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European Assessment Document for

Fibre ropes with end connectors

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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) 305/2011 as a basis for the preparation and issuing of European Technical Assessments (ETA).

Contents

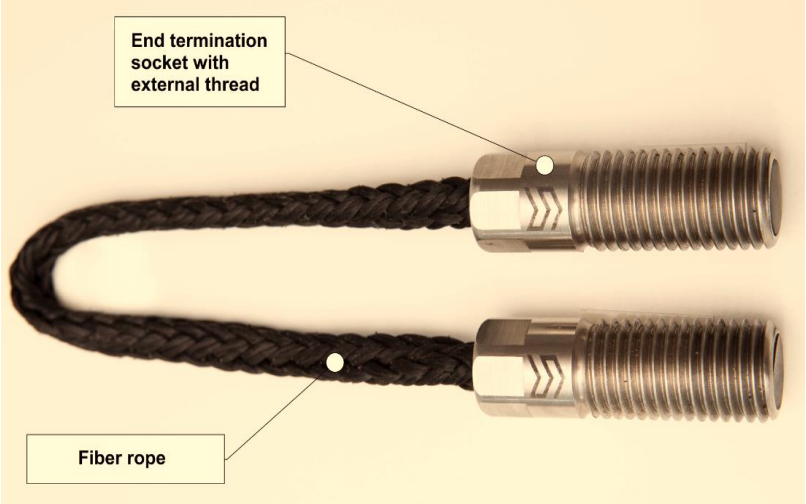
1 SCOPE OF THE EAD

1.1 Description of the construction product

The construction product is a fibre rope with end connectors (terminations) in which the rope is anchored by its end portions. The end connectors are resin filled sockets of stainless steel or galvanised/painted carbon steel, which are produced in accordance with EN 13411-4[1] and EN 1993-1-11, Annex C, section C.3. The rope is composed of braided strands of high modulus polyethylene (HMPE) fibers in accordance with EN ISO 10325, with known breaking force and elongation in accordance with EN ISO 2307. The approximate diameter of the rope ranges from 6 to 30 mm.

An example of the product is illustrated in Figure 1.1.1.

Figure 1.1.1: An example of the product



The fibre rope with end connectors is installed between a non-structural element (e.g. façade panel, electrical/mechanical installation element, equipment) and the primary or secondary structural element of the building via anchors and special fastening elements. The product may pass-through elements made of concrete. Anchors and special fastening elements are not covered by this EAD.

The product is not covered by a harmonised 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, e.g., with regard to the intended end use conditions, 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 as long as the details of the assessment methods as laid down in this EAD are respected.

[1] All undated references to standards in this EAD are to be understood as references to the dated versions listed in Clause 4.

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

1.2.1 Intended use(s)

The main function of the fibre rope with end connectors is the protection the non-structural elements from collapsing on accidental loads, e.g., earthquake, explosion or impact. The fibre rope with end connectors is used as a back-up system in addition to traditionally used connections which are already present in the building. Being activated upon a failure of the primary connections the fibre rope with end connectors guarantees additional protection that can prevent human casualties, equipment damage, damage to stored products or any other direct and indirect losses. Impact forces generated between the product and a moving object during the activation are evaluated in accordance with EN 1991-1-7, C.2.1.

The fibre rope with end connectors is intended to be used in the temperature range -30°C to +45°C without special assessment. The product is intended for alkaline environments when used in concreted structures.

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 fibre rope with end connectors for the intended use of 25 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[2].

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 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 referred to above.

2 ESSENTIAL CHARACTERISTICS AND RELEVANT ASSESSMENT METHODS AND CRITERIA

2.1 Essential characteristics of the product

Table 2.1.1 shows how the performance of the fibre rope with end connectors is assessed in relation to the essential characteristics.

Table 2.1.1 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
Basic Works Requirement 2: Safety in case of fire			
1	Reaction to fire	2.2.1	Class
Basic Works Requirement 4: Safety and accessibility in use			
2	Breaking strength	2.2.2	Level $R_{t,k}$ [kN]
3	Stiffness	2.2.2	Level k_t [kN/m]
4	Alkali resistance	2.2.3	Level and description $R_{u,alk}$ [kN], $k_{t,alk}$ [kN/m] $R_{t,alk,ret}$ [%], $k_{t,alk,ret}$ [%]
General aspects relating to the performances of the construction produc			
5	Corrosion	2.2.4	Description

2.2 Methods and criteria for assessing 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.

If for any components covered by harmonised standards or European Technical Assessments the manufacturer of the component has included the performance regarding the relevant essential characteristic in the Declaration of Performance, retesting of that component for issuing the ETA under the current EAD is not required.

