EUROPEAN ASSESSMENT DOCUMENT

EAD 230005-00-0106

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WIRE ROPE NET PANELS

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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).

Contents

1 SCOPE OF THE EAD

1.1 Description of the construction product

This EAD covers steel wire rope net panels (according to ISO/FDIS 17746) produced from components:

- Non–ferrous metallic (Zinc, Zinc / Aluminium alloy and advanced coating of class A or class B, according to EN 10264-1 -2 and ISO 7989-2) coated steel wires ropes (according to EN 12385 series and ISO 2408);
- Non–ferrous metallic (Zinc, Zinc / Aluminium alloy and advanced coating of class A, EN 10244-2 and ISO 7989-2) coated wire for crossing connection (double knot);
- Non-ferrous metallic coated clips/clamps for crossing connection (cross clip/clamp).

The wire rope net panels are made of square nets manufactured from ropes (ISO/FDIS 17746). An example of net panel is shown in Figure 1.

The crossing connection can be made in different ways:

- By double wire made by two bindings, each one obtained by looping a pair of steel wires with non-ferrous metallic coating. The two bindings tightly envelop the ropes crossing each other (see Figure 2);
- By fasteners, clips/clamps made by two half-shell steel clips which are pressed together and closed(see Figure 3);
- By wrapping ropes.

The wire rope can be closed by aluminium pressed ferrule of cylindrical shape made from aluminium Al 5150 A, with resistance not less than 90% of the rope breaking load. When border rope is requested, this rope can be fixed to the net rope using pressed C-ferrules of open shape made from aluminium Al 6060 T5.

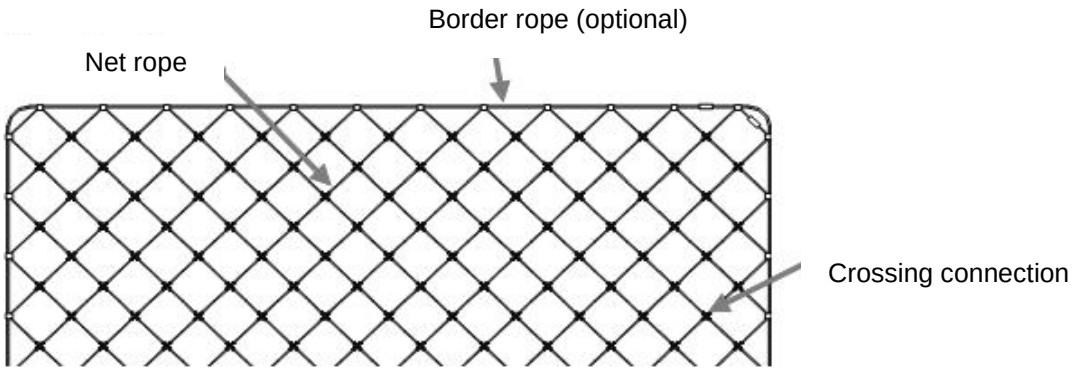


Figure 1 – Example of steel wire rope net panel layout (with border rope)

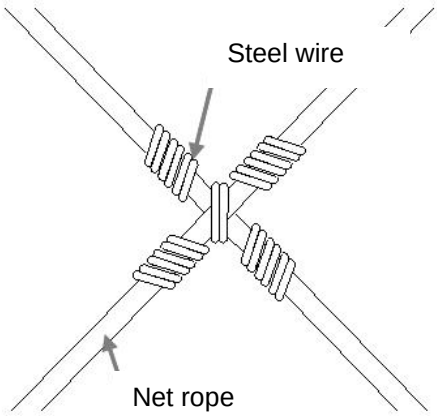


Figure 2 – Example of (double knot) wire crossing connection

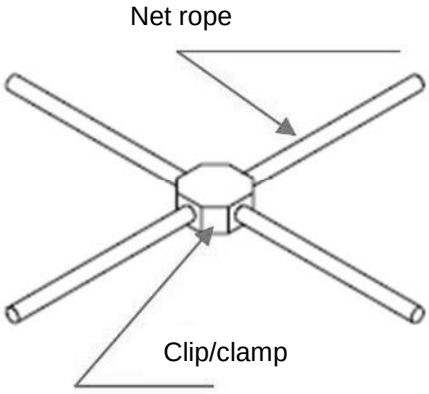


Figure 3 – Example of clip (cross clamp) cross connection

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)

