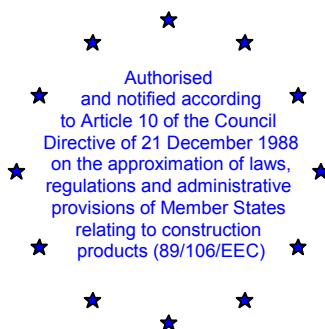


**INSTITUTO DE CIENCIAS DE  
LA CONSTRUCCIÓN  
EDUARDO TORROJA**

C/ Serrano Galvache n. 4  
28033 Madrid (Spain)  
Tel.: (34) 91 302 04 40  
Fax: (34) 91 302 07 00  
director.ietcc@csic.es  
www.ietcc.csic.es



**Miembro de EOTA  
EOTA MEMBER**

**European Technical Approval**

**ETA-13/1012**

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

**Nombre comercial:**

Trade name:

**TECFI Wedge Anchor ZJE**

**Beneficiario del DITE**

Holder of approval:

**TECFI S.p.A.,**  
S.S. Appia km 192  
81050 Pastoramo (CE) Italy

**Área genérica y uso del producto de construcción:**

Generic type and use of construction product:

**Anclaje de par controlado fabricado en acero galvanizado o acero inoxidable de medidas M6, M8, M10, M12, M14, M16 y M20 para uso único en hormigón no fisurado**

Torque controlled expansion anchor made of galvanized steel or stainless steel of sizes M6, M8, M10, M12, M14, M16 and M20 for use in non cracked concrete only

**Validez de / hasta:**

Validity from / to:

**28 – 06 – 2013 / 08 – 11 – 2015**

**Planta 1 de fabricación:**

Manufacturing plant 1:

**TECFI 1**

**Planta 2 de fabricación:**

Manufacturing plant 2:

**TECFI 2**

**El presente Documento de Idoneidad Técnica Europeo contiene:**

This European Technical Approval contains:

**17 páginas, incluyendo 9 anexos, los cuales forman parte del documento.**

17 pages, including 9 annexes, which form an integral part of the document.



Organización Europea para la Idoneidad Técnica  
European Organisation for Technical Approvals

## I. LEGAL BASES AND GENERAL CONDITIONS

1. This European Technical Approval is issued *by the Instituto de Ciencias de la Construcción Eduardo Torroja* in accordance with:
  - Council Directive (89/106/EEC)<sup>1</sup> of 21 December 1988 on the approximation of laws, regulations and administrative provisions of Member States relating to construction products, modified by the Council Directive 93/68/EEC of July 1993<sup>2</sup>.
  - *Real Decreto 1630/1992 de 29 de diciembre, por el que se dictan disposiciones para la libre circulación de productos de construcción en aplicación de la Directiva 89/106/CEE<sup>3</sup>. REAL DECRETO 1328/1995, de 28 de julio, por el que se modifican, en aplicación de la Directiva 93/68/CEE las disposiciones para la libre circulación, aprobadas por el Real Decreto 1630/1992, de 29 de diciembre. (B.O.E. 19.895) y la Orden CTE/2276/2002 de 4 de septiembre.*
  - 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“, Part 1 “Anchors in general“, and Part 2, “Torque-controlled expansion anchors”
2. The *Instituto de Ciencias de la Construcción Eduardo Torroja* is authorised to check whether the provisions of this European Technical Approval are met. Checking may take place in the manufacturing plant(s) (e.g. concerning the fulfilment of assumptions made in this European Technical Approval with regard to manufacturing). Nevertheless, the responsibility for the conformity of the products to the European Technical Approval and for their fitness for intended use remains with the holder of the European Technical Approval.
3. This European Technical Approval is not to be transferred to other manufacturers or agents of manufacturers other than those indicated on page 1, or manufacturing plants other than those indicated on page 1 laid down in the context of this European Technical Approval .
4. This European Technical Approval may be withdrawn by the *Instituto de Ciencias de la Construcción Eduardo Torroja* 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> Boletín Oficial del Estado n° 34 9.11.93.

<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 Tecfi ZJE01 in the range of M6 to M20 is an anchor made of galvanized steel. The Tecfi ZJE71 in the range of M6 to M20 is an anchor made of stainless steel. Both are placed into a drilled hole and anchored by torque-controlled expansion.

For the installed anchor see Figure given in Annex 1.

#### 1.2 Intended use

The anchors are 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 C20/25 to C50/60, according to ENV 206: 1990-03. It may be anchored in non-cracked concrete only.

For M6 to M14 anchor, reinforcement spacing should be higher than 150 mm.

The Tecfi ZJE01 anchor may only be used in concrete subject to dry internal conditions.

