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European Technical Assessment

ETA 17/0721
of 19/04/2021

(English language translation, the original version in Czech language)

Technical Assessment Body issuing the ETA: Technical and Test Institute for Construction Prague

Trade name of the construction product	CELO Injection System ResiFIX PYSF ResiFIX PYSF Change ResiFIX PYSF Tropical ResiFIX PYSF Express
Product family to which the construction product belongs	Product area code: 33 Bonded injection type anchor for use in uncracked concrete
Manufacturer	CELO Befestigungssysteme GmbH Industriestraße 6 86551 Aichach Germany
Manufacturing plant(s)	Plant 2
This European Technical Assessment contains	15 pages including 12 Annexes which form an integral part of this assessment.
This European Technical Assessment is issued in accordance with regulation (EU) No 305/2011, on the basis of	EAD 330499-01-0601 Bonded fasteners for use in concrete
This version replaces	ETA 17/0721 issued on 28/08/2017

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1. Technical description of the product

The CELO Injection System ResiFIX PYSF, ResiFIX PYSF Change, ResiFIX PYSF Tropical and ResiFIX PYSF Express for uncracked concrete is a bonded anchor consisting of a cartridge with injection mortar and a steel element. The steel elements consists of a commercial threaded rods, a hexagon nut and a washer. The steel elements are made of galvanized steel or stainless steel.

The steel element is placed into a drilled hole filled with injection mortar and is anchored via the bond between metal part, injection mortar and concrete.

The illustration and the description of the product are given in Annex A.

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

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

The provisions made in this European Technical Assessment are based on an assumed 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, but are to be regarded only as a means for choosing the products in relation to the expected economically reasonable working life of the works.

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

3.1 Mechanical resistance and stability (BWR 1)

Essential characteristic	Performance
Characteristic resistance to tension load (static and quasi-static loading)	Annex C1, C2
Characteristic resistance to shear load (static and quasi-static loading)	Annex C1, C3
Displacements under short term and long term loading	Annex C4
Durability	Annex B1
Characteristic resistance and displacements for seismic performance categories C1 and C2	NPA

3.2 Hygiene, health and environment (BWR 3)

No performance determined.

3.3 General aspects relating to fitness for use

Durability and serviceability are only ensured if the specifications of intended use according to Annex B1 are kept.

4. Assessment and verification of constancy of performance (AVCP) system applied with reference to its legal base

According to the Decision 96/582/EC of the European Commission[1] the system of assessment verification of constancy of performance (see Annex V to Regulation (EU) No 305/2011) given in the following table applies.

Product	Intended use	Level or class	System
Metal anchors for use in concrete	For fixing and/or supporting to concrete, structural elements (which contributes to the stability of the construction works) or heavy units	-	1

[1] Official Journal of the European Communities L 254 of 08.10.1996

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

5.1 Tasks of the manufacturer

The manufacturer may only use raw materials stated in the technical documentation of this European Technical Assessment.

The factory production control shall be in accordance with the control plan which is a part of the technical documentation of this European Technical Assessment. The control plan is laid down in the context of the factory production control system operated by the manufacturer and deposited at Technický a zkušební ústav stavební Praha, s.p.[2] The results of factory production control shall be recorded and evaluated in accordance with the provisions of the control plan.

5.2 Tasks of the notified bodies

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

The notified certification body involved by the manufacturer shall issue an certificate of constancy of performance of the product stating the conformity with the provisions of this European Technical assessment.

In cases where the provisions of the European Technical Assessment and its control plan are no longer fulfilled the notified body shall withdraw the certificate of constancy of performance and inform Technický a zkušební ústav stavební Praha, s.p without delay.

