

EUROPEAN ASSESSMENT DOCUMENT

EAD 331072-00-0601

October 2017

**ANCHOR DEVICES FOR
FASTENING PERSONAL FALL
PROTECTION SYSTEMS TO
CONCRETE STRUCTURES**

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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 No (EU) 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 various devices specially designed and engineered to be fastened to, or in some cases inserted into, concrete. The purpose of the devices is to arrest persons during a fall from heights.

They usually feature a metal substructure that gives the device the stability and connection to the concrete. An eye or fastening ring is fastened to its head either by a bolted or welded connection. In some cases the device consists of a single fastening ring which is directly fastened to the concrete.

This EAD also comprise the anchors that are used to fasten the anchor point. They are made of stainless steel.

The anchor devices for fastening personal fall protection systems are made of stainless steel in accordance with EN ISO 1127, EN 10088-4 or EN 10088-5, EN 10216-5, EN 10296-2. **Figure 1** shows some examples of the personal fall protection systems fastened to concrete structures.

The product is not covered by a harmonised European standard (hEN).



Figure 1: Examples of designs for anchor devices

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)

The anchor devices for fastening personal fall protection systems are intended to be used, fastened or inserted on flat roofs or other flat planes made of concrete only. The direction of force therefore shall be perpendicular ($90^\circ \pm 5\%$) to the fastening element. Thus use at a (concrete-) wall is intended only when the direction of force still applies at a 90° angle to the fastening axis. Overhead use/installation/insertion requires the performance of pullout-tests in accordance with ETAG 001².

The systems for personal fall protection fastened to concrete structures are not intended to be used in case of fire. Nonetheless, the manufacturer shall make sure that given a fall happens prior or due to a fire the fastening components or materials as well as any other parts of the device/system or kit are not softened or weakened or yield due to heat exposure, causing the falling person to pull out the device by his/her weight alone.

The anchor devices are used to protect operators working at height, by arresting them in a fall. The operators attach themselves to the eye or fastening ring using e.g. ropes and karabiners.

In the case of a fall the personal protection equipment that is attached to the anchor prevents physical damage to the operator, assuming the correct usage. The products are designed for use in all areas of industry, construction and maintenance.

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 anchor devices for fastening personal fall protection systems for the intended use of 25 years when installed in the works (provided that the product is subject to appropriate installation (see 1.1)). 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 works³.

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.

² The reference to ETAG 001 in this EAD applies as long as the ETAG 001 has not been replaced by an EAD

