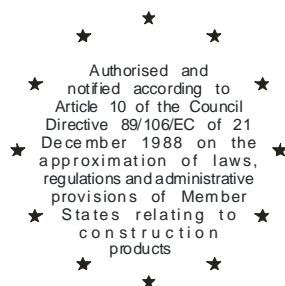


**TECHNICKÝ A ZKUŠEBNÍ ÚSTAV  
STAVEBNÍ PRAHA, s.p.**

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MEMBER OF EOTA

## European Technical Approval

## ETA-13/0597

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

Obchodní název  
*Trade name*

**Zetacartridge No2 Polyester Styrene Free chemická kotva z pozinkované nebo nerezové oceli**

***Zetacartridge No2 Polyester Styrene Free galvanized or stainless steel bonded anchor***

Držitel schválení  
*Holder of approval*

Zetapro Ltd.  
Unit B4, Thorne Enterprise Park  
King Edward Road, Thorne  
Doncaster, DN8 4HU  
United Kingdom

Typ a použití výrobku  
*Generic type and use of construction product*

Chemická injektovaná kotva pro kotvení nerezových nebo pozinkovaných ocelových tyčí do netrhlinového betonu o velikosti M8, M10, M12, M16, M20 a M24  
*Bonded injection type anchor made of galvanized or stainless steel for non cracked concrete: sizes M8, M10, M12, M16, M20 and M24*

Platnost  
*Validity*  
od  
*from*  
do  
*to*

04.06.2013  
15.04.2018

Výrobna  
*Manufacturing plant*

Zetapro Plant 1

Toto evropské technické schválení obsahuje  
*This European Technical Approval contains*

16 stran včetně 8 příloh, které tvoří nedílnou součást dokumentu  
*16 pages including 8 Annexes which form an integral part of the document*



European Organisation for Technical Approvals  
Evropská organizace pro technické schvalování

## I. LEGAL BASES AND GENERAL CONDITIONS

1. This European Technical Approval is issued by the Technical and Test Institute for Construction Prague (Technický a zkušební ústav stavební Praha, s.p.) in accordance with:
  - Council Directive 89/106/EEC of 21 December 1988 on the approximation of laws, regulations and administrative provisions of Member States relating to construction products<sup>1</sup>, modified by the Council Directive 93/68/EEC<sup>2</sup>; and Regulation (EC) No.1882/2003 of the European Parliament and of the Council<sup>3</sup>
  - the Government Decree No. 190/2002 Collection of Laws<sup>4</sup>, as amended
  - Common Procedural Rules for Requesting, Preparing and the Granting of European Technical Approvals set out in the Annex to Commission Decision 94/23/EC<sup>5</sup>;
  - Guideline for European Technical Approval of „Metal Anchors for use in Concrete“, ETAG 001, Part 1 ‘Anchors in general’ and Part 5 ‘Bonded anchors’.
2. Technický a zkušební ústav stavební Praha, s.p. is authorised to check whether the provisions of this European Technical Approval are met. Checking may take place in the manufacturing plant. Nevertheless, the responsibility for the conformity of the products to the European Technical Approval and for their fitness for the intended use remains with the holder of the European Technical Approval.
3. This European Technical Approval is not to be transferred to manufacturers or agents of manufacturers other than those indicated on page 1, or manufacturing plants other than those indicated on page 1 of this European Technical Approval.
4. This European Technical Approval may be withdrawn by the Technical and Test Institute for Construction Prague in particular pursuant to information by the Commission according to Article 5.1 of the Council Directive 89/106/EEC.
5. Reproduction of this European Technical Approval including transmission by electronic means shall be in full. However, partial reproduction can be made with the written consent of the Technical and Test Institute for Construction Prague. In this case, partial reproduction has to be designated as such. Texts and drawings of advertising brochures shall not contradict or misuse the European Technical Approval.
6. The European Technical Approval is issued by the approval body in its official language. This version corresponds to the version circulated within EOTA. Translations into other languages have to be designated as such.

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<sup>1</sup> Official Journal of the European Communities N<sup>o</sup> L 40, 11.02.1989, p. 12

<sup>2</sup> Official Journal of the European Communities N<sup>o</sup> L 220, 30.08.1993, p. 1

<sup>3</sup> Official Journal of the European Union no. L 284, 31.10.2003, p. 1

<sup>4</sup> Collection of Law of the Czech Republic Vol.79 No190 , 21.5.2002

<sup>5</sup> Official Journal of the European Communities N<sup>o</sup> L 17, 20.01.1994, p. 34

## **II. SPECIFIC CONDITIONS OF THE EUROPEAN TECHNICAL APPROVAL**

### **1 Definition of product and intended use**

#### **1.1 Definition of product**

The Zetacartridge No2 Polyester Styrene Free galvanized or stainless steel in the sizes M8 to M24 is bonded anchor (injection type) made of galvanized steel or stainless steel, which is placed into a drilled hole previously injected with two components injection mortar using an applicator gun equipped with a special mixing nozzle. The standard threaded rod is inserted into the resin with a slow and slight twisting motion.

