EUROPEAN ASSESSMENT DOCUMENT

EAD 080013-00-0102

February 2018

RECTANGULAR GEOGRID FOR THE STABILIZATION OF UNBOUND GRANULAR LAYERS UNDER APPLIED LOAD

www.eota.eu

The reference title and language for this EAD is English. The applicable rules of copyright refer to the document elaborated in and published by EOTA.

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 product “rectangular geogrid for the stabilization of unbound granular layers under applied load” named “geogrids” hereinafter are planar structures consisting of a regular open-network of integrally connected tensile bars. The bars are made from extruded polypropylene (white) or polyester (transparent) and welded into grids.

The geogrids are manufactured from integrally connected, extruded high tenacity bars of various cross sections, which are welded together at the appropriate centres to form the geogrids. A typical geogrid is illustrated in the following figure 1.1.1.

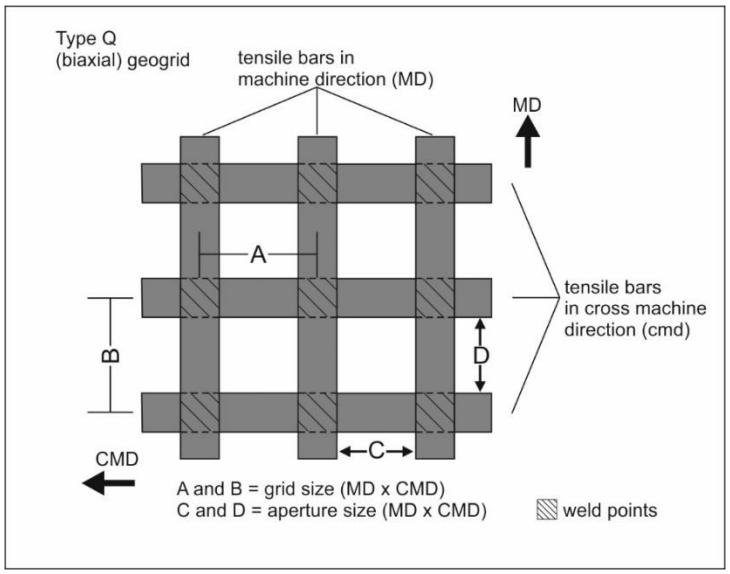


Figure 1.1.1: Typical geogrid

If a geocomposite is required, a nonwoven (PP grid with PP nonwoven; PET grid with PET nonwoven) is integrally welded between the bars of the geogrid in machine direction (md) and the bars in cross machine direction (cmd) or the nonwoven is glued to the subsurface of the geogrid bars.

The geogrids are manufactured in several standard grades of various strengths and biaxial aperture sizes. Only geogrids with a grid size A and B (see fig. 1.1.1) with a maximum size of 120mm per side are covered by this EAD.

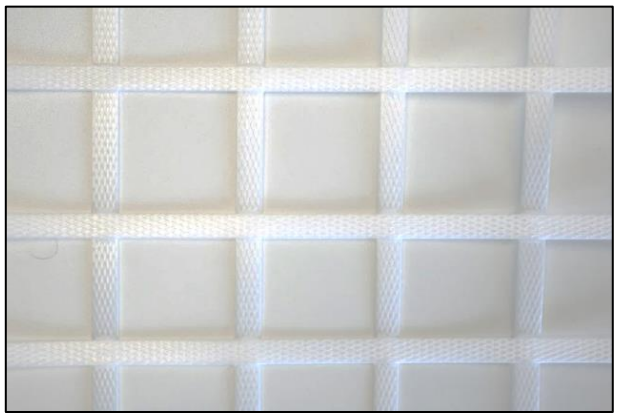


Figure 1.1.2: Example of a geogrid consisting of bars with structured surface

The surface of these geogrids is structured, not smooth. This favours a high shear strength and high adhesion, when the geogrids interact with the soil layer.

The product is not fully covered by the existing harmonized European standards (hEN). The existing functional terms specified in EN 10318-1 and the functional properties standardized in the harmonized European standards EN 13249, EN 13250, EN 13251, EN 13253, EN 13254, EN 13255, EN 13257, EN 13265 under mandate M/107 "Geotextiles", as amended by mandate M/386, do not correspond to the intended use of the product.

