



## EUROPEAN ASSESSMENT DOCUMENT

EAD 330232-01-0601-v01

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Variant

# TORQUE-CONTROLLED EXPANSION FASTENERS FOR USE IN CONCRETE WITH VARIABLE WORKING LIFE UP TO 50 YEARS

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This European Assessment Document (EAD) has been developed taking into account up-to-date technical and scientific knowledge at the time of issue and is published in accordance with the relevant provisions of Regulation (EU) No 305/2011 as a basis for the preparation and issuing of European Technical Assessments (ETA).

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# 1 SCOPE OF THE EAD

## 1.1 Description of the construction product

This EAD covers post-installed mechanical metal fasteners placed into pre-drilled holes perpendicular to the surface (maximum deviation 5°) in concrete and anchored therein by mechanical means such as friction or mechanical interlock. Mechanical fasteners are often used to connect structural elements and non-structural elements to structural components.

This EAD is a variant to EAD 330232-01-0601, due to the fact that EAD 330232-01-0601 covers products with estimated working lives above 50 years and it does not allow for a differentiated working life below 50 years.

The metal parts of the fastener are made of carbon steel or malleable cast iron with a zinc-based corrosion protection coating. The fasteners may include non-load bearing material, e.g., plastic parts, for rotation prevention. The fasteners are directly anchored in the concrete and transmit the applied loads.

The following operating principles of mechanical fasteners are covered by this EAD:

- Torque-controlled expansion fastener (TC)

This EAD applies to fasteners with the following dimensions:

- minimum thread size of 6 mm (M6).
- minimum fastening depth  $\min h_{ef}$  of 40 mm. In special cases, e.g., in anchoring structural components which are statically indeterminate (such as light-weight suspended ceilings) and subject to internal exposure conditions only,  $\min h_{ef}$  may be reduced to 30 mm and these required restrictions have to be clearly stated in the ETA.

The product is not fully covered by EAD 330232-01-06.01, since the EAD provides for an assessment based on one specified working life, whereas this EAD will provide for assessment of different working lives below 50 years.

### Torque-controlled expansion fasteners (TC)

The operating principle is shown in Figure 1.1. The expansion is achieved by a torque acting on the screw or bolt. The tension force applied to the fastener is transferred into the concrete via friction and, to a limited extent, via keying (mechanical interlock) between the expansion sleeve and the deformed concrete. The following types of torque-controlled expansion fasteners are distinguished:

- Sleeve type (Figure 1.1 a)
- Bolt type (Figure 1.1 b)