Wire rope net panels are intended to be used for:

- Retaining of unstable slopes;
- Control and prevention of rockfall and loose debris flow;
- Component of soil nailing system;

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 products for the intended use, in accordance with Annex

A in ISO/FDIS 17746, in relation to different wire coating and corrosivity categories (according to EN ISO 9223) of environment, when installed in the works when durability tests are performed according to cl. 2.2.4 in this EAD, moreover when tested according to 2.2.4:

for non-ferrous metallic coating Zn class B the number of hours in exposure is 200

for non-ferrous metallic coating Zn class A the number of hours in exposure is 500

for non-ferrous metallic coating Zn95/Al5 class B the number of hours in exposure is 500

for non-ferrous metallic coating Zn95/Al5 class A the number of hours in exposure is 1000

for non-ferrous metallic coating Zn90/Al10 class B the number of hours in exposure is 1000

for non-ferrous metallic coating Zn90/Al10 class A the number of hours in exposure is 2000

for non-ferrous advanced metallic coating class B the number of hours in exposure is 1000

for non-ferrous advanced metallic coating class A the number of hours in exposure is 2000

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[1].

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

1.3.1 Mesh size

Average value ($M = L_M / 3$ and $N = L_N / 3$ if relevant) of rectangular mesh openings. The mesh size measured along the single rope as a centre to centre distance through three meshes in both directions (L_M, L_N, if relevant). An example of mesh size measurement is shown in Figure 4.

1.3.2 Wire rope net panel

The panel is made from wire rope or ropes arranged in a plain structure and connected in the points of overlapping by interlinking of the wire ropes or by metallic clips.

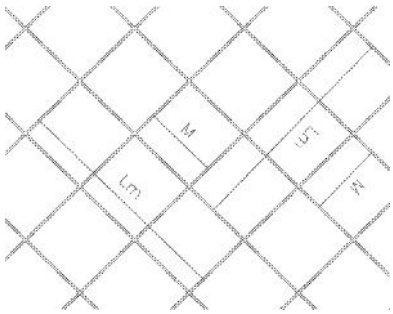


Figure 4 – Example of measurement of wire rope mesh size

[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 wire rope net panels 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	**Wire rope net components` characteristics:** **Wire rope** Wire rope diameter and designation Wire rope steel grade and minimum breaking force Wire rope coating type and mass **Connection wire** Connection wire diameter Connection wire tensile strength Connection wire coating type and mass **Connection cross clip/clamp** Cross fasteners/clip/clamp dimensions Cross fasteners/clip/clamp material Cross fasteners/clip/clamp coating type and mass **Crossing connection** Slipping force of connection Tear breaking force of connection **Wire rope mesh size**	2.2.1	 D_r (mm) and description f_y (N/mm^2), B_R (kN) description d (mm) f_t (N/mm^2) description (in mm) description description B_S (kN) B_T (kN) M x N (mm)
2	Tensile strength and elongation of net	2.2.2	p_m (kN/m) ε_m (mm/m)
3	Punching resistance and deflection of net	2.2.3	F_m (kN) δ_m (mm)
4	Durability in artificial atmosphere Neutral salt spray test with general condensation of moisture of mesh samples	2.2.4	Exposure time with surface DBR ≤ 5% surface (hours)

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

2.2.1 Wire rope net components` characteristics

2.2.1.1 Wire rope

The wire rope diameter D_r (in mm) and designation of wire rope net panel shall be tested according to EN 12385-2+A1 and by checking the inspection documents of incoming wire products.

The TAB shall inform the manufacturer of outcomes of the comparison of results with specifications supplied by the manufacturer.