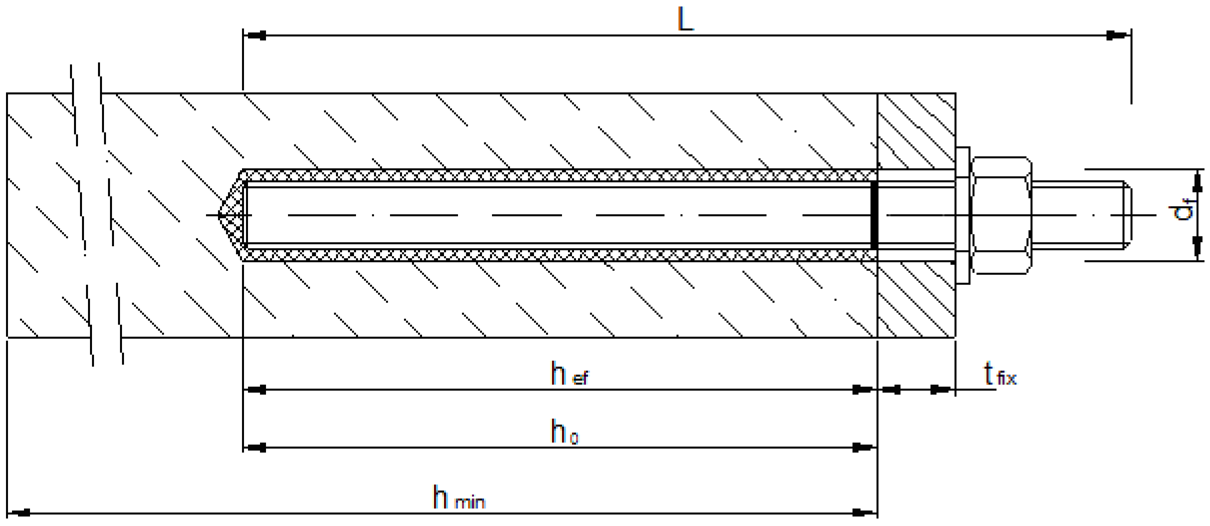
Issued in Prague on 19.04.2020

By

Ing. Mária Schaan
Head of the Technical Assessment Body

[2] The control plan is a confidential part of the documentation of the European Technical Assessment, but not published together with the ETA and only handed over to the approved body involved in the procedure of AVCP.

Installation threaded rod



d_f = diameter of clearance hole in the fixture
t_{fix} = thickness of fixture
h_{ef} = effective embedment depth
h_0 = depth of drill hole
h_{min} = minimum thickness of member

CELO Injection System for concrete
ResiFIX PYSF, ResiFIX PYSF Change, ResiFIX PYSF Express, ResiFIX PYSF Tropical

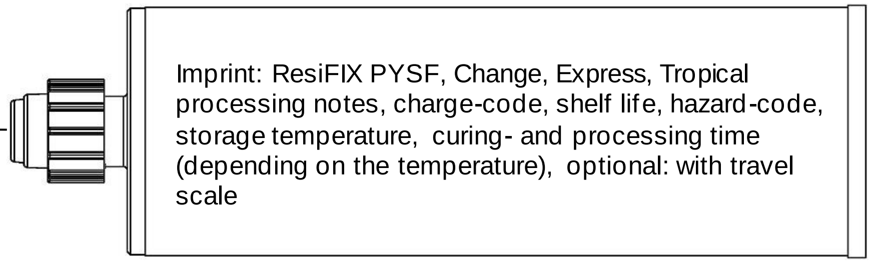
Product description
Installed conditions

Annex A 1

Cartridge: ResiFIX PYSF, Change, Express, Tropical

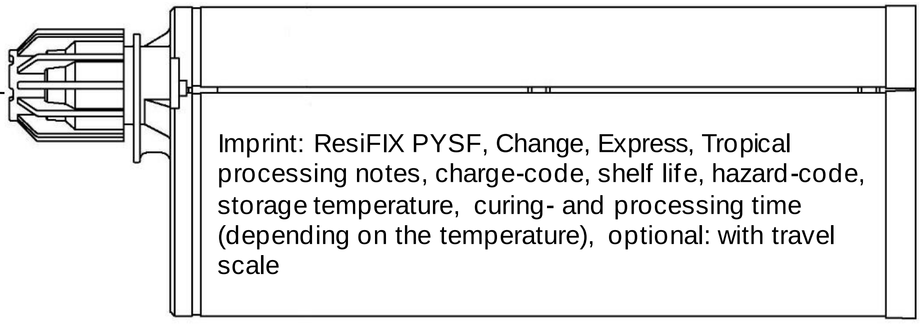
150 ml, 280 ml, 300 ml up to 330 ml and 380 ml up to 420 ml cartridge (Type: coaxial)

Sealing/Screw cap



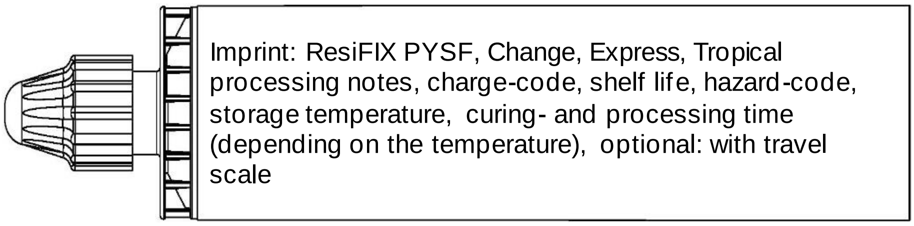
235 ml, 345 ml up to 360 ml and 825 ml cartridge (Type: "side-by-side")