The Tecfi ZJE71 anchor may be in concrete subject to dry internal conditions and also in concrete subject to external atmospheric exposure (including industrial and marine environment), or exposure in 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 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 can not be interpreted as a guarantee given by the producer, but are to be regarded only as a means for choosing the right product 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 Tecfi ZJE01 and ZJE71 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 1 to 4 shall correspond to the respective values laid down in the technical documentations <sup>(5)</sup> of this European Technical Approval. The characteristic anchor values for the design of anchorages are given in Annexes 5 to 9.

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(5) The technical documentation of this European Technical Approval is deposited at the *Instituto de Ciencias de la Construcción Eduardo Torroja* (IETcc) 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.

Each anchor is marked with its commercial name, the nominal diameter and the total length, according to Annex 1. A red colour ring marking identifies the standard embedment depth; the reduced embedment depth corresponds to the end of the threaded part to the concrete surface.

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

## 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 7.

## 3. Evaluation of Conformity and CE marking

### 3.1 Attestation of conformity and CE marking

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>(5)</sup>. The incoming raw materials shall be subject to controls and tests by the manufacturer before acceptance. Check of such as nuts, washers, wire for bolts and metal band for expansion clip 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:

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<sup>5</sup> The prescribed test plan has been deposited at the *Instituto de Ciencias de la Construcción Eduardo Torroja* (IETcc) and is only made available to the approved bodies involved in the conformity attestation procedure.

Component	Characteristics
Body	Zinc plated coating thickness (*)
	Steel mechanical characteristics (*)
	Steel chemical composition (*)
	Geometry (diameter and length)
	Vickers Hardness (*)
Washer	Zinc plated coating thickness (*)
	Steel mechanical characteristics (*)
	Steel chemical composition (*)
	Geometry (diameter and thickness)
Nut	Zinc plated coating thickness (*)
	Steel mechanical characteristics (*)
	Steel chemical composition (*)
	Geometry (diameter and length)
	Vickers Hardness (*)
Clip	Zinc plated coating thickness (*)
	Steel mechanical characteristics (*)
	Steel chemical composition (*)
	Geometry (diameter and thickness)

(\*) Test to be carried out only in case of new supplier

During the manufacture process, the anchor shall be subjected to visual control of correct assemblage and of completeness of the anchor.

The finished anchor shall be subjected to the control of tensile strength test of individual 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 Instituto de Ciencias de la Construcción Eduardo Torroja (IETcc).

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 Instituto de Ciencias de la Construcción Eduardo Torroja (IETcc) and the approved bodies involved.

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

The approved body shall ascertain that, in accordance with the prescribed test plan, the factory, in particular, staff and equipment, 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 in the Annexes to the European Technical Approval, in accordance with the prescribed test plan.

#### 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 Instituto de Ciencias de la Construcción Eduardo Torroja (IETcc).

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 7).
- 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 the inspection of the plant by the Instituto de Ciencias de la Construcción Eduardo Torroja (IETcc) 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.).

#### 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 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 in the direction of load application.
- Application of the torque moment given in Annex 3 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 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.



Instituto de Ciencias de la Construcción Eduardo Torroja  
**CONSEJO SUPERIOR DE INVESTIGACIONES CIENTÍFICAS**  
c/ Serrano Galvache nº4. 28033 Madrid. Tel: (34) 91 302 04 40 Fax: (34) 91 302 07 00  
[www.ietcc.csic.es](http://www.ietcc.csic.es)



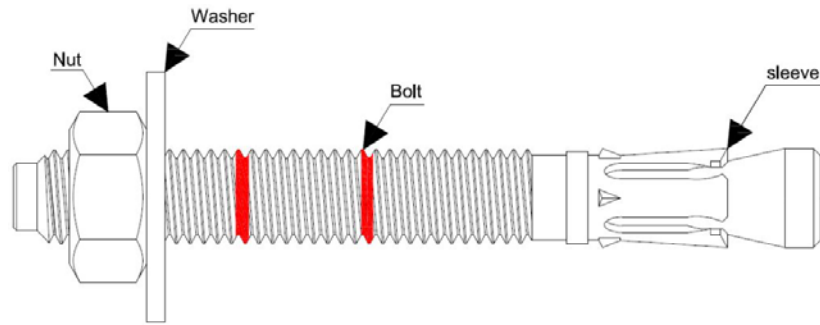
**On behalf of the Instituto de Ciencias de la Construcción Eduardo Torroja**  
Madrid, 28<sup>th</sup> June 2013  
The Director of the INSTITUTO DE CIENCIAS  
DE LA CONSTRUCCIÓN EDUARDO TORROJA

A handwritten signature in blue ink, appearing to read 'Ángel Arteaga Iriarte', is written over a light blue horizontal line.