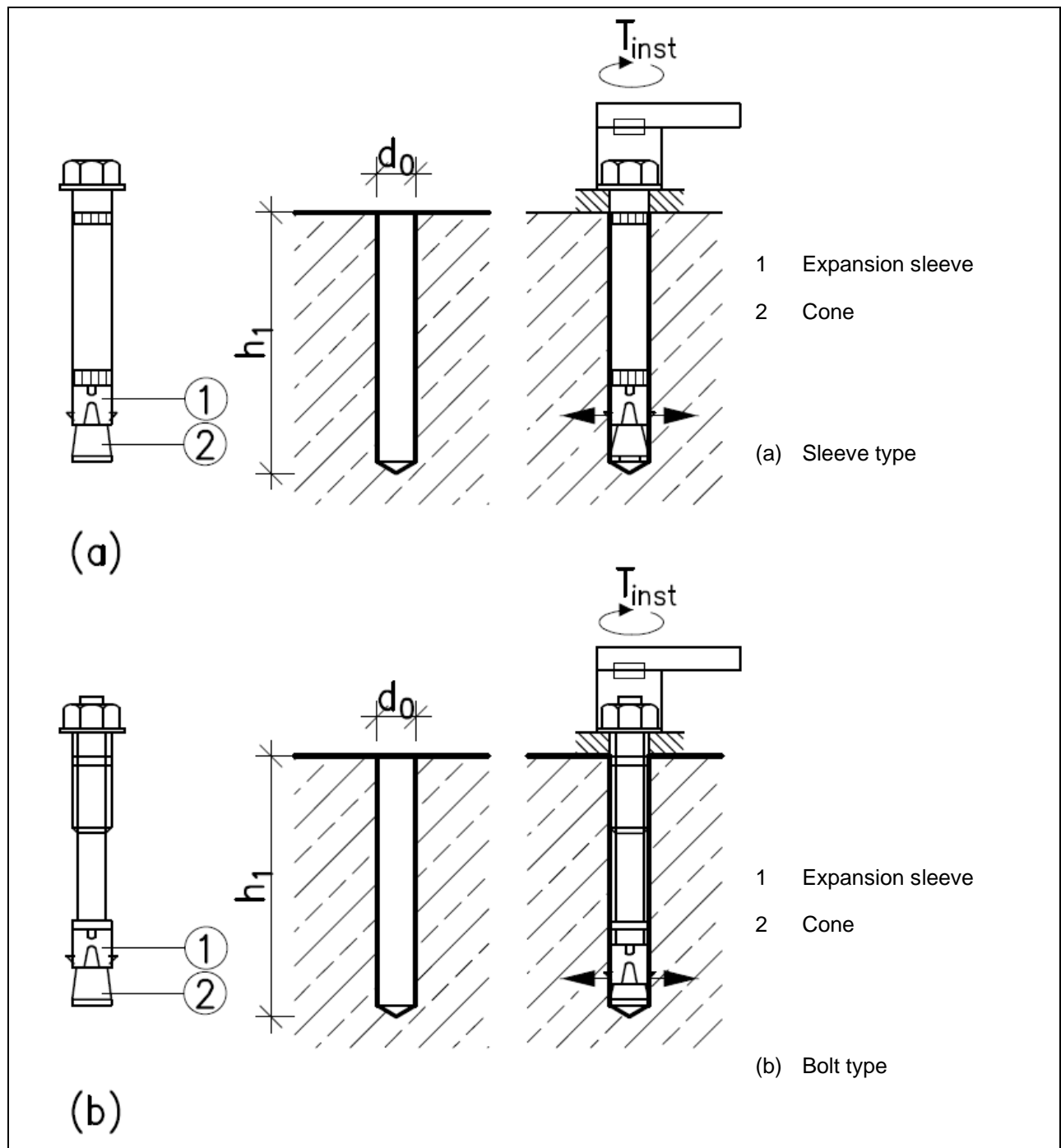


Figure 1.1 Example of torque-controlled expansion fasteners

The products addressed in this EAD are not covered by a harmonized European standard (hEN).

Concerning product packaging, transport, storage, maintenance, replacement and repair it is the responsibility of the manufacturer to undertake the appropriate measures and to advise his clients on the transport, storage, maintenance, replacement and repair of the product, as he considers necessary.

It is assumed that the product will be installed according to the manufacturer's instructions or (in absence of such instructions) according to the usual practice of the building professionals.

Relevant manufacturer's stipulations having influence on the performance of the product covered by this European Assessment Document, shall be considered for the determination of the performance and detailed in the ETA.

## 1.2 Information on the intended use(s) of the construction product

### 1.2.1 Intended use(s)

In this EAD the assessment is made to determine characteristic values of the mechanical fastener for calculations according to EN 1992-4<sup>1</sup>.

*For other design provisions additional test series may be required which are not covered by this EAD (such as tests under combined tension and shear load, tests with groups of fasteners for characteristic spacing in tension and shear, etc.).*

Mechanical fasteners are placed into pre-drilled holes for use in compacted reinforced or unreinforced normal weight concrete without fibres with strength classes in the range C20/25 to C50/60 all in accordance with EN 206.

The fastener is intended to be used

- in uncracked concrete only (Table 1, option 7 – 12)
- under static or quasi-static actions
- loaded in tension, shear or combined tension and shear.

*The loading on the fastener resulting from actions on the fixture (e. g. tension, shear, bending or torsion moments or any combination thereof) will generally be axial tension and/or shear. When the shear force is applied with a lever arm, a bending moment on the fastener will arise. It is presumed, that compressive forces acting in the axis of the fastener are transmitted by the fixture directly to the concrete without acting on the fastener's load transfer mechanism.*

The hardened concrete is at least 21 days old.

The covered temperature range of the anchorage base concrete during the working life is within the range -40 °C to +80 °C.

The thickness of the concrete member in which the fastener is installed is according to EAD 330232-01-0601

Any manufacturer's installation instructions (e.g., drilling technology, hole cleaning, installation tools, torque moments) shall be respected in the process of preparation of specimens and reported respectively in relation to product's performance in the ETA.

According to the intended use the manufacturer may choose one of the options given in Table 1.

