

BRL-K519/06

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Evaluation Guideline

for the Kiwa product certificate for PVC-P
geomembranes with or without
reinforcement



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Preface Kiwa

This Evaluation Guideline (BRL) has been developed by Board of Experts **KGWW**, in which all relevant parties in the field of **Plastics in Ground, Road and Hydraulic Engineering** are represented. The Board of Experts KGWW also supervises the certification activities and updates this BRL if required. All references to Board of Experts in this evaluation guideline pertain to the Board of Experts KGWW.

This evaluation guideline will be used by Kiwa in conjunction with the Kiwa Regulations for Certification, which include the general rules employed by Kiwa for its certification activities.

This BRL is issued in Dutch and English. In the event of any discrepancy or difference in interpretation between the two versions, the Dutch version shall be leading

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Binding declaration

This evaluation guideline has been declared binding by Kiwa effective **dd month year**

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1. Introduction

1.1. General

The requirements included in this evaluation guideline will be employed by Kiwa when dealing with an application for and the maintenance of a product certificate for **Polyvinyl chloride - Plasticized (PVC-P) Geomembranes** with or without reinforcement.

This BRL dated **yyyy-mm-dd** replaces BRL-K519 dated 2019-06-21.

The quality declarations issued on the basis of the old BRL will lose their validity after 24 months from the date of the new BRL.

When carrying out certification activities, Kiwa is bound by the requirements laid down in NEN-EN ISO/IEC 17065.

1.2. Field of application / Application areas

These geomembranes are intended for the application areas listed below. Certain application areas are associated with a specific geomembrane type designation. In addition, the UV type designation may apply to any of the application areas where the geomembrane is intended for above-ground installation and exposure to daylight.

1.2.1. General civil engineering applications – Geomembrane type (standard / no type designation)

This application area may include:

- Storage and containment of water
- Watertight partition constructions in general
- Protection of soil and groundwater from the effects of spills and other soil threats in the event of an emergency
- Stabilizing structures
- Underwater constructions

1.2.2. Drinking water containment – Geomembrane type (HA)

This application forms part of the general civil engineering application area specified in 1.2.1 and applies where the geomembrane is intended for the storage or containment of drinking water. Type HA geomembranes are suitable for contact with drinking water.

1.2.3. Storage of animal manure – Geomembrane type (MB)

This application area is intended for to the storage of animal manure or slurry either in a solid form (manure) or a semi-liquid form (slurry), and .may include:

- Covers (floating and tensioned)
- Manure basins and tanks
- Slurry bags
- Manure silo linings
- Manure bags and pillow tanks

1.2.4. Soil protection systems for industrial waste landfills and single-waste landfills – Geomembrane type (BV)

This application covers geomembranes intended for use in soil protection systems for industrial waste landfills and single-waste landfills as defined in Application Area C of UIT-83.

1.2.5. Separation and semi-permanent storage of mineral-oil-containing media – Geomembrane type (OB)

This application covers geomembranes intended for the separation and semi-permanent storage of mineral-oil-containing media.

1.2.6. Above-ground uncovered applications – Geomembrane type (UV)

The UV type designation applies in addition to the application areas specified above where the geomembrane is intended to be installed above ground and remain exposed to daylight. Type UV geomembranes are provided with enhanced UV stabilization to resist long-term UV ageing.

1.2.7. Additional application areas

Where applicable, the certificate holder may include application areas that do not fall within one of the application areas described above. In such cases, the certificate holder shall, in consultation with the certification body, include a detailed description of these application areas in the IQC scheme and on the certificate. Where necessary, additional requirements, tests and/or investigations shall be specified to demonstrate the suitability of the geomembrane for the intended application.

1.3. Acceptance of test reports provided by the supplier

With regard to the requirements included in this evaluation guideline, the applicant, in the view of third party assessments, can submit conformity reports issued by evaluation bodies to prove that the requirements of this BRL are being met. It will have to be demonstrated that the relevant inspection, analysis, test, and/or evaluation reports have been prepared by an institution that meets the corresponding applicable accreditation standard, namely:

- EN-ISO/IEC 17020 for inspection bodies
- EN-ISO/IEC 17021-1 for certification bodies certifying management systems
- EN-ISO/IEC 17024 for certification bodies certifying persons
- EN-ISO/IEC 17025 for laboratories
- EN-ISO/IEC 17065 for certification bodies certifying products, processes, and services

This requirement is considered to be fulfilled when a certificate of accreditation can be shown, issued either by the Board of Accreditation (Raad voor Accreditatie RvA) or by one of the institutions with which an agreement of mutual recognition and acceptance of accreditation has been concluded by the Board of Accreditation. If no certificate of accreditation can be submitted, the certification institution itself will verify if the accreditation criteria have been met.

1.4. Quality declaration

The quality declarations to be issued by Kiwa based on this evaluation guideline will be referred to as Kiwa product certificate.

A model of the product certificate has been included for information purposes in Annex I.

2. Terminology

2.1. Definitions

In this evaluation guideline, the following terms and definitions apply:

- **Board of Experts: KGWW** “Kunststoffen in Grond-, Weg- en Waterbouw”, Plastics in Ground, Road and Hydraulic Engineering.
- **Evaluation Guideline (BRL):** The agreements made by the Board of Experts on the subject of certification.
- **Product certificate:** a document in which Kiwa declares that a product may be deemed, on delivery, to comply with the product specification recorded in the product certificate.
- **Certification mark:** a protected mark, the use of which is authorized by Kiwa to suppliers whose products can be considered to comply with the applicable requirements upon delivery.
- **Initial assessment:** The initial evaluation of the supplier and the relevant products for granting the certificate.
- **Surveillance assessment:** periodic assessment carried out after granting the certificate to determine that the certified products and/or approved quality related processes continue to be in compliance with the requirements laid down in the evaluation guideline.
- **Product requirements:** requirements specified by means of measures or figures, focusing on (identifiable) characteristics of products and containing a limiting value to be achieved, which can be calculated or measured in an unequivocal manner.
- **IQC scheme:** Internal Quality Control scheme is a description of the quality inspections carried out by the supplier as part of his quality system.
- **Supplier:** the party (or parties) responsible for ensuring that the products meet and continue to meet the requirements on which the certification is based.
- **Drinking water:** water intended or partly intended for drinking, cooking or food preparation or other domestic purposes, excluding hot tap water, which is made available by pipeline to consumers or other customers (source Dutch drinking water act).
- **Tap water:** water intended or partly intended for drinking, cooking or food preparation or other domestic purposes. *Remark: Tap water can be drinking water, warm tap water or household water.*
- **Private Label Certificate:** A product certificate that only pertains to products that are also included in the product certificate of another supplier that has been certified by Kiwa, the only difference being that the products and product information of the private label holder bear a brand name that belongs to the private label holder.
- **PVC-P:** Poly-Vinyl Chloride - Plasticized. A thermoplastic formed by polymerization of the vinyl chloride monomer with a plasticizer additive.
- **Geomembrane:** A geomembrane is a type of membrane, but not all membranes are geomembranes; a geomembrane is a very low-permeability membrane used specifically in geotechnical and environmental engineering to act as a fluid or gas barrier.
- **Geomembrane with reinforcement:** is a geomembrane containing a fabric. The fabric determines the mechanical properties of the geomembrane, such as tensile strength and tear resistance.