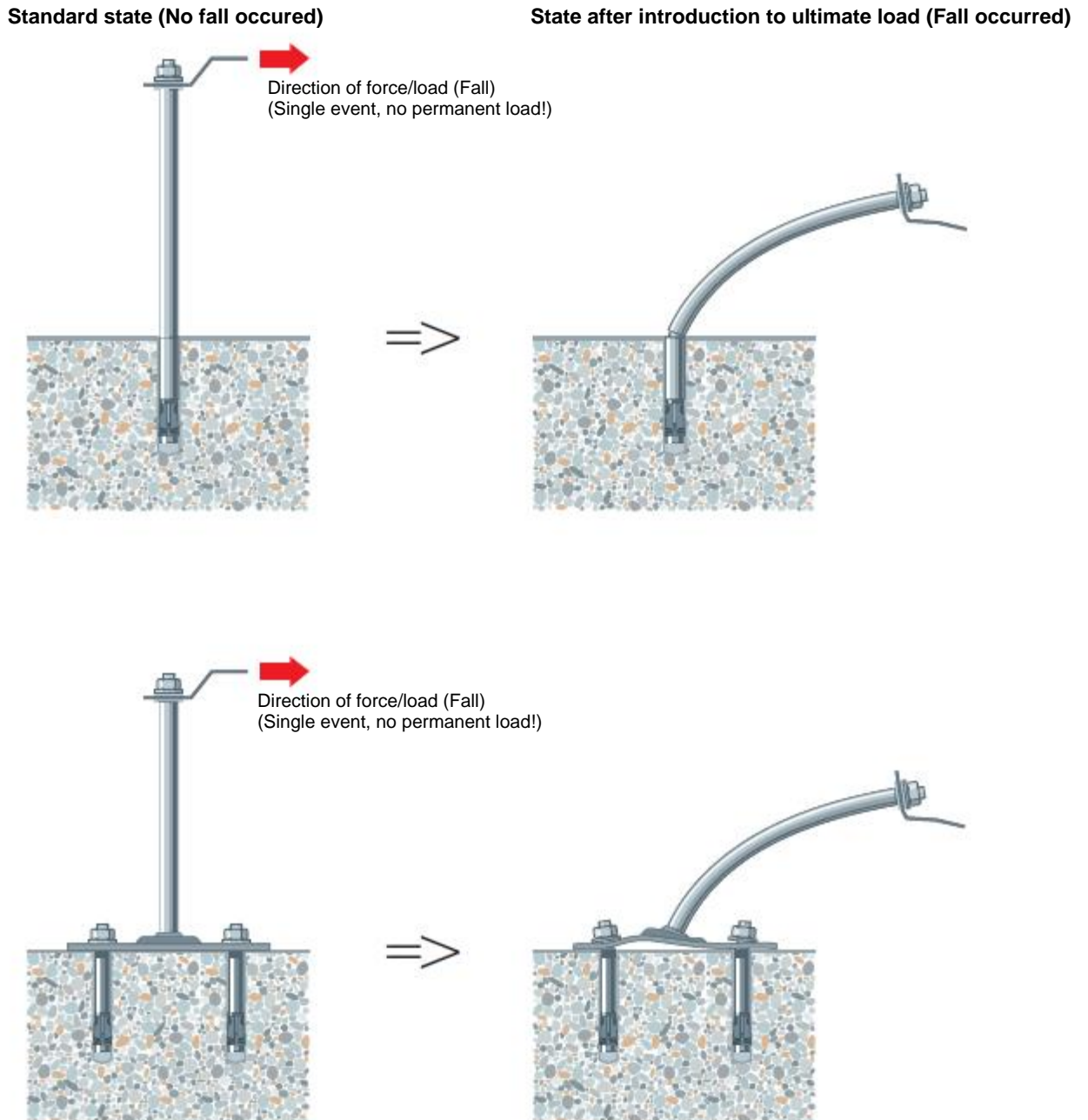
³ The real working life of a product incorporated in a specific works depends on the environmental conditions to which that works is subject, as well as on the particular conditions of the design, execution, use and maintenance of that works. Therefore, it cannot be excluded that in certain cases the real working life of the product may also be shorter than the working life referred to above.

1.3 Specific terms used in this EAD

1.3.1 Anchor/Anchor Device

The design resistance of the anchorage is not, as stated in the respective concrete anchor ETA, relevant for permanent load but instead for the ultimate load (see Figure 2).

Figure 2: Depiction of an anchor device before and after ultimate load (Fall occurred)



The concrete anchors are only loaded once and an evaluation under permanent loading is therefore not expedient.

The concrete anchors are either already assessed in accordance with the regulation (EU) 305/2011 or the manufacturer executes the tests in accordance to ETAG 001.

2 ESSENTIAL CHARACTERISTICS AND RELEVANT ASSESSMENT METHODS AND CRITERIA

2.1 Essential characteristics of the product

Table 1 shows how the performance of the anchor devices for fastening personal fall protection systems is assessed in relation to the essential characteristics.