Sealing/Screw cap



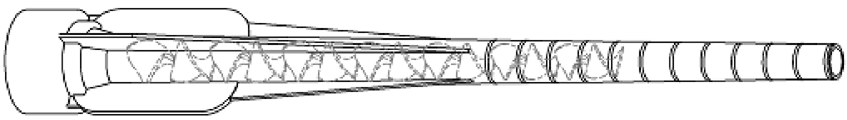
165 ml and 300 ml cartridge (Type: "foil tube")

Sealing/Screw cap



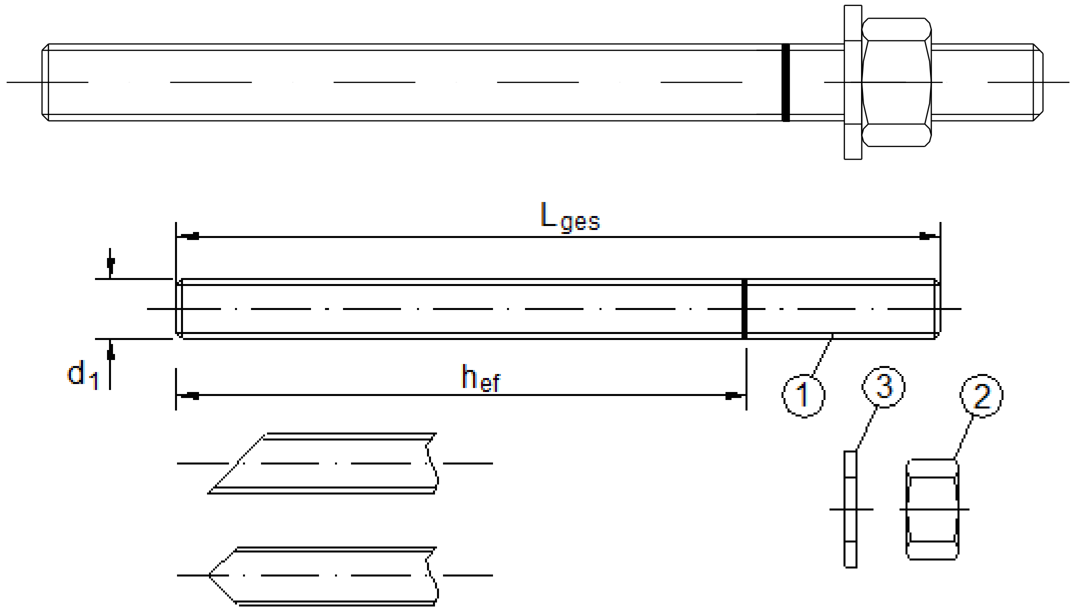
Static mixer

SM 14W



CELO Injection System for concrete **ResiFIX PYSF, ResiFIX PYSF Change, ResiFIX PYSF Express, ResiFIX PYSF Tropical**	**Annex A 2**
Product description Injection system	

Threaded rod M8, M10, M12, M16 with washer and hexagon nut



Commercial standard threaded rod with:

- Materials, dimensions and mechanical properties acc. Table A1
- Inspection certificate 3.1 acc. to EN 10204:2004
- Marking of embedment depth

CELO Injection System for concrete **ResiFIX PYSF, ResiFIX PYSF Change, ResiFIX PYSF Express, ResiFIX PYSF Tropical**	**Annex A 3**
Product description Threaded rod	