- **Coating:** refers to the layer of PVC-P applied on both sides of the fabric of the geomembrane, the coating provides for the watertightness of the geomembrane
- **Multilayer geomembrane:** A geomembrane composed of two or more distinct layers of materials that are combined to achieve improved mechanical, chemical, or barrier properties compared to a single-layer membrane.
- **Weld area:** The zone of material where two components are joined together by welding, in which the material has been locally fused or thermally bonded to form a continuous joint.
- **Animal manure/slurry:** Animal manure or slurry refers to organic waste produced by livestock, consisting of excreta (feces and urine), either in a solid form (manure) or a semi-liquid form (slurry), often used or treated as an agricultural fertilizer or for energy recovery.

3. Procedure for obtaining a quality declaration

3.1. Initial assessment

The initial assessment to be performed based on the product requirements as set in this evaluation guideline, including the test methods, depending on the type of product to be certified:

- a (type) testing to determine whether the products comply with the product and/or performance requirements
- production process assessment
- assessment of the quality system and the IQC scheme
- verification that the required procedures are in place and functioning effectively

3.2. Granting the certificate

After completing the initial assessment, the results are presented to the Decision maker (see 8.2). This person evaluates the results and decides whether the certificate can be granted or if additional data and/or tests are necessary before the certificate can be granted.

3.3. Assessment of the product and performance requirements

Kiwa will assess the products to be certified against the certification requirements as stated in this evaluation guideline or will have them assessed on its behalf.

The required samples will be drawn by or on behalf of Kiwa.

3.4. Production process assessment

When assessing the production process, it is investigated whether the producer is capable of continuously producing products that meet the certification requirements.

The assessment of the production process takes place during the ongoing work at the producer.

The assessment will at least include:

- The quality of raw materials, semi-finished products, and end products
- Internal transport and storage

3.5. Contract assessment

If the supplier is not the producer of the products to be certified, Kiwa will assess the agreement between the supplier and the producer.

This written agreement, shall be made available to Kiwa and must at least include:

That accreditation bodies, scheme managers and Kiwa will be given the opportunity to observe the certification activities carried out by Kiwa or on behalf of Kiwa at the producer.

4. Product requirements and determination methods

4.1. General

This chapter describes the requirements that the geomembrane shall meet, as well as the determination methods to establish that these requirements are being met.

The requirements and determination methods specified in this evaluation guideline are, where applicable, based on:

- Ministerial Regulation on the Materials and Chemicals for Drinking and Warm Water Supply ("Ministeriële Regeling materialen en chemicaliën drink- en warm tapwatervoorziening") (published in the Government Gazette), see 4.2
- The Dutch protocols for the application of plastic geomembrane for soil protection, gas, and liquid barrier layers ("Protocollen voor het toepassen van kunststof geomembranen voor bodembescherming en gas- en vloeistof barrièrelagen", UIT 83, UIT 84, and UIT 85.
- The harmonized European Standards for geosynthetic barriers i.e. EN 13361, EN13362, EN13491, EN13492, EN13493, EN15382, and EN16993.

4.2. Suitability for contact with drinking water

Products and materials that (may) come into contact with drinking water or warm tap water, shall not release substances in quantities that may be harmful for the health of the consumer or affect the quality of the water in any other way. Therefore the products or materials must comply with the toxicological, microbiological, and organoleptic requirements laid down in the Ministerial Regulation on the Materials and Chemicals for Drinking and Warm Water Supply ("*Ministeriële Regeling materialen en chemicaliën drink- en warm tapwatervoorziening*") (published in the Government Gazette). This means that the procedure for obtaining a recognized quality declaration, as referred to in the current Regulations, has to be concluded with a positive result. Products or materials that are provided with a quality declaration,¹ issued by, for example, a foreign certification body, may also be used in the Netherlands, provided that this quality declaration has been declared equivalent by the Minister to the quality declaration as referred to in the Regulation.

4.3. Hygienic treatment of products in contact with drinking water

The supplier must have a procedure in place that protects the products in such a way that hygiene is ensured during storage and transport.

Furthermore, the supplier shall inform the customer about the handling of delivered products which come into contact with drinking water and warm tap water, from arriving at the installation site through to the installation and commissioning. The primary reason for providing this information is to contribute to the awareness of the importance of hygienic working as a "prevention measure."

4.4. Sampling and conditioning

Sampling

Unless otherwise specified, a sample of the geomembrane shall be taken across the full width of the production roll and with a minimum length of 100 cm. This sample shall be used for the preparation of the required test specimens.

For geomembranes with a textured or profiled surface, test specimens shall include the texture or profile. Specimens shall therefore not be taken from smooth edge strips or other areas that do not represent the textured or profiled surface.

For analytical tests in which specimen geometry is not relevant (e.g. carbon black content or thermal stability), the texture or profile may be absent from the specimen, but only when this is necessary to allow proper positioning in the measuring equipment.

Conditioning

Unless otherwise specified, the geomembrane sample or the test specimens prepared from it shall be conditioned for at least 16 hours prior to testing at a temperature of 23 ± 2 °C and a relative humidity of 50 ± 5 %.

¹ Article 16 of the Regulation states: "A quality declaration issued by an independent certification body in another Member State of the European Union or in another state that is party to the Agreement on the European Economic Area is considered equivalent to a recognised quality declaration, provided that, in the opinion of the Minister, it demonstrates compliance with requirements that are at least equivalent to those referred to in this Regulation."

4.5. Materials

4.5.1. Formulation

- Geomembranes without reinforcement, as well as the coating layer of geomembranes with reinforcement, shall be manufactured from PVC-P.
- Plasticizers and additives may be used where necessary to achieve a product of acceptable quality.
- Only regenerate material from the same production process, such as edge trimmings, may be reused, up to a maximum content of 10%. If a higher percentage is used, the manufacturer shall demonstrate that all product specifications are fully met.
- The formulation for type (HA) geomembranes shall comply with the requirements of (4.2)
- In case of multilayer geomembranes, all layers shall be manufactured of the same PVC-P.

4.5.2. Declaration of the formulation, construction and properties of the geomembrane

The manufacturer shall document and declare to the certification body the following aspects:

- The complete formulation, including all constituent raw materials (e.g. binders, aggregates, admixtures, fillers, pigments, and any other ingredients), their respective suppliers, and their percentage content.
- The construction of the geomembrane layers, including the coating of reinforcement layers.
- Type of surface structure on each side of the geomembrane (e.g. smooth, profiled, embossed)
- Mass per square meter (g/m^2)
- Effective thickness of the geomembrane (mm)

Additional aspects in case the geomembrane has different sides

- The side to be exposed to sunlight
- The side to be exposed to the media
- The side to be welded

Additional aspects in the case of a geomembrane with reinforcement:

- The coating thickness on each side
- The composition or base material of the fabric
- The type of fabric (size; pattern; number of threads, warp/weft)
- The mass per square meter (g/m^2) of the fabric
- Mechanical properties for both directions (MD and CMD or warp and weft)

4.5.3. Verification of the formulation, production process.

- During the initial certification process (approval process), the certification body shall document the geomembrane formulation, including raw materials, suppliers, and percentage content as well as the steps of the production process.
- During post-certification surveillance audits, the certification body shall verify that the geomembranes are manufactured using the approved formulation and in accordance with the approved production process.
- The manufacturer shall inform the certification body of any intended changes to the product (i.e. aspects listed in 4.5.2) or the production process prior to implementation; the certification body shall determine whether reassessment is required.