D. Ángel Arteaga Iriarte



### Assembled anchor

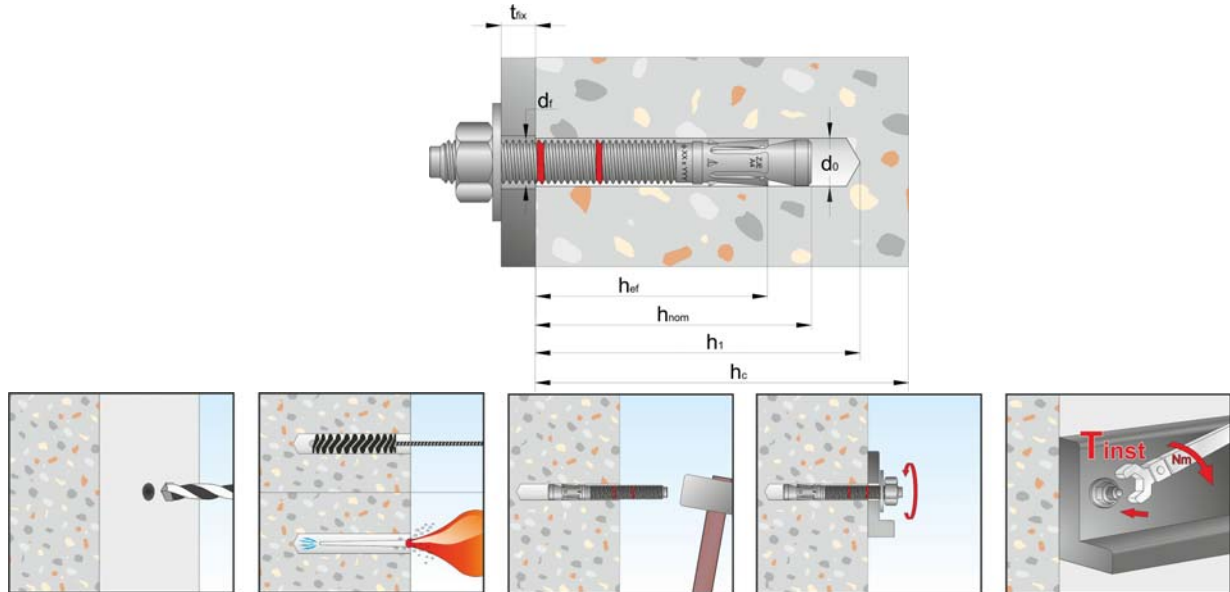


- 1.- Body
- 2.- Washer
- 3.- Nut
- 4.- Expansion clip

Identification on anchor:

- galvanized version: "T" + metric + "ZJE01" / metric x length
- stainless steel version: "T" + metric + "ZJE71" / metric x length

### Schema of the anchor in use



- $h_{ef}$ : Effective anchorage depth
- $h_1$ : Drilling hole depth
- $h_c$ : Minimum concrete depth
- $t_{fix}$ : Fixture thickness
- $d_0$ : Drill bit
- $d_f$ : Diameter of clearance hole on fixture