The threaded rod maybe used with a flat tip end, a one side 45° chamfer or with two sides 45° chamfer. The mortar cartridges are available in different sizes (150 ml to 850 ml) and system (coaxial, side by side or capsule in cartridge). The anchor is intended to be used with embedment depth from 8 diameters to 12 diameters.

The installed anchor is shown in Annex 1.

#### **1.2 Intended use**

The anchor is intended to be used for anchorages for which requirements for mechanical resistance and stability and safety in use in sense of the Essential Requirements 1 and 4 of Council Directive 89/106/EEC shall be fulfilled and failure of anchorages made with these products would compromise the stability of the works, cause risk to human life and/or lead to considerable economic consequence. Safety in case of fire (Essential Requirement 2) is not covered in this ETA. The anchor is to be used only for anchorages subject to static or quasistatic loading in reinforced or unreinforced normal weight concrete of strength class C20/25 at minimum and C50/60 at maximum according EN 206-1:2000-12.

The anchor may be used in non-cracked concrete only.

The anchor size may be instaled in dry, wet concrete or flooded hole (use category 2).

The anchor may be used in the following temperature ranges:

-40°C to +80°C (max long term temperature +50°C,  
max short term temperature +80°C)

##### Galvanized steel:

The anchor rod, nut and washer made of zinc plated steel may only be used in structures subject to dry internal conditions.

##### Stainless steel A4-70 and A4-80:

The anchor rod, nut and washers made of stainless steel may be used in structures subject to dry internal conditions and also in structures subject to external atmospheric exposure (including industrial and marine environmental), or exposure to permanently damp internal conditions, if no particular aggressive conditions exist. Such 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 deicing materials are used).

##### High corrosion resistant steel:

The anchor rod, nut and washers made of high corrosion resistant steel may be used in structures subject to dry internal conditions and also in structures subject to external atmospheric exposure, in permanently damp internal conditions or in other particular aggressive conditions. Such particular conditions are e.g. permanent, alternating immersion in seawater or the splash zone of seawater, chloride

atmosphere of indoor swimming pools or atmosphere with chemical pollution (e.g. in desulphurization plants or road tunnels where de-icing materials are used).

The provisions made in this European Technical Approval 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.

## **2 Characteristics of the product and methods of verification**

### **2.1 Characteristics of the product**

The anchors correspond to the drawings and information give in Annexes 1 and 5. The characteristic material values, dimensions and tolerances of the anchor not indicated in Annexes 1 and 5 shall correspond to the respective values laid down in the technical documentation<sup>6</sup> of this European Technical Approval.

The characteristic values of Zetacartridge No2 Polyester Styrene Free for the design of the anchorages are given in Annexes 6 - 7.

Each mortar cartridge is to be marked with the producer name, trade name, shelf-life and curing and processing time.

The Zetacartridge No2 Polyester Styrene Free galvanized bonded anchor is intended to be used with commercial standard threaded rods according to annex 1 and 6.

- Mechanical properties according to EN ISO 898-1
- Quality affirmation of the mechanical properties with an inspection document according to EN 10204:2004
- Marking of the threaded rod with the embedment depth. This may be done by the manufacturer of the rod or the person on job site.

The two components of the Zetacartridge No2 Polyester Styrene Free injection mortar could be delivered in unmixed condition in mortar cartridges in sizes of 150ml, 380ml, 400 ml, 410 ml in case of coaxial cartridges, 350 ml and 825 ml in case of side by side cartridges, 150 ml, 170 ml and 300 ml in case of two part foil capsule within in a single component cartridge according Annex 2.

### **2.2 Methods of verification**

The assessment of the fitness of the anchor for the intended use in relation to the requirements for safety in use in the sense of Essential Requirement 1 and 4 has been made in compliance with the Guideline for European Technical Approval of "Metal anchors for use in concrete ", ETAG 001, Part 1 "Anchors in general" and Part 5 "Bonded anchors", on the basis of Option 7.

In addition to the specific clauses relating to dangerous substances contained in this European Technical Approval, there may be other requirements applicable to the products falling within its scope (e.g. transposed European legislation and national laws, regulations and administrative provisions). In order to meet the provisions of the UE Construction Products Directive, these requirements need also to be complied with, when and where they apply.

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<sup>6</sup> The technical documentation of this European Technical Approval is deposited at the Technický a zkušební ústav stavební Praha, s.p, as far as relevant for the tasks of the approved bodies involved in the attestation of conformity producer, is handed over to the approved bodies.

