

## EUROPEAN ASSESSMENT DOCUMENT

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# Hexagonal woven mesh gabion boxes and mattresses

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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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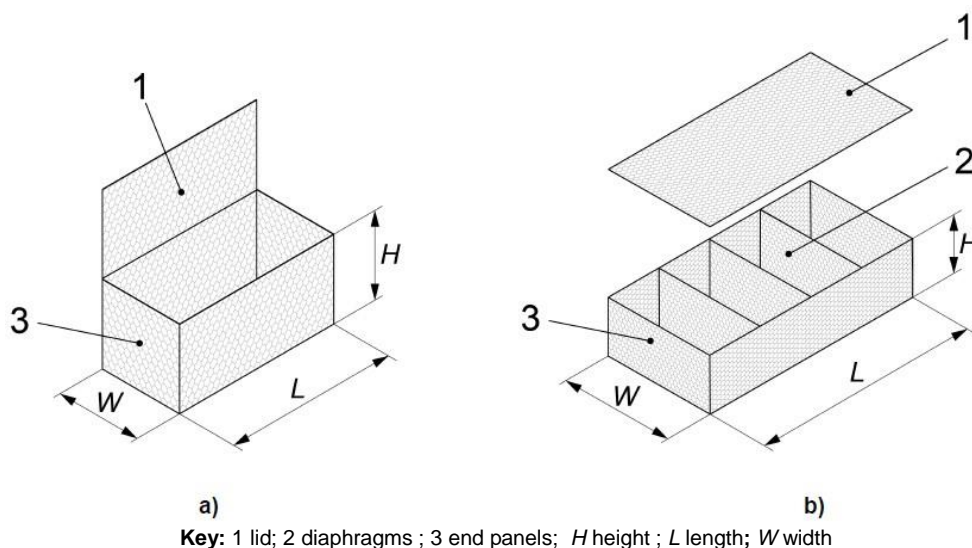
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# 1 SCOPE OF THE EAD

## 1.1 Description of the construction product

A gabion is a double-twisted wire mesh container of variable sizes, uniformly partitioned into internal cells, interconnected with other similar units, and filled with stone at the project site to form flexible, permeable, monolithic structures such as retaining walls, sea wall, channel linings, revetments, and weirs for erosion control projects (see Figure 1a and Figure 1b). A mattress (Figure 2) is a double-twisted wire mesh container uniformly partitioned into internal cells with relatively small height in relation to other dimensions, having generally smaller mesh openings than the mesh used for gabions; mattresses are generally used for riverbank protection and channel linings. This EAD also covers the sack gabions shown in Figure 3.

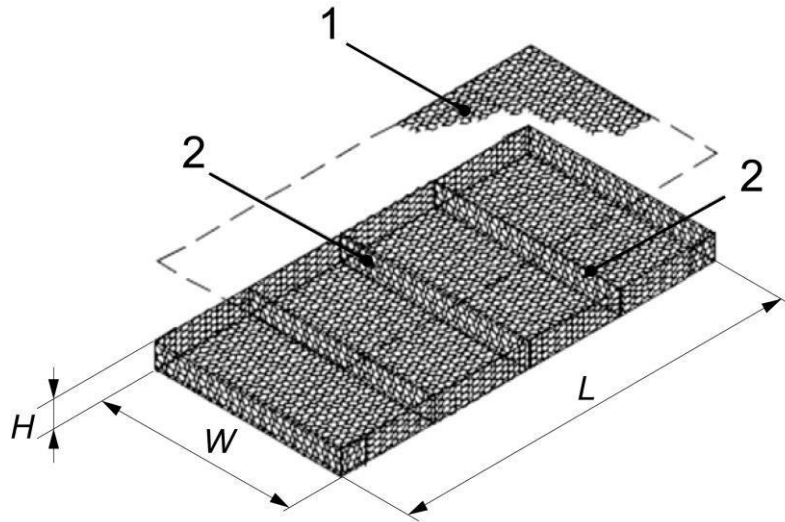
Gabions and mattresses are produced from double-twisted non-ferrous metallic Zinc / Aluminium alloy coated wire mesh and non-ferrous metallic coated and/or stainless steel wire for lacing wire, stiffeners, and fasteners used for manufacturing, assembling, and installation of the product. This EAD also covers gabions and mattresses in which the wire mesh, lacing wire, and stiffeners are poly(vinyl chloride) (PVC), poly(ester) (PE) or poly(amid) (PA6) coated after the Zn/Al alloy coating.



**Figure 1 – Gabions: a) without diaphragm, b) with diaphragms**

For connection of lid, bottom and intermediate diaphragms of the gabion (or mattresses) – during the installation, the following options can be used:

- 1) By hand employing lacing wire. The diameter of lacing wire shall be the same or thinner than the wire from which the mesh is woven (Figure 4).
- 2) By spirals. Once the gabion walls are placed tightly together so that the edge wires are in contact, around the edge wires the spiral is screwed. The ends of spiral are bent to prevent its removal.
- 3) With C-rings (or clips or similar fasteners) employing hand or pneumatic stapler. The units to be connected are put tightly together so that the edge wires are in contact and the C-rings (clips) are placed by such a way they encircle the edge wires of both adjacent walls. The maximum distance between the rings is 200 mm, see Figure 5.



