



EUROPEAN ASSESSMENT DOCUMENT

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**PREFABRICATED STEEL
AND STAINLESS STEEL
WIRE 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) 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

The construction products are prefabricated steel and stainless steel wire ropes with end connectors (terminations). The end connectors are for instance metal or resin filled sockets or swaged sockets and swaged fittings. These end connectors as well as other typical end connectors are given in Annex A. Further examples for typical steel and stainless steel wire ropes with end connectors are given in EN 1993-1-11, Annex C, sections C.2 and C.3. One system includes all rope diameters using the same type of end connector.

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 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 intended use comprises all typical structural applications of prefabricated steel and stainless steel wire ropes. The prefabricated steel and stainless steel wire ropes with end connectors are intended to be used for structures with predominantly static loads.

National regulations or administrative provisions on design and execution of works have to be followed when installing or incorporating the product into the works.

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 prefabricated steel and stainless steel wire ropes 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 works¹.

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 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 1 shows how the performance of prefabricated steel and stainless steel wire ropes with end connectors 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 (level, class, description)
Basic Works Requirement 1: Mechanical resistance and stability			
1	Breaking strength	2.2.1.	F_{uk} [kN]
2	Modulus of deformation / elasticity	2.2.2	E_Q [N/mm ²]
Basic Works Requirement 2: Safety in case of fire			
3	Reaction to fire	2.2.4	Class
General aspects relating to the performances of the construction product			
4	Resistance to corrosion	2.2.3	Description
5	Durability	2.2.5	Description

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

Characterisation of products to be assessed shall be done in accordance with available specifications, notably identification parameters given in 1.1.

This EAD contains provisions on how to declare certain performance characteristics. These provisions only apply if the manufacturer wishes to declare a performance for the relevant product characteristic.

2.2.1 Breaking strength, loss factor of end connectors

The characteristic value of the breaking strength F_{uk} of the prefabricated steel and stainless steel wire ropes with end connectors shall be determined by tension tests or by numerical methods.

The influence of clamps and saddles (e. g. slipping of ropes and clamps as well as transverse pressure) shall be taken into account according to EN 1993-1-11, sections 6.3 and 6.4.

If the breaking strength F_{uk} is determined by using numerical methods (e. g. finite element method), a benchmark to proof the accuracy of the numerical model has to be carried out as follows:

- Numerical calculation of at least two rope diameters using mechanical material properties given in inspection certificates 3.1 according to EN 10204,
- experimental tests on the two diameters calculated before (three tests per diameter),
- comparison of numerical and experimental result (mean values):

If the difference is $\leq 10\%$ the system can be calculated by using the numerical model (with characteristic values for the material properties).

If the difference is $> 10\%$ the numerical model is not accurate enough. In this case it is not allowed to determine the breaking strength F_{uk} using this model.

Provided that

- a structural analysis in accordance with EN 1993-1-1 / EN 1993-1-8 / EN 1993-1-11 has been provided for each size of the system and
- the stability of the design has been verified by a competent body in accordance with national law and
- the ratio of calculated breaking force of the rope itself and calculated breaking force of the critical cross section of the connector is a constant value (deviation up to to 10 %) for all rope diameters of one system one tension test for each of at least 3 rope diameters (the smallest, the largest and one medium diameter) will be deemed sufficient.

If the breaking strength F_{uk} is determined by tests it is assumed that the basic points are kept as follows:

- All rope diameters of one system use the same design for the end connectors,
- the ratio of calculated breaking force of the rope itself and calculated breaking force of the critical cross section of the connector is a constant value for all rope diameters of one system,
- for all parts used inspection certificates 3.1 according to EN 10204 including mechanical and chemical material properties have to be provided; the mechanical material parameters have to be determined considering the regulations for material tests given in
 - EN ISO 6892-1 (end connectors),
 - EN ISO 148-1 (end connectors) and
 - EN 10218-1 (wires).

Tests should be carried out according to Annex B. The minimum number of tests is

- 3 tests for each of at least 3 rope diameters (the smallest, the largest and one medium diameter) of each prefabricated rope type (incl. end connectors), if the number of different rope diameters per prefabricated rope type (incl. end connectors) is > 3 . If it is not possible to do the destructive test of the largest diameter numerical calculations according to the procedure described above have to be carried out.
- 3 tests for each rope diameter of each prefabricated rope type (incl. end connectors), if the number of different rope diameters per prefabricated rope type (incl. end connectors) is ≤ 3 .

In case of a non-constant value for the ratio of calculated breaking force of the rope itself and calculated breaking force of the critical cross section of the connector the smallest, the largest and the rope diameter with the lowest ratio of breaking forces (rope / end connector) shall be tested if the number of different rope diameters per system is > 3 (3 test for each rope diameter). If the number of different rope diameters per system is ≤ 3 all diameters shall be tested.