### **3 Evaluation of conformity of the product and CE marking**

#### **3.1 System of attestation of conformity**

The system of attestation of conformity 2 (i) (allocated to system 1) according to Council Directive 89/106/EEC Annex III provides:

- (a) Tasks of the manufacturer:
  - (1) factory production control,
  - (2) testing of samples taken at the factory by the manufacturer in accordance with a prescribed control plan.
- (b) Tasks of the approved body:
  - (3) initial type-testing of the product,
  - (4) initial inspection of factory and of factory production control,
  - (5) continuous surveillance, assessment and approval of factory production control.

#### **3.2 Responsibility**

##### **3.2.1 Tasks of the manufacturer**

###### **3.2.1.1 Factory production control**

The manufacturer shall exercise permanent internal control of production. All the elements, requirements and provisions adopted by the manufacturer shall be documented in a systematic manner in the form of written policies and procedures, including records of results performed. This production control system shall insure that the product is in conformity with this European Technical Approval.

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

The factory production control shall be in accordance with the control plan which is a part of the technical documentation of this European Technical Approval. 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.<sup>7</sup>.

The results of factory production control shall be recorded and evaluated in accordance with the provisions of the control plan.

###### **3.2.1.2 Other tasks of manufacturer**

The manufacturer shall, on the basis of a contract, involve a body which is approved for the tasks referred to in section 3.1 in the field of anchors in order to undertake the actions laid down in section 3.2.2. For this purpose, the control plan referred to in sections 3.2.1.1 and 3.2.2 shall be handed over by the manufacturer to the approved body involved.

The manufacturer shall make a declaration of conformity, stating that the construction product is in conformity with the provisions of this European Technical Approval.

##### **3.2.2 Tasks of the approved body**

The approved body shall perform the:

- initial type-testing of the product
- initial inspection of factory and of factory production control
- continuous surveillance, assessment and approval of factory production control

in accordance with the provisions laid down in the control plan.

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<sup>7</sup> The control plan is a confidential part of the documentation of the European Technical Approval, but not published together with the ETA and only handed over to the approved body involved in the procedure of attestation of conformity.  
See section 3.2.2.

The approved 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 approved certification body involved by the manufacturer shall issue an EC certificate of conformity of the factory production control stating the conformity with the factory production control of this European Technical Approval.

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

### **3.3 CE marking**

The CE-marking<sup>8</sup> shall be affixed on each packaging of the anchor. The symbol "CE" shall be accompanied by the following information:

- name or identifying mark of producer and manufacturing plant;
- the last two digits of the year in which the CE-marking was affixed;
- identification number of an approved body;
- number of the EC certificate of conformity;
- number of the European Technical Approval;
- use category (ETAG 001-1, Option 7).

## **4 Assumptions under which the fitness of the product for the intended use was favourably assessed**

### **4.1 Manufacturing**

The anchor is manufactured in accordance with the provisions of the European Technical Approval using the automated manufacturing process as verified by the inspection of the plant performed by the Technický a zkušební ústav stavební Praha, s.p. as laid down in the technical documentation.

### **4.2 Installation**

#### **4.2.1 Design of anchorages**

The fitness of the anchors for the intended use is given under the following conditions:

The anchorages are designed in accordance with the EOTA Technical Report TR 029 "Design of bonded anchors" under the responsibility of an engineer experienced in anchorages and concrete work.

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 support, etc.).

#### **4.2.2 Installation of anchor**

The fitness for use of the anchor can only be assumed if the following conditions of installation are met:

- anchor installation carried out by appropriately qualified personnel under the supervision of the person responsible for technical matters on site;
- use of the anchor only as supplied by the manufacturer without exchanging any components of the anchor; commercial standard threaded rods (in the case of rods made of galvanised steel - standard rods of the strength class  $\leq 8.8$  only), washers and hexagon nuts may be used if the following requirements are fulfilled:

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<sup>8</sup> Notes on the CE marking are stated in Guidance Paper D „CE marking under the Construction Products Directive“, Brussels, 01 August 2002

- Material, dimensions and mechanical properties according Annex 1
- Confirmation of material and mechanical properties by inspection certificate 3.1 according to EN 10204:2004,
- Marking of threaded rod with the envisage embedment depth. This may be done by the manufacturer of the rod or the person on job site
- anchor installation in accordance with the manufacturer's specifications and drawings using the tools indicated in this European Technical Approval;
- checks before placing the anchor to ensure that the strength class of the concrete in which the anchor is to be placed is in the range;
- check of the concrete being well compacted, e.g. without significant voids;
- keeping the effective anchorage depth;
- edge distance and spacing not less than the specified values without minus tolerance;
- placing drill holes without damaging the reinforcement;
- in case of aborted drill hole, the drill hole shall be filled with mortar;
- cleaning the drill hole by following: at least 2 x blowing, 2 x brushing, 2 x blowing, 2 x brushing and 2 x blowing. The cleaning brush shall be used according Annex 5 Table 1;
- anchor installation ensuring the specified embedment depth, that is the appropriate depth marking of the anchor not exceeding the concrete surface;
- mortar injection by using the equipment including the special mixing nozzle shown in Annex 2, discarding the first portion of mortar of each new cartridge until a homogenous color is achieved; taking from the manufacturer instruction the admissible processing time (open time) of a cartridge as a function of the ambient temperature of the concrete; filling the drill hole uniformly from the drill hole bottom, in order to avoid entrapment of air; removing the special mixing nozzle slowly bit by bit during pressing-out; filling the drill hole with a quantity of the injection mortar corresponding to  $\frac{1}{2}$  of the drill hole; inserting immediately the threaded rod, slowly and with a slight twisting motion, removing excess of injection mortar around the rod; observing the curing time according to Annex 5 table 3 until the rod may be loaded;
- during curing of the injection mortar the temperature of the concrete must not fall below +5°C;
- application of the torque moment given in Annex 5 table 1 using calibrated torque wrench.