Wire rope steel grade shall be expressed in ETA. The minimum breaking force B_R (in kN) shall be tested according to EN 12385-1+A1 and EN 13411-3+A1 and by checking the inspection documents of incoming products.

The TAB shall inform the manufacturer of outcomes of the comparison of test results with Table 5 in EN 12385+A1.

The wire rope coating type and mass (Zinc, Zinc / Aluminium alloy and advanced) of coating (class of coating) shall be tested according to EN 10264-1 and by checking the inspection documents of incoming products.

The TAB shall inform the manufacturer of outcomes of the comparison of test results with EN 10264-2 for Class A or Class B.

2.2.1.2 Connection wire

The diameter d (in mm) of connection wire shall expressed in ETA and shall be tested according to cl. 4.1 in EN 10218-2 and by checking the inspection documents of incoming wire products.

The TAB shall inform the manufacturer of outcomes of the comparison of test results with Table 1 (tolerance class T1) in EN 10218-2 for non-ferrous metallic coated wires.

The type of non-ferrous metallic Zinc, Zinc / Aluminium alloy and advanced coating and minimum coating mass on wires (in g/m^2) shall expressed in ETA and shall be tested in accordance with cl. 5.2.2 in EN 10244-2. The adherence wrapping test on non-ferrous metallic coated wires shall be carried out in accordance with cl. 6 in EN 10218-1 and by checking the inspection documents of incoming wire products.

The TAB shall inform the manufacturer of outcomes of the comparison of test results with Table 2 in EN 10244-2 for Class A or Class B.

The tensile strength f_y (N/mm^2) of connection wires shall expressed in ETA and shall be tested according to cl. 3 in EN 10218-1 and by checking the inspection documents of incoming wire products.

The TAB shall inform the manufacturer of outcomes of the comparison of results with specifications supplied by the manufacturer.

2.2.1.3 Connection cross-fastener/clip/clamp

The dimensions of cross fastener/clip/clamp shall be expressed in ETA. The dimensions shall be measured on at least three connection components / type.

The TAB shall inform the manufacturer of outcomes of the comparison of measured results with specifications supplied by the manufacturer with the specific tolerances.

The material of cross fastener/clip/clamp shall be expressed in ETA. The assessment shall be carried out by checking the inspection documents of incoming products.

The TAB shall inform the manufacturer of outcomes of the comparison of results with specifications supplied by the manufacturer.

The coating type and mass of cross fastener/clip/clamp shall be expressed in ETA. The coating type and mass of cross fastener/clip/clamp shall be assessed by checking the inspection documents of incoming products.

The TAB shall inform the manufacturer of outcomes of the comparison of results with specifications supplied by the manufacturer.

2.2.1.4 Crossing connection

The average slipping force B_S (in kN) shall be expressed in ETA. At least three samples according to C.3.2, Annex C, ETAG 027 (used as EAD) or according to cl. 8.2 in ISO/FDIS 17746 shall be tested.

The average tear breaking force B_T (in kN) shall be expressed in ETA. At least three samples according to cl. 8.3 in ISO/FDIS 17746 shall be tested.

2.2.1.5 Wire rope mesh size

The wire rope net size *M x N* (in mm) shall be measured according to cl. 1.3.1 in this EAD. The mesh size *M* and *N* shall be measured in at least three locations in three panels. The wire rope net size *M x N* (in mm) shall be expressed in ETA.

2.2.2 Tensile strength and elongation of net

The tensile strength shall be tested in accordance with Annex A in this EAD. The mean values and tolerances corresponding to 95% level of confidence shall be evaluated for test results $p_{max,i}$ (in kN/m) and $\varepsilon_{max,i}$ (in mm/m) of at least three specimens ($i \geq 3$). The mean value of tensile strength p_m (in kN/m) and mean value of elongation ε_m (in %) and their tolerances corresponding to 95% level of confidence shall be given in ETA.