Key: 1 lid; 2 diaphragms ;  $H$  height ;  $L$  length;  $W$  width

Figure 2 – Mattress

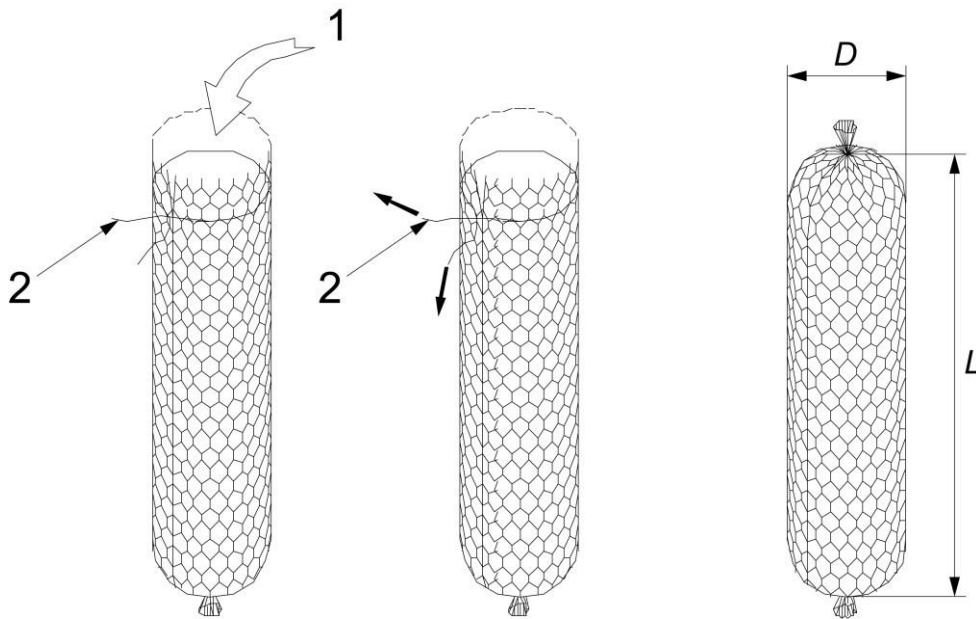
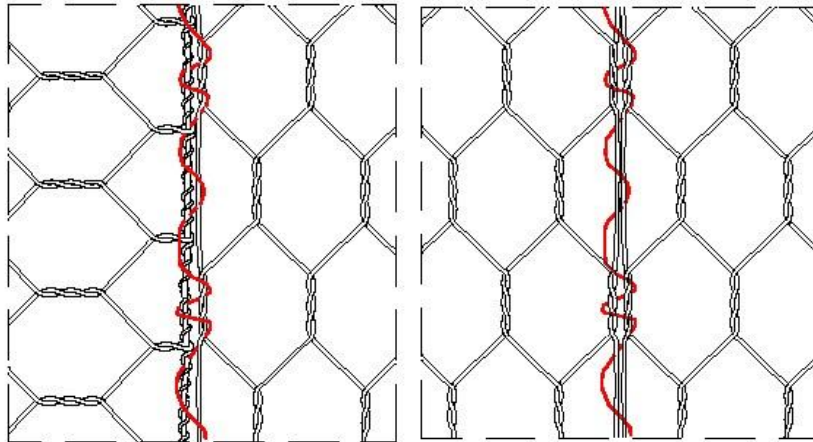
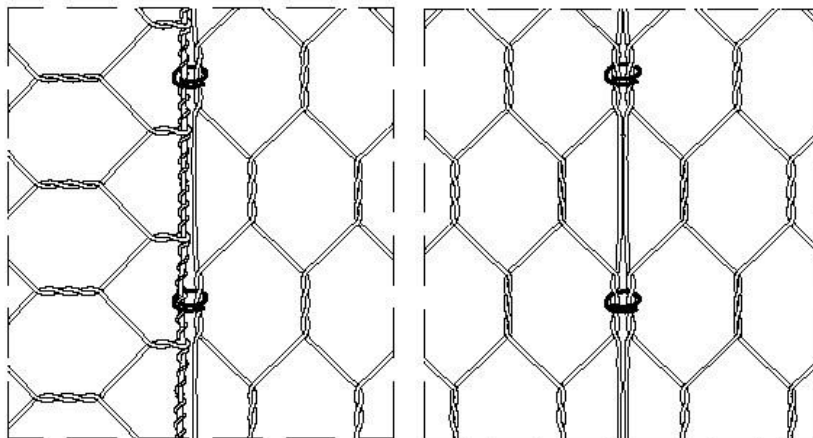


Figure 3 – Examples of sack gabions

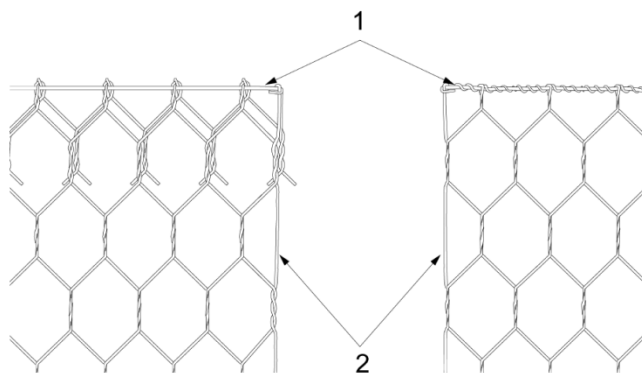
Key: 1 filling; 2 lacing wire ;  $D$  diameter ;  $L$  length;  $W$  width