#### **4.2.3 Responsibility of the manufacturer**

It is in the responsibility of the manufacturer to ensure that the information on the specific conditions according to (1) and (2) including Annexes referred to 4.2.1, 4.2.2 is given to those who are concerned. This information may be made by reproduction of the respective parts of the European Technical Approval. In addition, all installation data shall be shown clearly on the packaging and/or on an enclosed instruction sheet, preferably using illustration(s).

The minimum data required for manual are:

- drill bit diameter,
- thread diameter,
- maximum thickness of the fixture,
- minimum installation depth,
- required torque moment,

- admissible installation temperature range,
- curing time of the bonding material depending on the installation temperature,
- information on the installation procedure, include cleaning of the hole,
- reference to any special installation equipment needed,
- identification of the manufacturing batch.

All data shall be presented in a clear and explicit form.

## **5 Recommendations for the manufacturer**

### **5.1 Recommendations on packaging, transportation and storage**

The mortar cartridges shall be protected against sun radiation and shall be stored according to the manufacturer's instructions in dry conditions.

Zetacartridge No2 Polyester Styrene Free shall be stored at temperatures of at least +5°C to not more than +25°C.

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

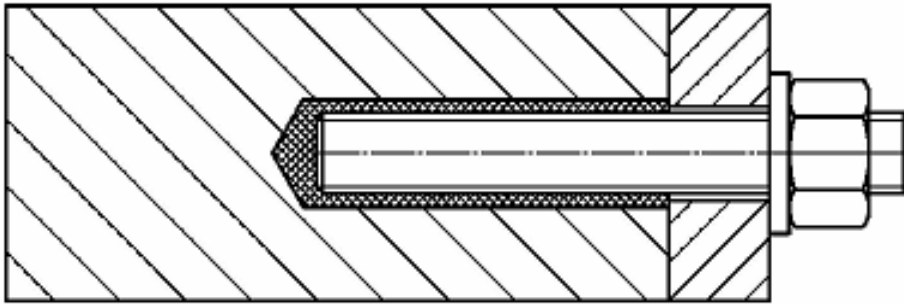
The original Czech version is signed by

**Ing. Jozef Pôbiš**  
Head of the Approval Body

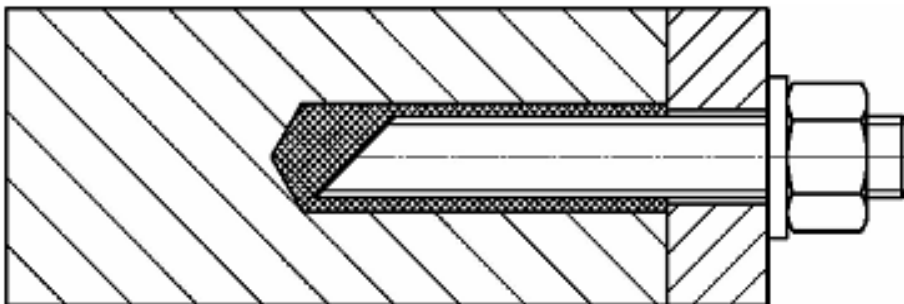


**Anchor in use**

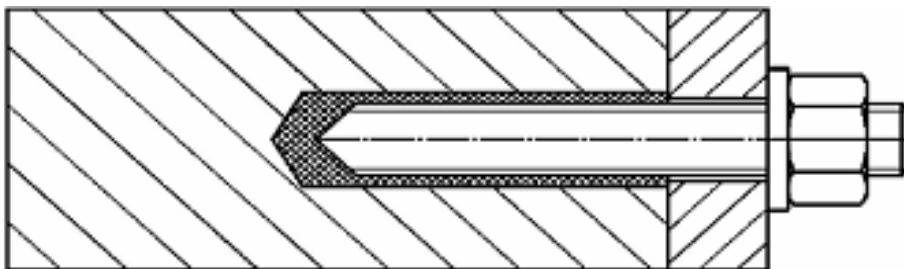
Standard threaded rod with flat tip end



Standard threaded rod with one side 45° chamfer



Standard threaded rod with two side 45° chamfer



**Threaded rod**

Standard commercial threaded rod (in the case of rods made of galvanised steel - standard rods of the strength class  $\leq 8.8$  only) with marked embedment depth  $h_{ef}$  from  $8d$  to  $12d$ .

