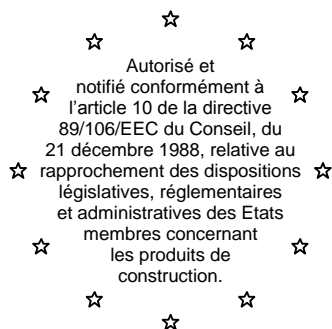


# Centre Scientifique et Technique du Bâtiment

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## European Technical Approval

## ETA-05/0044

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

Nom commercial :  
**Trade name:**

**SPIT TRIGA Z**

Titulaire :  
**Holder of approval:**

**Société SPIT**  
**Route de Lyon**  
**BP 104**  
**26501 BOURG LES VALENCE**

Type générique et utilisation prévue du  
produit de construction :

Cheville métallique en acier galvanisé, à expansion par vissage à couple contrôlé, de fixation dans le béton fissuré et non fissuré : diamètres M6, M8, M10, M12, M16 et M20.

**Generic type and use of  
construction product:**

**Torque-controlled expansion anchor, made of galvanised steel, for use in cracked and non cracked concrete: sizes M6, M8, M10, M12, M16 and M20.**

Validité du :  
au :

**01/09/2011**  
**01/09/2016**

**Validity from / to:**

Usine de fabrication :  
**Manufacturing plant:**

**Société SPIT**  
**Route de Lyon**  
**BP 104**  
**26501 BOURG LES VALENCE**

Le présent Agrément technique européen  
contient :

**This European Technical Approval  
contains:**

16 pages incluant 9 annexes faisant partie intégrante du document.

**16 pages including 9 annexes which form an integral part of  
the document.**

*This European Approval cancels and replaces ETA-05/0044 with validity from 23/03/2006 to 08/09/2011*

*Cet Agrément Technique Européen annule et remplace l'ATE ETA-05/0044 valide du 23/03/2006 au 08/09/2011*



Organisation pour l'Agrément Technique Européen  
European Organisation for Technical Approvals

## I LEGAL BASES AND GENERAL CONDITIONS

1. This European Technical Approval is issued by the Centre Scientifique et Technique du Bâtiment 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 of 22 July 1993<sup>2</sup>;
  - Décret n° 92-647 du 8 juillet 1992<sup>3</sup> concernant l'aptitude à l'usage des produits de construction;
  - Common Procedural Rules for Requesting, Preparing and the Granting of European Technical Approvals set out in the Annex of Commission Decision 94/23/EC<sup>4</sup>;
  - Guideline for European Technical Approval of « Metal Anchors for use in Concrete » ETAG 001, edition 1997, Part 1 « Anchors in general » and Part 2 « Torque-controlled expansion anchors ».
2. The Centre Scientifique et Technique du Bâtiment is authorised to check whether the provisions of this European Technical Approval are met. Checking may take place in the manufacturing plant (for example concerning the fulfilment of assumptions made in this European Technical Approval with regard to manufacturing). Nevertheless, the responsibility for the conformity of the products with 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 manufacturer 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 Centre Scientifique et Technique du Bâtiment pursuant to Article 5 (1) of the Council Directive 89/106/EEC.
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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° L 40, 11.2.1989, p. 12

<sup>2</sup> Official Journal of the European Communities n° L 220, 30.8.1993, p. 1

<sup>3</sup> Journal officiel de la République française du 14 juillet 1992

<sup>4</sup> Official Journal of the European Communities n° L 17, 20.1.1994, p. 34

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

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

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

The SPIT TRIGA Z anchor in the range of M6 to M20 is an anchor made of galvanised steel, which is placed into a drilled hole and anchored by torque-controlled expansion. The SPIT TRIGA Z anchor is produced in three versions : a screw version (type V), a threaded rod version (type E) and a countersunk head version (type TF) sizes M8 and M10.

For the installed anchor see Figure given 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 the 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 consequences.

The anchor is to be used only for anchorages subject to static or quasi-static loading in reinforced or unreinforced normal weight concrete of strength class C 20/25 at minimum to C 50/60 at most according to ENV 206-1: 2000-12. It may be anchored in cracked and non-cracked concrete.

The anchor may only be used in concrete subject to dry internal conditions.

The anchor (type V and E) may be used for anchorages whith requirements related to resistance to fire.

The provisions made in this European Technical Approval are based on an assumed intended working life of the anchor of 50 years. The indications given on the working life cannot be interpreted as a guarantee given by the producer, but are to be regarded only as a means for choosing the right products in relation to the expected economically reasonable working life of the works.