In the intended use of "stabilization", the bars of the grid are simultaneously stressed in several axes. As a result, an evaluation of the products in terms of tensile properties in multiaxial directions and the frictional properties of the bars of the grating, just to ensure a stabilizing effect, is not covered by the existing standards. In addition, the EN ISO 10319 standard does not cover the tensile test in multiaxial directions, as well as the EN ISO 12957-1 standard does not cover the shear test with lattice bars only.

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 of geogrids in terms of this document is to "stabilize" soil, to improve the bearing capacity with focus to increase the serviceability of unbound granular layers where static, cyclic and/or dynamic loads are applied to the structure.

Unbound granular layers are not appropriate to absorb tensile forces. They have to be stabilized by stiff geogrids, providing tensile resistance and providing lateral support to the grain structure to reduce deformations of the grain skeleton and of the composite structure under applied load even at low initial deformations. The parameters which are most relevant for stabilization are the tensile stiffness and a rigid and stiff structure of the product to provide appropriate interaction. Interacting with the unbound granular layer at applied load, the geogrid develops a resistance force and stabilizes the granular particles at static, cyclic and dynamic loading conditions.

The intended use of stabilisation is provided by the interlock of the aggregate with the geogrid and subsequent confinement of the particles increasing the lateral stress state and thus reducing or even inhibiting the horizontal movement of the granular particles and the accumulation of strain.

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 geogrid for the intended use of up to 50 or up to 100 years when installed in the works (provided that the geogrid is subject to appropriate installation (see 1.1)). These provisions are based upon the current state of the art and the available knowledge and experience.

When assessing the product, the intended use as foreseen by the manufacturer shall be taken into account. The real working life may be, in normal use conditions, considerably longer without major degradation affecting the basic requirements for works[1].

[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.

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 Geogrid

Geogrid is defined in EN ISO 10318-1 (clause 2.2.1.2.1). Geogrids are biaxial planar structures consisting of a regular open-network of integrally connected tensile bars with structured surface. The bars are made of extruded polypropylene or polyester, which are welded together at the appropriate centres to form geogrids. Only geogrids with a grid size of sides a and b of the rectangle with a maximum size of 120 mm per side are addressed.

1.3.2 Geosynthetic

The term *geosynthetic* used here is in accordance with clause 2.2.1 of EN ISO 10318-1.

1.3.3 Geocomposite

This term is used in accordance with clause 2.2.1.4 of EN ISO 10318-1.

1.3.4 Biaxial geogrid – Square regular open-network

This is defined as a regular open-network, consisting of square openings, which are formed by the connected tensile bars. The bars are welded into grids.

1.3.5 Weld points/ Junction

Weld points/junction are the areas of the product, where two bars meet and lay over each other, one in machine direction, one in cross machine direction. The one in machine direction lays over the bar in cross machine direction and is welded at this point. The length and the width of this weld point is in both directions the width of the bars.

1.3.6 Aperture size

The aperture size defines the space between the boundary of two bars in the same direction laying next to each other (figure 1.1.1).

1.3.7 Grid size

The grid size defines the distance from the centre of one bar to the centre of a bar parallel and next to the first (figure 1.1.1).

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 geogrid for the stabilization of unbound granular layers under applied load 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

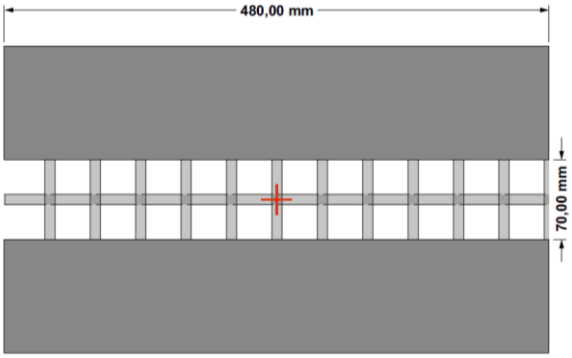
No	Essential characteristic	Assessment method	Type of expression of product performance
Basic Works Requirement 1: Mechanical resistance and stability			
1	Tensile strength and elongation at nominal strength and tensile secant stiffness at 0,5 % and 2 % elongation, md and cmd	EN ISO 10319, clause 9	level
2	Mass per unit area	EN ISO 9864, clause 5	level
3	Tensile secant stiffness at 0,5 % and 2 % elongation and every 15°clockwise direction	2.2.1	level
4	Friction characteristic	2.2.2	level
5	Resistance to Weathering	2.2.3	level
6	Resistance to Oxidation	2.2.4	level
7	Resistance to Hydrolysis	2.2.5	level
Basic Works Requirement 3: Hygiene, health and environment			
8	Release of dangerous substances	EN 13249, clause 4.4	level