**Figure 4 – Connection using lacing wire**



**Figure 5 – Connection using C-rings**



**Key:** 1 selvedge wire; 2 edge wire;

**Figure 6 – End adjustment of mesh**

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)

Gabions and mattresses made of hexagonal double twisted wire mesh are intended to be used for:

- earth retention,
- soil reinforcement,
- river training,
- erosion control,
- fascia systems,
- architectural claddings,
- free-standing walls,
- sound barriers,
- noise mitigation 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:

- a) Working life of the hexagonal woven mesh gabion boxes and mattresses for the intended use, in accordance with Annex 1, EN 10223-3, in relation to different wire coating and corrosive categories (according to EN ISO 9223) of environment, when installed in the works when durability tests are performed according to cl. 2.2.9.1, 2.2.9.2 and 2.2.9.3 in this EAD, moreover

When tested according to 2.2.9.1:

for non-ferrous metallic coating Zn95/Al5 and Zn95/Al5 + organic coating the number of cycles is 28;

for non-ferrous metallic coating Zn90/Al10 and Zn90/Al10 + organic coating the number of cycles is 56;

for non-ferrous advanced metallic coating and non-ferrous advanced metallic coating + organic coating the number of cycles is 56;

When tested according to 2.2.9.2:

for non-ferrous metallic coating Zn95/Al5 and Zn95/Al5 + organic coating the number of hours in exposure is 1000;

for non-ferrous metallic coating Zn90/Al10 and Zn90/Al10 + organic coating the number of hours in exposure is 2000;

for non-ferrous advanced metallic coating and non-ferrous advanced metallic coating + organic coating the number of hours in exposure is 2000;

When tested according to 2.2.9.3:

the change of retained tensile strength and elongation of organic coating material is not more than 25%.

- b) Working life of 25 years for corrosivity category C1 and C2 and 10 years for corrosivity category C3 (for corrosivity category see EN ISO 9223) for less number of cycles, less number of hours of exposure or

greater change in retained tensile strength and elongation of organic coating material than written in section a).

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<sup>1</sup>.

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 Double-twisted wire mesh

A mesh made by twisting continuous pairs of wires through three one-half turns (commonly called double-twisted) to form hexagonal-shaped openings which are then interconnected to adjacent wires to form hexagonal openings. Wires can be interwoven into the hexagonal double twisted mesh in equal distances orthogonally to the axis of twist when applied for front and back faces of gabions.

### 1.3.2 Mesh size of double twisted mesh

A distance measured at right angles between two twisted sides  $M$  (see Figure 7).

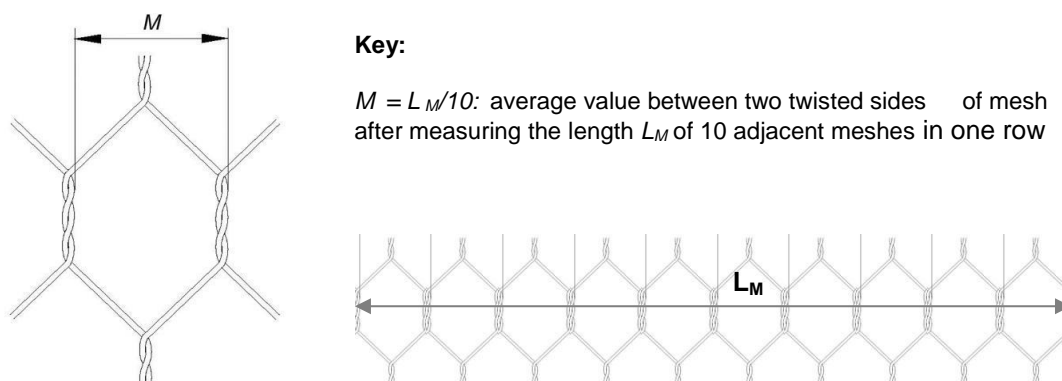


Figure 7 – Mesh size

### 1.3.3 Mesh designation

Definition of double twisted mesh type related to typical dimension of mesh, for example 6x8, 8x10.

### 1.3.4 Lacing wire

For gabions and gabion mattresses; a non-ferrous metallic-coated steel wire and/or with organic over coating or stainless steel wire used to assemble and interconnect empty units, to close and secure units filled with stone as a replacement for spiral binders or rings and also used as bracing tie to prevent face deformation.

<sup>1</sup> 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.



### **1.3.5 C-rings and clips**

Rings of C-shape and clips made from high strength steel wire with Zn/Al alloy coating or stainless steel wire, used to assemble and interconnect the empty gabions and to close and secure the units filled with stone.

### **1.3.6 Stiffener/bracing tie**

A length of wire with the equivalent corrosion protection as for gabions used to support of facing by forming a diagonal brace across the corners of a gabion cell, or by forming a transversal brace connecting the face and back of gabion cell.