4.6. Appearance

- The geomembrane shall be free from blisters, cracks, holes, scratches, indentations, and any other visible defects. Compliance shall be verified in accordance with EN 1850-2
- The geometry of any profiling or embossing shall conform to the manufacturer's specifications
- For geomembranes with reinforcement, the reinforcing fabric shall be fully encapsulated by the coating on both coated sides
- The color of the geomembrane shall be determined by the manufacture
- The selected color shall be specified in the geomembrane's formulation
- The colors of the upper and lower surfaces may differ; however, both surfaces shall comply with all applicable requirements

4.7. Width of the geomembrane

- The width shall be determined in accordance with EN 1848-2.
- The measured width of the geomembrane roll shall not be less than the nominal value specified by the manufacturer and shall not exceed 1.0% of the nominal value.

4.8. Effective thickness

4.8.1. Effective thickness of geomembranes without reinforcement

- The effective thickness (mechanical or optical) shall be determined in accordance with EN 1849-2
- The individual measurements of effective thickness (mechanical or optical) shall not deviate by more than $\pm 10\%$ from the effective thickness declared by the manufacturer.
- The average thickness per roll shall not be less than the declared effective thickness, and shall not exceed 10% of the declared effective thickness.
- Special Requirement for Type MB geomembranes (application area 1.2.3):
 - Non-load-bearing applications where the geomembrane is installed in the subsurface, below-grade (sunken) infrastructure: effective thickness ≥ 1.0 mm.
 - Floating covers of tanks and reservoirs: effective thickness ≥ 0.5 mm.

4.8.2. Effective thickness of geomembranes with reinforcement

- The effective thickness shall be determined on the test specimens as described in 4.7.3 and in accordance with EN 1849-2 and shall be measured “over the tops”, as illustrated in Figure (1).
- The individual measurements of effective thickness (mechanical or optical) shall not deviate by more than $\pm 10\%$ from the effective thickness declared by the manufacturer.

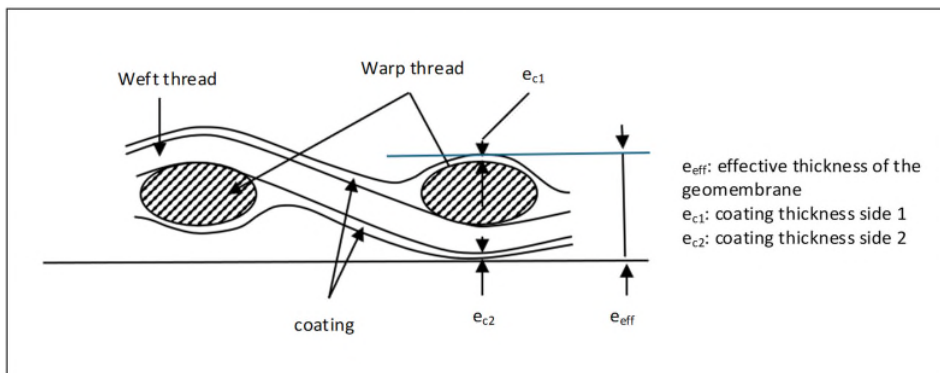


Figure 1 Illustration of thickness measurements

4.8.3. Coating thickness of geomembranes with reinforcement

- The coating thickness shall be determined optically on a minimum of three test specimens taken at regular intervals across the width of the geomembrane roll. The maximum distance between test specimens shall be 50 cm (the geomembrane strip width therefore determines the number of test specimens). The first test specimen shall be taken no more than 5 cm from the edge of the roll.
- Each test specimen shall include a cross-section of the production width, cut through the center and parallel to a weft thread.
- In-line or on-roll inspection shall be carried out using automated or hand-held measuring instruments.
- For each test specimen, the minimum coating thickness present on the fabric shall be measured on each side of the geomembrane, in the plane of the cross-section (through the center and parallel to a weft thread).
- The coating thickness on the fabric shall be measured with an accuracy of 0.02 mm.
- This means that the smallest division on the measuring eyepiece shall not exceed 0.01 mm.
- Using a measuring eyepiece with 100 divisions, coating thicknesses up to 1 mm. can be measured.
- Coatings thicker than 1.0 mm on the fabric may be measured, by exception, with an accuracy of 0.05 mm, provided that the smallest division on the measuring eyepiece does not exceed 0.025 mm.

- Each individual measurement of the coating thickness on either side of the geomembrane shall be not less than the coating thickness specified by the manufacturer. See Figure 1.
- Special Requirement for Type MB geomembranes (application area 1.2.3):
 - Non-load-bearing applications where the geomembrane is only applied as a water seal and where the tensile loads are carried by a supporting structure, including linings and floating covers in tanks and reservoirs: coating thickness ≥ 0.10 mm. on each side of the geomembrane and complies with group 2 for tear resistance (see 4.17)
 - Load bearing applications where the geomembrane is under continuous stress; e.g. tension roof covers; manure bags and connections to civil structures (e.g. clamping constructions): coating thickness ≥ 0.15 mm on each side of the geomembrane and complies with group 3 tear resistance and group 3 tensile strength (see 4.17 and 4.10.2 respectively)

4.9. Straightness and flatness of the geomembrane

- The straightness and flatness shall be determined in accordance with EN 1848-2
- The deviation from the straightness of the edges of the roll must not exceed 50 mm
- The deviation from the flatness of the roll shall not exceed 10 mm for geomembranes with an effective thickness ≤ 1.0 mm
- The deviation from the flatness of the roll shall not exceed 40 mm for geomembranes with an effective thickness > 1.0 mm

4.10. Tensile properties of geomembranes

4.10.1. Tensile properties of geomembranes without reinforcement

The tensile strength and elongation at break shall be determined in accordance with EN-ISO 527-1 and EN-ISO 527-3, with the following conditions:

- Number of test specimens: at least 5
- Type of test specimen: Type 5
- Test speed: 100 mm/min
- Initial gauge length (L_0): 50 mm
- The elongation at break shall be calculated in accordance with EN-ISO 527-1.
- The requirements that has to be met are described below:

Property	Requirement
Tensile strength per measurement in both directions	$\geq 15\text{N/mm}^2$ For BV Type: $\geq 85\%$ of the average value
Tensile strength average value in both directions	$\geq 18\text{ N/mm}^2$
Elongation at break average value in both directions	$\geq 300\%$

4.10.2. Tensile properties of geomembranes with reinforcement

Tensile strength and elongation at break shall be determined in accordance with EN-ISO 527-4, with the following modifications:

- Number of test specimens: at least 5
- Type of test specimen: Type 2, width 50 mm. (and the respective geomembrane thickness).
- Test specimen length: ≥ 250 mm.
- Grip length (distance between clamps): 150 ± 1 mm.
- Test speed: $100\text{ mm/min} \pm 10\%$.
- Elongation at break shall be determined from the clamp displacement ($L_0=150\pm 1\text{mm}$)
- Tensile strength (maximum load at break) shall be expressed in N per 50 mm of specimen width.