**Materials**

	Size	Material
Threaded rod	M8 to M24	Galvanized steel grade 5.8, 8.8, 10.9* EN ISO 898
		Stainless steel A4-70, A4-80 EN ISO 3506
		High corrosion resistant steel 1.4529 EN 10088
Nut	-	According to threaded rod
Washer	-	According to threaded rod

\*- Galvanized rod of high strength are sensitive to hydrogen induced brittle failure

Category: Non cracked concrete  
 Dry, wet concrete or flooded holes  
 Temperature range: -40°C to +80°C (max short term temperature +80°C, max long term temperature +50°C)

**Zetacartridge No2 Polyester Styrene Free  
 Galvanized or stainless steel bonded anchor**

Product and intended use

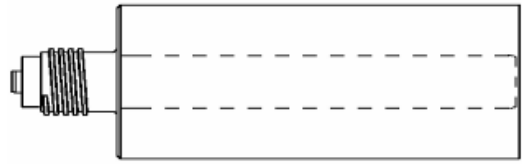
**Annex 1**

of European Technical Approval  
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**Cartridge**

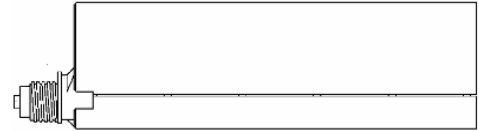
**Coaxial cartridge**

Zetacartridge No2 Polyester Styrene Free	150 ml
Zetacartridge No2 Polyester Styrene Free	380 ml
Zetacartridge No2 Polyester Styrene Free	400 ml
Zetacartridge No2 Polyester Styrene Free	410 ml



**Side by side cartridge**

Zetacartridge No2 Polyester Styrene Free	350 ml
Zetacartridge No2 Polyester Styrene Free	825 ml



**Two part foil capsule within in a single component cartridge**

Zetacartridge No2 Polyester Styrene Free	150 ml
Zetacartridge No2 Polyester Styrene Free	170 ml
Zetacartridge No2 Polyester Styrene Free	300 ml

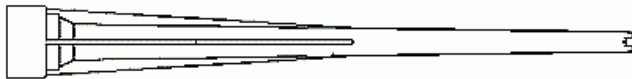


**Marking of the mortar cartridges**

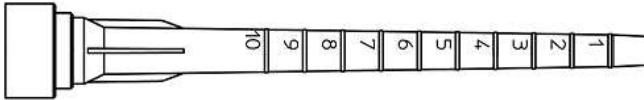
Identifying mark of the producer, Trade name, Charge code number, Storage life, Curing and processing time

**Mixing nozzle**

KW



RC



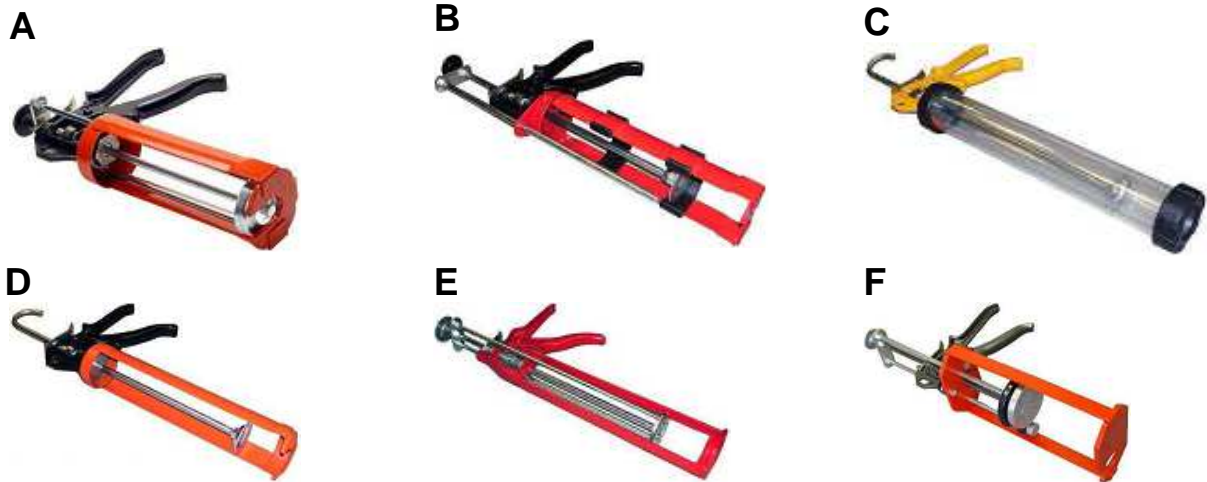
**Zetacartridge No2 Polyester Styrene Free  
 Galvanized or stainless steel bonded anchor**