### **1.3.7 Diaphragm**

Hexagonal double twisted wire mesh panel made of similar mesh as a gabion/mattress itself, connected to the back, front, lid and base panels to stabilize and ensure the position and the shape of gabion/mattress.

### **1.3.8 Selvedge wire**

A terminal wire used to edge the wire mesh perpendicular to the double twist by mechanically wrapping the mesh wires around it at least 2,5 times or by inserting it throughout the twists and folding one mesh length (see Figure 6).

### **1.3.9 Edge wire**

A terminal wire used to edge the wire mesh parallel to the double twist direction by continuously weaving it into the wire mesh (see Figure 6).

## 2 ESSENTIAL CHARACTERISTICS AND RELEVANT ASSESSMENT METHODS AND CRITERIA

### 2.1 Essential characteristics of the product

Table 1 shows how the performance of hexagonal woven mesh gabion boxes and mattresses 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)
<b>Basic Works Requirement 1: Mechanical resistance and stability</b>			
1	Mesh designation Mesh size	2.2.1	$M$ (mm)
2	Wire diameter	2.2.2	$d$ (mm)
3	Wire tensile strength and elongation	2.2.3	$f_t$ (N/mm <sup>2</sup> ) $\varepsilon$ (%)
4	Dimensions of product and connection components	2.2.4	$H, L, W, D, L_s$ (mm) Specific dimensions (mm)
5	Corrosion protection: non-ferrous metallic coating type class of coating mass	2.2.5	description description
6	Additional corrosion protection: organic coating type coating thickness and wire diameter coating concentricity coating integrity	2.2.6	description (mm) (%) description
7	Tensile resistance of mesh	2.2.7	$p_k$ (kN/m)
8	C-ring (or similar fastener) resistance to opening	2.2.8	$F_m$ (kN)
9	Durability in artificial atmospheres sulphur dioxide neutral salt spray UV resistance of organic coating	2.2.9	Number of cycles with surface DBR $\leq$ 5% (Number) Exposure time with surface DBR $\leq$ 5% surface (hours) % of retained tensile strength and elongation (%)

No	Essential characteristic	Assessment method	Type of expression of product performance (level, class, description)
Basic Works Requirement 2: Safety in case of fire			
10	Not specified in this version of EAD		
Basic Works Requirement 3: Hygiene, health and the environment			
11	Dangerous substances	2.2.10	description
Basic Works Requirement 4: Safety and accessibility in use			
12	Not specified in this version of EAD		
Basic Works Requirement 5: Protection against noise			
13	Airborne sound insulation	2.2.11	description
14	Sound absorption	2.2.12	description
Basic Works Requirement 6: Energy economy and heat retention			
15	Not specified in this version of EAD		
Basic Works Requirement 7: Sustainable use of natural resources			
16	Not specified in this version of EAD		

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

### 2.2.1 Mesh designation, mesh size $M$ (in mm)

The mesh size  $M$  (in mm) shall be measured according to cl. 3.1 in EN 10223-3 (see also 1.3.2 in this EAD). The mesh size  $M$  shall be measured on at least three samples. Each single measured value shall fulfil the nominal mesh size within the tolerances, both prescribed by the manufacturer. The mesh designation in relation to the mesh wire and selvedge and end wire (if relevant) diameter shall be checked (for example 5 x 7/2,7-3,4, where 5 x 7 is the mesh designation, 2,7 is the mesh wire diameter and 3,4 is the selvedge and/or edge wire diameter).

The TAB shall inform the manufacturer of outcomes of the comparison of test results with Table 2 in EN 10223-3.

### 2.2.2 Wire diameter $d$ (in mm)

The diameter  $d$  (in mm) of mesh wire, connection wires, selvedge and end wires as well, shall be verified according to cl. 4.1 in EN 10218-2. The verification shall be carried out by checking the inspection documents of incoming wire products and by additional checking according to the manufacturer's control plan.

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.

### 2.2.3 Wire tensile strength $f_t$ (in N/mm<sup>2</sup>) and elongation $\varepsilon$ (in %)

The tensile strength and elongation of mesh and connection components` wires and selvedge and end wires shall be verified according to cl. 3 in EN 10218-1. The verification shall be carried out by checking the inspection documents of incoming wire products and by additional checking according to the manufacturer`s control plan.

The TAB shall inform the manufacturer of outcomes of the comparison of test results with cl. 5.2 in EN 10223-3 for mesh, selvedge, edge and lacing wire and with cl. 6.9 in EN 10223-3 for connection component (C-ring) wire.

### 2.2.4 Dimensions of product and connection components $H, L, W, D$ and $L_s$ and specific dimensions of connection components (in mm)

The product dimensions (for informative values see Table 2, for dimensions, see Figures 1, 2 and 3) and connection components` dimensions *specific dimensions* (in mm) shall be measured at least on three samples for each type of product and each measurement shall fulfil the nominal dimensions within the tolerances, both prescribed by the manufacturer.

The TAB shall inform the manufacturer of outcomes of the comparison of test results with cl. 6.3 in EN 10223-3 (or informative Table 2).