Alternative test method:

- If desired, test specimens may be “unraveled” to whole fabric threads extending into the clamps.
- Each test specimen shall be loaded in the direction of the fabric threads.

- The maximum load measured for each test specimen shall be converted to tensile strength per 50 mm. specimen width by dividing the measured maximum load by the number of fabric threads in the specimen and multiplying by the number of fabric threads in 50 mm of geomembrane width.

The requirements that has to be met are described below:

Property	Geomembranes with reinforcement
Tensile strength per measurement in both directions	≥ Minimum values per strength group see Table 1
Tensile strength average value in both directions	≥ Values declared by the manufacturer
Elongation at break per measurement in both directions	≥ 10%

Table 1 Tensile strength groups for geomembranes with reinforcement

Strength group	Minimum tensile strength (N per 50mm of the test specimen width)
G1	1350
G2	1800
G3	3500
G4	4500
G5	7200 *The manufacturer shall declare a specific value for the upper limit

- Special Requirement for Type MB geomembranes (application area 1.2.3):
 - o Non-load-bearing and floating applications: coating thickness ≥ 0.10 mm on each side of the geomembrane and complies with group 2 for tear resistance (see 4.17)
 - o Load bearing applications: coating thickness ≥ 0.15 mm on each side of the geomembrane (see 4.8.3) and complies with group 3 tear resistance (see 4.17) and with group 3 tensile strength)

4.11. Resistance to delamination

This requirement applies only to multilayer geomembranes without reinforcement. The adhesion between the layers must be sufficient and there must be no delamination between the layers.

The resistance to delamination shall be assessed by carrying out the tensile test as described in (4.10.1) where each test specimen shall be stretched to 150% elongation and then released, followed by a visual examination in accordance with EN 1850 to identify any delamination phenomena.

4.12. Permeability to liquids

The geomembrane shall have a sufficient level of impermeability to prevent liquid transport during use.

- The level of permeability shall be assessed by conducting permeability test according to EN 14150.
- The measured flow rate should not exceed 1 g/m²/day

4.13. Resistance to dynamic puncture

The geomembrane must have sufficient resistance to puncture caused by falling objects.

This requirement shall be assessed by performing a puncture test according to EN 12691 (Method A) with the modifications:

- The test shall be performed as pass/fail test at given drop heights.
 - o Geomembrane without reinforcement shall be tested at the drop heights given in Table 2.
 - o Geomembrane with reinforcement shall be tested at a drop height of 300mm.
- After the impact, the test specimen is examined for possible puncture by vacuum pressure leakage test. the pressure difference applied to the zone of impact shall be 0.1 bar.
- Acceptance criteria: no leak shall be detected in any of the test specimens. However, in the case of geomembranes with reinforcement, damage on the impact side is permitted provided that the

coating on the reverse side remains intact, in other words leakage is permitted but must not extend across the entire width.

Table 2 Drop heights for geomembranes without reinforcement

Geomembrane thickness (mm)	Drop height (mm)
0.5	100
0.8	200
1.0	300
1.2	500
1.5	700 750 for Type BV (application area 1.2.4)

Note about drop height

- The drop height for intermediate thicknesses shall be determined by linear interpolation between the next smaller and larger thickness values.
- The following applies to geomembranes used as bottom seal/basin seal:
 - o Geomembranes without reinforcement for use without bank protection: Drop height ≥ 750 mm
 - o Geomembranes without reinforcement for use with bank protection: Drop height ≥ 300 mm.

4.14. Resistance to static puncture

The geomembrane must have sufficient resistance to damage caused by point loads originating from the subgrade or from overlying layers.

- This requirement shall be assessed by performing a puncture test according to EN-ISO 12236.
- The recorded push-through force shall be > 2000 N per mm of geomembrane thickness.

4.15. Dimensional stability at high temperatures (behavior after heating)

The geomembrane shall exhibit dimensional stability when exposed to elevated temperatures. Testing shall be performed in accordance with EN 1107-2 (storage in an oven at 80°C for 6 hours). The following criteria shall be met after oven storage:

- Geomembranes without reinforcement: The change in longitudinal and transversal dimensions shall not exceed 2%.
- Geomembranes with reinforcement: The change in longitudinal and transversal dimensions shall not exceed 0.5%.
- All geomembranes (with & without reinforcement): The material shall be free from cracks, blisters, and tears, as assessed in accordance with EN 1850-2.

4.16. Foldability at low temperatures

The geomembrane must be able to handle mechanical stresses like bending or folding without cracking when used in cold environments.

This property is assessed by performing the foldability test according to EN 495-5 with the following modification:

	Geomembranes without reinforcement	Geomembranes with reinforcement.
Test temperature	-20°C	-10°C
Test specimens	• 4 specimens (2 from the longitudinal direction + 2 from the transversal direction) • If the top and bottom side of the geomembrane are made of different material or has a different surface structure, then the test shall be performed on	• The test must be performed on each side of the geomembrane separately. • 4 specimens from each side (2 from warp direction + 2 from the weft direction)

	each side separately as prescribed above.	
Acceptance criteria	None of the test specimens shall exhibit cracks or fractures	None of the test specimens shall exhibit cracks or fractures in the coating

4.17. Tear resistance

The geomembrane must have sufficient resistance to tearing. The tear resistance shall be determined in accordance with EN 12310-2, conditions and acceptance criteria are described below:

	Geomembranes without reinforcement	Geomembranes with reinforcement.
Test conditions	The test shall be carried out in machine direction using 5 specimens	The test shall be carried out in two direction (warp and weft) using five test specimens per direction
Tear strength per measurement	≥ 85% of the average value declared by the manufacturer	≥ Minimum values per tear resistance group see Table 3
Tear strength average value	≥ 100 N/mm	≥ Value declared by the manufacturer

Table 3 Tear strength groups for geomembranes with reinforcement

Tear resistance group	Minimum tear strength (N)
G1	80
G2	120
G3	400
G4	800
G5	1500
	*The supplier shall declare a specific value for the upper limit

- Special Requirement for Type MB geomembranes (application area 1.2.3):
 - o Non-load-bearing and floating applications: coating thickness ≥ 0.10 mm on each side of the geomembrane (see 4.8.3) and complies with group 2 for tear strength(see table 3).
 - o Load bearing applications: coating thickness ≥ 0.15 mm on each side of the geomembrane (see 4.8.3) and complies with group 3 tear resistance and with group 3 tensile strength (see 4.10.2)

4.18. Resistance to UV aging – covered applications

Geomembranes intended for covered application shall have sufficient UV aging resistance to remain uncovered for at least 1 year. This shall be demonstrated in accordance with EN 13361, EN13362, EN13491, EN13492, EN13493, EN15382, and EN16993².