Table 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 method	Type of expression of product performance <i>(level, class, description)</i>
Basic Works Requirement 2: Safety in case of fire			
1	Reaction to fire	2.2.2	Class (acc. with classification after test)
Basic Works Requirement 4: Safety and accessibility in use			
3	Static loading	2.2.3	Level (N _{R,k} [kN])
4	Dynamic loading	2.2.4	Level (for each user)
5	Check of deformation capacity in case of constraining forces	2.2.5	Description
6	Durability	2.2.6	Level (in acc. with EN ISO 12944, EN 1993-1-3, EN 1993-1-4; EN 1090-1)

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

2.2.1 General

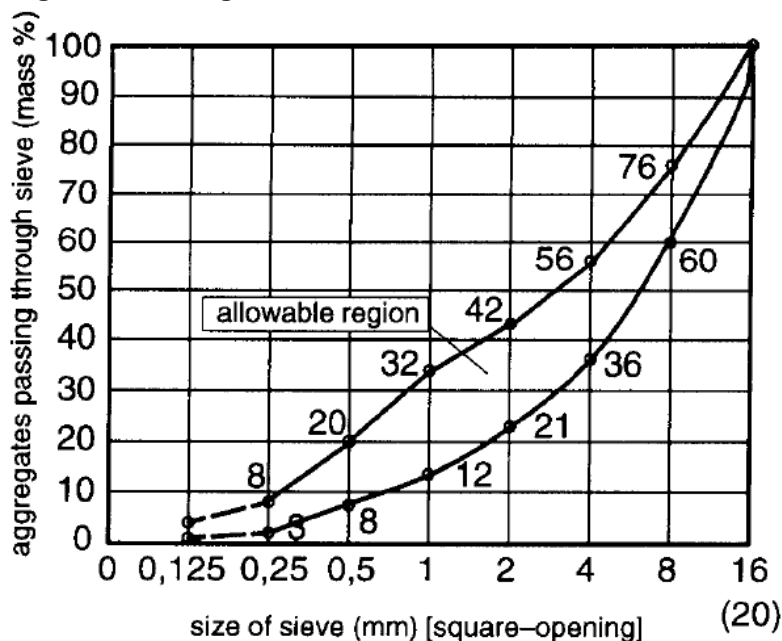
Before conducting the tests in accordance to 2.2.2, 2.2.3, 2.2.4, 2.2.5, 2.2.6, the following requirements shall be met:

The test arrangement (that means the concrete arrangement) may be customized to the wishes of the manufacturer (dimensions, etc.) as long as it meets the requirements of EN 206 as well as the following requirements (also given in EOTA TR 48 Section 3.1.2).

2.2.1.1 Aggregates

Aggregates shall be of medium hardness and with a grading curve falling within the boundaries given in **Figure 3**. The maximum aggregate size shall be 16 mm or 20 mm. The aggregate density shall be between 2.0 and 3.0 t/m³ (see EN 206 [8] and ISO 6783 [9]).

Figure 3: Grading Curve



2.2.1.2 Cement

The concrete shall be produced using Portland cement Type CEM I or CEM II/A-LL, CEM II/B-LL (see EN 197-1 [10])

2.2.1.3 Water/cement ratio and cement content

The water/cement ratio shall not exceed 0,75 and the cement content shall be at least 240 kg/m³. No additives likely to change the concrete properties (e.g. fly ash, silica fume, limestone powder or other powders) shall be added to the mix.

2.2.1.4 Concrete strength

The tests shall be carried out in concrete of two strengths: low strength (strength class C 20/25) and high strength (strength class C 50/60) concrete. The following mean compressive strengths shall be obtained for the two classes when testing the anchors:

C 20/25: f_{cm} = 20-30 MPa (cylinder: diameter 150 mm, height 300 mm)
 = 25-35 MPa (cube: 150 x 150 x 150 mm)

C 50/60: f_{cm} = 50-60 MPa (cylinder: diameter 150 mm, height 300 mm)
 = 60-70 MPa (cube: 150 x 150 x 150 mm)

It is recommended to measure the concrete compressive strength either on cylinders (diameter 150 mm, height 300 mm) or cubes (150 mm).

The tests may be carried out using drilling cores, provided that the abovementioned applies.

