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Established pursuant to Annex II of the Council Directive 89/106 of 21 December 1988 on the approximation of laws, regulations and administrative provisions of Member States relating to construction products (Construction Products Directive)

## **ETAG 030**

GUIDELINE FOR  
EUROPEAN TECHNICAL APPROVAL  
of  
**Dowels for Structural Joints**  
**Part 2: Seismic Action**

Edition April 2013

This Guideline for European Technical Approval is established and published in accordance with Article 11 of the Construction Products Directive as a basis for the preparation and issue of European Technical Approvals in accordance with Article 9.1 of the Construction Products Directive.

European Technical Approvals are issued by approval bodies authorised and notified in accordance with Article 10 of the Construction Products Directive. These bodies are organized in EOTA.

The European Technical Approval, according to the Construction Products Directive, is a favourable technical assessment of the fitness for use of a construction product and the technical specification of the assessed product, serving as basis for the CE marking of this product when and where a harmonised standard according to the Directive is not or not yet available.

Due to technical innovation and the progress of the state of the art, Guidelines for technical approval might not reflect the latest developments and experiences gained in approval procedures. The reader of this Guideline is therefore advised to check with an EOTA member whether there are further provisions which have to be taken into account in the use of the Guideline.

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# 1 Scope of the ETAG

See ETAG 01 – Part 1, General.

This Part 2 of the ETAG only deals with dowels for structural joints, or dowel connector, that transmit static and seismic loads and are not exposed to highly<sup>1</sup> aggressive agents in the environment.

Dowels subjected to dynamic loading installed in dissipative areas are not covered by this part of ETAG.

The present part complements the ETAG 30 – Part 1 (edition April 2013). This part refers only to the Essential Requirement 1; for the others requirements, it is necessary to refer to ETAG 30 – Part 1.

## 1.1 Definition of the construction product

See ETAG 01 – Part 1, General.

## 1.2 Intended use of the construction product

See ETAG 01 – Part 1, General.

Regarding specific terms for seismic actions, refer to EN 1998-1 and to EN 1998-2.

The present document is not applicable in case of use in dissipative areas.

Dowels that may be subjected to repeated loading in such a way as to cause fatigue-related phenomena or dowels that may be subjected to an aggressive environment liable to cause accelerated corrosion will be covered by further parts of this ETAG.

For types of families of products, see Table 1 of ETAG 30 – Part 1.

## 1.3 Assumed working life of the construction product

The provisions and the verification and assessment methods included or referred to in this ETAG have been written based upon the assumed working life of the dowel for an intended use not less than the working life of the works where installed, provided that the dowel is subject to appropriate installation, use and maintenance (see 4.4). These provisions are based upon the current state of the art and the available knowledge and experience.

In any case, because it is not simple to remove and replace dowels, the assumed working life shall not be less than 50 years.

"Assumed working life" means that, when an assessment following the ETAG/CUAP provisions is made, and when this working life has elapsed, the real working life may be, in normal use conditions, considerably longer without major degradation affecting the Essential Requirements<sup>2</sup>.

The indications given as to the working life of the construction product cannot be interpreted as a guarantee given by the product manufacturer or his representative or the Approval Body issuing the ETA, but are regarded only as a means for choosing the appropriate products in relation to the expected economically reasonable working life of the works (see 5.2.2 of the Interpretative Documents).

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<sup>1</sup> See EN ISO 12944-2:1998, Table 1.

<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 and the particular conditions of the design, execution, use and maintenance of that works may be outside this ETAG. Therefore, it cannot be excluded that in these cases the real working life of the product may also be shorter than the assumed working life.

## **1.4 Terminology**

### **1.4.1 *Common terms relating to the Construction Products Directive***

See ETAG 30 – Part 1.

### **1.4.2 *Specific terms used in this ETAG***

See ETAG 30 – Part 1.

Regarding terms about seismic action, reference is made to EN 1998-1 and to EN 1998-2.

## **1.5 Procedure in the case of a significant deviation from the ETAG**

See ETAG 30 – Part 1.

## 2 Assessment of fitness for use

### 2.1 Meaning of "fitness for use"

See ETAG 30 – Part 1.

### 2.2 Elements of the assessment of fitness for use

See ETAG 30 – Part 1.

### 2.3 Relationship of requirements to the product characteristics and methods of verification and assessment

The product characteristics, methods of verification and assessment criteria which are relevant for the fitness of dowels connectors under seismic actions for the intended use referred to in 1.2 are given in Table 2.