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

#### **2.1. Characteristics of product**

The anchor in the range of M6 to M20 corresponds to the drawings and provisions given in Annexes 1 to 4. The characteristic material values, dimensions and tolerances of the anchor not indicated in Annexes 3 to 5 shall correspond to the respective values laid down in the technical documentation<sup>5</sup> of this European Technical Approval. The characteristic anchor values for the design of anchorages regarding mechanical resistance and stability are given in Annexes 6 and 7. The characteristic anchor values for the design of anchorages regarding resistance to fire are given in Annexes 8 and 9. They are valid for use in a system that is required to provide a specific fire resistance class.

Each anchor is marked on the distance sleeve as mentioned in Annex 1 with the logo of SPIT, the name "TRIGA Z" and the nominal diameter. Ex: S TRIGA Z M16

The anchor shall only be packaged and supplied as a complete unit.

<sup>5</sup> The technical documentation of this European Technical Approval is deposited at the Centre Scientifique et Technique du Bâtiment and, as far as relevant for the tasks of the approved bodies involved in the attestation of conformity procedure, is handed over to the approved bodies.

## 2.2. Methods of verification

The assessment of fitness of the anchor for the intended use in relation to the requirements for mechanical resistance and stability and safety in use in the sense of the Essential Requirements 1 and 4 has been made in accordance with the « Guideline for European Technical Approval of Metal Anchors for use in Concrete », Part 1 « Anchors in general » and Part 2 « Torque-controlled expansion anchors », on the basis of Option 1.

The assessment of the anchor for the intended use in relation to the requirements for resistance to fire has been made in accordance with the Technical Report N°020 “Evaluation of anchorages in concrete concerning resistance to fire”.

## 3 Evaluation of Conformity and CE marking

### 3.1. Attestation of conformity system

The system of attestation of conformity 2 (i) (referred to as system 1) according to Council Directive 89/106/EEC Annex III laid down by the European Commission provides:

a) tasks for the manufacturer:

1. factory production control,
2. further testing of samples taken at the factory by the manufacturer in accordance with a prescribed test plan.

b) tasks for 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. Responsibilities

#### 3.2.1. Tasks of the manufacturer, factory production control

The manufacturer has a factory production control system in the plant and exercises permanent internal control of production. All the elements, requirements and provisions adopted by the manufacturer are documented in a systematic manner in the form of written policies and procedures. This production control system ensures that the product is in conformity with the European Technical Approval.

The manufacturer shall only use raw materials supplied with the relevant inspection documents as laid down in the prescribed test plan<sup>6</sup>. The incoming raw materials shall be subject to controls and tests by the manufacturer before acceptance. Check of incoming materials such as nuts, washers, wire for bolts and metal band for expansion sleeves shall include control of the inspection documents presented by suppliers (comparison with nominal values) by verifying dimension and determining material properties, e.g. tensile strength, hardness, surface finish.

The manufactured components of the anchor shall be subjected to the following tests:

- Dimensions of component parts:
  - Screw or threaded rod (diameter, length);
  - Distance sleeve (length, inner and outer diameter);
  - Expansion sleeve (length, thickness, inner and outer diameter);
  - hexagonal nut (proper running, wrench size across flats);
  - washer (diameters, thickness);
  - cone (diameter, angle).

<sup>6</sup> The prescribed test plan has been deposited at the Centre Scientifique et Technique du Bâtiment and is only made available to the approved bodies involved in the conformity attestation procedure.

- Material properties: screw or threaded rod (yielding and ultimate tensile strengths), sleeves (ultimate tensile strength), hexagonal nut (proof load), washer (hardness), cone (hardness and roughness).
- Thickness of the galvanised treatment or coating of the elements.
- Visual control of correct assembly and of completeness of the anchor.

The frequency of controls and tests conducted during production and on the assembled anchor is laid down in the prescribed test plan taking account of the automated manufacturing process of the anchor.

The results of factory production control are recorded and evaluated. The records include at least the following information:

- designation of the product, basic material and components;
- type of control or testing;
- date of manufacture of the product and date of testing of the product or basic material and components;
- result of control and testing and, if appropriate, comparison with requirements;
- signature of person responsible for factory production control.

The records shall be presented to the inspection body during the continuous surveillance. On request, they shall be presented to the Centre Scientifique et Technique du Bâtiment.

Details of the extent, nature and frequency of testing and controls to be performed within the factory production control shall correspond to the prescribed test plan which is part of the technical documentation of this European Technical Approval.

### 3.2.2. Tasks of approved bodies

#### 3.2.2.1. Initial type-testing of the product

For initial type-testing the results of the tests performed as part of the assessment for the European Technical Approval shall be used unless there are changes in the production line or plant. In such cases the necessary initial type-testing has to be agreed between the Centre Scientifique et Technique du Bâtiment and the approved bodies involved.