4.19. Resistance to UV aging – uncovered applications

Type UV geomembranes intended for uncovered applications where the geomembrane remains exposed to daylight (application area 1.2.6) shall have a special UV stabilization to resist UV aging.

The resistance to UV aging in this case shall be demonstrated by performing the ‘special’ accelerated UV aging process and the evaluation tests as prescribed below.

² These standards prescribe the following test procedure and acceptance criteria:

- Accelerated UV aging in accordance with EN 12224 (350 MJ/m², corresponding to 3000 h exposure in a QUV device);
- Subsequent determination of the retained mechanical properties in accordance with EN 12226;
- Verification that the reduction in tensile strength and elongation at break does not exceed 25%.

4.19.1. Accelerated UV aging process:

- The UV exposure shall be carried out using Ci4000 Weather-Ometer equipment that complies with ISO 4892-1 and ISO 4892-2 (Method A). On this basis, the equipment can also be considered to comply with the relevant requirements in EN 513 and EOTA Technical Report TR 010.
- The test pieces shall be placed in the Ci4000 Weather-Ometer with the side to be exposed facing the light source.
- The exposure duration is 4000 hours. The calculation method of the exposure duration is explained in Annex III.
- Type “S” High Borate Borosilicate shall be used as the optical filter system around the Xenon lamp for both the inner and outer filters.
- The time-averaged intensity between 280 and 400 nm must be $(57 \pm 0.5) \text{ W/m}^2$. This intensity shall be ensured by continuously measuring the intensity at 340 nm throughout the entire exposure period. The intensity at 340 nm shall be regulated to 0.50 W/m^2 by means of the automatic intensity control of the Xenon lamp present in the device.
- The Xenon lamp and filter system shall be replaced periodically according to the specifications of the equipment manufacturer.
- The black standard temperature shall be $(65 \pm 0.3) ^\circ\text{C}$ at the end of the drying interval of the irrigation cycle.
- The room temperature shall be controlled at $(40 \pm 0.5) ^\circ\text{C}$.
- The relative humidity during the drying interval shall be controlled at $(50 \pm 5) \%$.
- The irrigation cycle shall consist of 18 minutes of spraying with demineralized water and a drying interval of 102 minutes.

4.19.2. Evaluation tests and acceptance criteria for geomembrane without reinforcement

- The UV aged material is subjected to the following tests:
 - Tensile strength according to (4.10.1) but on 3 test specimens cut from the weakest direction.
 - Elongation-at-break according to (4.10.1) but on 3 test specimens cut from the weakest direction.
 - Folding at low temperature according to (4.16)

The criteria to be met are as follows:

	Geomembranes with thickness = 0.5mm	Geomembranes with thickness > 0.5 mm
Change in tensile strength from the original condition*	$\leq 30\%$	
Change in elongation at break from the original condition*	$\leq 30\%$	$\leq 25\%$
Foldability at low temperatures	None of the test specimens shall exhibit cracks or fractures	

*Note: the original conditions are determined on control specimens according to (4.10.1)

4.19.3. Evaluation tests and acceptance criteria for geomembranes with reinforcement

- The UV aged material is subjected to folding test according to (4.16) followed by a leak tightness check.
- Leak tightness is checked by means of a vacuum test according to the following procedure:
 - Condition the test specimens that were subjected to folding in a controlled environment at $23 ^\circ\text{C}$ and 50 % relative humidity (RH) for at least 1 hour before testing.
 - Prepare the vacuum test setup: Use a vacuum bell jar with an effective surface area of at least 40 mm in diameter.
 - Ensure the non-UV-exposed side of the test specimen is positioned at the level of the fold seam.
 - Place a layer of water on the geomembrane, on the negative pressure side.
 - Apply a negative pressure of 0.1 bar inside the bell jar and maintain this pressure for 1 minute.
 - Observe the specimen to check for any signs of leakage during the 1 minute period. If no leakage occurs within 1 minute the specimen is considered leak tight.
- Acceptance criteria to be met: all test specimen shall be leak tight.

4.20. Loss of plasticizer

The loss of the plasticizer is determined according to ISO 176 (method B: activated carbon method). The measured loss in plasticizer mass should be $\leq 1.0\%$

4.21. Thermal stability

The geomembrane should have sufficient thermal stability.

- This property shall be demonstrated by determining the stability time in accordance with EN-ISO 182-2 using a test mass of (1000 ± 50) mg, and test temperature of 200°C .
- Stability time shall be ≥ 20 mins, for Type UV geomembranes the stability time shall be ≥ 40 mins.

4.22. Behavior and leaching after extraction in water

This property shall be assessed by performing the immersion procedure and subsequent evaluation tests as specified below.

Immersion procedure

Immersion shall be carried out in accordance with ISO 62 under the following conditions:

- Test specimens shall be prepared in accordance with (4.16).
- The specimens shall be immersed in a water bath at $50 \pm 1^\circ\text{C}$ for 1000 ± 10 hours.
- The water shall be replaced every 168 hours.
- After immersion, the specimens shall be rinsed with distilled water and carefully dried using filter paper.
- The specimens shall subsequently be conditioned for 7 days at $23 \pm 2^\circ\text{C}$ and $50 \pm 5\%$ relative humidity.
- After conditioning, the evaluation tests described below shall be performed.

Evaluation tests and acceptance criteria

For geomembranes without reinforcement:

- Folding test in accordance with (4.16).
- Weight change according to ISO 62: The weight change shall not exceed 3%.

For geomembranes with reinforcement:

- Folding test in accordance with (4.16).

Alternative method

As an alternative, immersion may be performed in accordance with EN 14415. In that case, the evaluation tests and criteria for the chemical resistance described in (4.23) shall apply.

4.23. Chemical resistance

The geomembrane must be able to withstand exposure to substances and chemicals in its service environment without losing its performance or integrity over time. This property is demonstrated by chemical resistance test where the geomembrane is exposed to different media (depending on the application area) for a prescribed period of time, followed by the evaluation tests described below:

- Geomembranes without reinforcement: Weight change, change in tensile strength, change in elongation at break
- Geomembranes with reinforcement: folding test

The test media for each application area/geomembrane type are given in (Table 4), the composition of test media is given in Annex IV.

Table 4 Test media for chemical resistance test for each application area

Medium	1	2	3	4	5	Additional media to be specified
	Ammonium hydroxide	Acetic acid	Sulfuric acid	Synthetic manure	Mineral oils	
All application areas	X					

Additional for HA			X			
Additional for MB		X		X		
Additional for BV		X				X
Additional for OB		X			X	
Additional for UV		X	X			

The following applies for testing with additional unspecified media:

- The test media shall be agreed in advance between Kiwa and the certificate holder.
- The composition of the test medium shall be clearly defined and documented.
- All the requirements mentioned in this section shall be met.
- If the requirements are met, the composition of the relevant additional medium shall be stated in the certificate, together with the resulting change in mass, melt flow rate, and elongation at break.