2.2.1 Reaction to fire

The fibre rope with end connectors shall be tested, using the method(s) relevant for the corresponding reaction to fire class in accordance with EN 13501-1, taking into account Annex B (mounting and fixing rules). The fibre rope with end connectors shall be classified in accordance with the Commission Delegated Regulation (EU) No 2016/364 in connection with EN 13501-1.

The reaction to fire class shall be stated in the ETA.

2.2.2 Breaking strength and stiffness

Purpose of the assessment

Tensile tests shall be performed to evaluate the breaking strength and the stiffness of the fibre rope with end connectors.

Assessment method

Breaking strength and stiffness of the specimens shall be determined by tensile tests carried out in accordance with Annex A.

Number of specimens subjected to testing shall be at least five per product type. The smallest length of rope (L) is normally selected for the test.

Tests shall be performed at a temperature of 23±2°C and, if specified by the manufacturer, at the maximum service temperature.

Expression of results

The following mechanical properties shall be determined and reported in the ETA:

a) Breaking strength (characteristic value) $R_{t,k}$ [kN].

b) Stiffness (average value) k_t [kN/m].

c) Mode of failure (failure of rope, failure at connection of rope with end termination socket, etc.).

The characteristic value shall be determined by using the appropriate value of k_n for unknown V_x reported in EN 1990, Annex D, Table D1.

For the fibre rope with end connectors with rope of lengths L_{tot}, that are different from tested ones with rope of length L, the tensile stiffness $k_t(L_{tot})$ shall be calculated using the expression:

$$k_t(L_{tot}) = k_t \frac{L_{tot}}{L} \quad (2.2.2.1)$$

where

L_{tot} [m] = rope length of the product
L [m] = rope length of the tested specimens
$k_{tot}(L_{tot})$ [kN/m] = stiffness of the product
k_t [kN/m] = stiffness of the tested specimens

2.2.3 Alkali resistance

Purpose of the assessment

This test shall be performed to evaluate the influence of alkali attack on the efficiency of the fibre rope with end connectors.

Assessment method

Conditioning shall be done by immerging specimens in a liquid with pH=12.5 for 1,000 and 3,000 hours at a temperature of 23±2°C and, if specified by the manufacturer, at the maximum service temperature.

Conditioned specimens shall then be tested in tension according to 2.2.2.

Number of specimens subjected to testing shall be five per product type.

Expression of results

Conditioned specimens shall be visually examined prior to testing using 5× magnification to surface changes shall be described. The observations shall be reported in the ETA. The characteristic value of breaking strength $R_{u,alk}$ [kN] and average (arithmetic mean) value of stiffness $k_{t,alk}$ [kN/m] shall be determined and reported in ETA. The meaning of the mechanical properties is the same of that indicated in clause 2.2.2. The characteristic value shall be determined by using the appropriate value of k_n for unknown V_X in accordance with EN 1990, Annex D, Table D1.

The percentage of average mechanical properties ($R_{t,alk,ret}$ [%] and $k_{t,alk,ret}$ [%]) retained by exposed specimens with respect to the values recorded for unconditioned specimens (clause 2.2.2) and the exposure conditions shall also be reported in the ETA. These percentages shall be calculated on the basis of average results of the set of tested specimens.

2.2.4 Corrosion

The assessment of the fibre rope with end connectors' corrosion is carried out by means of the assessment of the socket corrosion representative of this essential characteristic for the product.

By considering the corrosion protection of the socket of the fibre rope with end connectors obtained from the Manufacturer's Product Installation Instructions based on following standards depending on the metal sockets and the possible additional measures of corrosion protection (e.g., EN ISO 12944-1 & EN ISO 12944-6):

- For carbon steels: EN 10025-1 clause 7.4.3.
- For stainless steels: EN 10088-3 and EN 10088-5.

The associated category of corrosivity of atmospheres, in function of the field of application and the material corrosion protection, shall be assessed and stated in the ETA in accordance with EN ISO 9223.

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 98/214/EC.

The system is **2+**.