#### 3.2.2.2. Initial inspection of factory and of factory production control

The approved body shall ascertain that, in accordance with the prescribed test plan, the factory and the factory production control are suitable to ensure continuous and orderly manufacturing of the anchor according to the specifications mentioned in 2.1. as well as to the Annexes to the European Technical Approval.

#### 3.2.2.3. Continuous surveillance

The approved body shall visit the factory at least once a year for regular inspection. It has to be verified that the system of factory production control and the specified automated manufacturing process are maintained taking account of the prescribed test plan.

Continuous surveillance and assessment of factory production control have to be performed according to the prescribed test plan.

The results of product certification and continuous surveillance shall be made available on demand by the certification body or inspection body, respectively, to the Centre Scientifique et Technique du Bâtiment. In cases where the provisions of the European Technical Approval and the prescribed test plan are no longer fulfilled the conformity certificate shall be withdrawn.

### 3.3. CE-Marking

The CE marking shall be affixed on each packaging of anchors. The symbol « CE » shall be accompanied by the following information:

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

## 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 identified during inspection of the plant by the Centre Scientifique et Technique du Bâtiment and the approved body and 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 « Guideline for European Technical Approval of Metal Anchors for Use in Concrete », Annex C, Method A, for torque-controlled expansion 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.).

The design of anchorages under fire exposure has to consider the conditions given in the Technical Report N°020 “Evaluation of anchorages in concrete concerning resistance to fire”. The relevant characteristic anchor values are given in Annex 8 Table 9 for resistance to fire under tension loads and in Annex 9 Table 10 for resistance to fire under shear loads. The design methods covers anchors with a fire attack from one side only. If the fire attack is from more than one side, the design method may be taken only if the edge distance of the anchor is  $c \geq 300$  mm.

#### 4.2.2. Installation of anchors

The fitness for use of the anchor can only be assumed if the anchor is installed as follows:

- anchor installation carried out by appropriately qualified personnel and under the supervision of the person responsible for technical matters on the site;
- use of the anchor only as supplied by the manufacturer without exchanging the components of an anchor;
- anchor installation in accordance with the manufacturer’s specifications and drawings prepared for that purpose and using the appropriate special tools;
- thickness of the fixture corresponding to the range of required thickness values for the type of anchor;

- 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 given and is not lower than that of the concrete to which the characteristic loads apply;
- check of concrete being well compacted, e.g. without significant voids;
- clearing the hole of drilling dust;
- anchor installation ensuring the specified embedment depth, that is the appropriate depth marking of the anchor not exceeding the concrete surface or embedment depth control;
- keeping of the edge distance and spacing to the specified values without minus tolerances;
- positioning of the drill holes without damaging the reinforcement;
- in case of aborted hole: new drilling at a minimum distance away of twice the depth of the aborted hole or smaller distance if the aborted drill hole is filled with high strength mortar and if under shear or oblique tension load it is not to the anchor in the direction of load application;
- application of the torque moment given in Annex 4 using a calibrated torque wrench.

#### 4.2.3. Responsibility of the manufacturer

It is the manufacturer's responsibility to ensure that the information on the specific conditions according to 1 and 2 including Annexes referred to in 4.2.1. and 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 package and/or on an enclosed instruction sheet, preferably using illustration(s).

The minimum data required are:

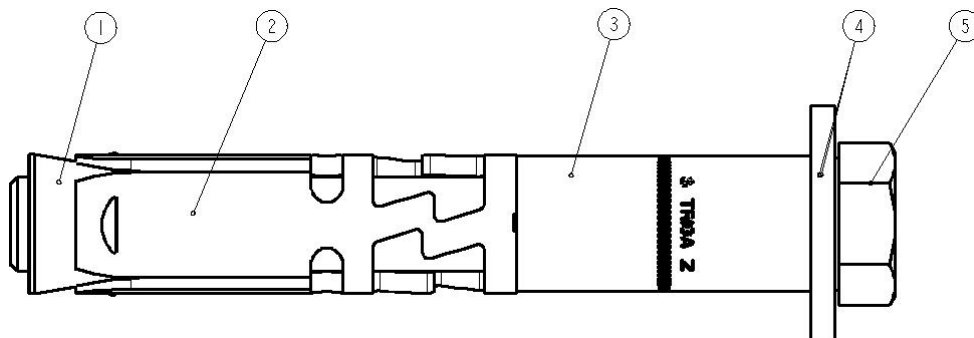
- drill bit diameter,
- thread diameter,
- maximum thickness of the fixture,
- minimum installation depth,
- minimum hole depth,
- required torque moment,
- information on the installation procedure, including cleaning of the hole, preferably by means of an illustration,
- reference to any special installation equipment needed,
- identification of the manufacturing batch.