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

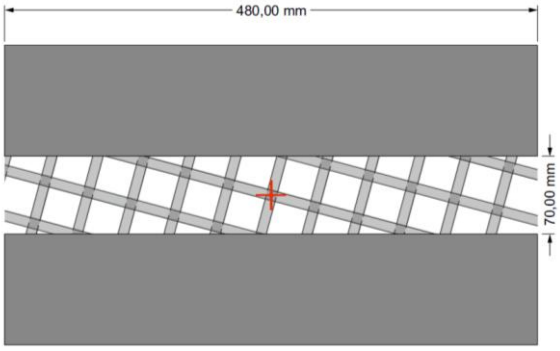
This chapter is intended to provide instructions for TABs. Therefore, the use of wordings such as “shall be stated in the ETA” or “it has to be given in the ETA” shall be understood only as such instructions for TABs on how results of assessments shall be presented in the ETA. Such wordings do not impose 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.

2.2.1 Tensile secant stiffness at 0,5 % and 2 % elongation and every 15° clockwise direction

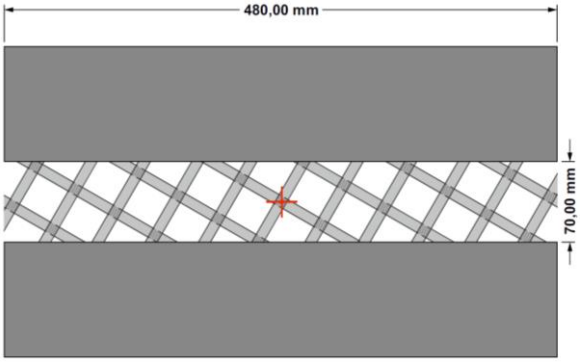
The tensile tests shall be done in accordance with EN ISO 10319. The specimen has to be rotated every 15 ° clockwise direction and the radial secant stiffness has to be determined at 0,5 % and 2 % elongation. The following figure 2.2.1.1 shows, how the specimen has to be clamped into the testing-machine for the example for a = b = 40 mm grid size according to figure 1.1.1.



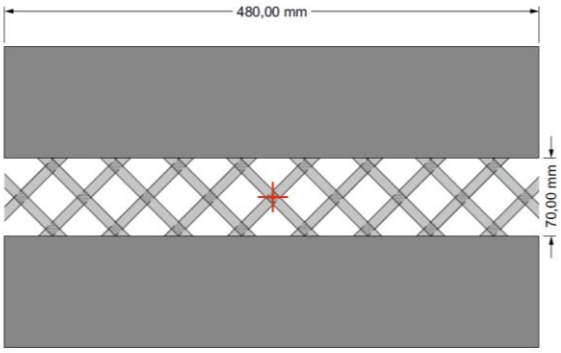
a) Clamping of the specimen in md (0° rotation)
11 md tensile bars are clamped



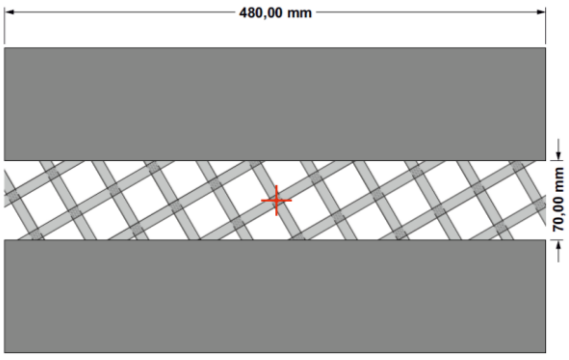
b) Clamping of the specimen with 15° rotation
11 md tensile bars are clamped