The immersion procedure shall be performed according to EN 14414 with the following modifications:

- Immersion temperature = 30 ± 0.5 °C
- Immersion period: 8 weeks (56 days), the immersion media should be renewed after 4 weeks
- Immersion media: as mentioned in Table 4.
- Conditioning: no conditioning is needed for control and immersed pieces. Immersed pieces are removed from the medium, patted dry, and the evaluation tests are performed immediately.

The evaluation tests and acceptance criteria are as follows:

	Evaluation test*	Acceptance criteria
Geomembranes without reinforcement	Change in weight	Max. $\pm 10\%$ For Type BV: Max. $-1\% / +4\%$
	Change in tensile strength (control pieces vs immersed pieces) determined according to EN-ISO 527	Max. $\pm 25\%$ For Type BV: Max. $-15\% / +10\%$
	Change in elongation at break (control pieces vs immersed pieces) determined according to EN-ISO 527	Max. $\pm 25\%$
Geomembranes with reinforcement	Folding test according to (4.16)	According to (4.16)

* Control specimens shall be tested at the same time as the immersed specimens.

4.24. Weldability of the geomembrane

Since geomembranes are installed by welding adjacent sheets together, the performance of the welded joints is an integral part of the overall performance of the geomembrane in its intended application.

Therefore, this BRL includes the following tests on welded specimens to verify that the geomembrane can be welded successfully and that the resulting welded joints meet the specified performance requirements.

4.24.1. Peel characteristics of welded joints on geomembranes without reinforcement

Peel characteristics shall be assessed in accordance with EN 12316-2, with the following conditions

- Number of test specimens per weld is ≥ 5
- The test specimens shall be cut perpendicular to the length of the weld
- Dimension of the test specimen: Width: 50 ± 1 mm, Clamping length: 70 mm, and the weld should have an overlap of 20 to 40 mm (See figure 6.1)
- Pulling speed : 100 mm/min
- The criteria to be met are as follows:

Failure mode	Failure mode A (peeling of the joint) as follows: • At least 80% of the weld width shall remain attached (peeling shall not exceed 20% of the weld width).
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	- This requirement is also deemed to be met if fracture occurs in the specimen before more than 20% of the weld width has been peeled. Adhesion is considered present if the surface structure is clearly different from the unwelded area. Or Failure mode B (break outside the joint) as follows: - The specimen shall exhibit ductile fracture before more than 30% of the weld length has been peeled.
Peel strength	- Average peel strength per test specimen shall be ≥ 6 N/mm of the specimen width, and - Average peel strength for all tests specimens per weld shall be ≥ 7 N/mm of the specimen width

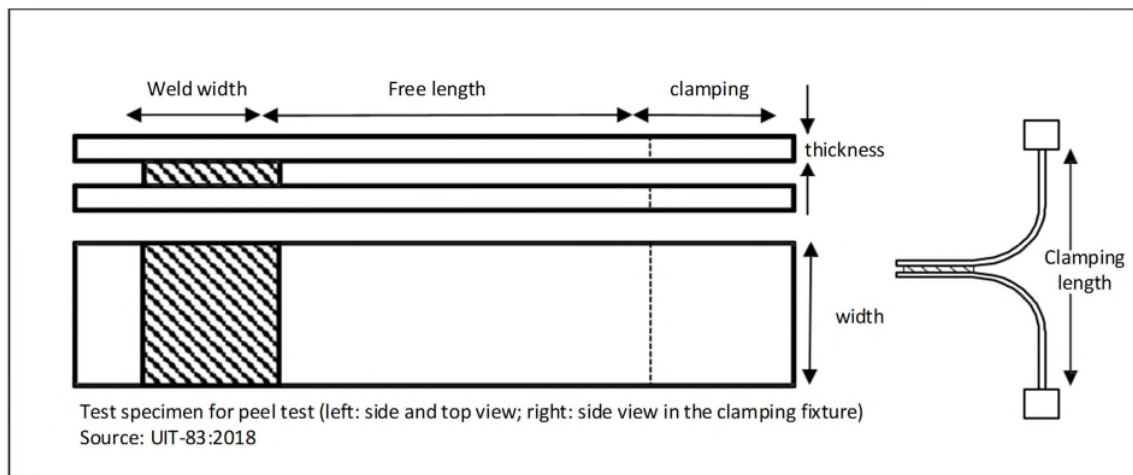


Figure 2 Illustration of test specimen for peel test

4.24.2. Peel characteristics of welded joints on geomembranes with reinforcement

- Peel characteristics shall be assessed as described in 4.24.1
- If the weld has an overlap of less than 20 mm, then the test shall be performed with the following deviations:
 - The specimens must be taken parallel to the weld direction.
 - The weld width may be taken as the specimen width.
 - The weld must be peeled over a length of at least 250 mm in the weld direction (regardless of the number of specimens).
- The criteria to be met are as follows:

Failure mode	Class (C) delamination, as follows: - Fine-mesh geomembrane: The coating must detach from the fabric over at least 80% of the peeled portion of test specimen. - Open-mesh geomembrane: $\geq 80\%$ of surface between the fabric shows ductile fracture
Peel strength	- Average peel strength per specimen shall be ≥ 1.5 N/mm of the specimen width, and - Average peel strength for all specimens per weld shall be ≥ 2.0 N/mm of the specimen width, and - Average peel strength for all specimens per weld shall be $\geq 90\%$ of the value specified by the manufacturer.

4.24.3. Elongation at break of welded joints on geomembranes without reinforcement

The elongation at break of the welded geomembrane shall be at least 50% of the elongation at break of the unwelded geomembrane. This is determined by comparing the elongation at break of separate sets of the same material (welded and unwelded).

The test is carried out according to EN-ISO527-4 with the following modifications:

- Specimen width: 50 mm
- Specimen length: minimum 200 mm
- Number of test specimens per weld is ≥ 5
- The test specimens shall be cut perpendicular to the weld, or from the unwelded material.
- Clamping length for welded material: 100 mm + weld width
- Clamping length for unwelded material: 100 mm
- Test speed: 500 mm/min

Explanation

Unwelded material is tested with a clamping length of 100 mm. Since for welded material the applicable clamping length is 100 mm + weld width, its elongation at break shall be calculated accordingly.

For example:

If the weld width is 50 mm, the clamping length becomes 150 mm. If fracture occurs at 400 mm between the grips, the elongation at break is:

$$\left(\frac{400 - 150}{100} \right) \times 100\% = 250\%.$$

4.24.4. Tensile strength of welded joints on geomembranes with reinforcement

The tensile strength of the welded geomembrane shall be at least 75% of the tensile strength of the unwelded geomembrane. This is determined by comparing the tensile strength of separate sets of the same material (welded and unwelded).

The test is carried out according to EN-ISO527-4 with the following modifications:

- Specimen width: 50 mm
- Specimen length: minimum 200 mm
- Number of test specimens per set is ≥ 5
- The test specimens shall be cut perpendicular to the weld, or from the unwelded material. The welded and unwelded specimens shall be tested in the same main direction.
- Clamping length for welded material: 200 mm + weld width
- Clamping length for unwelded material: 200 mm
- Test speed: 100 mm/min

Note 1: The tensile strength in this section is measured differently than in (4.10.2), so both welded and unwelded material must be tested according to this procedure.