Table A1: Materials

Part	Designation	Material		
Steel, zinc plated (Steel acc. to EN 10087:1998 or EN 10263:2001) zinc plated ≥ 5 µm acc. to EN ISO 4042:1999 or hot-dip galvanised ≥ 40 µm acc. to EN ISO 1461:2009 and EN ISO 10684:2004+AC:2009 or sherardized ≥ 40 µm acc. to EN ISO 17668:2016				
1	Anchor rod	Property class acc. to EN ISO 898-1:2013	4.6	f_{uk}=400 N/mm²; f_{yk}=240 N/mm²; A_5 > 8% fracture elongation
			4.8	f_{uk}=400 N/mm²; f_{yk}=320 N/mm²; A_5 > 8% fracture elongation
			5.6	f_{uk}=500 N/mm²; f_{yk}=300 N/mm²; A_5 > 8% fracture elongation
			5.8	f_{uk}=500 N/mm²; f_{yk}=400 N/mm²; A_5 > 8% fracture elongation
			8.8	f_{uk}=800 N/mm²; f_{yk}=640 N/mm²; A_5 > 8% fracture elongation
2	Hexagon nut	Property class acc. to EN ISO 898-2:2012	4	for anchor rod class 4.6 or 4.8
			5	for anchor rod class 5.6 or 5.8
			8	for anchor rod class 8.8
3	Washer, (e.g.: EN ISO 887:2006, EN ISO 7089:2000, EN ISO 7093:2000 oder EN ISO 7094:2000)	Steel, zinc plated, hot-dip galvanised or sherardized		
Stainless steel A2 (Material 1.4301 / 1.4311 / 1.4307 / 1.4567 or 1.4541, acc. to EN 10088-1:2014) **and** **Stainless steel A4 (Material 1.4401 / 1.4404 / 1.4571 / 1.4362 or 1.4578, acc. to EN 10088-1:2014)**				
1	Anchor rod [1)]	Property class acc. to EN ISO 3506-1:2009	50	f_{uk}=500 N/mm²; f_{yk}=210 N/mm²; A_5 > 8% fracture elongation
			70	f_{uk}=700 N/mm²; f_{yk}=450 N/mm²; A_5 > 8% fracture elongation
			80	f_{uk}=800 N/mm²; f_{yk}=600 N/mm²; A_5 > 8% fracture elongation
2	Hexagon nut [1)]	Property class acc. to EN ISO 3506-1:2009	50	for anchor rod class 50
			70	for anchor rod class 70
			80	for anchor rod class 80
3	Washer, (e.g.: EN ISO 887:2006, EN ISO 7089:2000, EN ISO 7093:2000 oder EN ISO 7094:2000)	A2: Material 1.4301, 1.4311 / 1.4307 / 1.4567 or 1.4541, EN 10088-1:2014 A4: Material 1.4401, 1.4404 / 1.4571 / 1.4362 or 1.4578, EN 10088-1:2014		
High corrosion resistance steel (Material 1.4529 or 1.4565, acc. to EN 10088-1: 2014)				
1	Anchor rod	Property class acc. to EN ISO 3506-1:2009	50	f_{uk}=500 N/mm²; f_{yk}=210 N/mm²; A_5 > 8% fracture elongation
			70	f_{uk}=700 N/mm²; f_{yk}=450 N/mm²; A_5 > 8% fracture elongation
			80	f_{uk}=800 N/mm²; f_{yk}=600 N/mm²; A_5 > 8% fracture elongation
2	Hexagon nut	Property class acc. to EN ISO 3506-1:2009	50	for anchor rod class 50
			70	for anchor rod class 70
			80	for anchor rod class 80
3	Washer, (e.g.: EN ISO 887:2006, EN ISO 7089:2000, EN ISO 7093:2000 oder EN ISO 7094:2000)	Material 1.4529 or 1.4565, acc. to EN 10088-1: 2014		

[1)] Strength class 80 only for stainless steel A4 + high corrosion resistance steel HCR

Specifications of intended use

Anchorages subject to:
- Static and quasi-static loads

Base materials:
- Reinforced or unreinforced normal weight concrete without fibres according to EN 206:2013+A1:2016.
- Strength classes C20/25 to C50/60 according to EN 206:2013+A1:2016.
- Uncracked concrete

Temperature range:
- T1: - 40 °C to +40 °C (max long term temperature +24 °C and max short term temperature +40 °C)
- T2: - 40 °C to +80 °C (max long term temperature +50 °C and max short term temperature +80 °C)

Use conditions (Environmental conditions):
- Structures subject to dry internal conditions (all materials)
- For all other conditions according to EN 1993-1-4:2006+A1:2015 corresponding to corrosion resistance class:
  - Stainless steel class A2 according to Annex A 4, Table A1: CRC II
  - Stainless steel class A4 according to Annex A 4, Table A1: CRC III
  - High corrosion resistance steel HCR according to Annex A 4, Table A1: CRC V

Design:
- Verifiable calculation notes and drawings are prepared taking account of the loads to be anchored. The position of the anchor is indicated on the design drawings (e. g. position of the anchor relative to reinforcement or to supports, etc.).
- Anchorages are designed under the responsibility of an engineer experienced in anchorages and concrete work.
- Anchorages under static or quasi-static actions are designed in accordance with EN 1992-4

Concrete condition:
- I1 – installation in dry or wet (water saturated) concrete and use in service in dry or wet concrete
- I2 – installation in water-filled drill holes (not sea water) and use in service in dry or wet concrete

Installation:
- Hole drilling by hammer or compressed air drill mode.
- Anchor installation carried out by appropriately qualified personnel and under the supervision of the person responsible for technical matters of the site.

Installation direction:
- D3 - Downward and horizontal and upwards (e.g. overhead) installation.