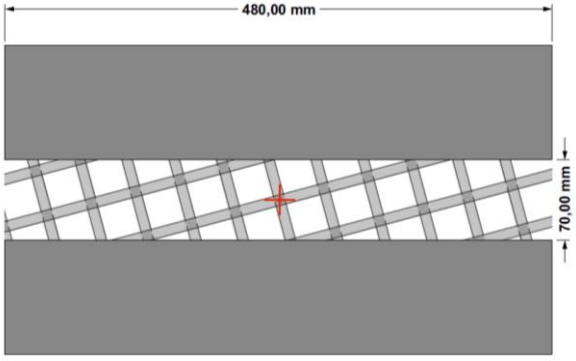
c) Clamping of the specimen with 30° rotation
9 md tensile bars are clamped



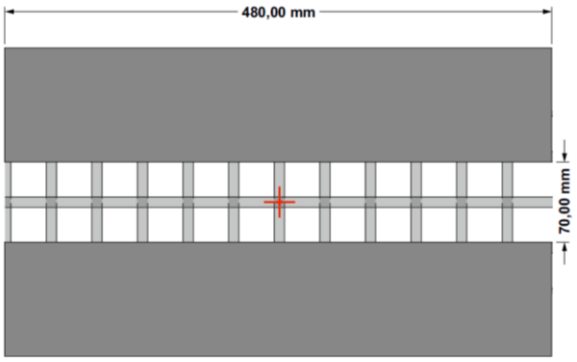
d) Clamping of the specimen with 45° rotation
7 md/cmd tensile bars are clamped



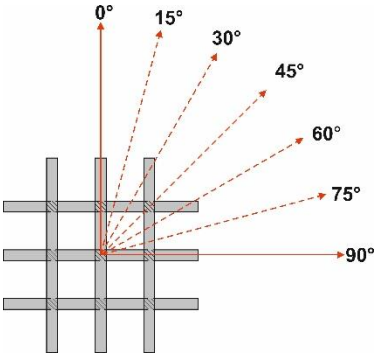
e) Clamping of the specimen with 60° rotation
9 cmd tensile bars are clamped



f) Clamping of the specimen with 75° rotation
11 cmd tensile bars are clamped



g) Clamping of the specimen in cmd (90° rotation) 11 cmd tensile bars are clamped



h) Scheme of testing directions

Figure 2.2.1.1: Clamping of the specimen (example grid size 40 mm x 40 mm)

Because of the tensile tests in different directions the minimal effective width of specimen shall be larger than EN ISO 10319 requires. The nominal effective width shall be at least 300 mm (clamping the specimen with 45° rotation). Products of grid size less than or equal 80 mm shall contain at least four complete tensile elements (bars) in the width direction. Products of grid size greater than 80 mm and less or equal than 120 mm shall contain at least three complete tensile elements in the width direction.

The nominal length between the jaws shall be at least 70 mm. In case of 45° rotation a minimum of one junction line shall be positioned between the jaws.

The specimen sizes shall be determined to maintain symmetry about the centre point and balance in the tensile forces during testing.