Note 2: The tensile strength of geomembrane with reinforcement depends mainly on the strength of the reinforcement yarns (roughly: strength per yarn $\times$ number of yarns across the specimen).

Yarns that do not run fully from grip to grip (in unwelded geomembrane) or from grip into the weld (in welded geomembrane) do not contribute fully and should be avoided. This can be done by cutting specimens to include a whole number of yarns or, if needed, by carefully adjusting the specimen to a fixed number of yarns. The maximum load of each adjusted specimen is then converted to tensile strength per 50 mm width by dividing the load by the number of yarns in the specimen and multiplying by the number of yarns per 50 mm of geomembrane.

4.24.5. Declaration of mechanical properties of welded joints

The manufacturer shall declare the mechanical properties of welded joints, as determined by testing welded specimens.

The declared values shall be determined in accordance with the applicable test methods specified in this BRL and shall be accompanied by details of the welding conditions used to produce the test specimens. As a minimum, the manufacturer shall declare the welding method, the relevant welding parameters, and the weld width. This information is required because the mechanical properties of welded joints depend on the welding process. It ensures that the declared performance can be correctly interpreted and reproduced.

4.25. Biological resistance

Biological resistance is only required for specific uses.

Resistance to root penetration: No penetration, tested according to NPR-CEN/TS 14416.

Resistance to pest or rodent attack: No penetration; the test method is yet to be defined.

Resistance to Microorganisms:

- Tested according to EN 12225
- Resulting mass change shall be $\leq 15\%$
- Resulting change in tensile strength and elongation at break shall be $\leq 25\%$

5. Markings

5.1. General marking

The product shall be marked with following:

- Trade name or registered trademark
- Material (PVC-P)
- Actual geomembrane thickness
- Applicable geomembrane type(s) e.g. UV, MB, HA, OB, BV (see the explanation given below)
- Batch number
- Production date or production date code (required only if the production date cannot be traced from the batch number).

5.2. Certification marking

After entering into a Kiwa certification agreement, the certified products shall marked with:

- Kiwa wordmark “KIWA”
- HA type shall be marked with **KIWA**  or  or “Kiwa Water Mark”

5.3. Method and place of marking

The markings described above shall be applied to the product in a suitable method that provides clear, legible, and durable identification, e.g. painting, stenciling, or printing

The markings shall be placed on:

- The geomembrane at least once every two meters of roll length.
- The packaging of each roll.

Explanation:

For example, a PVC-P geomembrane with a thickness of 1.0 mm and with MB and UV type designations should be marked with the following information:

Trade name - “KIWA” - PVC-P - 1.0 - MB UV - Batch number - Production date/code if applicable

Notes:

For larger projects, it is recommended that the packaging of the geomembrane section(s) be marked with the following additional information:

- Project identification
- Section number

6. Requirements of the quality system

This chapter contains the requirements that shall be met by the supplier's quality system.

6.1. Manager of the quality system

Within the supplier's organizational structure, an employee who will be in charge of managing the supplier's quality system must have been appointed.

6.2. Internal quality control plan

The supplier shall have an internal quality control scheme (IQC scheme) which is applied by them.

The following must be demonstrably recorded in this IQC scheme:

- which aspects must be inspected by the supplier
- according to what methods such inspections are carried out
- how often these inspections are carried out
- in what way the inspection results are recorded and kept

This IQC scheme should at least be an equivalent derivative of the model IQC scheme as shown in Annex II.

6.3. Management of test and measuring equipment

The supplier shall verify the availability of necessary test and measuring equipment for demonstrating product conformity with the requirements in this evaluation guideline.

If and when required, the test and measuring equipment shall be calibrated at specified intervals.

The supplier shall record and evaluate the validity of the previous measuring data if at the time of calibration it is established that the equipment is not functioning properly.

The measuring equipment in question must carry an identification that allows for determining the calibration status.

The supplier shall record the results of the calibration.

6.4. Procedures and working instructions

The supplier shall be able to provide procedures and work instructions for the following:

- Incoming goods control
- Batch release and finished product control
- Handling products with deviations
- Handling customer complaints about product and/or services delivered.
- Maintenance of production equipment
- Calibration of measuring and test equipment
- Handling and storage

6.5. Other requirements of the quality system

The supplier must be able to provide the following:

- The organization's organizational chart
- The responsibilities and qualification requirements of the personnel involved
- A system for the control of documents relating to all subjects in this chapter.

7. Summary of assessments

This chapter provides a summary of the requirements that shall be assessed by Kiwa within the scope of:

- **The initial assessment:** The assessment conducted to verify that all requirements specified in the BRL are met, in order to grant the certificate.
- **Surveillance assessments:** The periodic assessments carried out after the certificate has been granted, to verify that the certified products continue to comply with the requirements specified in the BRL. The frequency of the surveillance assessments for this BRL is 3 visits per year (See 8.5).

7.1. Assessment matrix

The following frequencies apply:

- Per type (see 1.2) and thickness.
- Per type.
- Per smallest thickness per type.
- Per biggest thickness per type.
- Per smallest and biggest thickness per type.

Requirement	BRL article no.	Initial assessment for granting the certificate	Surveillance assessment after certificate is granted	
				Frequency
Product requirements				
Suitability for contact with drinking water	4.2	b	b	1x year
Hygienic treatment of products in contact with drinking water	4.3	a	a	Every visit
Materials	4.5	b	b	Every visit
Appearance	4.6	a	a	Every visit
Width of the geomembrane	4.7	a	a	Every visit
Effective thickness	4.8	a	a	1x year
Straightness and flatness of the geomembrane	4.9	a	a	Every visit
Tensile properties of the geomembrane	4.10	e	b	1x year
Resistance to delamination	4.11	e	b	1x 2 years
Permeability to liquids	4.12	c	c	1x 5 years
Resistance to dynamic puncture	4.13	a	b	1x 2 years
Resistance to static puncture	4.14	a	b	1x 2 years
Dimensional stability at high temperatures (behavior after heating)	4.15	e	b	1x year
Foldability at low temperatures	4.16	d	d	1x 3 years
Tear resistance	4.17	a	b	1x year
Resistance to UV aging – covered applications	4.18	c	c	1x 5 years
Resistance to UV aging – uncovered applications	4.19	c	c	1x 5 years
Loss of plasticizer	4.20	c	c	1x 2 years
Thermal stability	4.21	b	b	1x 3 years
Behavior and leaching after extraction in water	4.22	c	c	1x 3 years
Chemical resistance	4.23	c	c	1x 5 years
Weldability of the geomembrane	4.24	c	b	1x 3 years
Biological resistance	4.26	c	c	1x5 years
Markings				
General marking	5.1	a	a	Every visit
Certification marking	5.2	a	a	Every visit
Requirements of the quality system				

Requirement	BRL article no.	Initial assessment for granting the certificate	Surveillance assessment after certificate is granted	
				Frequency
Manager of the quality system	6.1	x	x	1x year
Internal quality control plan	6.2	x	x	1x year
Management of test and measurement equipment	6.3	x	x	1x year
Procedures and working instructions	6.4	x	x	1x year
Other requirements of the quality system	6.5	x	x	1x year

Note: The manufacturer shall inform the certification body of any intended changes to the product (i.e. aspects listed in 4.5.2) or the production process prior to implementation; the certification body shall determine whether reassessment is required.