In addition, with regard to reaction to fire for products covered by this EAD the applicable European Legal Act is: Decision 98/214/EC, amended by 2001/596/EC.

The systems are:

1 for A1, A2, B, C classes (Products/Materials for which a clearly identifiable stage in the production process results in an improvement of the reaction to fire classification, e.g., an addition of fire retardants or a limiting of organic material).

3 for A1, A2, B, C classes (Products/Materials for which there is not a clearly identifiable stage in the production process resulting in an improvement of the reaction to fire classification) and D, E classes.

4 for A1 to E classes (Products/Materials that do not require to be tested for reaction to fire, e.g., Products/materials of Classes A1 in accordance with Commission Decision 96/603/EC) and F class.

3.2 Tasks of the manufacturer

The cornerstones of the actions to be undertaken by the manufacturer of the product in the procedure of assessment and verification of constancy of performance are laid down in Table 3.2.1.

Table 3.2.1 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	*Rope* Dimensions and tensile characteristics of the rope	Supplier's data check	Conformity with the order	-	Once per delivery
2	*Socket* Incoming raw material	Check of inspection certificate	Conformity with the order	-	Once per delivery
3	*Socket* Geometry, dimension and tolerances	According to control plan	According to control plan	-	Every cast socket
4	*Socket* Protective coating thickness	According to control plan	According to control plan	-	Every relevant socket
5	Breaking strength	See clause 2.2.2	According to control plan	3	Every production batch
6	Stiffness	See clause 2.2.2	According to control plan	3	Every production batch

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 product are laid down in Table 3.3.1.

Table 3.3.1 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	Notified Body will ascertain that the factory production control with the staff and equipment are suitable to ensure a continuous and orderly manufacturing of the of the fibre rope with end connectors.	Verification of the complete FPC as described in the control plan agreed between the TAB and the manufacturer	According to Control plan	According to Control plan	When starting the production process, after its modification or when starting a new production line.
Continuous surveillance, assessment and evaluation of factory production control					
2	The Notified Body will ascertain that the system of factory production control and the specified manufacturing process are maintained taking account of the control plan	Verification of the controls carried out by the manufacturer as described in the control plan agreed between the TAB and the manufacturer with reference to the raw materials, to the process and to the product as indicated in Table 3.2.1	According to Control plan	According to Control plan	Once per year

The intervention of the notified body for reaction to fire under AVCP system 1 is only necessary for products/materials for which a clearly identifiable stage in the production process results in an improvement of the reaction to fire classification (e.g., an addition of fire retardants or a limiting of organic material).

In this case the cornerstones of the tasks to be undertaken by the notified body under AVCP system 1 are laid down in Table 3.3.2.

Table 3.3.2 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 control carried out by the manufacturer regarding the constancy of performance related to reaction to fire and taking into account a limiting of organic material and/or the addition of fire retardants. *(for AVCP system 1 only)*					
1	Where the intervention of the Notified Body is necessary only because the conditions for the applicability of system 1 are fulfilled for reaction to fire, the notified body will consider especially the clearly identifiable stage in the production process which results in an improvement of the reaction to fire classification (e.g. an addition of fire retardants or a limiting of organic material)	Verification of the complete FPC as described in the control plan agreed between the TAB and the manufacturer	As defined in the control plan agreed between the TAB and the manufacturer	As defined in the control plan agreed between the TAB and the manufacturer	When starting the production process, after its modification or when starting a new production line.
Continuous surveillance, assessment and evaluation of factory production control carried out by the manufacturer regarding the constancy of performance related to reaction to fire and taking into account a limiting of organic material and/or the addition of fire retardants. *(for AVCP system 1 only)*					
2	Where the intervention of the Notified Body is necessary only because the conditions for the applicability of system 1 are fulfilled for reaction to fire, the notified body will consider especially the clearly identifiable stage in the production process which results in an improvement of the reaction to fire classification (e.g. an addition of fire retardants or a limiting of organic material)	Verification of the controls carried out by the manufacturer as described in the control plan agreed between the TAB and the manufacturer with reference to the raw materials, to the process and to the product as indicated in Table 3.2.1	As defined in the control plan agreed between the TAB and the manufacturer	As defined in the control plan agreed between the TAB and the manufacturer	Once per year