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

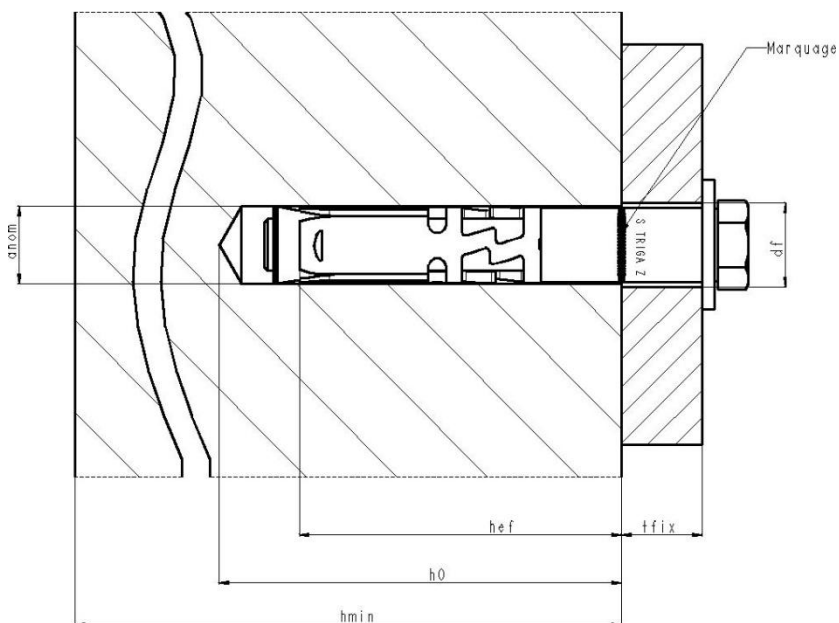
**The original French version is signed by  
Le Directeur Technique**

**C. BALOCHE**

**Assembled anchor and schema of the anchor in use :**



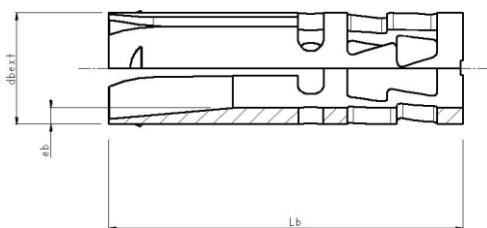
- 1. cone
- 2. expansion sleeve
- 3. distance sleeve
- 4. washer
- 5. screw (or threaded rod with hexagonal nut or countersunk head )



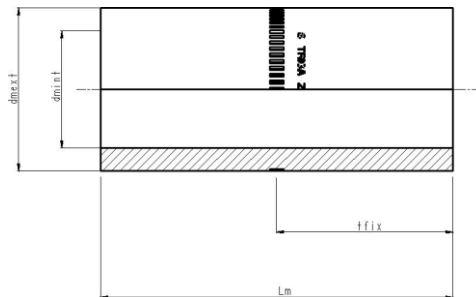
<p><b>SPIT TRIGA Z expansion anchor</b></p>	<p><b>Annex 1</b></p>
<p><b>Product and intended use</b></p>	<p>of European Technical Approval <b>ETA-05/0044</b></p>



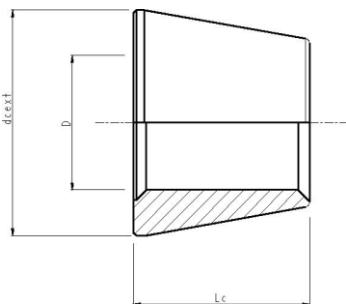
**Dimensions of the elements :**



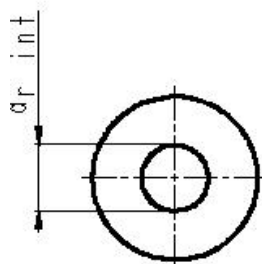
**Expansion sleeve**



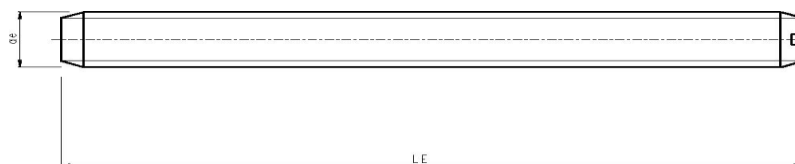
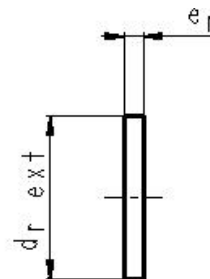
**Distance sleeve**