Tecfi ZJE01, ZJE71 anchor

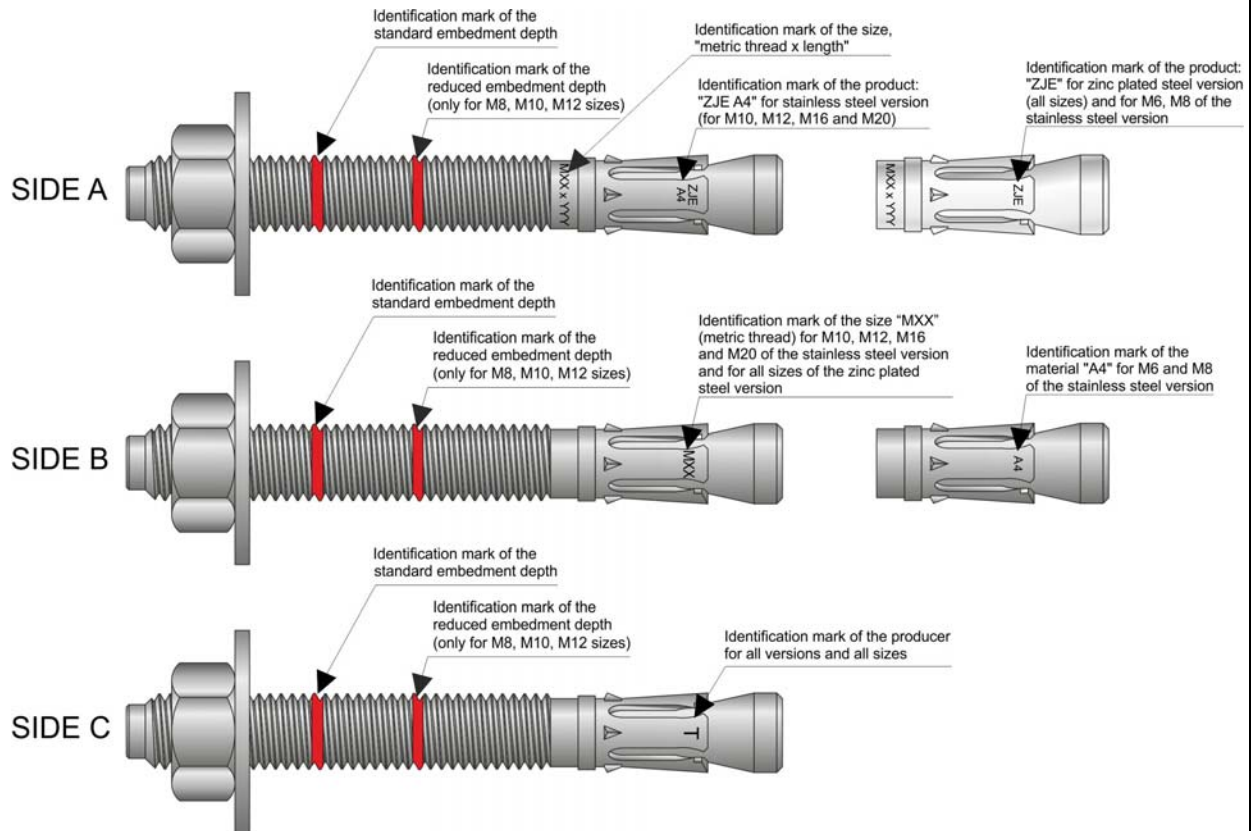
Product and intended use

**Annex 1**  
of European  
Technical Approval

**ETA-13/1012**

**Table 1. Materials**

Item	Designation	Tecfi ZJE01 GALVANIZED STEEL	Tecfi ZJE71 STAINLESS STEEL
1	Body	Steel Q215 GB/T 701 galvanized $\geq 5 \mu\text{m}$ ISO 4042 A2J	Stainless steel, grade A4
2	Washer	DIN 125 or DIN 9021 galvanized $\geq 5 \mu\text{m}$ ISO 4042 A2J	DIN 125 or DIN 9021 stainless steel, grade A4
3	Nut	DIN 934 galvanized $\geq 5 \mu\text{m}$ ISO 4042 A2J	DIN934 stainless steel, grade A4
4	Expansion clip	Steel DC03 EN101239 or SPCD JIS G3141 galvanized $\geq 5 \mu\text{m}$ ISO 4042 A2J	Stainless steel, grade A4



Tecfi ZJE01, ZJE71 anchor

Materials of anchors

**Annex 2**  
 of European  
 Technical Approval  
**ETA-13/1012**

**Table 2. Installation data**

<b>Tecfi ZJE01 (galvanized steel)</b>			M6	M8	M10	M12	M14	M16	M20
Nominal diameter of the drill bit	$d_o$	[mm]	6	8	10	12	14	16	20
Diameter of clearance in the fixture	$d_f$	[mm]	7	9	12	14	16	18	22
Required torque moment	$T_{ins}$	[Nm]	7	20	35	60	90	120	240
<b>Standard embedment depth</b>			$h_{ef, std}$						
Total length of the bolt	$L_{min}$	[mm]	60	75	90	110	120	125	170
	$L_{max}$	[mm]	180	155	230	250	250	280	270
Minimum thickness of the concrete member	$h_{min}$	[mm]	100	100	110	130	150	168	206
Depth of drilled hole to deepest point	$h_1$	[mm]	55	65	75	85	100	110	135
Overall anchor embedment depth in the concrete	$h_{nom}$	[mm]	49.5	59.5	66.5	77	91	103.5	125
Effective anchorage depth	$h_{ef, std}$	[mm]	40	48	55	65	75	84	103
Maximum thickness of fixture (from – to)	$t_{fix, max}$	[mm]	2-122	5-85	10-150	18-158	12-142	3-158	23-123
Minimum allowable spacing	$s_{min}$	[mm]	50	65	70	85	100	110	135
Minimum allowable edge distance	$c_{min}$	[mm]	50	65	70	85	100	110	135
<b>Reduced embedment depth</b>			$h_{ef, red}$						
Total length of the bolt	$L_{min}$	[mm]	--	60	70	90	--	--	--
	$L_{max}$	[mm]	--	155	230	250	--	--	--
Minimum thickness of the concrete member	$h_{min}$	[mm]	--	100	100	100	--	--	--
Depth of drilled hole to deepest point	$h_1$	[mm]	--	50	60	70	--	--	--
Overall anchor embedment depth in the concrete	$h_{nom}$	[mm]	--	46.5	53.5	62	--	--	--
Effective anchorage depth	$h_{ef, red}$	[mm]	--	35 <sup>1)</sup>	42	50	--	--	--
Maximum thickness of fixture (from – to)	$t_{fix, max}$	[mm]	--	3-98	3-163	13-173	--	--	--
Minimum allowable spacing	$s_{min}$	[mm]	--	65	70	85	--	--	--
Minimum allowable edge distance	$c_{min}$	[mm]	--	65	70	85	--	--	--