2.2.2 Reaction to fire

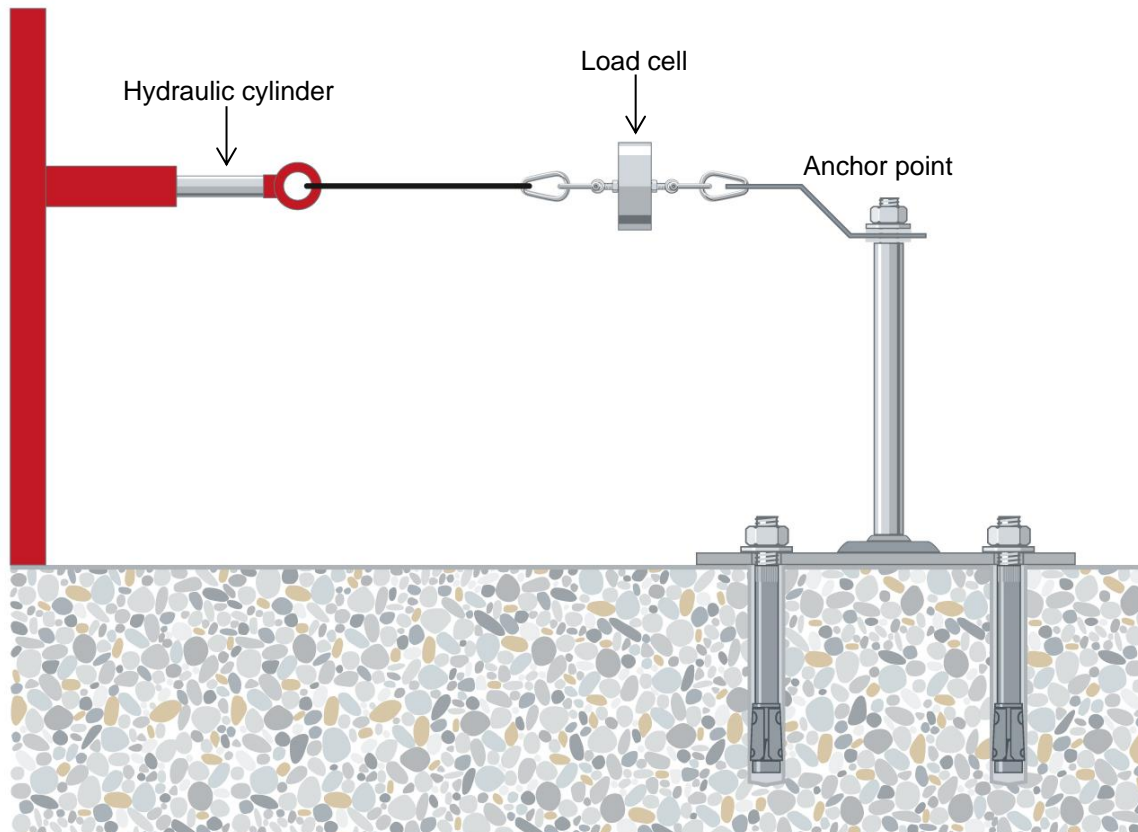
The anchor devices for fastening personal fall protection systems are considered to satisfy the requirements for performance Class A1 of the characteristic reaction to fire, in accordance with the EC decision 96/603/EC (as amended) without the need for further testing on the basis of its conformity with the specification of the product detailed in that Decision and its intended end use application being covered by that Decision.

The product shall be classified according to EN 13501-1 and Delegated Regulation 2016/364/EU.

2.2.3 Static loading

For the declaration of the product's performance related to the load bearing capacity, centric tension load tests shall be performed. If the load is perpendicular to the middle axis, the load bearing capacity shall be tested in the most unfavourable load direction (see Figure 4).

Figure 4: Example of a test arrangement of anchor devices for testing static loading



The failure loads and failure modes shall be documented. The maximum load shall be reached after one minute at the earliest in accordance with EOTA TR 048 Section 3.2. The assessment shall be based on the probability of failure.