**Table 2 – Product characteristics and methods of verification and assessment**

Nr	Product characteristic	Option "No Performance Determined"	Method of verification and assessment	Expression of product performance
(1)	(2)	(3)	(4)	(5)
Essential Requirement 1: Mechanical resistance and stability (under seismic action)				
1	Declared ultimate deformation $d_u$	No	2.4.1.1.1	Values of: shear force, crack width and displacements 2.4.1.1.2
2	Declared maximum transmissible shear force $F_u$	No		
3	Declared Serviceability Limit State $F_s$	No		
4	Declared maximum serviceability displacement $d_s$	No		
5	Designed working life	Yes	1.3	Value
where: $d_u$ = ultimate deformation declared by the manufacturer $F_u$ = maximum transmissible shear force declared by the manufacturer $F_s$ = serviceability limit state force declared by the manufacturer $d_s$ = maximum serviceability displacement declared by the manufacturer				

For use categories, see Table 3 in ETAG 30 – Part 1.

For stability categories, see Table 4 in ETAG 30 – Part 1.

For environmental reference classification, see Table 5 in ETAG 30 – Part 1.

For stainless steel grade, see Table 6 in ETAG 30 – Part 1.

## 2.4 Product characteristics which are relevant for the fitness for use

### 2.4.1 Essential requirement 1: Mechanical resistance and stability

#### 2.4.1.1 Method of assessing and judging

##### 2.4.1.1.1 Fitness for use

The dowel connector shall be capable to guarantee its intended behavior under maximum expected displacement. Ductile behavior of the rod elements shall be guaranteed at collapse after the tests under quasi-static condition. During cyclic tests the dowel shall remain in the elastic field.

The dowel connector can only be considered as fit for use under seismic actions if it passes the following 3 types of tests:

##### 1) Test Type 1: Test at the collapse limit state

10 tests of this type shall be carried out. The tests shall be carried out at maximum device deformation  $d_u$  (at least  $\gamma_m [1,5]$  times the maximum design force under collapse seismic action and the maximum design displacement under collapse seismic action plus 10 mm), applying 10 times a force  $F_u$ .

##### 2) Test Type 2: Test at serviceability limit state

10 tests of this type shall be carried out. The test shall be carried out at the maximum longitudinal displacement admitted for serviceability limit state  $d_s$  under seismic action, applying 100 cycles of force  $F_s$  corresponding to serviceability limit state.

##### 3) Test Type 3: Test at serviceability limit state at minimum elongation

10 tests of this type shall be carried out. The test shall be carried out at 10 mm device elongation applying 100 times a force  $F_s$  (not smaller than  $\gamma_m [1,5]$  times the maximum design force under collapse seismic action for the device).

##### 2.4.1.1.2 Assessment of allowable conditions of use

For the fitness of use of dowel connector the following conditions shall be verified.

**1) Test Type 1:** After the test, the maximum crack width in concrete around the anchorage shall not exceed 0,5 mm. At the end of the test a transverse force will be applied. Failure shall be attained for a force larger than  $F_u$ .

If the test is passed for a given test member (concrete slab with properties chosen by the manufacturer; i.e. thickness, concrete strength), concrete slabs with equal or higher properties (thickness, concrete strength) shall be qualified for the tested dowel size.

**2) Test Type 2:** After the test, the maximum crack width in concrete around the anchorage shall be not larger than 0,3 mm.

**3) Test Type 3:** After the test, the maximum crack width in concrete around the anchorage shall be not larger than 0,3 mm.

##### 2.4.1.2 Method of verification

All values given for material strength of:

- steel are in accordance with EN 10025 and EN 6892-1,
- concrete are in accordance with EN 206-1.

At any step of the assessment, the special properties of stainless steel such as lower Young's modulus and hence lower stiffness shall be taken into account.

The characteristics of the products in relation with ER1 can be determined either by using Method 1 or Method 2 given below.

## **A. Method 1**

### **A.1 Tests**

See ETAG 030 – Part 1.

### **A.2 Test arrangement**

See ETAG 030 – Part 1.

### **A.3 Dowel connectors with perpendicular horizontal movement to the dowel axis allowed**

See ETAG 030 – Part 1.

### **A.4 Material properties**

#### Concrete specimen

The concrete specimens shall be in accordance with EN 206-1 and have to meet the following requirements:

- cement type shall be CEM I 32.5 R or CEM I 42.5 R (according to EN 197-1),
- the water-cement ratio should not exceed 0,75. The cement content shall be at least 240 kg/m<sup>3</sup>,
- concrete admixtures, which may affect the concrete properties (like fly ash, silica powders, limestone powder), shall not be added.

#### Evaluation of the material properties

The following material properties have to be determined in the approval tests:

- concrete compression strength,
- concrete tensile strength in bending,
- stress-strain curve of the materials used for the dowel connector, *i.e.* materials strain at yielding and failure,
- yield strength and tensile strength of the reinforcement,
- toughness of the materials used for the dowel connector.