**Cone**



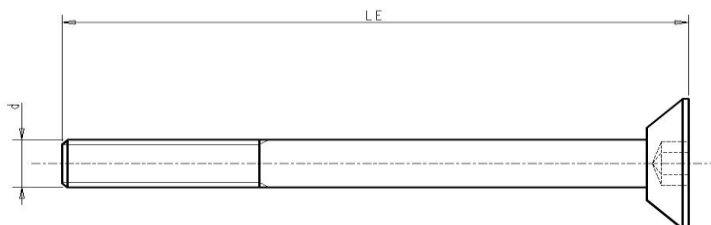
**washer**



**Threaded rod (type E)**



**Screw (type V)**



**Countersunk head screw (type TF)**

**SPIT TRIGA Z expansion anchor**

**Dimensions of the elements**

**Annex 2**

of European  
Technical Approval  
**ETA-05/0044**

**Table 1 : Dimensions**

<b>Dimensions of anchor bolt SPIT TRIGA Z</b>																											
<b>References</b>	<b>Rod</b>		<b>Washer</b>			<b>Distance sleeve</b>				<b>Expansion sleeve</b>			<b>Cone</b>														
<b>TRIGA Z</b>	<b>LE</b>	<b>d</b>	<b>Er</b>	<b>dr<sub>ext</sub></b>	<b>dr<sub>int</sub></b>	<b>Lm</b>	<b>dm<sub>ext</sub></b> <b>t</b>	<b>dm<sub>int</sub></b>	<b>t<sub>fix</sub></b>	<b>Lb</b>	<b>db<sub>ext</sub></b>	<b>eb</b>	<b>Lc</b>	<b>dc</b>	<b>D</b>												
<b>V6-10/5</b>	65	6	2	18	6,7	25	9,5	6,2	5	30	9,5	1,5	8	9,8	6												
<b>V6-10/20</b>	80					40			20																		
<b>E6-10/50</b>	117					70			20																		
<b>V8-12/10</b>	80	8	2	20	8,7	30	11,5	8,2	10	40	11,5	1,5	9,5	11,8	8												
<b>V8-12/20</b>	90					40			20																		
<b>V8-12/50</b>	80					70			50																		
<b>E8-12/20</b>	99					40			20																		
<b>E8-12/35</b>	114					55			35																		
<b>E8-12/55</b>	134					75			55																		
<b>E8-12/95</b>	174					115			95																		
<b>TF8-12/16</b>	85					30			16																		
<b>TF8-12/26</b>	95					40			26																		
<b>V10-15/10</b>	95					10			3							26	10,5	30	14,5	10,2	10	50	14,5	2	10,5	14,8	10
<b>V10-15/20</b>	105																	40			20						
<b>V10-15/55</b>	95	75	55																								
<b>E10-15/20</b>	114	40	20																								
<b>E10-15/35</b>	129	55	35																								
<b>E10-15/55</b>	149	75	55																								
<b>E10-15/100</b>	194	120	100																								
<b>TF10-15/27</b>	105	40	27																								
<b>V12-18/10</b>	105	12	3	30	12,5		33	17,5		12,4	10	57	17,5	2,5	13			17,8			12						
<b>V12-18/25</b>	120					48	25																				
<b>V12-18/55</b>	105					78	55																				
<b>E12-18/25</b>	132					48	25																				
<b>E12-18/45</b>	152					68	45																				
<b>E12-18/65</b>	172					88	65																				
<b>E12-18/100</b>	207					123	100																				
<b>V16-24/10</b>	130	16	4	40	16,7	35	23	16,5	10	75	23,5	3,5	18,7	23,8	16												
<b>V16-24/25</b>	145					50			25																		
<b>V16-24/50</b>	145					75			50																		
<b>E16-24/25</b>	159					50			25																		
<b>E16-24/55</b>	189					80			55																		
<b>E16-24/100</b>	234					125			100																		
<b>V20-28/25</b>	170	20	4	45	20,7	56	27	20,5	25	94	27,5	3,5	19,6	27,8	20												
<b>E20-28/25</b>	192					56			25																		
<b>E20-28/60</b>	227					91			60																		
<b>E20-28/100</b>	267					131			100																		

**SPIT TRIGA Z expansion anchor****Dimensions of the elements****Annex 3**of European  
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**ETA-05/0044**

**Table 2: Installation data**

	Embedment depth $h_{ef}$	Drill hole diameter	Depth of drill hole $h_1$	Thickness of fixture $t_{fix}$	Setting torque $T_{inst}$	Thickness of concrete member	Diameter of clearance hole $d_f$						
	[mm]	[mm]	[mm]	[mm]	[mm]	[mm]	[mm]						
V6-10/5	50	10	70	5	15	100	12						
V6-10/20				20									
E6-10/50				50									
V8-12/10	60	12	80	1	25	120	14						
V8-12/20				10									
V8-12/50				50									
E8-12/20				20									
E8-12/35				35									
E8-12/55				55									
E8-12/95				95									
TF8-12/16				16									
TF8-12/26				26									
V10-15/10				70				15	90	10	50	140	17
V10-15/20										20			
V10-15/55	55												
E10-15/20	20												
E10-15/35	35												
E10-15/55	55												
E10-15/100	100												
TF10-15/27	27												
V12-18/10	80	18	105	10	80	160	20						
V12-18/25				25									
V12-18/55				55									
E12-18/25				25									
E12-18/45				45									
E12-18/65				65									
E12-18/100				100									
V16-24/10				100				24	131	10	120	200	26
V16-24/25	25												
V16-24/50	50												
E16-24/25	25												
E16-24/55	55												
E16-24/100	100												
V20-28/25	125	28	157	25	200	250	31						
E20-28/25				25									
E20-28/60				60									
E20-28/100				100									