Table B1: Installation parameters for threaded rod

Anchor size		M 8	M 10	M 12	M 16
Nominal drill hole diameter	d_0 [mm] =	10	12	14	18
Effective anchorage depth	$h_{ef,min}$ [mm] =	60	60	70	80
	$h_{ef,max}$ [mm] =	160	200	240	320
Diameter of clearance hole in the fixture	d_f [mm] ≤	9	12	14	18
Maximum torque moment	T_{inst} [Nm] ≤	10	20	40	80
Thickness of fixture	$t_{fix,min}$ [mm] >	0			
	$t_{fix,max}$ [mm] <	1500			
Minimum thickness of member	h_{min} [mm]	h_{ef} + 30 mm ≥ 100 mm			$h_{ef} + 2d_0$
Minimum spacing	s_{min} [mm]	40	50	60	80
Minimum edge distance	c_{min} [mm]	40	50	60	80

Steel brush RBT

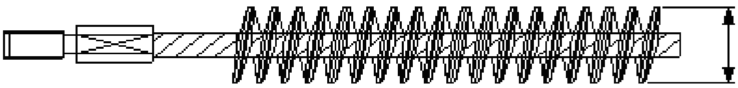


Table B2: Parameter cleaning and setting tools

Threaded Rod	d_0 Drill bit - ∅	d_b Brush - ∅		$d_{b,min}$ min. Brush - ∅
(mm)	(mm)	(mm)		(mm)
M8	10	RBT10	12	10,5
M10	12	RBT12	14	12,5
M12	14	RBT14	16	14,5
M16	18	RBT18	20	18,5

Hand pump (volume 750 ml)
Drill bit diameter (d_0): 10 mm to 20 mm
and anchorage depth up to 240 mm

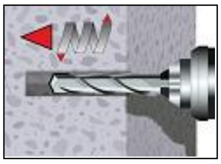
Recommended compressed air tool (min 6 bar)
All applications

CELO Injection System for concrete
ResiFIX PYSF, ResiFIX PYSF Change, ResiFIX PYSF Express, ResiFIX PYSF Tropical

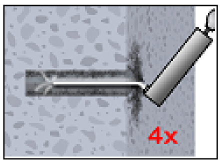
Intended use
Installation parameters
Cleaning and setting tools

Annex B 2

Installation instructions



1. Drill with hammer drill a hole into the base material to the size and embedment depth required by the selected anchor (Table B1). In case of aborted drill hole: the drill hole shall be filled with mortar.



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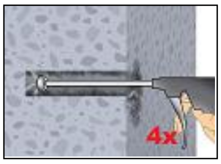
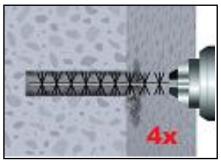


Attention! Standing water in the bore hole must be removed before cleaning.

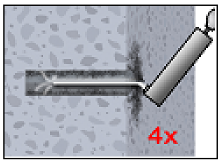
2a. Starting from the bottom or back of the bore hole, blow the hole clean with compressed air (min. 6 bar) or a hand pump (Annex B2) a minimum of four times. If the bore hole ground is not reached an extension shall be used.

The hand-pump can be used for anchor sizes up to bore hole diameter 20 mm.

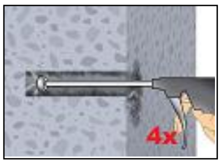
For bore holes larger then 20 mm or deeper 240 mm, compressed air (min. 6 bar) **must** be used.



2b. Check brush diameter (Table B2) and attach the brush to a drilling machine or a battery screwdriver. Brush the hole with an appropriate sized wire brush > $d_{b,min}$ (Table B2) a minimum of four times.
If the bore hole ground is not reached with the brush, a brush extension shall be used (Table B2).

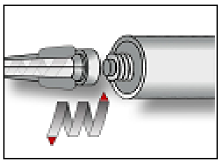


or

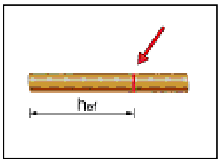


2c. Finally blow the hole clean again with compressed air (min. 6 bar) or a hand pump (Annex B2) a minimum of four times. If the bore hole ground is not reached an extension shall be used.
The hand-pump can be used for anchor sizes up to bore hole diameter 20 mm.
For bore holes deeper than 240 mm, compressed air (min. 6 bar) **must** be used.

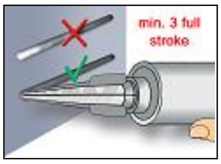
After cleaning, the bore hole has to be protected against re-contamination in an appropriate way, until dispensing the mortar in the bore hole. If necessary, the cleaning repeated has to be directly before dispensing the mortar.
In-flowing water must not contaminate the bore hole again



3. Attach a supplied static-mixing nozzle to the cartridge and load the cartridge into the correct dispensing tool. Cut off the foil tube clip before use.
For every working interruption longer than the recommended working time (Table B3) as well as for new cartridges, a new static-mixer shall be used.