2.2.3 Punching resistance and deflection of net

The punching resistance shall be tested in accordance with Annex B in ISO/FDIS 17746. The mean values and tolerances corresponding to 95% level of confidence shall be evaluated for test results $F_{max,i}$ (in kN) and $\delta_{max,i}$ (in mm) of at least three specimens ($i \geq 3$). The mean value of punching resistance F_m (in kN) and mean value of deflection δ_m (in mm) of net and their tolerances corresponding to 95% level of confidence shall be given in ETA.

> Note – Considering that both, the non-ferrous metallic coating type and class, do not influence the test procedure and results according to cl. 2.2.1.4, cl. 2.2.1.5, cl. 2.2.3 and cl. 2.2.4 the test samples can be selected with any of the coating given in ETA.

2.2.4 Durability

Neutral salt spray test with general condensation of moisture on non-ferrous metallic coated net samples (ropes and wires, cross-clamps, clips, knot) shall be carried out according to cl. EN ISO 9227. The number of hours of exposure after which each net sample does not show more than 5% of DBR (Dark Brown Rust) shall be given in ETA.

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 2003/728/EC

The system is: [1]

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	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]**					
Manufacturer`s production					
1	**Product:** Wire rope mesh size Slipping force Tensile strength and elongation of net Neutral salt spray test	. 2.2.2.5 2.2.1.4 2.2.3 2.2.5	 2.2.2.5 2.2.1.4 2.2.3 2.2.5	 1 sample / type 1 sample / type 1 sample / type According to control plan	 1 / day 1 / month 1 / year 1 each 2 years
Incoming product					
2	**Wire of knot:** Outer diameter Adherence Coating type and mass Tensile strength **Clip/clamp:** Dimensions Material Coating type and mass	 2.2.1.2 2.2.1.2 2.2.1.2 2.2.1.2 2.2.1.3 2.2.1.3 2.2.1.3	Manufacturer‘s technical file	Inspection certificate of supplier, type 3.1 EN 10204	According to manufacturer‘s technical file
3	**Net rope characteristics:** Diameter Designation Breaking force Nominal strength of a rope wire Corrosion protection of the rope (coating type and mass)	 2.2.1.1 2.2.1.1 2.2.1.1 2.2.1.1 2.2.1.1	Manufacturer‘s technical file	Inspection certificate of supplier, type 3.1 EN 10204	

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 wire rope net panels are laid down in Table 3.

Table 3 – 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 wire rope net panels	-	Laid down in control plan	-	1
Continuing surveillance, assessment and evaluation of factory production control					
2	Verifying that the system of factory production control and the specified automated manufacturing process are maintained taking account of the control plan	-	Laid down in control plan	-	1/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 10218-1	Steel wire and wire products. General. Part 1: Test methods
EN 10218-2	Steel wire and wire products. General. Part 2: Wire dimensions and tolerances
EN 10244-1	Steel wire and wire products. Non-ferrous metallic coatings on steel wire. Part 1: General principles
EN 10244-2	Steel wire and wire products. Non-ferrous metallic coatings on steel wire. Part 2: Zinc or zinc alloy coatings
EN 10264-1	Steel wire and wire products - Steel wire for ropes - Part 1: General requirements
EN 12385-1+A1	Steel wire ropes. Safety. Part 1: General requirements
EN 12385-2+A1	Steel wire ropes. Safety. Part 2: Definitions, designation and classification
EN 13411-3+A1	Terminations for steel wire ropes. Safety. Part 3: Ferrules and ferrule-securing
EN ISO 9223	Corrosion of metals and alloys. Corrosivity of atmospheres. Classification, determination and estimation
EN ISO 9227	Corrosion tests in artificial atmospheres - Salt spray tests EN ISO 7500-1/AC Metallic materials. Verification of static uniaxial testing machines. Part 1: Tension/compression testing machines. Verification and calibration of the force-measuring system
ISO 7989-2	Steel wire and wire products. Non-ferrous metallic coatings on steel wire. Part 2: Zinc or zinc-alloy coating
ISO/FDIS 17746	Steel wire rope net panels and rolls — Definitions and specifications
ISO 2408	Steel wire ropes for general purposes. Minimum requirements
ETAG 027 used as EAD	Falling Rock Protection Kit, April 2013

ANNEX A LONGITUDINAL TENSILE TEST WITH NO LATERAL CONTRACTION

A1 Test method

The test method is according to Annex C in ISO/FDIS 17746: 2016.