**Table 3: Minimum spacing and edge distance**

Cracked and non-cracked concrete			M6	M8	M10	M12	M16	M20
Minimum spacing	$S_{min}$	(mm)	50	60	70	80	100	125
For $C_{min} =$		(mm)	80	100	100	160	180	300
Minimum edge distance	$C_{min}$	(mm)	50	60	70	80	100	150
For $S_{min} =$		(mm)	100	100	160	200	220	300

SPIT TRIGA Z expansion anchor

Installation data

Annex 4

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**Table 4 : Matériaux**

Part	Designation	Material	Coating
1	Cone	1.0765 steel EN 10 087	Galvanised 5 µm
2	Expansion sleeve	1.5530 steel EN 10 149-2	Galvanised 5 µm
3	Distance sleeve	TS 37 a BK or S300Pb NF A 49 341	Galvanised 5 µm
4	Threaded rod	Steel Grade 8.8 EN 20 898-1	Galvanised 5 µm
5	Screw	Steel Grade 8.8 EN 20 898-1	Galvanised 5 µm
6	Washer	HLE S550MC	Galvanised 5 µm
7	Hexagonal nut	Grade 8 EN 20 898-2	Galvanised 5 µm

**SPIT TRIGA Z expansion anchor**

**Materials**

**Annex 5**

of European  
Technical Approval  
**ETA-05/0044**

**Table 5: Characteristic values of resistance in tension of design method A**

			M6	M8	M10	M12	M16	M20
<b>Steel failure</b>								
Characteristic resistance	$N_{Rk,s}$	(kN)	16	29	46	67	126	196
Partial safety factor	$\gamma_{Ms}$	-	1,50	1,50	1,50	1,50	1,50	1,50
<b>Pull-through failure in cracked and non-cracked concrete</b>								
Characteristic resistance in non-cracked concrete C20/25	$N_{Rk,p}$	(kN)	-*	20	-*	-*	-*	-*
Characteristic resistance in cracked concrete C20/25	$N_{Rk,p}$	(kN)	5	12	16	-*	-*	-*
Partial safety factor	$\gamma_{Mp}$		1,50					
Increasing factor for $N_{Rk}$	C30/37		1,22					
	C40/50		1,41					
	C50/60		1,55					
	$\psi_c$	-						
<b>Concrete cone failure in cracked and non-cracked concrete</b>								
Effective anchorage depth	$h_{ef}$	(mm)	50	60	70	80	100	125
Partial safety factor	$\gamma_{Mc}$	-	1,50					
	$\psi_{ucr,N}$	-	1,4					
Spacing	$s_{cr,N}$	(mm)	150	180	210	240	300	375
	$s_{cr,sp}$	(mm)	300	300	300	300	380	480
Edge distance	$c_{cr,N}$	(mm)	75	90	105	120	150	185
	$c_{cr,sp}$	(mm)	150	150	150	150	190	240

\* not decisive failure mode

**Table 6 : Displacements under tension loads**

<b>Screw , threaded rod and countersunk head versions</b>			M6	M8	M10	M12	M16	M20
Tension load in non-cracked concrete C20/25 (kN)			7,7	9,5	14,1	17,2	24,0	33,5
Displacement	$\delta_{N0}$	(mm)	0,1	0,1	0,1	0,1	0,1	0,1
	$\delta_{N\infty}$	(mm)	0,1	0,1	0,1	0,1	0,1	0,1
Tension load in cracked concrete C20/25 (kN)			2,4	5,7	7,6	12,3	17,1	23,9
Displacement	$\delta_{N0}$	(mm)	0,6	0,6	0,6	0,7	0,7	0,8
	$\delta_{N\infty}$	(mm)	0,6	0,6	0,7	0,7	1,0	1,0
Tension load in non-cracked concrete C50/60 (kN)			7,7	13,9	21,8	26,6	37,2	51,9
Displacement	$\delta_{N0}$	(mm)	0,1	0,2	0,4	0,5	0,8	1,2
	$\delta_{N\infty}$	(mm)	0,1	0,2	0,4	0,5	0,8	1,2
Tension load in cracked concrete C50/60 (kN)			3,7	8,9	11,8	19,0	26,6	37,1
Displacement	$\delta_{N0}$	(mm)	0,7	0,9	1,1	1,3	1,7	2,2
	$\delta_{N\infty}$	(mm)	0,7	0,9	1,1	1,3	1,7	2,2