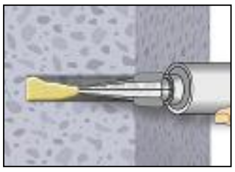
4. Prior to inserting the anchor rod into the filled bore hole, the position of the embedment depth shall be marked on the anchor rods.



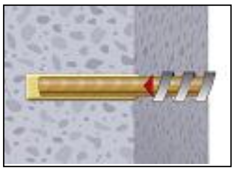
5. Prior to dispensing into the drill hole, squeeze out separately a minimum of three full strokes and discard non-uniformly mixed adhesive components until the mortar shows a consistent grey or blue (ResiFIX PYSF Change) colour. For foil tube cartridges it must be discarded a minimum of six full strokes.

CELO Injection System for concrete **ResiFIX PYSF, ResiFIX PYSF Change, ResiFIX PYSF Express, ResiFIX PYSF Tropical**	**Annex B 3**
Intended use Installation instructions	

Installation instructions (continuation)

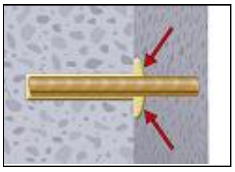


6. Starting from the bottom or back of the cleaned anchor hole fill the hole up to approximately two-thirds with adhesive. Slowly withdraw the static mixing nozzle as the hole fills to avoid creating air pockets. If the bottom or back of the anchor hole is not reached, an appropriate extension nozzle must be used. Observe the gel-/ working times given in Table B3.

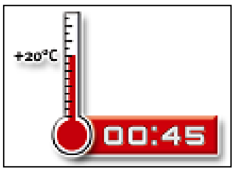


7. Push the threaded rod into the anchor hole while turning slightly to ensure positive distribution of the adhesive until the embedment depth is reached.

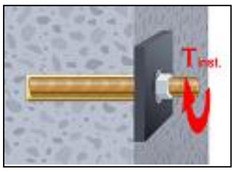
The anchor should be free of dirt, grease, oil or other foreign material.



8. Be sure that the anchor is fully seated at the bottom of the hole and that excess mortar is visible at the top of the hole. If these requirements are not maintained, the application has to be renewed. For overhead application the anchor rod should be fixed (e.g. wedges).



9. Allow the adhesive to cure to the specified time prior to applying any load or torque. Do not move or load the anchor until it is fully cured (attend Table B3).



10. After full curing, the add-on part can be installed with the max. torque (Table B1) by using a calibrated torque wrench.

Table B3: Minimum curing time

Concrete temperature	ResiFIX PYSF Tropical		ResiFIX PYSF, ResiFIX PYSF Change[1]		ResiFIX PYSF Express	
	Max. working time	Min. curing time	Max. working time	Min. curing time	Max. working time	Min. curing time
-10 to -6 °C					60 min	4 h
-5 to -1 °C			90 min	6 h	45 min	2 h
0 to +4 °C			45 min	3 h	25 min	80 min
+5 to +9 °C			25 min	2 h	10 min	45 min
+10 to +14 °C	30 min	5 h	20 min	100 min	4 min	25 min
+15 to +19 °C	20 min	210 min	15 min	80 min	3 min	20 min
+20 to +29 °C	15 min	145 min	6 min	45 min	2 min	15 min
+30 to +34 °C	10 min	80 min	4 min	25 min		
+35 to +39 °C	6 min	45 min	2 min	20 min		
+40 to +44 °C	4 min	25 min				
+45 °C	2 min	20 min				
Cartridge temperature	**+5°C to +45°C**		**+5°C to +40°C**		**0°C to +30°C**	

[1] The ResiFIX PYSF Change injection mortar has a curing time proof by changing the color from blue to gray after curing minimum time. The curing time proof is only valid for the standard version of the mortar.

CELO Injection System for concrete
ResiFIX PYSF, ResiFIX PYSF Change, ResiFIX PYSF Express, ResiFIX PYSF Tropical

Intended use
Installation instructions (continuation)
Curing time

Annex B 4

Table C1: Characteristic values for steel tension resistance and steel shear resistance of threaded rods