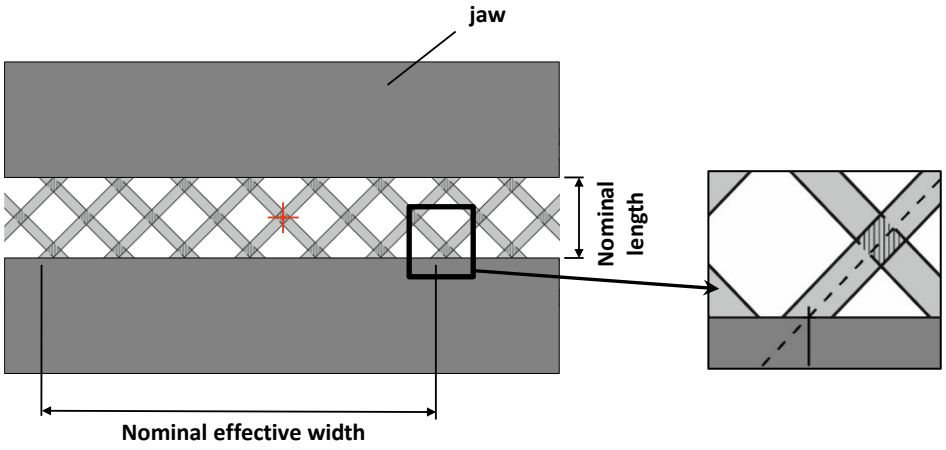


Figure 2.2.1.2: Nominal effective width and nominal length of the clamped specimen, example with 45° rotation

The results of the tensile secant stiffnesses shall be stated in the ETA as shown in figure 2.2.1.3.

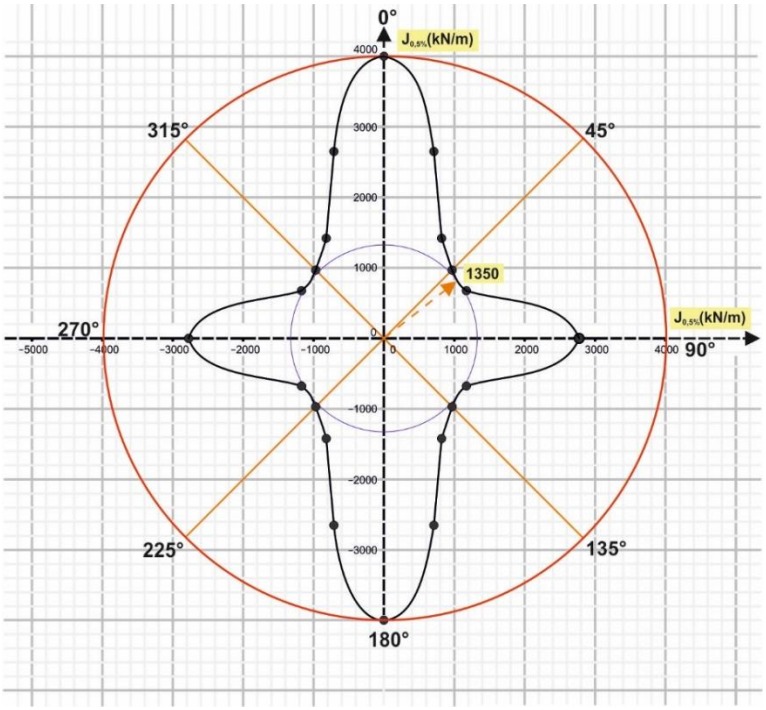


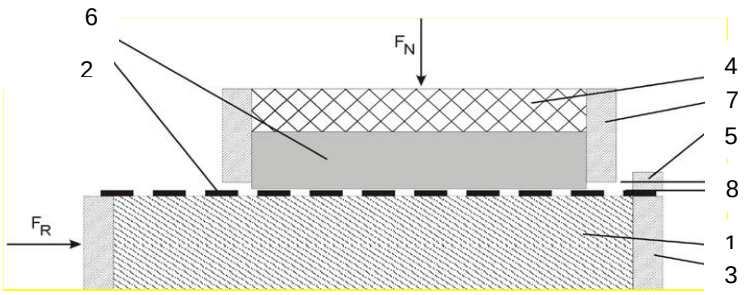
Figure 2.2.1.3: Example for the description of the radial secant stiffness (minimum $J_{0\%-0,5\%}$ = 1.350 kN/m)

The minimum secant stiffness values $J_{0\%-0,5\%}$ and $J_{0\%-2,0\%}$ shall be stated in the ETA.

2.2.2 Friction characteristics

Data on friction characteristics are important regarding the force transmission between the soil and the surface of the geogrid.

The determination of friction characteristics of the structured geogrid surface shall be done by a direct shear test based on EN ISO 12957-1 (figure 2.2.2.1). Figure 2.2.2.2 shows the position of the geosynthetic bars (right next to each other, without space).