- ✓ Intended use covered by the assessment option
- ✗ Intended use not covered by the assessment option

**Table 1 Assessment options covered by this EAD**

Option		Non cracked concrete	One value for all concrete strength classes	Different values for C20/25 to C50/60	One value for load direction	Separate values for tension and shear capacity	$C_{cr} / S_{cr}$	$C_{min} < C_{cr} / S_{min} < S_{cr}$	Design method acc. to prEN 1992-4		
7	✓	✓	✗	✓	✗	✓	✓	✓	A		
8			✓	✗							
9			✗	✓	✓	✗			✓	✗	C
10			✓	✗							
11			✗	✓							
12			✓	✗							

<sup>1</sup> All undated references to standards or to EADs in this EAD are to be understood as references to the dated versions listed in clause 4

### **1.2.2 Working life/Durability**

The assessment methods included or referred to in this EAD have been written based on the manufacturer's request to take into account a working life of the fastener for the intended use, which is varied depending on the corrosion protection and the environmental conditions but not exceeding 50 years. These provisions are based upon the current state of the art and the available knowledge and experience.

When assessing the product, the intended use as foreseen by the manufacturer shall be taken into account. The real working life may be, in normal use conditions, considerably longer without major degradation affecting the basic requirements for works<sup>2</sup>.

The indications given as to the working life of the construction product cannot be interpreted as a guarantee neither given by the product manufacturer or his representative nor by EOTA when drafting this EAD nor by the Technical Assessment Body issuing an ETA based on this EAD, but are regarded only as a means for expressing the expected economically reasonable working life of the product.

### **1.3 Specific terms used in this EAD**

See section 1.3 of EAD 330232-01-0601

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<sup>2</sup> The real working life of a product incorporated in a specific works depends on the environmental conditions to which that works is subject, as well as on the particular conditions of the design, execution, use and maintenance of that works. Therefore, it cannot be excluded that in certain cases the real working life of the product may also be shorter than the assumed working life.

## 2 ESSENTIAL CHARACTERISTICS AND RELEVANT ASSESSMENT METHODS AND CRITERIA

### 2.1 Essential characteristics of the product

Table 2.1 shows how the performance of the torque-controlled expansion fasteners for use in concrete with variable working life up to 50 years are established in relation to the essential characteristics.

Table 2.1 Essential characteristics of the product and methods and criteria for assessing the performance of the product in relation to those essential characteristics

No	Essential characteristic	Assessment methods	Type of expression of product performance
<b>Basic Works Requirement 1: Mechanical resistance and stability</b>			
Characteristic resistance to tension load (static and quasi-static loading) Method A			
1	Resistance to steel failure	EAD 330232-01-0601 section 2.2.1	Level $N_{Rk,s}$ [kN] <sub>f</sub>
2	Resistance to pull-out failure	EAD 330232-01-0601 section 2.2.2	Level $N_{Rk,p}$ [kN], $\psi_c$ [-]
3	Resistance to concrete cone failure	EAD 330232-01-0601 section 2.2.3	Level $k_{ucr,N}$ [-], $h_{ef}$ , $c_N$ [mm]
4	Robustness	EAD 330232-01-0601 section 2.2.4	Level $\gamma_{inst}$ [-]
5	Minimum edge distance and spacing	EAD 330232-01-0601 section 2.2.5	Level $c_{min}$ , $s_{min}$ , $h_{min}$ [mm]
6	Edge distance to prevent splitting under load	EAD 330232-01-0601 section 2.2.6	Level $N^0_{Rk,sp}$ [kN]
Characteristic resistance to shear load (static and quasi-static loading)			
7	Resistance to steel failure under shear load	EAD 330232-01-0601 section 2.2.7	Level $V^0_{Rk,s}$ [kN], $M^0_{Rk,s}$ [Nm], $k_7$ [-]
8	Resistance to pry-out failure	EAD 330232-01-0601 section 2.2.8	Level $k_8$ [-]
Characteristic resistance for simplified design			
9	Method B	EAD 330232-01-0601 section 2.2.9.1	Level $F^0_{Rk}$ [kN], $M^0_{Rk,s}$ [Nm], $\psi_c$ [-], $s_{min}$ , $c_{min}$ , $h_{min}$ [mm]
10	Method C	EAD 330232-01-0601 section 2.2.9.2	Level $F_{Rk}$ [kN], $M^0_{Rk,s}$ [Nm], $c_{min}$ , $s_{min}$ , $h_{min}$ [mm]
Displacements			
11	Displacements under static and quasi-static loading	EAD 330232-01-0601 section 2.2.10	Level $\delta_{N0}$ , $\delta_{N\infty}$ , $\delta_{V0}$ , $\delta_{V\infty}$ [mm]
<b>Basic Works Requirement 2: Safety in case of fire</b>			
12	Reaction to fire	EAD 330232-01-0601 section 2.2.16	Class (A1)
Resistance to fire			
13	Fire resistance to steel failure (tension load)	EAD 330232-01-0601 section 2.2.17	Level $N_{Rk,s,fi}$ [kN]