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**Table 7: Characteristics values of resistance to shear loads of design method A.**

			M6	M8	M10	M12	M16	M20
<b>Steel failure without lever arm</b>								
<b>Screw and countersunk versions – type V and TF</b>								
Characteristic resistance	$V_{Rk,s}$	(kN)	23,4	32,6	49,1	72,7	117,2	173,5
Partial safety factor	$\gamma_{Ms}$	-	1,25					
<b>Threaded rod version – type E</b>								
Characteristic resistance	$V_{Rk,s}$	(kN)	14,3	19,0	31,0	47,4	93,1	109,9
Partial safety factor	$\gamma_{Ms}$	-	1,25					
<b>Threaded rod only (without distance sleeve)</b>								
Characteristic resistance	$V_{Rk,s}$	(kN)	8,0	14,6	23,2	33,7	62,8	98,0
Partial safety factor	$\gamma_{Ms}$	-	1,25					
<b>Steel failure without lever arm</b>								
Characteristic resistance	$M_{Rk,s}$	(Nm)	12	30	60	105	266	519
Partial safety factor	$\gamma_{Ms}$	-	1,25					
<b>Pry out failure</b>								
Factor in equation (5.6)	k	-	1	2				
	$\gamma_{Mpr}$	-	1,50					
<b>Concrete edge failure</b>								
Effective length of anchor Under shear loading	$l_f$	(mm)	50	60	70	80	100	125
Outside diameter of anchor	$d_{nom}$	(mm)	9,5	11,5	14,5	17,5	23,5	27,4
Partial safety factor	$\gamma_{Mc}$	-	1,50					

**Table 8: Displacements under shear loads**

<b>Screw and countersunk head versions</b>		M6	M8	M10	M12	M16	M20	
Shear load in cracked and non-cracked concrete C20/25 to C50/60	(kN)	13,4	18,6	28,1	41,5	67,0	99,1	
Displacement	$\delta_{v0}$	(mm)	6,0 (+1,5)	6,4 (+1,5)	6,9 (+1,5)	7,4 (+1,5)	8,3 (+2,0)	9,4 (+2,0)
	$\delta_{v\infty}$	(mm)	9,0 (+1,5)	9,7 (+1,5)	10,4 (+1,5)	11,0 (+1,5)	12,4 (+2,0)	14,1 (+2,0)

<b>Threaded rod version</b>		M6	M8	M10	M12	M16	M20	
Shear load in cracked and non-cracked concrete C20/25 to C50/60		8,2	10,9	17,7	27,1	53,2	62,8	
Displacement	$\delta_{v0}$	(mm)	4,5 (+1,5)	4,8 (+1,5)	5,0 (+1,5)	5,3 (+1,5)	5,8 (+2,0)	6,5 (+2,0)
	$\delta_{v\infty}$	(mm)	6,7 (+1,5)	7,1 (+1,5)	7,5 (+1,5)	7,9 (+1,5)	8,8 (+2,0)	9,8 (+2,0)

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**Table 9: Characteristic values of resistance to tension loads under fire exposure**

Fire resistance duration = 30 minutes			M6	M8	M10	M12	M16	M20
<b>Steel failure</b>								
Characteristic resistance	$N_{Rk,s,fi,30}$	(kN)	0,9	2,8	4,5	17,6	32,8	51,1
<b>Pull-out failure</b>								
Characteristic resistance in concrete C20/25 to C50/60	$N_{Rk,p,fi,30}$	(kN)	1,2	3,0	4,0	-	-	-
<b>Concrete cone failure</b>								
Characteristic resistance in concrete C20/25 to C50/60	$N_{Rk,c,fi,30}$	(kN)	3,2	5,0	7,4	10,3	18,0	31,4

Fire resistance duration = 60 minutes			M6	M8	M10	M12	M16	M20
<b>Steel failure</b>								
Characteristic resistance	$N_{Rk,s,fi,60}$	(kN)	0,6	2,1	3,3	11,4	21,3	33,2
<b>Pull-out failure</b>								
Characteristic resistance in concrete C20/25 to C50/60	$N_{Rk,p,fi,60}$	(kN)	1,2	3,0	4,0	-	-	-
<b>Concrete cone failure</b>								
Characteristic resistance in concrete C20/25 to C50/60	$N_{Rk,c,fi,60}$	(kN)	3,2	5,0	7,4	10,3	18,0	31,4