<sup>1)</sup> Use restricted to anchoring of structural components which are statically indeterminate

Tecfi ZJE01, ZJE71 anchor	<b>Annex 3</b> of European Technical Approval <b>ETA-13/1012</b>
Installation data for Tecfi ZJE01 anchor	

**Table 2. Installation data (/continued)**

<b>Tecfi ZJE71 (stainless steel, grade A4)</b>			M6	M8	M10	M12	M16	M20
Nominal diameter of the drill bit	$d_o$	[mm]	6	8	10	12	16	20
Diameter of clearance in the fixture	$d_f$	[mm]	7	9	12	14	18	22
Required torque moment	$T_{ins}$	[Nm]	7	20	35	60	120	240
<b>Standard embedment depth</b>			$h_{ef, std}$					
Total length of the bolt	$L_{min}$	[mm]	60	75	90	110	125	170
	$L_{max}$	[mm]	180	155	170	180	170	220
Minimum thickness of the concrete member	$h_{min}$	[mm]	100	100	110	130	168	206
Depth of drilled hole to deepest point	$h_1$	[mm]	55	65	75	85	110	135
Overall anchor embedment depth in the concrete	$h_{nom}$	[mm]	49.5	59.5	66.5	77	103.5	125
Effective anchorage depth	$h_{ef, std}$	[mm]	40	48	55	65	84	103
Maximum thickness of fixture (from – to)	$t_{fix, max}$	[mm]	2-122	5-85	10-90	18-88	3-48	23-73
Minimum allowable spacing	$s_{min}$	[mm]	50	65	70	85	110	135
Minimum allowable edge distance	$c_{min}$	[mm]	50	65	70	85	110	135
<b>Reduced embedment depth</b>			$h_{ef, red}$					
Total length of the bolt	$L_{min}$	[mm]	--	60	70	90	--	--
	$L_{max}$	[mm]	--	155	170	180	--	--
Minimum thickness of the concrete member	$h_{min}$	[mm]	--	100	100	100	--	--
Depth of drilled hole to deepest point	$h_1$	[mm]	--	50	60	70	--	--
Overall anchor embedment depth in the concrete	$h_{nom}$	[mm]	--	46.5	53.5	62	--	--
Effective anchorage depth	$h_{ef, red}$	[mm]	--	35 <sup>1)</sup>	42	50	--	--
Maximum thickness of fixture (from – to)	$t_{fix, max}$	[mm]	--	3-98	3-103	13-103	--	--
Minimum allowable spacing	$s_{min}$	[mm]	--	65	70	85	--	--
Minimum allowable edge distance	$c_{min}$	[mm]	--	65	70	85	--	--

<sup>1)</sup> Use restricted to anchoring of structural components which are statically indeterminate