If anchor devices for fastening personal fall protection systems with small edge distances are tested, it shall be made sure that any concrete edge failure is not prevented by the test setup of the anchor devices for fastening personal fall protection systems; i.e. that the test is performed in direction of the free edge.

Tests shall be carried out using measuring equipment having calibration traceable to international standards. The load application equipment shall be designed to avoid sudden increases in load, especially at the beginning of the test. The measuring error of the load applied shall not exceed 2 % over the whole measuring range (see EOTA TR 048 Section 3.1.6).

Displacements shall be recorded continuously (e.g. by means of electrical displacement transducers) with a measuring error not exceeding 1% measuring range (see EOTA TR 048 Section 3.1.6).

Depending on where the failure occurs, the evaluation has to be made according to section 2.2.3.1 (failure of the metallic components of the anchor point's metal substructure) or 2.2.3.2 (failure of the concrete anchoring).

2.2.3.1 Evaluation – failure of the metallic components of the anchor point's metal substructure

For determination of the 5% fractile value, the tests shall be evaluated statistically according to EN 1990, Annex D, section D7.2 assuming an unknown Variance V_x , (failure of the metallic components of the anchor point's metal substructure kit). Tests with different configurations (for example different heights of

the anchor point) may be treated as a family of test series and evaluated as one sample if justified by mechanical behaviour and/or failure mode. The manufacturer shall perform the tests with at least 3 specimens.

The 5% fractile value shall be appropriately adjusted to allow for variations between the actual measured properties of the test specimens and their nominal values. Adjustments of both 5% fractile values should be made in respect of the actual measured values of the dimensions and strength properties. For guidance on adjustment of test results see

- EN 1993-1-3, Annex A, section A.6.2 for metallic components of the anchor point

If test results obtained in test with non-cracked concrete shall be transferred to cracked concrete, reduction of test results (adjusted 5% characteristic value) may be calculated using the minimum ratio of k_{cr}/k_{ucr} and $N_{RK,p,cr}/N_{RK,p,ucr}$ as given in the ETA of the expansion anchors or using the ratio $\tau_{RK,cr}/\tau_{RK,ucr}$ as given in the ETA of the bonded anchors.

Material factors given in EN 1992 and EN 1993 apply according to failure mode and failed part of the anchor point or its supporting structure.

A series of tests carried out on a number of otherwise similar structures, portions of structures, members, sheets or other structural components, in which one or more parameters is varied, may be treated as a single family of tests, provided that they all have the same failure mode. The parameters that are varied may include cross-sectional dimensions, spans, thicknesses and material strengths (see EN 1993-1-3, Annex A, Section A.6.3.2.).

The test results (failure loads) shall be multiplied by a correction factor which takes account of the ratio of guaranteed minimum tensile/yield strength and the tensile/yield strength of the building components made of metal used in the tests. The corrected test results shall be evaluated statistically (determination of 5% fractiles, confidence level of 75%) according to EN 1990. The corrected and statistically evaluated test results (5% fractiles) are the characteristic values of the tested types.

The design values of resistance of hidden fastenings are the characteristic values divided by the recommended partial safety factor $\gamma_M = 1.1$ for compression and $\gamma_M = 1.33$ for tension. The recommended partial safety factors γ_M should be used in cases where no value is given in national regulations of the member state where the hidden fastenings are used.

local bearing of sheeting: $\alpha = (R_{m,min}/R_m) \times (t_{l,min}/t_l) \leq 1.0$

local bearing of metal substructure: $a = (R_{m,min}/R_m) \times (t_{ll,min}/t_{ll}) \leq 1.0$

with:

$R_{m,min}$ = minimum tensile strength of the relevant metal components t_l or t_{ll} according to the relevant product standard

R_m = tensile strength of the relevant metal components t_l or t_{ll} used for the tests

$t_{l,min}$, $t_{ll,min}$ = minimum thickness of the relevant components used for the test. t_l or t_{ll} thickness of the relevant components according to the relevant product standard.