**Table 2 (Informative) – Dimensions of product**

Product	Length (m)	Width (m)	Height (m)	Diameter of sack gabion (m)
Gabion	1,0	1,0	0,3; 0,5; 1,0	0,95
	1,5	1,0	0,3; 0,5; 1,0	
	2,0	1,0	0,3; 0,5; 1,0	
	3,0	1,0	0,3; 0,5; 1,0	
	4,0	1,0	0,3; 0,5; 1,0	
Tolerances	± 5%	± 5%	± 5%	± 5%
Mattresses	3,0	2,0; 3,0	0,17; 0,23; 0,3	
	4,0	2,0; 3,0	0,17; 0,23; 0,3	
	5,0	2,0; 3,0	0,17; 0,23; 0,3	
	6,0	2,0; 3,0	0,17; 0,23; 0,3	
Tolerances	± 5%	± 5%	± 25 mm	

### 2.2.5 Corrosion protection: non-ferrous metallic coating- type and class of coating mass

The type of non-ferrous metallic Zinc/Aluminium alloy coating (informative types are: Zn/95/Al5, Zn90/Al10) and minimum coating mass on wires (in g/m<sup>2</sup>) shall be verified 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. The verification shall be carried out by checking the inspection documents of incoming wire products and by additional checking according to the manufacturer`s control plan.

The TAB shall inform the manufacturer of outcomes of the comparison of test results with Table 2 in EN 10244-2 for Class A and/or in specific case for Class E (when PA6 additional organic coating is used).

### 2.2.6 Additional corrosion protection: organic coating

#### 2.2.6.1 Organic coating on wire

The diameter (in mm) and minimum coating thickness of organic coated wires (possible types of organic coating are: PVC in accordance with EN 10245-2, PE in accordance with EN 10245-3, PA6 in accordance with EN 10245-5) together with concentricity (in %) shall be verified in accordance with cl. 5.2.4 in EN 10245-1. The verification shall be carried out by checking the inspection documents of incoming wire products and by additional checking according to the manufacturer`s control plan.

The TAB shall inform the manufacturer of outcomes of the comparison of test results with cl. 6.5 in EN 10223-3 and Table 2 in EN 10218-2.

### 2.2.6.2 Organic coating in double twist region of mesh

Coating integrity in double twist region of mesh tested according to Annex A in this EAD shall be verified at 50 % of the characteristic values of tensile strength of the mesh as defined in Clause 2.2.7 in this EAD. Coating integrity is fulfilled when no cracks (tested at least on one sample from each mesh type) in the organic coating within the double twists region occur.

The following statement shall be given in ETA: No cracks (no visible underlying steel wire) in organic coating within the double twist region occur at 50 % of the characteristic value of tensile strength of the mesh.

### 2.2.7 Tensile resistance of mesh $p_k$ (in kN/m)

The mechanical resistance of double twisted wire mesh is determined by characteristic tensile strength  $p_k$  (in kN/m) of mesh in the direction parallel with the axis of twist. The test procedure for mesh is in accordance with cl.9, EN 10223-3. The 5%-fractile of tensile strength measured in a test series shall be calculated according to D7, EN 1990 for normal distribution and known coefficient of variation and value of  $k_n$  depending on the number of test series. The characteristic value  $p_k$  (in kN/m) at least from three test results shall be calculated. The characteristic strength shall be checked periodically (yearly) after at least three tests on the same mesh type.

### 2.2.8 C-ring (or similar fastener) resistance to opening $F_m$ (in kN)

The average resistance to opening (measured on minimum of 5 samples)  $F_m$  (in kN) of C-ring (or similar fastener) when tested in accordance with Annex 2 in this EAD shall be recorded in ETA.

The TAB shall inform the manufacturer of outcomes of the comparison of test results with cl. 6.9 in EN 10223-3.

### 2.2.9 Durability in artificial atmospheres

#### 2.2.9.1 Sulphur dioxide test with general condensation of moisture of Zn/Al alloy coated and Zn/Al alloy + organic mesh samples

Sulphur dioxide test with discontinuous exposure on mesh samples (at least one sample for each mesh designation) shall be carried out according to cl. 6.7.1 and cl. 6.7.2 in EN 10223-3. For Zn/Al alloy and Zn/Al alloy + organic coating or equivalent advanced coated mesh samples, the number of cycles of discontinuous exposure after which each mesh sample does not show more than 5% of DBR (Dark Brown Rust) shall be given in ETA. For Zn/Al + organic coated mesh samples the permeated rust shall be evaluated without removing the organic coating.

#### 2.2.9.2 Neutral salt spray test with general condensation of moisture of Zn/Al alloy and Zn/Al alloy + organic coated mesh samples

Neutral salt spray (NSS) test on mesh samples (at least one sample) shall be carried out according to cl. 6.7.1 and cl. 6.7.2 in EN 10223-3. For Zn/Al alloy and Zn/Al alloy + organic coating or equivalent advanced coated mesh samples, the number of hours of exposure after which each mesh sample does not show more than 5% of DBR (Dark Brown Rust) shall be given in ETA. For Zn/Al + organic coated mesh samples the permeated rust shall be evaluated without removing the organic coating.

#### 2.2.9.3 UV resistance of organic coating

The raw organic material durability shall be demonstrated by method of exposition according to cl. 6.7.3 in EN 10223-3. The average relationship of initial and retained tensile strength and elongation in % resulting calculated from at least three samples shall be given in ETA.