4 REFERENCE DOCUMENTS

EN 1993-1-11:2025	Eurocode 3: Design of steel structures - Part 1-11: Design of structures with tension component
EN 1991-1-7:2006	Eurocode 1 - Actions on structures - Part 1-7: General actions - Accidental actions
EN 13411-4:2021	Terminations for steel wire ropes - Safety - Part 4: Metal and resin socketing
EN ISO 10325:2018	Fibre ropes - High modulus polyethylene - 8-strand braided ropes, 12-strand braided ropes and covered ropes
EN ISO 2307:2019	Fibre ropes. Determination of certain physical and mechanical properties
EN ISO 12944-1:2017	Paints and varnishes. Corrosion protection of steel structures by protective paint systems - Part 1: General introduction (ISO 12944-1:2017)
EN ISO 12944-6:2018	Paints and varnishes - Corrosion protection of steel structures by protective paint systems - Part 6: Laboratory performance test methods
EN 10025-1:2004	Hot rolled products of structural steels - Part 1: General technical delivery conditions
EN 10088-3:2023	Stainless steels - Technical delivery conditions for semi-finished products, bars, rods, wire, sections and bright products of corrosion resistant steels for general purposes
EN 10088-5:2009	Stainless steels - Technical delivery conditions for bars, rods, wire, sections and bright products of corrosion resisting steels for construction purposes
EN ISO 9223:2012	Corrosion of metals and alloys. Corrosivity of atmospheres. Classification, determination and estimation
EN ISO 6892-1:2019	Metallic materials - Tensile testing - Part 1: Method of test at room temperature
EN ISO 9513:2012/AC:2013	Metallic materials - Calibration of extensometer systems used in uniaxial testing - Technical Corrigendum 1
EN 13501-1:2018	Fire classification of construction materials and building elements - Part 1: Classification using data from reaction to fire tests
EN 13823:2020+A1:2022	Reaction to fire tests for building products. Building products excluding floorings exposed to the thermal attack by a single burning item
EN ISO 11925-2:2020	Reaction to fire tests. Ignitability of products subjected to direct impingement of flame - Single-flame source test

ANNEX A: TENSILE TESTING OF SPECIMENS

A1. Test procedure

A specimen shall be mounted in the grips of a mechanical testing machine and loaded with monotonically increasing displacement while load and movement shall be recorded.

The anchorage shall be suited to the geometry of the test pieces and shall have the capacity transmit only the tensile force along the longitudinal axis of the test specimens.

The load shall be applied under displacement control at a constant speed not exceeding 0.5 mm/s, until failure occurs. Fluctuation of a set displacement speed shall not exceed 5 %.

The load ($R_{i,max}$) and corresponding displacement d ($R_{i,max}$) at failure shall be recorded, along with the failure mode and location.

The average (arithmetic mean) and characteristic value of the breaking strength $R_{t,k}$ [kN] and average (arithmetic mean) of the stiffness k_t shall be determined.

The stiffness $k_{t,i}$ of the specimens shall be calculated as

$$k_{t,i} = \frac{R_{i,max}}{d\,(R_{i,max})} \qquad \text{(A1.1)}$$

where

$k_{t,i}$ [kN/m] = stiffness of the tested specimen
$R_{i,max}$ [kN] = load of the tested specimen at failure
d ($R_{i,max}$) [m]] = displacement of the tested specimen at failure

A2. Apparatus

The testing machine shall have the appropriate load capacity to withstand the foreseen ultimate forces and shall be equipped with an appropriately calibrated load cell classifiable at least in class 1 with reference to EN ISO 6892-1 (resolution higher than 0.1 %).

For the determination of displacement, the used extensometer shall be in accordance with EN ISO 9513, class 1 or better, in the relevant range.

A3. Report

At least the following information shall be reported:

- Date and location of the test
- Identification of the material tested including material specification, type, and designation, manufacturer
- Method of preparation of test specimen including labelling system and geometry
- Description of the test machine
- Conditioning parameters and results
- Temperature and humidity of testing laboratory
- Number of specimens tested
- Speed of testing
- Load-displacement curve and tabulated results
- Individual breaking strengths, average, standard deviation, and coefficient of variation (in percent) for the population
- Individual displacement at failure and average, standard deviation, and coefficient of variation (in percent) for population
- Calculated stiffness, average, standard deviation, and coefficient of variation (in percent) for population
- Failure mode and location of failure for each specimen

ANNEX B: REACTION TO FIRE – MOUNTING AND FIXING RULES

B1. General

Reaction to fire is determined using methods, referenced to in EN 13501-1 with additional rules as stated out in this annex for fixing and mounting of the test specimen.