The corrected test results shall be evaluated statistically (determination of 5% fractile, confidence level 75%). Generally a normal distribution can be assumed.

2.2.3.2 Evaluation – Failure of the concrete anchoring

For the determination of the 5%-fractile the tests shall be evaluated acc. to the relevant parts of ETAG 001 (i. e. part 2 for metal expansion anchors). This determination depends on the failure of the anchor during the tests. Failure of the anchors can occur by rupture of the steel of the anchor, pull-out of the anchor or rupture of the concrete (concrete cone failure or failure of the close edge). Other special failure modes are also possible.

The test results gathered in the tests have to be normalized to the nominal strength of the relevant anchor part (i. e. for concrete cone failure the results have to be normalized taking the concrete compressive strength into account acc. to ETAG 001, chap. 6.0 (b))

If test results obtained in tests with non-cracked concrete shall be transferred to cracked concrete, a reduction of the test results (adjusted 5% characteristic value) may be calculated using the minimum ratio of k_{cr}/k_{ucr} and $N_{Rk,p,cr}/N_{Rk,p,ucr}$ as given in the ETA of the anchors or using the ratio $\tau_{Rk,cr}/\tau_{Rk,ucr}$ as given in the ETA of the bonded anchors.

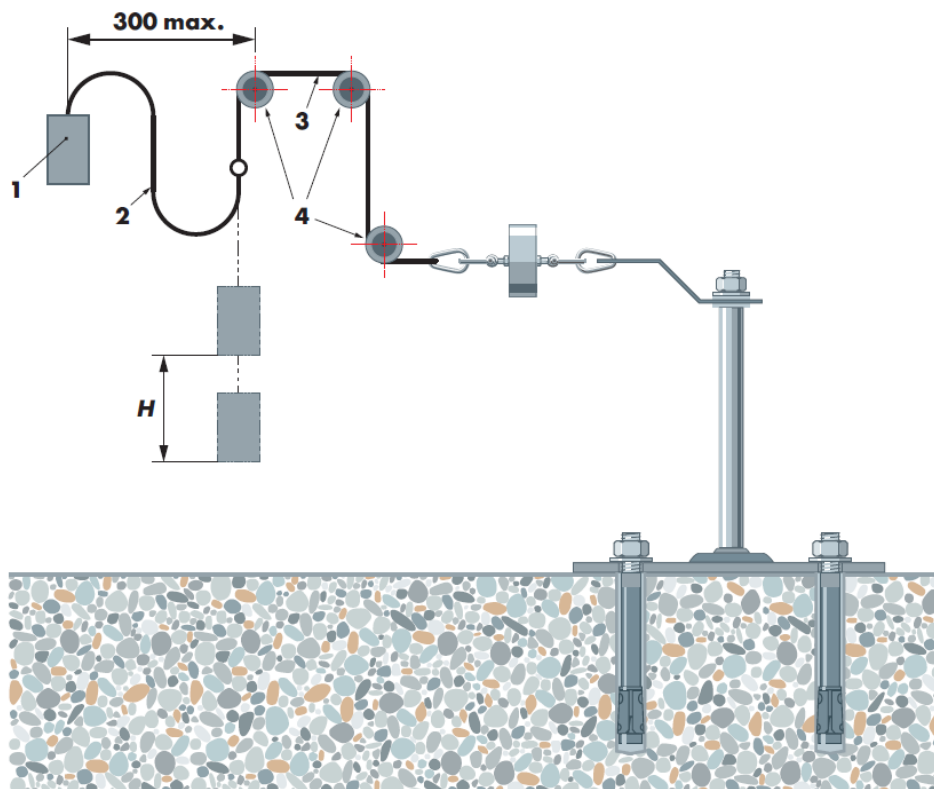
2.2.4 Dynamic loading

Figure 5 shows schematically the test arrangement to be used. The test arrangement shall be calibrated by connecting the rope to a rigid anchor point and by determining the fall distance H of the rigid test mass (100 ± 1) kg in such way that a fall arrest load of $(9 + 0.5)$ kN is created. Three consecutive tests at the same anchor have to be conducted and only one of the tests has to fit the fall arrest load of $(9 + 0.5)$ kN for calibration. After successful calibration, the rope is connected to the anchor point. If the anchor devices are used by multiple users, each user shall be taken into account by adding a (100 ± 1) kg load to the anchor point. The initial rigid test mass continues to be applied to the anchor point.