Cartridge, mixing nozzle

**Annex 2**

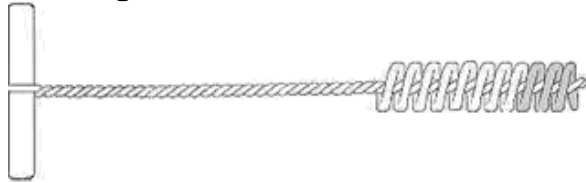
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**Applicator gun**



Applicator gun	A	B	C	D	E	F
Cartridge	Coaxial 380ml 400ml 410ml	Side by side 350ml	Foil capsule 150ml 300ml	Foil capsule 150ml 300ml	Coaxial 150ml	Side by side 825ml

**Cleaning brush**



**Zetacartridge No2 Polyester Styrene Free  
 Galvanized or stainless steel bonded anchor**

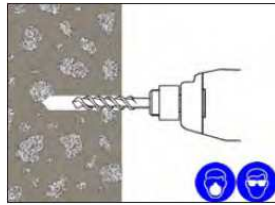
Applicator gun

**Annex 3**

of European Technical Approval  
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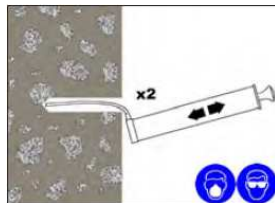
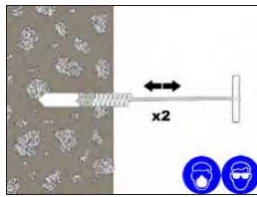
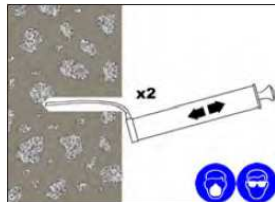
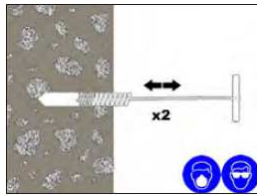
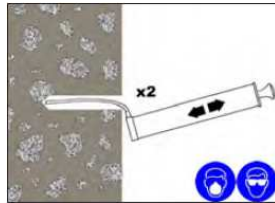
## Installation procedure

1. Drill the hole to the correct diameter and depth. This can be done with either a rotary percussion or rotary hammer drilling machine depending upon the substrate.



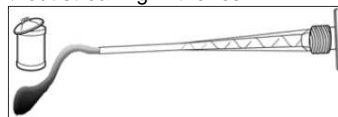
2. Thoroughly clean the hole in the following sequence using the Zetapro Brush with the required extensions and a Zetapro Blow Pump.

**Blow Clean x2.**  
**Brush Clean x2.**  
**Blow Clean x2.**  
**Brush Clean x2.**  
**Blow Clean x2.**

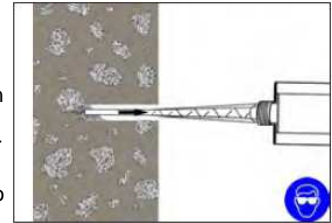


**If the hole collects water after the initial cleaning this water must be removed before injecting the resin.**

3. Select the appropriate static mixer nozzle for the installation, open the cartridge/foil and screw onto the mouth of the cartridge. Insert the cartridge into the correct applicator gun.  
 4. Extrude the first part of the cartridge to waste until an even colour has been achieved without streaking in the resin.

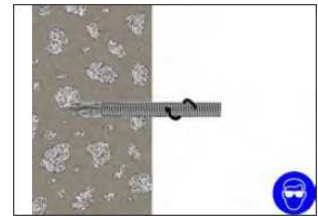


5. If necessary, cut the extension tube to the depth of the hole and push onto the end of the mixer nozzle, and (for threaded bar 16mm dia. or more) fit the correct resin stopper to the other end. Attach extension tubing and resin stopper.



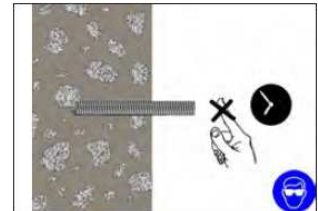
6. Insert the mixer nozzle (resin stopper / extension tube if applicable) to the bottom of the hole. Begin to extrude the resin and slowly withdraw the mixer nozzle from the hole ensuring that there are no air voids as the mixer nozzle is withdrawn. Fill the hole to approximately 1/2 to 3/4 full and remove the mixer nozzle completely.

7. Insert the clean threaded bar, free from oil or other release agents, to the bottom of the hole using a back and forth twisting motion ensuring all the threads are thoroughly coated. Adjust to the correct position within the stated working time.

