	0-100	(-)

Chemical Substances	Concentration %	Resistance
Aniline	0-100	(-)
Benzene	100	(-)
Sodium carbonate	10	(+)
Diesel fuel	0-100	(+)
Sodium chloride	0-100	(+)
Bromine water	5	(+)
Chlorine water	0-100	(+)
Sea water	0-100	(+)
Deionized water	0-100	(+)
Demineralized water		(+)
Leaded or no-lead gasoline	100	(-)
Turpentine (oil)		(o)
Ethanolamine	100	(-)
Ethylene glycol	0-100	(+)
Fuel	100	(+)
Heptane	100	(+)
Hexane	100	(o)
Heavy motor oil	100	(+)
Ammonium hydroxide or Ammoniac	25	(-)
Ammonium hydroxide or Ammoniac	20	(o)
Ammonium hydroxide or Ammoniac	5	(+)
Sodium hydroxide (or Caustic soda)	25	(o)
Methyl isobutyl ketone	100	(-)
Ozone ()	Concent. < 4 ppm in water	(-)
Phenol	5	(-)
Carbon tetrachloride	100	(-)
Trichloroethylene		(-)
Xylene	0-100	(-)

▪ ***Resistant*** (+) : The samples in contact with the substance do not exhibit any visible damages such as cracks, attacked surfaces, exploded corners or major swellings.

▪ ***Non resistant*** (-) : Usage not recommended. The samples in contact with the substance were damaged.

▪ ***Sensible*** (o) : Usage with precautions with respect to exposure, usage field, applications to be redone. The samples in contact with the substance exhibit a slight attack on the material.