### 2.2.10 Content, emission and/or release of dangerous substances

The performance of the product related to the emissions and/or release and, where appropriate, the content of dangerous substances will be assessed on the basis of the information provided by the manufacturer using the following methods and criteria EOTA TR 034.

Regarding the release scenarios referred to in the EOTA TR 034, the following use categories have to be considered:

Category S/W1: Product with direct contact to soil-, ground- and surface water

Category S/W2: Product with no direct contact to but possible impact on soil-, ground- and surface water

Category S/W3: Product with no contact to and no impact on soil-, ground- and surface water

Category S/W1 is applicable for products which are in contact with soil or water in a way that dangerous substances could be released directly out of the product.

Category S/W2 is applicable for products which can be leached by rain and could release dangerous substances which can have impact on soil and water.

Category S/W3 is applicable for products which are completely covered with tight products capable of avoiding any kind of migration of dangerous substances to soil or water.

The product and/or constituents of the product listed in EOTA TR 034 and the related dangerous substances which have to be considered, shall be assessed by the given methods taking into account the installation conditions of the construction product and the release scenarios resulting from there.

After identifying the release scenarios taking into account the intended use of the product:

1. The assessment of the product will be made by resorting to already existing European assessment methods developed by CEN (or by EOTA, if CEN has not yet developed such methods).
2. If European assessment methods as mentioned above do not yet exist and if the manufacturer wants to have his product used in a Member State which has requirements on the assessment of the performance of the product concerning dangerous substances, the national assessment method applicable in that specific Member State will be taken into account when choosing the assessment method.

#### **2.2.11 Airborne sound insulation**

In case of use of gabion products as sound barriers for roads and railways the ETA may include assessment of airborne sound insulation, based on given guidance for the composition of the barrier. Although the composition and type of filling material of the barrier is to be indicated in the ETA for such cases, it does not form part of the ETA. Verification of airborne sound insulation shall be carried out according to EN 1793-2. The results shall be expressed according to clause 6.1 and Annex A, EN 1793-1.

#### **2.2.12 Sound absorption**

In case of use of gabion products as sound barriers for roads and railways the ETA may include verification of sound absorption, based on given guidance for the design of the barrier. Although the composition of the barrier is to be indicated in the ETA it does not form part of the ETA. Verification of airborne sound insulation shall be carried out according to EN 1793-2. The results shall be expressed according to clause 6.1 and Annex A, EN 1793-1.

### **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 3.

**Table 3 – Control plan for the manufacturer; cornerstones**

No	Subject/type of control (product, raw/constituent material, component -indicating characteristic concerned)	Test or control method (refer to 2.2)	Criteria, if any	Minimum number of samples	Minimum frequency of control
<b>Factory production control (FPC)</b>					
<b>Manufacturer`s production</b>					
1	<b>Product:</b> Mesh dimensions, mesh size	2.2.1	2.2.1	1 sample / type	1 / day
	Product dimensions	2.2.4	2.2.4	1 sample / type	1 / day
	Connection component dimensions	2.2.4	2.2.4	1 sample / type	1 / day
	Coating integrity	2.2.6.2	2.2.6.2	1 samples / type	1 / year
	Tensile resistance of mesh	2.2.7	2.2.7	3 samples / type	2 / year
	Opening resistance of connection components	2.2.8	2.2.8	5 samples / type	1 / year
	Sulphur dioxide test	2.2.9.1	2.2.9.1	1 sample / mesh type and wire diameter	1 / 2 years
	Neutral salt spray test	2.2.9.2	2.2.9.2	1 sample / mesh type and wire diameter	1 / 2 years
	UV resistance	2.2.9.3	2.2.9.3	According to control plan	1 / 2 years
	<b>Factory production control (FPC)</b>				
<b>Incoming product</b>					
2	<b>Wire chemical composition:</b> For each components	Manufacturer`s technical file	Manufacturer`s technical file	Inspection certificate of supplier, type 3.1 EN 10204	
3	<b>Metallic coated wire:</b> Outer diameter	2.2.2		Inspection certificate of supplier, type 3.1 EN 10204	Every shipment
	Adhesion	2.2.5		In addition 1 / each diameter	
	Visual	2.2.2			
Coating mass	2.2.5				
4	<b>Organic coated wire (also if produced by the manufacturer):</b> Outer diameter	2.2.6.1	Inspection certificate of supplier, type 3.1 EN 10204	Every shipment	
	Visual	2.2.6.1	In addition 1 / each diameter		
	Thickness/concentricity	2.2.6.1			
5	<b>Wire mechanical characteristics:</b> Tensile strength	2.2.3	Inspection certificate of supplier, type 3.1 EN 10204	2 / year	
			In addition 1 / each diameter		

### 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 hexagonal woven mesh gabion boxes and mattresses are laid down in Table 4.

**Table 4 – Control plan for the notified body; 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)</i>	Criteria, if any	Minimum number of samples	Minimum frequency of control
<b>Initial inspection of the manufacturing plant and of factory production control</b>					
1	Ascertain that the factory production control with the staff and equipment are suitable to ensure a continuous and orderly manufacturing of the hexagonal woven mesh gabion boxes and mattresses	-	Laid down in control plan	-	1
<b>Continuing surveillance, assessment and evaluation of factory production control</b>					
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.