The test is passed if no failure occurs and the weight does not touch the ground. It has to be ensured that the energy released by the fall of the weight is absorbed only by the anchor device for fastening personal fall protection systems.

The test method described in this clause is in analogy to the tests described in EN 795.

Figure 5: Example of a test arrangement of anchor devices for testing dynamic loads



2.2.5 Check of deformation capacity in case of constraining forces

The load shall be increased up to 0.7 kN and the corresponding displacement perpendicular to the middle axis in direction of the load shall be recorded. If the anchor device is deformable, the displacement after unloading the anchor device shall be determined. The mean deformation of at least three tests shall equal

to or lower than 10 mm. The test load must be removed afterwards and the permanent deformation must be observed and recorded.

If the anchor device is asymmetric, the direction to be tested is the direction in which the biggest deformation forces are to be expected. If this direction cannot be determined, multiple directions shall be tested to be able to determine the direction with the biggest deformation. If the anchor point is rigid no deformation must occur at a load of 0.7 kN. If anchor points are propped up during the deformation tests, for example through insulation, the type of insulation used shall be clearly specified (material thickness, manufacturer, etc.). The tests shall be performed for every possible setup, if a propping effect (e.g. insulation material) is to be taken into account.

Tests shall be carried out using measuring equipment having calibration traceable to international standards. The load application equipment shall be designed to avoid sudden increases in load, especially at the beginning of the test. The measuring error of the load shall not exceed 2 % over the whole measuring range (see EOTA TR 048 Section 3.1.6).

Displacements shall be recorded continuously (e. g. by means of electrical displacement transducers) with a measuring error not exceeding 1 % measuring range (see EOTA TR 048 Section 3.1.6).

2.2.6 Durability

Concerning the corrosion protection of anchor devices for fastening personal fall protection systems, the rules given in EN 1993-1-3 and EN 1993-1-4 shall be taken into account. Devices or systems which are intended for use in external environments with $\geq C2$ corrosion in accordance with EN ISO 12944-2 shall be made of stainless steel.

If the devices or systems are painted and if the paint or coating combination is not considered in EN ISO 12944-5, they shall be tested in accordance with EN ISO 12944-6:1998.

Structural and environmental particularities, differences and distinctive features shall be taken into account.

3 ASSESSMENT AND VERIFICATION OF CONSTANCY OF PERFORMANCE

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

For the products covered by this EAD the applicable European legal act is: Decision (EU) 2018/771

The system is: 1+

3.2 Tasks of the manufacturer

The cornerstones of the actions to be undertaken by the manufacturer of the anchor devices for fastening personal fall protection systems in the procedure of verification of constancy of performance are laid down in Table 3.1.

Table 3.1 Control plan for the manufacturer; cornerstones

No	Subject/type of control	Test or control method	Criteria, if any	Minimum number of samples	Minimum frequency of control
Factory production control (FPC) [including testing of samples taken at the factory in accordance with a prescribed test plan]					
1	Check of initial materials	Inspection document 3.1. acc. to EN 10204 (to be furnished by the supplier)	1)	---	Every manufacturing batch
2	Geometry and dimensions	Check of geometry, dimensions and tolerances			
3	Dynamic loading	See 2.2.5	1)	1 test	Every manufacturing batch
4	Static loading	See 2.2.4	1)	3 tests	Every manufacturing batch

1) In accordance with the manufacturer technical file

3.3 Tasks of the notified body

The cornerstones of the actions to be undertaken by the notified body in the procedure of assessment and verification of constancy of performance for the fastening personal fall protection systems are laid down in Table 3.2.