Legend
1 Rigid underlay
2 Test specimen (geosynthetic bars)
3. movable shear box
4 Loading system
5 Clamping
6 Normsand, EN 196-1
7 Rigid shear box
8 Gap, max. 0.5 mm

Figure 2.2.2.1: Shear box with constant shear surface according with EN ISO 12957-1

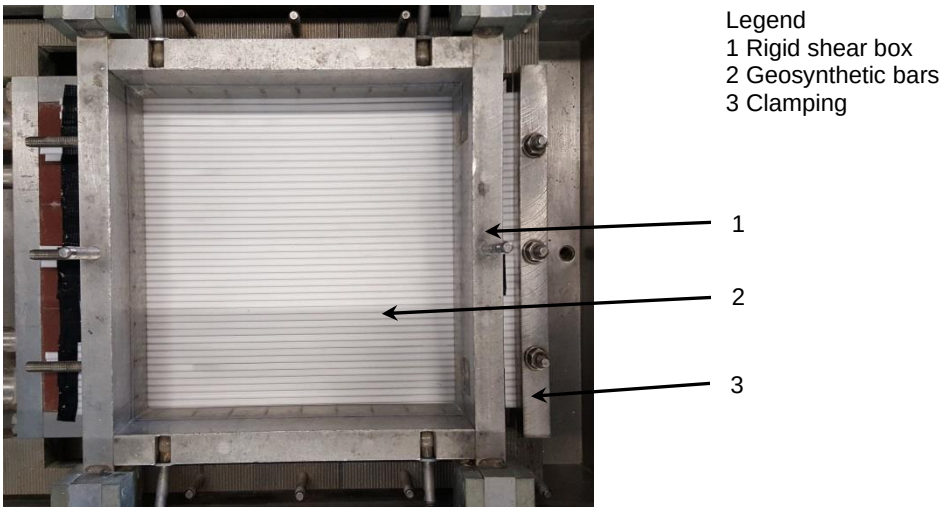


Figure 2.2.2.2: Test-set up shear test: top view on built-in geosynthetic bars

Expression of results

The results in the ETA shall show the maximum shear stresses related to the normal stresses at 20 kPa, 40 kPa, 60 kPa.

For a range of products only the product with the lowest mass per unit area shall be subjected to the tests.

2.2.3 Resistance to weathering

The resistance to weathering shall be determined for the geogrid or geocomposite in accordance with EN 13249, Annex B and EN 12224. The results of the residual strength shall be given in % and in N.

The samples shall be prepared according to the selected characteristics of EN 12226. According to paragraph 4.2, test specimens for geogrids shall be cut with one or more complete ribs in width and at least one joint and preferably three joints in length. For testing geocomposites consisting of more than one geosynthetic product, the components must be tested individually for resistance. Where this is not practicable, a technical justification for an alternative test method shall be presented. Further sampling shall be carried out according to EN 12226, Table 1 (see GGR for geogrids or GCO for geocomposites). For a range of products only the product with the lowest mass per unit area shall be subjected to the tests.

2.2.4 Resistance to oxidation

The resistance to oxidation shall be determined for the relevant raw materials of the geogrid or geocomposite in accordance with EN 13249, Annex B. The provisions of EN 13249 apply, subdivided according to the raw materials in paragraph B 4.2. For geogrids made of polyester, paragraph B.4.2.1 and for geogrids made of polypropylene, paragraph B.4.2.2 apply. The results of the residual strength shall be given in % and in N.

The samples shall be prepared according to the selected characteristics of EN 12226. According to paragraph 4.2, test specimens for geogrids shall be cut with one or more complete ribs in width and at least one joint and preferably three joints in length. For testing geocomposites consisting of more than one geosynthetic product, the components must be tested individually for resistance. Where this is not practicable, a technical justification for an alternative test method shall be presented. Further sampling shall be carried out according to EN 12226, Table 1 (see GGR for geogrids or GCO for geocomposites). For a range of products only the product with the lowest mass per unit area shall be subjected to the tests.

2.2.5 Resistance to hydrolysis

The resistance to hydrolysis shall be determined for the relevant raw materials of the geogrid or geocomposite in accordance with EN 13249, Annex B. The provisions of EN 13249 apply, subdivided according to raw materials from paragraph B 4.2. For polyester geogrids, paragraph B.4.2.1 applies. The results of the residual strength shall be given in % and in N.