EOTA TR 034	General BWR 3 checklist for EADs/ETAs
EN 10223-3	Steel wire and wire products for fencing and netting - Part 3: Hexagonal steel wire mesh products for civil engineering purposes
EN 10204	Metallic products. Types of inspection documents
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 10245-1	Steel wire and wire products. Organic coatings on steel wire. Part 1: General rules
EN 10245-2	Steel wire and wire products. Organic coatings on steel wire. Part 2: PVC finished wire
EN 10245-3	Steel wire and wire products - Organic coatings on steel wire - Part 3: PE coated wire
EN 10245-5	Steel wire and wire products. Organic coatings on steel wire. Part 5: Polyamide coated wire
EN 1990+A1+A1/AC Eurocode 0:	Basis of Structural Design
EN 1793-1	Road traffic noise reducing devices. Test method for determining the acoustic performance. Part 1: Intrinsic characteristics of sound absorption
EN 1793-2	Road traffic noise reducing devices. Test method for determining the acoustic performance. Part 2: Intrinsic characteristics of airborne sound insulation under diffuse sound field conditions
EN 1793-3	Road traffic noise reducing devices. Test method for determining the acoustic performance. Part 3: Normalized traffic noise spectrum
EN ISO 9223	Corrosion of metals and alloys. Corrosivity of atmospheres. Classification, determination and estimation
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

## ANNEX 1 - INTEGRITY OF ORGANIC COATING ON WIRES OF DOUBLE TWISTED MESH

### 1.1 Scope

The aim of this test is to show the integrity of organic coating on the wires when the net is loaded by tension.

### 1.2 Terms and definitions

For the purposes mentioned above the following symbols and definitions are applied:

**Panel:** Element made of double twisted net prepared for the longitudinal tensile test with a minimum width equal to 8 times the size of the single mesh and a length allowing a distance between the equipment grip tools equal to a complete mesh length .

**Sample:** The sample prepared for the evaluation of the integrity of the polymer coating inside the double twists of the net is made of panel central ones.

### 1.3 Sampling

For each type of double twist wire mesh produced with organic coated wire 1 panel (see Figure 1.1) in order to perform the longitudinal tensile test (according to cl. 9, EN 10223-3), shall be sampled.

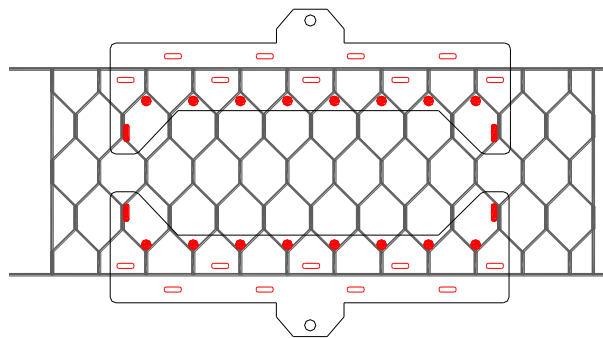


Figure 1.1 - Panel

Each panel samples is subject to tensile strength test according to cl.9, EN 10223-3, up to 50% of the characteristic tensile strength values.

For each tensioned panel the double twist region (sample) will be verified (see Figures 1.2, 1.3 and 1.4).

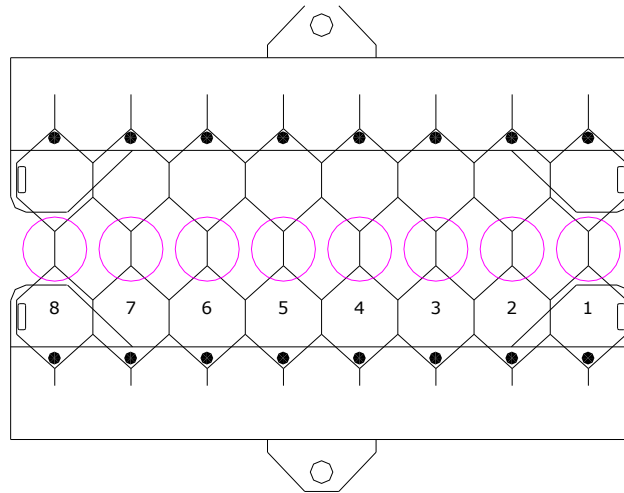
From each sample the wires in the double twist shall be cut around 10 cm long, corresponding to panel central twists as highlighted by marks in Figures 1.2, 1.3 and 1.4.

### 1.4 Test arrangement

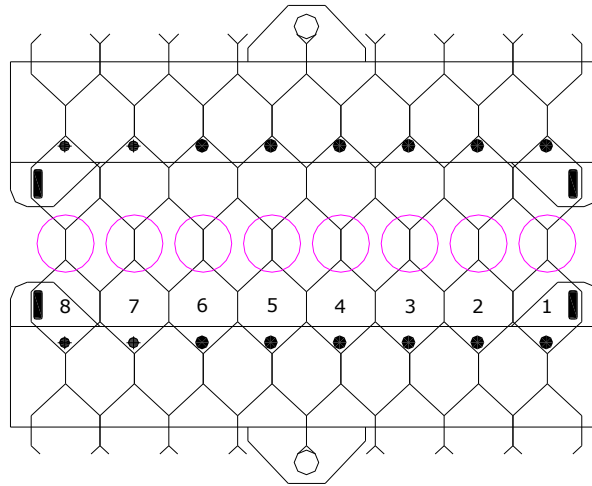
The upper and lower ends of the net sample are used to hang it to the supports of the traction machine during the tensioning and therefore they cannot be used to evaluate for the outcome of the test.