Size				**M 8**	**M 10**	**M 12**	**M 16**
Cross section area		A_s	[mm^2]	36,6	58	84,3	157
Characteristic tension resistance, Steel failure [1)]							
Steel, Property class 4.6 and 4.8		$N_{Rk,s}$	[kN]	15 (13)	23 (21)	34	63
Steel, Property class 5.6 and 5.8		$N_{Rk,s}$	[kN]	18 (17)	29 (27)	42	78
Steel, Property class 8.8		$N_{Rk,s}$	[kN]	29 (27)	46 (43)	67	125
Stainless steel A2, A4 and HCR, Property class 50		$N_{Rk,s}$	[kN]	18	29	42	79
Stainless steel A2, A4 and HCR, Property class 70		$N_{Rk,s}$	[kN]	26	41	59	110
Stainless steel A4 and HCR, Property class 80		$N_{Rk,s}$	[kN]	29	46	67	126
Characteristic tension resistance, Partial safety factor [2)]							
Steel, Property class 4.6		$\gamma_{Ms,N}$	[-]	2,0			
Steel, Property class 4.8		$\gamma_{Ms,N}$	[-]	1,5			
Steel, Property class 5.6		$\gamma_{Ms,N}$	[-]	2,0			
Steel, Property class 5.8		$\gamma_{Ms,N}$	[-]	1,5			
Steel, Property class 8.8		$\gamma_{Ms,N}$	[-]	1,5			
Stainless steel A2, A4 and HCR, Property class 50		$\gamma_{Ms,N}$	[-]	2,86			
Stainless steel A2, A4 and HCR, Property class 70		$\gamma_{Ms,N}$	[-]	1,87			
Stainless steel A4 and HCR, Property class 80		$\gamma_{Ms,N}$	[-]	1,6			
Characteristic shear resistance, Steel failure [1)]							
Without lever arm	Steel, Property class 4.6 and 4.8	$V^0_{Rk,s}$	[kN]	9 (8)	14 (13)	20	38
	Steel, Property class 5.6 and 5.8	$V^0_{Rk,s}$	[kN]	9 (8)	15 (13)	21	39
	Steel, Property class 8.8	$V^0_{Rk,s}$	[kN]	15 (13)	23 (21)	34	63
	Stainless steel A2, A4 and HCR, Property class 50	$V^0_{Rk,s}$	[kN]	9	15	21	39
	Stainless steel A2, A4 and HCR, Property class 70	$V^0_{Rk,s}$	[kN]	13	20	30	55
	Stainless steel A4 and HCR, Property class 80	$V^0_{Rk,s}$	[kN]	15	23	34	63
With lever arm	Steel, Property class 4.6 and 4.8	$M^0_{Rk,s}$	[Nm]	15 (13)	30 (27)	52	133
	Steel, Property class 5.6 and 5.8	$M^0_{Rk,s}$	[Nm]	19 (16)	37 (33)	65	166
	Steel, Property class 8.8	$M^0_{Rk,s}$	[Nm]	30 (26)	60 (53)	105	266
	Stainless steel A2, A4 and HCR, Property class 50	$M^0_{Rk,s}$	[Nm]	19	37	66	167
	Stainless steel A2, A4 and HCR, Property class 70	$M^0_{Rk,s}$	[Nm]	26	52	92	232
	Stainless steel A4 and HCR, Property class 80	$M^0_{Rk,s}$	[Nm]	30	59	105	266
Characteristic shear resistance, Partial safety factor [2)]							
Steel, Property class 4.6		$\gamma_{Ms,V}$	[-]	1,67			
Steel, Property class 4.8		$\gamma_{Ms,V}$	[-]	1,25			
Steel, Property class 5.6		$\gamma_{Ms,V}$	[-]	1,67			
Steel, Property class 5.8		$\gamma_{Ms,V}$	[-]	1,25			
Steel, Property class 8.8		$\gamma_{Ms,V}$	[-]	1,25			
Stainless steel A2, A4 and HCR, Property class 50 50		$\gamma_{Ms,V}$	[-]	2,38			
Stainless steel A2, A4 and HCR, Property class 50 70		$\gamma_{Ms,V}$	[-]	1,56			
Stainless steel A4 and HCR, Property class 80		$\gamma_{Ms,V}$	[-]	1,33			

[1)] Values are only valid for the given stress area A_s. Values in brackets are valid for undersized threaded rods with smaller stress area A_s for hot dipped threaded rods galvanized according to EN ISO 10684:2004+AC:2009.
[2)] in absence of national regulation

CELO Injection System for concrete **ResiFIX PYSF, ResiFIX PYSF Change, ResiFIX PYSF Express, ResiFIX PYSF Tropical**	**Annex C 1**
Performances Characteristic values for steel tension resistance and steel shear resistance of threaded rods	