Table 3.2 Control plan for the notified body; cornerstones

No	Subject/type of control	Test or control method	Criteria, if any	Minimum number of samples	Minimum frequency of control
Initial inspection of the manufacturing plant and of factory production control					
1	Ascertain that the factory production control with the staff and equipment are suitable to ensure a continuous and orderly manufacturing of the punching shear reinforcement	Verification of the complete FPC, to be implemented by the manufacturer	---	---	When starting the production or a new production line
Continuous surveillance, assessment and evaluation of factory production control					
2	Ascertain that the system of factory production control and the specified automated manufacturing process are maintained	Verification of the controls carried out by the manufacturer on the raw materials, on the process and on the product as indicated in Table 3.1	---	---	1 per year
Audit-testing of samples taken by the notified product certification body at the manufacturing plant or at the manufacturer's storage facilities					
3	Static loading	2.2.3	1)	3 tests	1 per year
4	Dynamic loading	2.2.4	1)	1 test	
5	Check of deformation capacity in case of constraining forces	2.2.5	1)	1 test	

¹⁾ In accordance with the manufacturer technical file

4 REFERENCE DOCUMENTS

As far as no edition date is given in the list of standards thereafter, the standard in its current version at the time of issuing the European Technical Assessment is of relevance.

EN 206	Concrete - Specification, performance, production and conformity
EN 13501	Fire classification of construction products and building elements
EN 13501-1	Fire classification of construction products and building elements - Part 1
EN 1090-1	Execution of steel structures and aluminium structures - Part 1: Requirements for conformity assessment of structural components
EN 1090-2	Execution of steel structures and aluminium structures - Part 2
EN 1990	Eurocode 1 - Basis of structural design
EN 1993	Eurocode 3 - Design of steel structures
EN 1993-1-3	Eurocode 3 - Design of steel structures - Part 1-3: General rules - Supplementary rules for cold-formed members and sheeting
EN 1993-1-4	Eurocode 3 - Design of steel structures - Part 1-4: General rules - Supplementary rules for stainless steels
ISO 6783	Coarse aggregates for concrete; Determination of particle density and water absorption; Hydrostatic balance method
EN ISO 12944-2	Paints and varnishes - Corrosion protection of steel structures by protective paint systems - Part 2: Classification of environments
EN ISO 12944-5	Paints and varnishes - Corrosion protection of steel structures by protective paint systems - Part 5: Protective paint systems
EN ISO 12944-6	Paints and varnishes - Corrosion protection of steel structures by protective paint systems - Part 6: Laboratory performance test
EN ISO 1127	Stainless steel tubes - Dimensions, tolerances and conventional masses per unit length
EN 10025-1	Hot rolled products of structural steels - Part 1: General technical delivery conditions
EN 10088-4	Stainless steels - Part 4: Technical delivery conditions for sheet/plate and strip of corrosion resisting steels for construction purposes
EN 10088-5	Stainless steels - Part 5: Technical delivery conditions for bars, rods, wire, sections and bright products of corrosion resisting steels for construction purposes
EN 10216-5	Seamless steel tubes for pressure purposes - Technical delivery conditions - Part 5: Stainless steel tubes;
EN 10296-2	Welded circular steel tubes for mechanical and general engineering purposes - Technical delivery conditions - Part 2: Stainless steel;
EN 10210	Hot finished structural hollow sections of non-alloy and fine grain steels
EN 10219	Cold formed welded structural hollow sections of non-alloy and fine grain steels

EN 10220	Seamless and welded steel tubes
EN 10204	Metallic products - Types of inspection documents
ETAG 001	Metal Anchors for Use in Concrete
EN 795	Personal fall protection equipment - Anchor devices
EOTA TR 048	Details of tests for post-installed fasteners in concrete