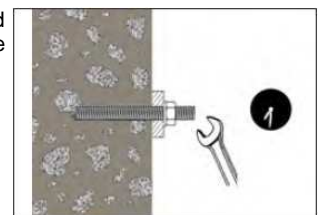


8. Any excess resin should be expelled from the hole evenly around the steel element showing that the hole is full. This excess resin should be removed from around the mouth of the hole before it sets.

9. Leave the anchor to cure. Do not disturb the anchor until the appropriate loading/curing time has elapsed depending on the substrate conditions and ambient temperature.



10. Attach the fixture and tighten the nut to the recommended torque. **Do not overtighten.**



**Zetacartridge No2 Polyester Styrene Free  
 Galvanized or stainless steel bonded anchor**

Installation procedure

**Annex 4**

of European Technical Approval  
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**Table 1: Installation parameter**

Size		M8	M10	M12	M16	M20	M24
Nominal drill hole diameter	$\varnothing d_0$ [mm]	10	12	14	18	22	26
Diameter of cleaning brush	$d_b$ [mm]	14	14	20	20	29	29
Torque moment	$T_{inst}$ [Nm]	10	20	40	80	150	200
$h_{ef,min} = 8d$							
Depth of drill hole	$h_0$ [mm]	64	80	96	128	160	192
Minimum edge distance	$c_{min}$ [mm]	35	40	50	65	80	96
Minimum spacing	$s_{min}$ [mm]	35	40	50	65	80	96
Minimum thickness of member	$h_{min}$ [mm]	$h_{ef} + 30 \text{ mm} \geq 100 \text{ mm}$				$h_{ef} + 2d_0$	
$h_{ef,max} = 12d$							
Depth of drill hole	$h_0$ [mm]	96	120	144	192	240	288
Minimum edge distance	$c_{min}$ [mm]	50	60	70	95	120	145
Minimum spacing	$s_{min}$ [mm]	50	60	70	95	120	145
Minimum thickness of member	$h_{min}$ [mm]	$h_{ef} + 30 \text{ mm} \geq 100 \text{ mm}$				$h_{ef} + 2d_0$	

**Table 2: Cleaning**

All diameters
- 2 x blowing
- 2 x brushing
- 2 x blowing
- 2 x brushing
- 2 x blowing

**Table 3: Minimum curing time Zetacartridge No2 Polyester Styrene Free**

Resin cartridge temperature [°C]	T Work [mins]	Base material Temperature [°C]	T Load [mins]
min +5	18	min +5	145
+5 to +10	10	+5 to +10	
+10 to +20	6	+10 to +20	85
+20 to +25	5	+20 to +25	50
+25 to +30	4	+25 to +30	40
+30		+30	35

T work is typical gel time at highest temperature

T load is set at the lowest temperature

**Zetacartridge No2 Polyester Styrene Free  
 Galvanized or stainless steel bonded anchor**

Installation parameters, Cleaning, Curing time

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**Table 4:** Design method TR 029  
 Characteristic values of resistance to tension load

<b>Steel failure – Characteristic resistance</b>								
<b>Size</b>			<b>M8</b>	<b>M10</b>	<b>M12</b>	<b>M16</b>	<b>M20</b>	<b>M24</b>
Steel grade <b>5.8</b>	$N_{Rk,s}$	[kN]	18	29	42	79	123	177
Partial safety factor	$\gamma_{Ms}$	[-]	1,5					
Steel grade <b>8.8</b>	$N_{Rk,s}$	[kN]	29	46	67	126	196	282
Partial safety factor	$\gamma_{Ms}$	[-]	1,5					
Steel grade <b>10.9</b>	$N_{Rk,s}$	[kN]	37	58	84	157	245	353
Partial safety factor	$\gamma_{Ms}$	[-]	1,4					
Stainless steel grade <b>A4-70</b>	$N_{Rk,s}$	[kN]	26	41	59	110	172	247
Partial safety factor	$\gamma_{Ms}$	[-]	1,9					
Stainless steel grade <b>A4-80</b>	$N_{Rk,s}$	[kN]	29	46	67	126	196	282
Partial safety factor	$\gamma_{Ms}$	[-]	1,6					
Stainless steel grade <b>1.4529</b>	$N_{Rk,s}$	[kN]	26	41	59	110	172	247
Partial safety factor	$\gamma_{Ms}$	[-]	1,5					

<b>Combined pullout and concrete cone failure in non-cracked concrete C20/25</b>								
<b>Size</b>			<b>M8</b>	<b>M10</b>	<b>M12</b>	<b>M16</b>	<b>M20</b>	<b>M24</b>
<b>Characteristic bond resistance in non-cracked concrete</b>								
Characteristic bond resistance Dry/wet concrete and flooded hole	$\tau_{Rk}$	[N/mm <sup>2</sup> ]	8	7	8	7,5	6,5	6,5
Partial safety factor	$\gamma_{Mc}$	[-]	1,8					
Factor for concrete	C20/25		1,12					
	C30/37	$\psi_c$	1,19					
	C50/60		1,30					