The concrete strength class in the approval test has to meet the requirements of the concrete strength class given later in the ETA with a tolerance of  $\pm 5$  N/mm<sup>2</sup> and has to be constant (same batch).

### **A.5 Measuring equipment**

See ETAG 030 – Part 1.

### **A.6 Test report**

See ETAG 030 – Part 1

#### **A.7 Number of tests**

See ETAG 030 – Part 1

#### **B. Method 2**

See ETAG 030 – Part 1.

#### **2.4.1.3 Dimensions and tolerances**

See ETAG 030 – Part 1.

### **3 Evaluation and attestation of conformity and CE marking**

See ETAG 030 – Part 1, clause 3

## **4 Assumptions under which the fitness for the intended use is assessed**

In all the following assessment procedures, it will be assumed that the dowels are installed in concrete members designed and executed to a standard similar or in accordance to EC 2. All concrete properties will be related to EN 206-1, and taking into account either of the methods presented in Annex A.

### **4.1 Manufacture of the product**

It is assumed that the product is manufactured in accordance with the ETA issued on the grounds of this ETAG. All welding occurring during the manufacture process of the dowel connector has to be performed in the factory; no part of the process may be performed on site.

### **4.2 Packaging, transport, storage of the product**

It is assumed that the product is transported in such a way that damage to the weld seams cannot occur, also the smoothness of the surfaces has to be maintained.

### **4.3 Installation of the product in the works**

It is assumed that the concrete members joined by the dowel connector are designed according to a standard or code similar to EC 2, that all forces transmitted by the dowel connector and distributed by the reinforcement described in the ETA are properly transmitted to the supports or to other structural members designed to resist this action-effect, using either European or national standards, but always applying good engineering practice. A Product Handbook (or leaflet, provided by manufacturer) consisting of installation instructions shall always be on hand when installing dowel connectors on site.

### **4.4 Use, maintenance, repair**

It is assumed that the dowels will stay functional throughout their entire assumed working life span. If, by unforeseen actions or environmental conditions, repair is necessary, the national or relevant Guidelines or standards for the repair and strengthening of concrete structures shall be observed.



## 5 Identification of the construction product

### 5.1 Means of identification

The product which is the subject of the Technical Approval shall be identified by:

- testing of product characteristics as laid down in Table 10,
- fingerprinting,
- formulation.

These three parameters should be obtained from the manufacturer, for the material used.

If the dowel connector contains plastic parts, an appropriate method shall be determined by the Approval Body to identify the plastic components.

For the dowels, the parameters are:

- manufacturing process parameters,
- calculations, detailing, drawings.

**Table 10 – Product characteristics, methods of verification and criteria used for checking the product identity**

Number	Product characteristic*	Verification method: 5.2.1.1	Criteria for product identity: 5.2.1.2
(1)	(2)	(3)	(4)
	Mechanical strength	EN 10025, EN 6892-1	Yield stress
	Chemical properties		

\* These characteristics are also relevant to the fitness for use (see 2.3, Table 2).

### 5.2 Product characteristics which are relevant for identification checking

#### 5.2.1 Identification characteristic of the product (for steel used)

##### 5.2.1.1 Method of verification

The method of verification of the steel used to manufacture the dowel connector may be described in each ETA according to the specifics of the ETA contents. However, for all steel products, samples may be taken and tested in accordance with EN 6892-1 and EN 10025 for mechanical strength, and also for the chemical composition of the steel, in order to ascertain that either they are of the same grade as the manufacturer's technical specifications or that they exhibit not lesser performance (e.g. see Table 6).

##### 5.2.1.2 Criteria for product identity

The criteria for product identity shall be described in each ETA according to the specific ETA content as needed by the Approval Body and shall always form part of the ETA.

## **6 Format of ETAs issued on the basis of the ETAG**

European Technical Approvals issued on the basis of this ETAG shall be in accordance with the ETA format given in the Annex C to the ETAG.

## **7 Reference documents**

This part of ETA-Guideline 030 incorporates, by dated or undated reference, provisions from other publications. These normative references are cited at the appropriate places in the text and the publications are listed below. For dated references subsequent amendments to, or revisions of these publications, apply to this ETA-Guideline only when incorporated in it by amendment or revision. For undated references the latest dated revision of the publication referred to applies.

See ETAG 030 – Part 1.

- EN 1998-1, *Eurocode 8 – Design of structures for earthquake resistance – Part 1: General rules, seismic actions and rules for buildings.*
- EN 1998-2, *Eurocode 8 – Design of structures for earthquake resistance – Part 2: Bridges.*

## **Annex A DESIGN OF THE WORKS**

See ETAG 030 – Part 1.

## **Annex B CONTROL PLAN**

See ETAG 030 – Part 1.

## **Annex C ETA MODEL FOR DOWELS FOR STRUCTURAL JOINTS**

See ETAG 030 – Part 1.