Tecfi ZJE01, ZJE71 anchor

Installation data for Tecfi ZJE71 anchor

**Annex 4**  
 of European  
 Technical Approval  
**ETA-13/1012**

**Table 3. Characteristic values of resistance to tension loads of design method A**

Tecfi ZJE01 (galvanized steel)			M6	M8	M10	M12	M14	M16	M20	
<b>Steel failure</b>										
Characteristic resistance	$N_{Rk,s}$	[kN]	7.7	16.4	25.6	35.4	51.7	65.0	104.4	
Partial safety factor	$\gamma_{M,s}$	[-]	1.40	1.40	1.40	1.43	1.43	1.43	1.47	
<b>Pull out failure</b>										
<b>Standard embedment depth</b>		$h_{ef,std}$								
Char. resistance in C20/25 non cracked concrete	$N_{Rk,p}$	[kN]	-- <sup>2)</sup>	12	16	25	30	35	50	
Partial safety factor	$\gamma_{M,p}$	[-]	--	1.5 <sup>3)</sup>	1.8 <sup>3)</sup>					
<b>Reduced embedment depth</b>		$h_{ef,red}$								
Char. resistance in C20/25 non cracked concrete	$N_{Rk,p}$	[kN]	-- <sup>2)</sup>	9 <sup>1)</sup>	12	16	--	--	--	
Partial safety factor	$\gamma_{M,p}$	[-]	--	1.5 <sup>3)</sup>			--	--	--	
Increasing factors for both embedment depths	$\Psi_c$	C30/37	1.22							
	$\Psi_c$	C40/50	1.41							
	$\Psi_c$	C50/60	1.55							
<b>Concrete cone failure and splitting failure</b>										
<b>Standard embedment depth</b>		$h_{ef,std}$								
Effective anchorage depth	$h_{ef,std}$	[mm]	40	48	55	65	75	84	103	
Char. resistance in C20/25 non cracked concrete	$N_{Rk,c}$	[kN]	12.7	16.7	20.5	26.4	32.7	38.8	52.6	
Partial safety factor	$\gamma_{M,c}=\gamma_{M,sp}$	[-]	1.5 <sup>3)</sup>			1.8 <sup>3)</sup>				
Spacing	$s_{cr,N}$	[mm]	120	144	165	195	225	252	309	
	$s_{cr,sp}$	[mm]	160	192	220	260	300	336	412	
Edge distance	$c_{cr,N}$	[mm]	60	72	83	98	113	126	155	
	$c_{cr,sp}$	[mm]	80	96	110	130	150	168	206	
<b>Reduced embedment depth</b>		$h_{ef,red}$								
Effective anchorage depth	$h_{ef,red}$	[mm]	--	35 <sup>1)</sup>	42	50	--	--	--	
Char. resistance in C20/25 non cracked concrete	$N_{Rk,c}$	[kN]		10.4 <sup>1)</sup>	13.7	17.8				
Partial safety factor	$\gamma_{M,c}=\gamma_{M,sp}$	[-]	--	1.5 <sup>3)</sup>			--	--	--	
Spacing	$s_{cr,N}$	[mm]	--	105 <sup>1)</sup>	126	150	--	--	--	
	$s_{cr,sp}$	[mm]	--	140 <sup>1)</sup>	168	200	--	--	--	
Edge distance	$c_{cr,N}$	[mm]	--	53 <sup>1)</sup>	63	75	--	--	--	
	$c_{cr,sp}$	[mm]	--	70 <sup>1)</sup>	84	100	--	--	--	
Increasing factor for both embedment depths	$\Psi_c$	C30/37	1.22							
	$\Psi_c$	C40/50	1.41							
	$\Psi_c$	C50/60	1.55							

<sup>1)</sup> Use restricted to anchoring of structural components which are statically indeterminate

<sup>2)</sup> Pull out failure is not decisive

<sup>3)</sup> The partial safety factor  $\gamma_2$  is included

Tecfi ZJE01, ZJE71 anchor

Design method A, characteristic values of tension resistance and design values; Tecfi ZJE01 galvanized steel

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**Table 3. Characteristic values of resistance to tension loads of design method A (continued)**

Tecfi ZJE71 (stainless steel, grade A4)			M6	M8	M10	M12	M16	M20
<b>Steel failure</b>								
Characteristic resistance	$N_{Rk,s}$	[kN]	10.1	19.1	34.3	49.6	85.9	140.7
Partial safety factor	$\gamma_{M,s}$	[-]	1.68					
<b>Pull out failure</b>								
<b>Standard embedment depth</b>			$h_{ef, std}$					
Charact. resistance in C20/25 non cracked concrete	$N_{Rk,p}$	[kN]	-- <sup>2)</sup>	12	16	25	35	50
Partial safety factor	$\gamma_{M,p}$	[-]	--	1.5 <sup>3)</sup>	1.8 <sup>3)</sup>			
<b>Reduced embedment depth</b>			$h_{ef, red}$					
Charact. resistance in C20/25 non cracked concrete	$N_{Rk,p}$	[kN]	--	9 <sup>1)</sup>	12	16	--	--
Partial safety factor	$\gamma_{M,p}$	[-]	--	1.8 <sup>3)</sup>			--	--
Increasing factors	$\Psi_c$	C30/37	1.22					
	$\Psi_c$	C40/50	1.41					
	$\Psi_c$	C50/60	1.55					
<b>Concrete cone failure and splitting failure</b>								
<b>Standard embedment depth</b>			$h_{ef, std}$					
Effective anchorage depth	$h_{ef, std}$	[mm]	40	48	55	65	84	103
Charact. resistance in C20/25 non cracked concrete	$N_{Rk,c}$	[kN]	12.7	16.7	20.5	26.4	38.8	52.6
Partial safety factor	$\gamma_{M,c} = \gamma_{M,sp}$	[-]	1.5 <sup>3)</sup>			1.8 <sup>3)</sup>		
Spacing	$s_{cr,N}$	[mm]	120	144	165	195	252	309
	$s_{cr,sp}$	[mm]	160	192	220	260	336	412
Edge distance	$c_{cr,N}$	[mm]	60	72	83	98	126	155
	$c_{cr,sp}$	[mm]	80	96	110	130	168	206
<b>Reduced embedment depth</b>			$h_{ef, red}$					
Effective anchorage depth	$h_{ef, red}$	[mm]	--	35 <sup>1)</sup>	42	50	--	--
Charact. resistance in C20/25 non cracked concrete	$N_{Rk,c}$	[kN]	--	10.4 <sup>1)</sup>	13.7	17.8	--	--
Partial safety factor	$\gamma_{M,c} = \gamma_{M,sp}$	[-]	--	1.8 <sup>3)</sup>			--	--
Spacing	$s_{cr,N}$	[mm]	--	105 <sup>1)</sup>	126	150	--	--
	$s_{cr,sp}$	[mm]	--	140 <sup>1)</sup>	168	200	--	--
Edge distance	$c_{cr,N}$	[mm]	--	53 <sup>1)</sup>	63	75	--	--
	$c_{cr,sp}$	[mm]	--	70 <sup>1)</sup>	84	100	--	-
Increasing factor	$\Psi_c$	C30/37	1.22					
	$\Psi_c$	C40/50	1.41					
	$\Psi_c$	C50/60	1.55					