Each sample sample's effective width is made of a fixed number of wires in relation to the mesh type:

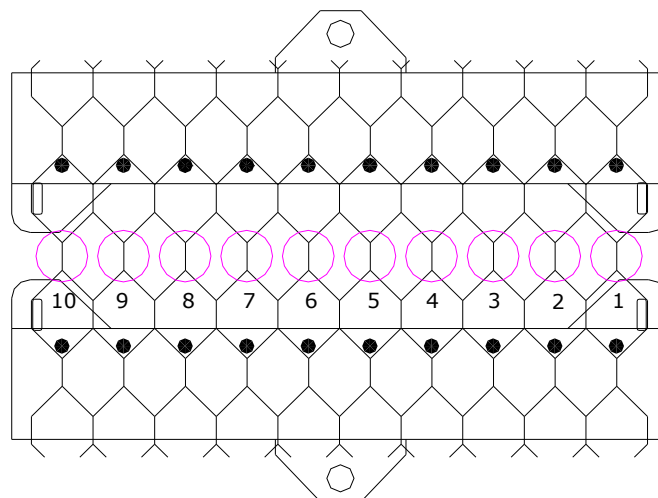
- n. 16 wire sections for 10 x 12 mesh type
- n. 16 wire sections for 8 x 10 mesh type
- n. 20 wire sections for 6 x 8 mesh type



**Figure 1.2 – Sample for 10 x 12 mesh type**



**Figure 1.3 – Sample for 8 x 10 mesh type**



**Figure 1.4 – Sample for 6 x 8 mesh type**

### 1.5 Evaluation of test results

For each sample visual inspection of integrity of organic coating is carried out for each wire portion in correspondence with the double twists.

Damage shall be classified into 4 categories:

#### **Category 1: General abrasion**

Abrasion means the condition of the organic coating where the wire inside the twists has left an imprint that does not let the underlying steel wire visible.

#### **Category 2: Splits**

Split means a region of wire in which the organic coating is locally cut and raised and so the underlying steel wire can be visible.

#### **Category 3: Cuts**

Cut means a region of the wire clearly cut where organic strips are still in contact.

#### **Category 4: Bruises**

Bruise means a wire region where organic coating is pressed and the underlying steel wire can visible.

If the mesh made from organic coated wire when tested in tensile test, shows cracks in the organic coating within the double twists region at 50 % of the characteristic values of tensile strength of mesh (whenever the underlying steel wire is clearly visible), the integrity is not fulfilled and the test shall be accepted.

### 1.6 Test Report

The test report shall include at least the following information:

- Name of laboratory and name of operator who performed the tests;
- Characteristics of the testing machine and its calibration certificate;
- Date of test;
- Identification of the tested panel and sample (supplier and material nature of the surface treatment, dimensions, etc.);
- Documentation of test by photographs;
- Results expressed by category and/or different categories in % to the tested overall length.

## **ANNEX 2 - C- RING (OR SIMILAR FASTENER) RESISTANCE TO OPENING, TEST METHOD**

### **1.1 Scope**

The aim of this test is to show the pull-apart resistance of C-ring (or similar) fastener used to assemble gabion units.

### **1.2 Test Specimen**

The test specimen is the closed C-ring (or similar fastener) itself.

### **1.3 Test equipment**

The traction machine shall be in accordance with the requirements of EN ISO 7500-1 and shall be at least of Class 1. The testing apparatus shall be able to memorize or record the maximum force resulting opening staples.

### **1.4 Test Conditions**

#### **1.4.1 Method of sample fixing**

The specimen shall be maintained by suitable means such as yokes, shackles or other mounting for the tensile test. The equipment shall keep the test sample so that the load is applied along the longitudinal axis of the C-ring (or similar) fastener through the closure.

#### **1.4.2 Test procedure**

Speed of application of the load is 5 mm/min with an uncertainty of less than 5 %, until the complete opening of the tested C-ring.

#### **1.4.3 Number of samples per type fastener**

For determination of the average opening load at least 5 samples for each type of C-ring (or similar fastener) shall be tested.

#### **1.4.4 Determination of the opening load**

The opening load is considered to be a maximum load achieved during the test i. e. the force corresponding to the maximum recorded and stored by the testing apparatus fitted to the testing machine value or the maximum value on force – opening diagram recorded.

### **1.5 Test report**

The test report shall include at least the following information:

- Name of the laboratory and the name of the operator who performed the tests;
- The characteristics of the testing machine and its calibration certificate;
- Identification of the tested C-ring (or similar fastener) (supplier and material nature of the surface treatment, dimensions, etc.);
- The date of test and results (opening load, mean and standard deviation of the results by C-ring type (or similar fastener), with appropriate, observations justify the results, force – opening diagram – if relevant).