The samples shall be prepared according to the selected characteristics of EN 12226. According to paragraph 4.2, test specimens for geogrids shall be cut with one or more complete ribs in width and at least one joint and preferably three joints in length. For testing geocomposites consisting of more than one geosynthetic product, the components must be tested individually for resistance. Where this is not practicable, a technical justification for an alternative test method shall be presented. Further sampling shall be carried out according to EN 12226, Table 1 (see GGR for geogrids or GCO for geocomposites). For a range of products only the product with the lowest mass per unit area shall be subjected to the tests.

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: Commission delegated decision (EU) 2015/1958.

The system is: 2+

3.2 Tasks of the manufacturer

The cornerstones of the actions to be undertaken by the manufacturer of the geogrid 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 *(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
Factory production control (FPC) including testing of samples taken at the factory in accordance with a prescribed test plan					
1	Tensile strength and elongation at nominal strength and tensile secant stiffness at 0,5 % and 2 % elongation, md and cmd	EN ISO 10319, clause 9	See control plan	-	1 test per production batch
2	Mass per unit area	EN ISO 9864, clause 5	See control plan	-	1 test per production batch
3	Tensile secant stiffness at 0,5 % and 2 % elongation and every 15°clockwise direction	2.2.1	See control plan	2.2.1	5 years
4	Friction characteristics	2.2.2	See control plan	2.2.2	5 years
Initial type-testing geogrid and geocomposite					
5	Resistance to weathering	2.2.3	See control plan	2.2.3	5 years
6	Resistance to oxidation	2.2.4	See control plan	2.2.4	5 years
7	Resistance to hydrolysis	2.2.5	See control plan	2.2.5	5 years
8	Release of dangerous substances	2.2.6	See control plan	2.2.6	5 years

3.3 Tasks of the notified body

The cornerstones of the actions to be undertaken by the notified body of the geogrid in the procedure of assessment and verification of constancy of performance are laid down in Table 3.3.1.

Table 3.3.1 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					
1	Inspection of the factory and the factory production control (FPC)	Control of devices, equipment and the documentation of the FPC	parameter according to table 3.2.1	See control plan	Initial inspection
Continuous surveillance, assessment and evaluation of factory production control					
2	Surveillance, assessment and judgement of the factory production control (FPC)	Control of the documentation of the FPC	parameter according to table 3.2.1	See control plan	Once a year

4 REFERENCE DOCUMENTS

EN 196-1:2016	Methods of testing cement – Part 1: Determination of strength
EN ISO 9864:2005	Geosynthetics - Test method for the determination of mass per unit area of geotextiles and geotextile-related products (ISO 9864:2005)
EN ISO 10318-1:2015	Geotextiles and geotextile related products – Terms and definitions
EN ISO 10319:2015	Geosynthetics - Wide-width tensile test
EN 12224:2000	Geotextiles and geotextile-related products: Determination of the resistance to weathering
EN 12226:2012	Geosynthetics – General test for evaluation durability testing
EN ISO 12957-1:2018	Geotextiles - Determination of friction characteristics - Direct shear test
EN 13249:2016	Geotextiles and geotextile-related products – Characteristics required for use in the construction of roads and other trafficked areas (excluding railways and asphalt inclusion)
EN 13250:2016	Geotextiles and geotextile-related products – Characteristics required for use in the construction of railways
EN 13251:2016	Geotextiles and geotextile-related products – Characteristics required for use in earthworks, foundations and retaining structures
EN 13253:2016	Geotextiles and geotextile-related products – Characteristics required for use in erosion control works (coastal protection, bank revetments)
EN 13254:2016	Geotextiles and geotextile-related products – Characteristics required for the use in the construction of reservoirs and dams
EN 13255:2016	Geotextiles and geotextile-related products – Characteristics required for use in the construction of canals
EN 13257:2016	Geotextiles and geotextile-related products – Characteristics required for use in solid waste disposals
EN 13265:2016	Geotextiles and geotextile-related products – Characteristics required for use in liquid waste containment projects