<sup>1)</sup> Use restricted to anchoring of structural components which are statically indeterminate

<sup>2)</sup> Pull out failure is not decisive

<sup>3)</sup> The partial safety factor  $\gamma_2$  is included

Tecfi ZJE01, ZJE71 anchor

Design method A, characteristic values of tension resistance and design values; Tecfi ZJE71 stainless steel

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**Table 4. Displacements under tension loads**

<b>Tecfi ZJE01 (galvanized steel)</b>			M6	M8	M10	M12	M14	M16	M20
<b>Standard embedment depth</b>			$h_{ef, std}$						
Tension load in non cracked concrete C20/25 to C50/60	N	[kN]	2.8	5.0	6.0	9.3	10.7	16.0	17.0
Displacement	$\bar{\delta}_{N0}$	[mm]	0.70	1.12	1.07	1.32	1.82	2.38	3.56
	$\bar{\delta}_{N\infty}$	[mm]	1.47	2.34	2.24	2.77	3.82	4.99	7.47
<b>Reduced embedment depth</b>			$h_{ef, red}$						
Tension load in non cracked concrete C20/25 to C50/60	N	[kN]	--	4.2	5.7	7.6	--	--	--
Displacement	$\bar{\delta}_{N0}$	[mm]	--	0.20	0.13	0.06	--	--	--
	$\bar{\delta}_{N\infty}$	[mm]	--	1.78	1.78	1.78	--	--	--
<b>Tecfi ZJE71 (stainless steel, grade A4)</b>			M6	M8	M10	M12	M16	M20	
<b>Standard embedment depth</b>			$h_{ef, std}$						
Tension load in non cracked concrete C20/25 to C50/60	N	[kN]	4.3	5.7	6.3	9.9	13.8	19.8	
Displacement	$\bar{\delta}_{N0}$	[mm]	0.42	0.22	0.17	0.19	0.19	0.11	
	$\bar{\delta}_{N\infty}$	[mm]	1.33	1.33	1.33	1.33	1.33	1.33	
<b>Reduced embedment depth</b>			$h_{ef, red}$						
Tension load in non cracked concrete C20/25 to C50/60	N	[kN]	--	4.2	5.7	7.6	--	--	
Displacement	$\bar{\delta}_{N0}$	[mm]	--	0.07	0.04	0.32	--	--	
	$\bar{\delta}_{N\infty}$	[mm]	--	0.60	0.60	0.60	--	--	

Tecfi ZJE01, ZJE71 anchor

Displacements under tension loads

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**Table 5. Characteristic values of resistance to shear loads of design method A**