No	Essential characteristic	Assessment methods	Type of expression of product performance
14	Fire resistance to pull-out failure (tension load)	EAD 330232-01-0601 section 2.2.18	Level $N_{Rk,p,fi}$ [kN]
15	Fire resistance to steel failure (shear load)	EAD 330232-01-0601 section 2.2.19	Level $V_{Rk,s,fi}$ [kN], $M^0_{Rk,s,fi}$ [Nm]
Aspects of durability linked with the Basic Works Requirements			
16	Durability	2.2.1	Description

## 2.2 Methods and criteria for assessing and classification of the performance of the product in relation to essential characteristics of the product

This chapter is intended to provide instructions for TABs. Therefore, the use of wordings such as “shall be stated in the ETA” or “it has to be given in the ETA” shall be understood only as such instructions for TABs on how results of assessments shall be presented in the ETA. Such wordings do not impose any obligations for the manufacturer and the TAB shall not carry out the assessment of the performance in relation to a given essential characteristic when the manufacturer does not wish to declare this performance in the Declaration of Performance.

### 2.2.1 Durability

The fastener characteristics shall not change during the working life, therefore the mechanical properties on which the functioning and bearing behaviour of the fastener depends (e.g., material, coating) shall not be adversely affected by ambient physico-chemical effects such as corrosion and degradation caused by environmental conditions (e.g., alkalinity, moisture, pollution). Furthermore, those parts of fasteners that are intended to move against each other during installation (e.g., nut on thread or cone in sleeve) or in use (e.g., cone in sleeve) shall not be subject to jamming so that the behaviour is not impaired when the fastener is loaded to failure.

Corrosion:

The assessment/testing required with respect to corrosion resistance will depend on the specification of the fastener in relation to its use and exposure to environmental conditions

Coating:

The following environmental conditions shall be taken into account in assessing durability of coatings:

dry internal conditions

- high alkalinity ( $pH \geq 13.2$ )
- temperature in range  $-5^{\circ}C$  to  $+40^{\circ}C$

other environmental conditions

- high alkalinity ( $pH \geq 13.2$ )
- temperature in range  $-40^{\circ}C$  to  $+80^{\circ}C$
- condensed water
- chlorides
- sulphur dioxide
- nitrogen oxide
- ammonia

The following test conditions for checking the durability and indicating a working life of the specified coating depend on the type of coating

**Table 2.2 Description of typical atmospheric environments indoor related to the estimation of corrosivity categories according to EN ISO 9223-2012-02 Table C.1 and the corresponding durability categories according to EAD-330232-01-0601 chapter 2.2.20 a (1) – (2)**

Corrosivity category	Corrosivity	Typical environments – Examples	
		Indoor	EAD-330232-01-0601 chapter 2.2.20
C1	Very low	Heated spaces with low relative humidity and insignificant pollution, e.g., offices, schools, museums	(1)
C2	Low	Unheated spaces with varying temperature and relative humidity. Low frequency of condensation and low pollution, e.g., storage, sport halls	(1)
C3	Medium	Spaces with moderate frequency of condensation and moderate pollution from production process, e.g., food-processing plants, laundries, breweries, dairies	(2)
C4	High	Spaces with high frequency of condensation and high pollution from production process, e.g., industrial processing plants, swimming pools	(2)
C5	Very High	Spaces with very high frequency of condensation and/or high pollution from production process, e.g., mines, caverns for industrial purposes, unventilated sheds in subtropical and tropical zones	(3)
CX	Extreme	Spaces with almost permanent condensation or extensive periods of exposure to extreme humidity effects and/or high pollution from production process, e.g., unventilated sheds in humid tropical zones with penetration of outdoor pollution including airborne chlorides and corrosion-stimulating particulate matter	(3)

**Table 2.3 Description of typical atmospheric environments outdoor related to the estimation of corrosivity categories according to EN ISO 9223-2012-02 Table C.1 and the corresponding durability categories according to EAD-330232-01-0601 chapter 2.2.20 a (1) – (2)**