<b>Splitting failure</b>								
<b>Size</b>			<b>M8</b>	<b>M10</b>	<b>M12</b>	<b>M16</b>	<b>M20</b>	<b>M24</b>
Edge distance	$c_{cr,sp}$	[mm]	2,0 $h_{ef}$			1,5 $h_{ef}$		
Spacing	$s_{cr,sp}$	[mm]	4,0 $h_{ef}$			3,0 $h_{ef}$		
Partial safety factor	$\gamma_{Msp}$	[-]	1,8					

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Design method TR 029  
 Characteristic values of resistance to tension load

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**Table 5:** Design method TR 029  
 Characteristic values of resistance to shear load

<b>Steel failure without lever arm</b>								
<b>Size</b>			<b>M8</b>	<b>M10</b>	<b>M12</b>	<b>M16</b>	<b>M20</b>	<b>M24</b>
Steel grade <b>5.8</b>	$V_{Rk,s}$	[kN]	9	15	21	39	61	88
Partial safety factor	$\gamma_{Ms}$	[-]	1,25					
Steel grade <b>8.8</b>	$V_{Rk,s}$	[kN]	15	23	34	63	98	141
Partial safety factor	$\gamma_{Ms}$	[-]	1,25					
Steel grade <b>10.9</b>	$V_{Rk,s}$	[kN]	18	29	42	79	123	177
Partial safety factor	$\gamma_{Ms}$	[-]	1,5					
Stainless steel grade <b>A4-70</b>	$V_{Rk,s}$	[kN]	13	20	30	55	86	124
Partial safety factor	$\gamma_{Ms}$	[-]	1,56					
Stainless steel grade <b>A4-80</b>	$V_{Rk,s}$	[kN]	15	23	34	63	98	141
Partial safety factor	$\gamma_{Ms}$	[-]	1,33					
Stainless steel grade <b>1.4529</b>	$V_{Rk,s}$	[kN]	13	20	30	55	86	124
Partial safety factor	$\gamma_{Ms}$	[-]	1,25					

<b>Steel failure with lever arm</b>								
<b>Size</b>			<b>M8</b>	<b>M10</b>	<b>M12</b>	<b>M16</b>	<b>M20</b>	<b>M24</b>
Steel grade <b>5.8</b>	$M^o_{Rk,s}$	[kN]	19	37	66	166	325	561
Partial safety factor	$\gamma_{Ms}$	[-]	1,25					
Steel grade <b>8.8</b>	$M^o_{Rk,s}$	[kN]	30	60	105	266	519	898
Partial safety factor	$\gamma_{Ms}$	[-]	1,25					
Steel grade <b>10.9</b>	$M^o_{Rk,s}$	[kN]	37	75	131	333	649	1123
Partial safety factor	$\gamma_{Ms}$	[-]	1,50					
Stainless steel grade <b>A4-70</b>	$M^o_{Rk,s}$	[kN]	26	52	92	233	454	786
Partial safety factor	$\gamma_{Ms}$	[-]	1,56					
Stainless steel grade <b>A4-80</b>	$M^o_{Rk,s}$	[kN]	30	60	105	266	519	898
Partial safety factor	$\gamma_{Ms}$	[-]	1,33					
Stainless steel grade <b>1.4529</b>	$M^o_{Rk,s}$	[kN]	26	52	92	233	454	786
Partial safety factor	$\gamma_{Ms}$	[-]	1,25					

<b>Concrete pryout failure</b>								
Factor <i>k</i> from TR 029								2
Design of bonded anchors, Part 5.2.3.3								
Partial safety factor	$\gamma_{Mp}$	[-]						1,5

<b>Concrete edge failure</b>								
<b>Size</b>			<b>M8</b>	<b>M10</b>	<b>M12</b>	<b>M16</b>	<b>M20</b>	<b>M24</b>
See section 5.2.3.4 of Technical Report TR 029 for the Design of Bonded Anchors								
Partial safety factor	$\gamma_{Mc}$	[-]						1,5

**Zetacartridge No2 Polyester Styrene Free  
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Design method TR 029  
 Characteristic values of resistance to shear load

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**Table 6:** Displacement under tension and shear load

Anchor size		M8	M10	M12	M16	M20	M24
Tension load	F [kN]	6,3	7,9	11,9	23,8	29,8	45,6
Displacement	$\delta_{N0}$ [mm]	0,2	0,2	0,3	0,5	0,7	0,9
	$\delta_{N\infty}$ [mm]	0,4	0,4	0,4	0,4	0,4	0,4
Shear load	F [kN]	5,2	8,3	12,0	22,4	35,0	50,4
Displacement	$\delta_{V0}$ [mm]	0,1	0,1	0,2	0,4	0,8	1,5
	$\delta_{V\infty}$ [mm]	0,2	0,2	0,3	0,6	1,2	2,3

**Zetacartridge No2 Polyester Styrene Free  
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Displacement under tension and shear load

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