<b>Tecfi ZJE01 (galvanized steel)</b>				M6	M8	M10	M12	M14	M16	M20
<b>Steel failure without lever arm</b>										
Characteristic resistance	$V_{Rk,s}$	[kN]		5.1	9.3	14.7	20.6	28.1	38.4	56.3
Partial safety factor	$\gamma_{M,s}$	[-]		1.25						
<b>Steel failure with lever arm</b>										
Characteristic resistance	$M^0_{Rk,s}$	[Nm]		7.7	19.1	38.1	64.1	102.2	163.1	298.5
Partial safety factor	$\gamma_{M,s}$	[-]		1.25						
<b>Concrete pryout resistance</b>										
Factor in equation (5.6) of ETAG, Annex C §5.2.3.3	for $h_{ef, std}$	k	[-]	1.0			2.0			
	for $h_{ef, red}$	k	[-]	--	1.0 <sup>1)</sup>	1.0	--	--	--	--
Partial safety factor	$\gamma_{M,c}$	[-]		1.5 <sup>2)</sup>						
<b>Concrete edge failure</b>										
Effective length of anchor under shear loads	for $h_{ef, std}$	$l_f$	[mm]	40	48	55	65	75	84	103
	for $h_{ef, red}$	$l_f$	[mm]	--	35 <sup>1)</sup>	42	50	--	--	--
Outside diameter of anchor	$d_{nom}$	[mm]		6	8	10	12	14	16	20
Partial safety factor	$\gamma_{M,c}$	[-]		1.5 <sup>2)</sup>						
<b>Tecfi ZJE71 (stainless steel, grade A4)</b>										
<b>Steel failure without lever arm</b>										
Characteristic resistance	$V_{Rk,s}$	[kN]		6.0	10.9	17.4	25.2	47.1	73.5	
Partial safety factor	$\gamma_{M,s}$	[-]		1.52						
<b>Steel failure with lever arm</b>										
Characteristic resistance	$M^0_{Rk,s}$	[Nm]		9.2	22.5	44.9	78.6	200	389	
Partial safety factor	$\gamma_{M,s}$	[-]		1.52						
<b>Concrete pryout resistance</b>										
Factor in equation (5.6) of ETAG, Annex C §5.2.3.3	for $h_{ef, std}$	K	[-]	1.0			2.0			
	for $h_{ef, red}$	K	[-]	--	1.0 <sup>1)</sup>	1.0	--	--	--	--
Partial safety factor	$\gamma_{M,c}$	[-]		1.5 <sup>2)</sup>						
<b>Concrete edge failure</b>										
Effective length of anchor under shear loads	for $h_{ef, std}$	$l_f$	[mm]	40	48	55	65	84	103	
	for $h_{ef, red}$	$l_f$	[mm]	--	35 <sup>1)</sup>	42	50	--	--	--
Outside diameter of anchor	$d_{nom}$	[mm]		6	8	10	12	16	20	
Partial safety factor	$\gamma_{M,c}$	[-]		1.5 <sup>2)</sup>						

<sup>1)</sup> Use restricted to anchoring of structural components which are statically indeterminate

<sup>2)</sup> The partial safety factor  $\gamma_2$  is included

Tecfi ZJE01, ZJE71 anchor

Design method A, characteristic values of shear resistance and design values.

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**Table 6. Displacements under shear loads**

<b>Tecfi ZJE01 (galvanized steel)</b>			M6	M8	M10	M12	M14	M16	M20
<b>Standard embedment depth</b> $h_{ef, std}$									
Shear load in non cracked concrete C20/25 to C50/60	V	[kN]	2.9	5.3	8.4	11.8	16.0	21.9	32.1
Displacement	$\bar{\delta}_{V0}$	[mm]	0,65	2,80	1,75	2,45	2,78	3,53	4,13
	$\bar{\delta}_{V\infty}$	[mm]	0,98	4,20	2,63	3,68	4,16	5,29	6,19
<b>Reduced embedment depth</b> $h_{ef, red}$									
Shear load in non cracked concrete C20/25 to C50/60	V	[kN]	--	5.3	8.4	11.8	--	--	--
Displacement	$\bar{\delta}_{V0}$	[mm]	--	0.59	1.22	1.10	--	--	--
	$\bar{\delta}_{V\infty}$	[mm]	--	0.89	1.83	1.65	--	--	--
<b>Tecfi ZJE71 (stainless steel, grade A4)</b>			M6	M8	M10	M12	M16	M20	
<b>Standard embedment depth</b> $h_{ef, std}$									
Shear load in non cracked concrete C20/25 to C50/60	V	[kN]	2.8	5.1	8.1	11.8	22.1	34.5	
Displacement	$\bar{\delta}_{V0}$	[mm]	1.66	1.79	3.83	4.13	5.75	6.59	
	$\bar{\delta}_{V\infty}$	[mm]	2.49	2.68	5.74	6.19	8.62	9.88	
<b>Reduced embedment depth</b> $h_{ef, red}$									
Shear load in non cracked concrete C20/25 to C50/60	V	[kN]	--	5.1	8.1	11.8	--	--	
Displacement	$\bar{\delta}_{V0}$	[mm]	--	0.60	3.83	4.13	--	--	
	$\bar{\delta}_{V\infty}$	[mm]	--	0.90	5.74	6.19	--	--	

Tecfi ZJE01, ZJE71 anchor

Displacements under shear loads

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