Corrosivity category	Corrosivity	Typical environments – Examples	
		Outdoor	EAD-330232-01-0601 chapter 2.2.20
C1	Very low	Dry or cold zone, atmospheric environment with very low pollution and time of wetness, e.g., certain deserts, Central Arctic/Antarctic	(2)
C2	Low	Temperate zone, atmospheric environment with low pollution ( $\text{SO}_2 < 5 \mu\text{g}/\text{m}^3$ ), e.g., rural areas, small towns Dry or cold zone, atmospheric environment with short time or wetness, e.g., deserts, subarctic areas	(2)
C3	Medium	Temperate zone, atmospheric environment with medium pollution ( $\text{SO}_2 5 \mu\text{g}/\text{m}^3$ to $30 \mu\text{g}/\text{m}^3$ ), or some effect of chlorides, e.g., urban areas, coastal areas with low deposition of chlorides. Subtropical and tropical zone, atmosphere with low pollution	(2)
C4	High	Temperate zone, atmospheric environment with high pollution ( $\text{SO}_2 30 \mu\text{g}/\text{m}^3$ to $90 \mu\text{g}/\text{m}^3$ ), or substantial effect of chlorides, e.g., polluted urban areas, industrial areas, coastal areas without spray of salt water or exposure to strong effect of de-icing salts. Subtropical and tropical zone, atmosphere with medium pollution	(2)
C5	Very High	Temperate zone, atmospheric environment with very high pollution ( $\text{SO}_2 90 \mu\text{g}/\text{m}^3$ to $250 \mu\text{g}/\text{m}^3$ ), or significant effect of chlorides, e.g., industrial areas, coastal areas, sheltered positions on coastline Subtropical and tropical zone, atmosphere with medium pollution	(3)
CX	Extreme	Subtropical and tropical zone (very high time of wetness), atmospheric environment with very high $\text{SO}_2$ pollution (higher than $250 \mu\text{g}/\text{m}^3$ ) including accompanying and production factors and/or strong effect of chlorides, e.g., extreme industrial areas, coastal and offshore areas, occasional contact with salt spray	(3)

For the zinc-based coatings covered by this EAD, the first year corrosion rate is determined in accordance with EN ISO 9223, see EN ISO 9223 figure 1 and table 2, and the corrosion rate corresponding to the working life declared in the ETA is calculated on the basis of the method described in EN ISO 9224. The alloy composition of the coating and the thickness of the coating shall be stated in the ETA as a function of the stated estimated working life.

Table 2.4 provides an example of the estimated working lives for hot dip galvanized coatings according to EN ISO 10684 for coatings calculated with mean thickness of minimum  $50 \mu\text{m}$  in accordance with the above provisions. The corrosion protection is applied and specified in accordance with EN ISO 14713-2 and EN ISO 10684.

**Table 2.4 Example of calculation in accordance with EN ISO 9224 of durability of hot dip galvanized coatings according to EN ISO 10684 for coatings with mean thickness of minimum 50 µm**

Corrosivity category	Corrosivity	Durability
		Thickness according to Chapter 8.3 $\geq 50\mu\text{m}$ in average Durability [years]
C1	Very low	500
C2	Low	75
C3	Medium	25
C4	High	12,5
C5	Very High	5
CX	Extreme	2

### **3 ASSESSMENT AND VERIFICATION OF CONSTANCY OF PERFORMANCE**

#### **3.1 System(s) of assessment and verification of constancy of performance to be applied**

EAD 330232-01-0601, Clause 3.1 applies.

#### **3.2 Tasks of the manufacturer**

EAD 330232-01-0601, Clause 3.2 applies.

#### **3.3 Tasks of the notified body**

EAD 330232-01-0601, Clause 3.3 applies

## 4 REFERENCE DOCUMENTS

EAD 330232-01-0601:2019	European Assessment Document for Mechanical fasteners for use in concrete
EN13501-1:2018	Fire classification of construction products and building elements - Part 1: Classification using test data from fire reaction to fire tests
EN ISO 10684:2004	Fasteners – Hot dip galvanized coatings
EN ISO 14713-2:2020	Zinc coatings – Guidelines and recommendations for the protection against corrosion of iron and steel in structures – Part 2: Hot dip galvanizing
EN ISO 9223:2012	Corrosion of metals and alloys – Corrosivity of atmospheres – Classification, determination and estimation
EN ISO 9224:2012	Corrosion of metals and alloys – Corrosivity of atmospheres – Guiding values for the corrosivity categories
EN 1992-4:2018	Design of fastenings for use in concrete
EN 206: 2013+A1:2016	Concrete – Specification, performance, production and conformity