Fire resistance duration = 90 minutes			M6	M8	M10	M12	M16	M20
<b>Steel failure</b>								
Characteristic resistance	$N_{Rk,s,fi,90}$	(kN)	0,4	1,3	2,1	5,3	9,8	15,3
<b>Pull-out failure</b>								
Characteristic resistance in concrete C20/25 to C50/60	$N_{Rk,p,fi,90}$	(kN)	1,2	3,0	4,0	-	-	-
<b>Concrete cone failure</b>								
Characteristic resistance in concrete C20/25 to C50/60	$N_{Rk,c,fi,90}$	(kN)	3,2	5,0	7,4	10,3	18,0	31,4

Fire resistance duration = 120 minutes			M6	M8	M10	M12	M16	M20
<b>Steel failure</b>								
Characteristic resistance	$N_{Rk,s,fi,120}$	(kN)	0,3	0,9	1,5	2,2	4,1	6,4
<b>Pull-out failure</b>								
Characteristic resistance in concrete C20/25 to C50/60	$N_{Rk,p,fi,120}$	(kN)	1,0	2,4	3,2	-	-	-
<b>Concrete cone failure</b>								
Characteristic resistance in concrete C20/25 to C50/60	$N_{Rk,c,fi,120}$	(kN)	2,5	4,0	5,9	8,2	14,4	25,2

<b>Spacing</b>	$S_{cr,N}$	(mm)	<b>4 x <math>h_{ef}</math></b>					
	$S_{min}$	(mm)	50	60	70	80	100	125
<b>Edge distance</b>	$C_{cr,N}$	(mm)	<b>2 x <math>h_{ef}</math></b>					
	$C_{min}$	(mm)	c <sub>min</sub> = 2 x $h_{ef}$ ; if the fire attack is from more than one side, the edge distance of the anchor has to be $\geq 300$ mm and $\geq 2$ x $h_{ef}$					

In absence of other national regulation the partial safety factor for resistance under fire exposure  $\gamma_{M,fi} = 1,0$  is recommended.

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**Table 10: Characteristic values of resistance to shear loads under fire exposure**

Fire resistance duration = 30 minutes			M6	M8	M10	M12	M16	M20
<b>Steel failure without lever arm</b>								
Characteristic resistance	$V_{Rk,s,fi,30}$	(kN)	0,9	2,8	4,5	17,6	32,8	51,1
<b>Steel failure with lever arm</b>								
Characteristic bending resistance	$M_{Rk,s,fi,30}$	(N.m)	0,9	2,9	5,8	27,3	69,5	135,5

Fire resistance duration = 60 minutes			M6	M8	M10	M12	M16	M20
<b>Steel failure without lever arm</b>								
Characteristic resistance	$V_{Rk,s,fi,60}$	(kN)	0,6	2,1	3,3	11,4	21,3	33,2
<b>Steel failure with lever arm</b>								
Characteristic bending resistance	$M_{Rk,s,fi,60}$	(N.m)	0,6	2,1	4,2	17,8	45,2	88,1

Fire resistance duration = 90 minutes			M6	M8	M10	M12	M16	M20
<b>Steel failure without lever arm</b>								
Characteristic resistance	$V_{Rk,s,fi,90}$	(kN)	0,4	1,3	2,1	5,3	9,8	15,3
<b>Steel failure with lever arm</b>								
Characteristic bending resistance	$M_{Rk,s,fi,90}$	(N.m)	0,4	1,3	2,7	8,2	20,9	40,7

Fire resistance duration = 120 minutes			M6	M8	M10	M12	M16	M20
<b>Steel failure without lever arm</b>								
Characteristic resistance	$V_{Rk,s,fi,120}$	(kN)	0,3	0,9	1,5	2,2	4,1	6,4
<b>Steel failure with lever arm</b>								
Characteristic bending resistance	$M_{Rk,s,fi,120}$	(N.m)	0,3	0,9	1,9	3,4	8,7	17,0

**Concrete pry-out failure**

In Eq. (5.6) of ETAG 001 Annex C, §5.2.2.3, the k factor = 2 and the relevant values of  $N_{Rk,c,fi}$  given in the above Annex 8 Table 9 have to be considered in the design.

**Concrete edge failure**

The characteristic resistance  $V_{Rk,c,fi}^0$  in C20/25 to C50/60 concrete is determined by:  
 $V_{Rk,c,fi}^0 = 0,25 \times V_{Rk,c}^0 (\leq R90)$  and  $V_{Rk,c,fi}^0 = 0,20 \times V_{Rk,c}^0 (R120)$   
 with  $V_{Rk,c}^0$  initial value of the characteristic resistance in cracked concrete C20/25 under normal temperature according to ETAG 001, Annex C, §5.2.3.4.

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