The product consists of end connector, made of steel socket filled with resin and rope between the connectors. Only testing of the whole product is foreseen as the rope is the only combustible component of the product that can be exposed to fire in end-use conditions.

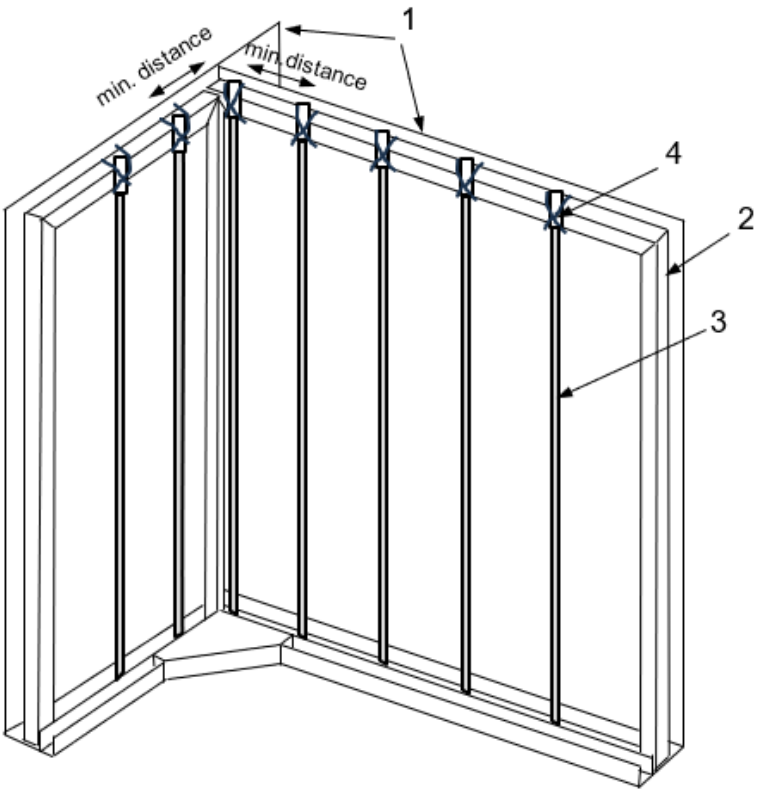
B2. EN 13823 (SBI)

Fibre ropes with end connectors with a total length of 1.5 m shall be installed vertically with the smallest distance between two adjacent ropes, specified in Manufacturer's Product Installation Instructions (MPII), starting at the corner of the long wing next to the vertical profile of the supporting frame, but not in contact with the vertical profile. The rope shall be straightened and fastened at both ends with steel wire to the supporting frame. Two steel frames with external dimensions of 1000 mm × 1500 mm and 495 mm × 1500 mm can be used, made of steel profiles, e.g. 30×30 L-profiles.

The frame shall be pressed against the U-profiles of the SBI trolley. If the product can only be manufactured with a length of less than 1.5 m, specimens are made from the longest producible ropes in such a way, that the required length (1.5 m) is achieved by several successive full-length samples, with the first full-length sample starting at the bottom. The successive fibre ropes can be attached to each other with a steel wire at the ends of the fibre ropes.

The backing boards shall be placed 80 mm behind the specimen.

One test is carried out on the thickest and one on the thinnest fibre ropes. The worst result is also representative for other thicknesses between tested. The results refer to the tested or greater distance between the two neighbouring ropes and to the same as tested or fewer pieces of ropes per m^2.



Key:

1 Backing Board
2 Frame
3 Product
4 Fixation

Figure B.2.1: Installation of specimen according to EN 13823

B3. EN ISO 11925-2

Fibre rope is placed vertically and straighten at the mid-width of the holder. For easier installation additional frame from flat steel profiles of outer dimensions 90 mm × 250 mm can be used and clamped in the specimen holder. Tested rope can be fixed to the frame with steel wire.

The flame shall be positioned on the surface of the fibre rope. Edge exposure is not applicable.

Both the thickest and the thinnest rope shall be tested, and the worst result shall apply to tested thicknesses and all thicknesses between them.