Table C2: Characteristic values under tension loads in uncracked concrete

Anchor size threaded rod				M 8	M 10	M 12	M 16
Steel failure							
Characteristic tension resistance		$N_{Rk,s}$	[kN]	$A_s \cdot f_{uk}$ (or see Table C1)			
Partial factor		$\gamma_{Ms,N}$	[-]	see Table C1			
Combined pull-out and concrete cone failure							
Characteristic bond resistance in uncracked concrete C20/25							
Temperature range I: 40°C/24°C	dry and wet concrete	$\tau_{Rk,ucr}$	[N/mm²]	8,5	8,0	8,0	8,0
	flooded bore hole	$\tau_{Rk,ucr}$	[N/mm²]	8,5	8,0	8,0	8,0
Temperature range II: 80°C/50°C	dry and wet concrete	$\tau_{Rk,ucr}$	[N/mm²]	6,5	6,0	6,0	6,0
	flooded bore hole	$\tau_{Rk,ucr}$	[N/mm²]	6,5	6,0	6,0	6,0
Increasing factors for concrete ψ_c		C25/30		1,04			
		C30/37		1,08			
		C35/45		1,13			
		C40/50		1,15			
		C45/55		1,17			
		C50/60		1,19			
Concrete cone failure							
Factor		$k_{ucr,N}$	[-]	11,0			
Edge distance		$c_{cr,N}$	[mm]	1,5 h_{ef}			
Axial distance		$s_{cr,N}$	[mm]	2 $c_{cr,N}$			
Splitting failure							
Edge distance	$h/h_{ef} \geq 2,0$	$c_{cr,sp}$	[mm]	1,0 h_{ef}			
	$2,0 > h/h_{ef} > 1,3$			$2 \cdot h_{ef} \left(2,5 - \frac{h}{h_{ef}}\right)$			
	$h/h_{ef} \leq 1,3$			2,4 h_{ef}			
Axial distance		$s_{cr,sp}$	[mm]	2 $c_{cr,sp}$			
Installation factor							
for dry and wet concrete		γ_{inst}	[-]	1,2			
for flooded bore hole		γ_{inst}	[-]	1,2			

Table C3: Characteristic values under shear loads in uncracked concrete

Anchor size threaded rod			M 8	M 10	M 12	M 16
Steel failure without lever arm						
Characteristic shear resistance Steel, strength class 4.6 and 4.8	$V^0_{Rk,s}$	[kN]	$0,6 \cdot A_s \cdot f_{uk}$ (or see Table C1)			
Characteristic shear resistance Steel, strength class 5.6, 5.8 and 8.8 Stainless Steel A2, A4 and HCR, all classes	$V^0_{Rk,s}$	[kN]	$0,5 \cdot A_s \cdot f_{uk}$ (or see Table C1)			
Partial factor	$\gamma_{Ms,V}$	[-]	see Table C1			
Ductility factor	k_7	[-]	1,0			
Steel failure with lever arm						
Characteristic bending moment	$M^0_{Rk,s}$	[Nm]	$1,2 \cdot W_{el} \cdot f_{uk}$ (or see Table C1)			
Partial factor	$\gamma_{Ms,V}$	[-]	see Table C1			
Concrete pry-out failure						
Factor	k_8	[-]	2,0			
Installation factor	γ_{inst}	[-]	1,0			
Concrete edge failure						
Effective length of fastener	l_f	[mm]	$l_f = \min(h_{ef}; 12\ d_{nom})$			
Outside diameter of fastener	d_{nom}	[mm]	8	10	12	16
Installation factor	γ_{inst}	[-]	1,0			

Table C4: Displacement under tension load[1)]

Anchor size threaded rod			M 8	M 10	M 12	M 16
Uncracked concrete C20/25						
Temperature range I: 40°C/24°C	δ_{N0}-factor	[mm/(N/mm²)]	0,03	0,04	0,05	0,07
	$\delta_{N\infty}$-factor	[mm/(N/mm²)]	0,07	0,08	0,08	0,08
Temperature range II: 80°C/50°C	δ_{N0}-factor	[mm/(N/mm²)]	0,02	0,03	0,03	0,04
	$\delta_{N\infty}$-factor	[mm/(N/mm²)]	0,15	0,17	0,17	0,17

1) Calculation of the displacement
$\delta_{N0} = \delta_{N0}\text{-factor} \cdot \tau$;
$\delta_{N\infty} = \delta_{N\infty}\text{-factor} \cdot \tau$;

Table C5: Displacement under shear load[1)]

Anchor size threaded rod			M 8	M 10	M 12	M 16
For uncracked concrete C20/25						
All temperature ranges	δ_{V0}-factor	[mm/kN]	0,02	0,02	0,01	0,01
	$\delta_{V\infty}$-factor	[mm/kN]	0,03	0,02	0,02	0,01

1) Calculation of the displacement
$\delta_{V0} = \delta_{V0}\text{-factor} \cdot V$;
$\delta_{V\infty} = \delta_{V\infty}\text{-factor} \cdot V$;