The characteristic values of the breaking strength F_{uk} of the prefabricated ropes with end connectors shall be determined as 5%-fractile of the single test results F_t according to EN 1990, Annex D, assuming that the variation coefficient V_x is unknown. Generally a normal distribution can be assumed.

Each test result F_t shall be divided by the breaking force F_{min} of the rope itself (determined in a test using an end connector with $k_e = 1,0$ according to EN 1993-1-11, table 6.3) in order to determine the loss factor k_e ($\leq 1,0$) for the corresponding type of end connector.

The characteristic values F_{uk} as well as the loss factors k_e shall be determined from the test results.

The method described in EN 1993-1-11, section 6.2 shall be used to determine the design value of tension resistance F_{Rd} from the characteristic values determined by tests.

2.2.2 Modulus of deformation / elasticity

The modulus of deformation / elasticity E_Q of the prefabricated steel and stainless steel wire ropes with end connectors shall be determined according to EN 1993-1-11, section 3.2.2. If tests are carried out according to EN 1993-1-11, section 3.2.2 the modulus of deformation / elasticity shall be determined from the tests described in 2.2.1.

2.2.3 Resistance of corrosion

The corrosion protection of components which are not made of corrosion-resistant steel shall be carried out according to EN 1993-1 and EN ISO 12944. For stainless steel components the rules given in EN 1993-

1-4 shall apply to the material selection and to the manufacture of corrosion-resistant structures. Further references for a corrosion-resistant execution are given in EN 1090-2.

Declaration according to EN ISO 12944 for components which are not made of corrosion-resistant steel or EN 1993-1-4 for stainless steel components.

2.2.4 Reaction to fire

The prefabricated steel and stainless steel wire ropes with end connectors are considered to satisfy the requirements for performance class A1 of the characteristic reaction to fire in accordance with the Decision 1996/603/EC (as amended) without the need for testing on the basis of it fulfilling the conditions set out in that Decision and its intended use being covered by that Decision. Therefore the performance of the product is A1 according to EN 13501-1.

2.2.5 Durability

The rules given in EN 1993-1-11, section 4 and EN 1990-2 shall be taken into account. For metal or resin filled sockets EN 13411-4 applies.

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 1998/214/EC

The system is: **2+**

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 2.

Table 2 Control plan for the manufacturer; cornerstones

No	Subject/type of control (<i>product, raw/constituent material, component - indicating characteristic concerned</i>)	Test or control method (<i>refer to 2.2 or 3.4</i>)	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	Initial materials	Check of inspection certificate 3.1 according to EN 10204	Results have to fulfil requirements of ETA	-	Each production unit
2	Geometry, dimension and tolerances	Check of geometry, dimensions and tolerances	Results have to fulfil requirements of ETA	-	Each production unit
3	Check of external and internal quality of cast components	Check if properties of the cast material stated in the ETA correspond to the material properties stated in the annex to inspection certificate 3.1 according to EN 10204	Results have to fulfil requirements of ETA	Every cast component	Each production unit
4	Breaking strength, Loss factor, Modulus of deformation/elasticity	According to clause 2.2.1 and 2.2.2	Results have to fulfil requirements of ETA	1*)	Each production unit

*) per prefabricated rope type and diameter (incl. end connector)

3.3 Tasks of the notified body

The cornerstones of the actions to be undertaken by the notified body of the product in the procedure of assessment and verification of constancy of performance are laid down in Table 3.

Table 3 Control plan for the notified body; cornerstones

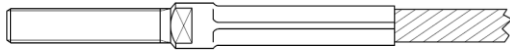
No	Subject/type of control (product, raw/constituent material, component - indicating characteristic concerned)	Test or control method (refer to 2.2 or 3.4)	Criteria, if any	Minimum number of samples	Minimum frequency of control
Initial inspection of the manufacturing plant and of factory production control (for systems 1+, 1 and 2+ only)					
1	Initial materials	Check of inspection certificate 3.1 according to EN10204	Results have to fulfil requirements of ETA	-	When starting the production or a new production line
2	Geometry, dimension and tolerances	Check of geometry, dimensions and tolerances	Results have to fulfil requirements of ETA	-	When starting the production or a new production line
3	Check of external and internal quality of cast components	Check if properties of the cast material stated in the ETA correspond to the material properties stated in the annex to inspection certificate 3.1 according to EN 10204	Results have to fulfil requirements of ETA	Every cast component	When starting the production or a new production line
4	Breaking strength, Loss factor, Modulus of deformation/elasticity	According to clause 2.2.1 and 2.2.2	Results have to fulfil requirements of ETA	-	When starting the production or a new production line
Continuous surveillance, assessment and evaluation of factory production control (for systems 1+, 1 and 2+ only)					
5	Initial materials	Check of inspection certificate 3.1 according to EN10204	Results have to fulfil requirements of ETA	-	Twice a year
6	Geometry, dimension and tolerances	Check of geometry, dimensions and tolerances	Results have to fulfil requirements of ETA	-	Twice a year
7	Check of external and internal quality of cast components	Check if properties of the cast material stated in the ETA correspond to the material properties stated in the annex to inspection certificate 3.1 according to EN 10204	Results have to fulfil requirements of ETA	Every cast component	When starting the production or a new production line
8	Breaking strength, Loss factor, Modulus of deformation/elasticity	According to clause 2.2.1 and 2.2.2	Results have to fulfil requirements of ETA	-	Twice a year