A2 Assessment of test results

During the test longitudinal tensile test with no lateral contraction, the following data shall be continuously recorded:

- Longitudinal force;
- Transversal forces;
- Displacement of the movable beam in longitudinal direction (applied load direction) ΔL (in mm).

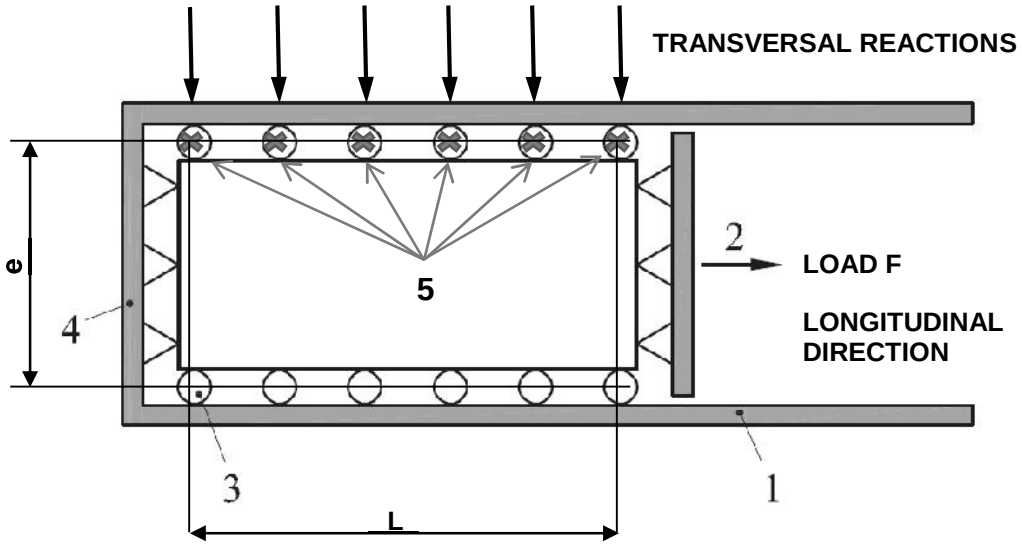
The tensile strength is determined as:

$$p_{max} = F_{max} / e \qquad \text{(kN/m)}$$

where

F_{max} in (kN) is the maximum recorded force (collapse load) in longitudinal direction

e in (m) is the distance between the outer supports of net (transversally to the direction of applied load, see Figure A.1). Figure A.1 is based on Figure C.1 in ISO/FDIS 17746: 2016.



Key:

1. Fixed frame
2. Movable beam
3. Lateral constraint (movable in londitudinal direction) to which the net is connected
   Note - The number of lateral constraint depends on the configuration of sample
4. Side connection
5. Load cells to measure transversal reactions

Figure A.1 – Test set-up

If it can be demonstrated that no transversal forces arise in tensile test in accordance with this Annex, for example for orthogonal nets, the tensile test shall be performed without connecting the transversal ropes of the samples of net and connecting only the longitudinal ropes. Due to the fact that the production technology may affect the actual resistances of ropes, this shall be considered in the tensile test.

The test report shall contain the following information:

- Detailed and particular description of test specimen: ring size and number of loops, component characteristics (diameter of wires, breaking forces);
- Distances *e* and *L*;
- Longitudinal force vs. displacement in longitudinal direction (of movable beam) diagram;
- Transversal forces vs. displacement in longitudinal direction (of movable beam) diagram;
- Collapse load in longitudinal direction;
- Transversal forces in each load cell installed transversally at collapse load;
- Displacement of movable beam ΔL at collapse load and corresponding elongation $\varepsilon_{max} = \Delta L/L$;
- Description of failure modes;
- Photographic documentation of specimen before and after the test including the way of connection of mesh to the frame.