4 REFERENCE DOCUMENTS

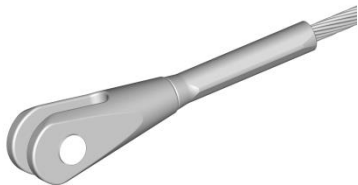
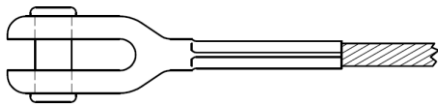
As far as no edition date is given in the list of standards thereafter, the standard in its current version at the time of issuing the European Technical Assessment is of relevance.

EN 1993-1-1	Eurocode 3: Design of steel structures – Part 1-1: General rules and rules for buildings
EN 1993-1-4	Eurocode 3: Design of steel structures - Part 1-4: General rules - Supplementary rules for stainless steels
EN 1993-1-8	Eurocode 3: Design of steel structures – Part 1-8: Design of joints
EN 1993-1-11	Eurocode 3: Design of steel structures – Part 1-11: Design of structures with tension components
EN 10204	Metallic Products - Types of inspection documents
EN 13411-4	Terminations for steel wire ropes - Safety - Part 4: Metal and resin socketing
EN 13501-1	Fire classification of construction products and building elements – Part 1: Classification using test data from reaction to fire tests
EN ISO 6892-1	Metallic materials - Tensile testing - Part 1: Method of test at room temperature
EN ISO 148-1	Metallic materials - Charpy pendulum impact test – Part 1: Test method
EN 10218-1	Steel wire and wire products – General – Part 1: Test methods
EN 1090-2	Execution of steel structures and aluminium structures - Part 2: Technical requirements for steel structures
EN 1990	Basis of structural design
EN ISO 12944	Paints and varnishes – Corrosion protection of steel structures by protective paint systems

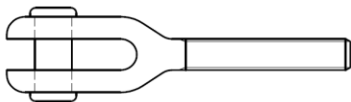
ANNEX A EXAMPLES FOR TYPICAL END CONNECTORS



End connector with external thread



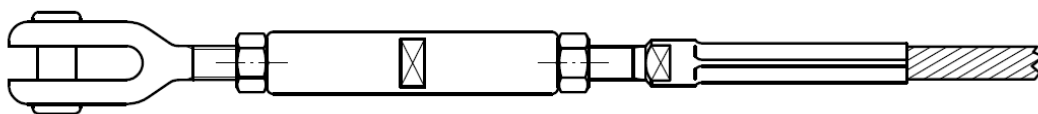
Fork end connector



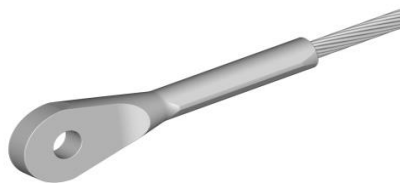
Fork end connector with external thread



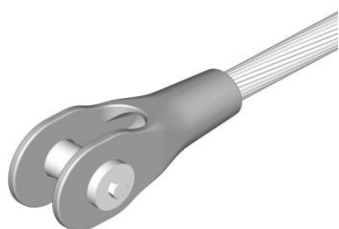
Turnbuckle



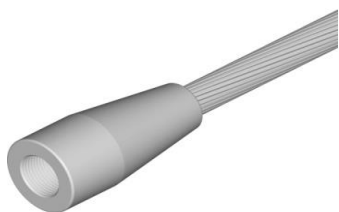
Combination of fork end connector, turnbuckle and end connector with external thread



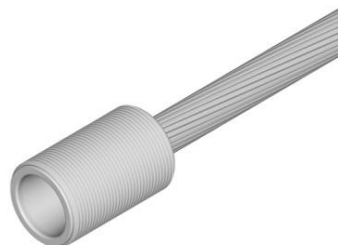
End connector for pin connections



Metal or resin filled fork end connector socket



Metal or resin filled conical socket with internal thread



Metal or resin filled cylindrical socket with external thread



Metal or resin filled fork end connector socket adjustable

ANNEX B SCHEMATIC DIAGRAM OF TENSION TESTS