8. Agreements on the implementation of certification

8.1. General

The certification body must have a procedure in place in which the general regulations used for certification are established.

8.2. Certification staff

The staff involved in the certification may be sub-divided into:

- Certification assessor/Reviewer (**CAS/RV**): in charge of carrying out the design and documentation evaluations, pre-certification tests, initial investigations, and evaluation of applications and reviewing conformity assessments.
- Site assessor (**SAS**): in charge of carrying out external inspections at the supplier's works
- Decision maker (**DM**): in charge of taking decisions in connection with the pre-certification tests carried out, continuing the certification based on the inspections carried out and taking decisions on the need to take corrective actions

8.2.1. Competence criteria certification staff

The competence criteria for the implementing certification staff are laid down in the following table. The competence of the certification staff involved must have been demonstrably recorded.

Basic competences	Evaluation criteria
Knowledge of company processes. Skills for conducting professional assessments on products, processes, services, installations, design, and management systems.	<i>Relevant work experience</i> SAS, CAS/RV : 1 year DM : 5 years, including 1 year related to certification <i>Relevant technical knowledge and experience at the level of:</i> SAS : High school CAS/RV, DM : Bachelor
Skills with regard to site assessments to be performed Adequate communication skills (e.g. writing reports, presentation skills and interviewing skills).	SAS : Kiwa Assessment training or equivalent and 4 site assessments including 1 supervised self-reliant assessment.
Execution of Initial Investigation	CAS : 3 initial assessments under supervision.
Conducting reviews	RV : evaluation of 3 reviews

Technical competences	Evaluation criteria
Education	PM, CAS, SAS Background in mechanical engineering or other relevant fields.
Experience	PM, CAS, SAS Knowledge and understanding of the BRL at a detailed level 4 assessments related to the BRL (or relevant BRLs)

Legenda:

- Product manager: (**PM**)
- Site assessor (**SAS**)
- Certification assessor (**SAS**)
- Reviewer (**RV**)
- Decision maker (**DM**)

8.2.2. *Qualifications Certification staff*

The qualification of the Certification staff shall be demonstrated by means of assessing the education and experience to the above mentioned requirements. In case staff is to be qualified on the basis of deflecting criteria, written records shall be kept.

The authority regarding qualifications shall be recorded in the quality assurance system of the certification body.

8.3. Initial assessment report

The certification body records the results of the initial assessment in a report. This report shall comply with the following requirements:

- completeness: the report provides a verdict about all requirements included in the evaluation guideline
- traceability: the findings on which the verdicts have been based shall be recorded and traceable
- basis for decision: the DM shall be able to base their decision on the findings included in the report

8.4. Decision for granting the certificate and/or imposing of measures

The decision for granting the certificate or the imposing measures with regard to the certificate shall be based on the results recorded in the file.

The results of an initial assessment and a periodic assessment (in case of critical non-conformities) must be assessed by a reviewer.

Based on the performed review, the decision maker will decide if:

- The certificate can be granted
- Sanctions are imposed
- The certificate shall be suspended or revoked.

The reviewer and the decision maker shall not have been involved in the preparation of the results based on which the decision is being made.

The decision shall be recorded in a traceable manner.

8.5. Nature and frequency of surveillance assessments

The certification body shall carry out surveillance assessments on site at the supplier to verify compliance with their obligations. The Board of Experts decides on the frequency of assessments.

At the time this BRL entered into force, the frequency of surveillance assessments is 3 assessments per year.

An overview of the assessments to be performed by the certification body is given in the test matrix and must cover at least:

- the product specifications laid down in the certificate
- the production process of the products
- the supplier's IQC Scheme and the results of the inspections performed by the supplier
- the correct way of applying markings to the certified products
- compliance with the required procedures
- dealing with complaints about delivered products

For suppliers with a private label certificate, the frequency of assessments for the products covered by this certificate is established at 1 assessment per 2 years. The assessments are conducted at the site of private label holder and focused on the aspects inserted in the IQC scheme and the results of the control performed by the private label holder. The IQC scheme of the private label holder shall at least refer to:

- the correct way of applying markings to the certified products
- compliance with required procedures for receiving and final inspection
- the storage of products and goods
- dealing with complaints about delivered products

The results of each assessment shall be recorded by Kiwa in a traceable manner in a report.

8.6. Non conformities

When the certification requirements are not met, measures are taken by Kiwa in accordance with the sanctions policy as written in the Kiwa Regulation for Certification. The Kiwa Regulation for Certification and the Sanctions Policy are available page on the Kiwa website.

The following applies with regards to the relevance, follow-up of nonconformities, and the sanctions policy.

Severity of nonconformities

The severity of the issued nonconformity in relation to the assessment conducted after granting the product certificate by certification body can be differentiated as follows:

- Nonconformities entitled as critical are deviations that can directly affect the quality and/or performance of product and/or process
- Other" nonconformities (noncritical nonconformities)

Follow-up nonconformities

The follow-up procedure for nonconformities by a certification body is as follows:

- The certification body shall be able to deal with **critical nonconformities** within the time frame established by the certification body, but shall not exceed the maximum term of **30 business days**;
- The certification body shall be able to deal with **noncritical nonconformities** within the time frame established by the certification body, but shall not exceed the maximum term of **90 business days**.

8.7. Report to the Board of Experts

The certification body shall report at least annually about the performed certification activities. In this report the following aspects shall be included:

- changes in number of issued certificates (granted/withdrawn)
- number of executed surveillance assessments in relation to the established minimum
- results of the surveillance assessments
- measures imposed in case of nonconformities
- complaints received from third parties about certified products

8.8. Interpretation of requirements

The Board of Experts may record the interpretation of requirements of this evaluation guideline in one or more separate interpretation document(s). This or those interpretation documents will be available to the members of the BoE, the certification bodies, and the certificate holders who are active based on this evaluation guideline. This or those interpretation documents will be published on Kiwa's website.

9. List of standards and norms

9.1. Public law rules

Number	Title	Version
	Ministerial Regulation on the Materials and Chemicals for Drinking and Warm Water Supply ("Ministeriële Regeling materialen en chemicaliën drink- en warm tapwatervoorziening") (published in the Government Gazette)	2017

9.2. Standards / normative documents

Number	Title	Version
EN-ISO/IEC 17020	Conformity assessment - Requirements for the operation of various types of bodies performing inspection	*
EN-ISO/IEC 17021	Conformity assessment - Requirements for bodies providing audit and certification of management systems	*
EN-ISO/IEC 17024	Conformity assessment - General requirements for bodies operating certification of persons	*
EN-ISO/IEC 17025	General requirements for the competence of testing and calibration laboratories	*
EN-ISO/IEC 17065	Conformity assessment - Requirements for bodies certifying products, processes and services	*
EN 13361	Geosynthetic barriers — Characteristics required for use in the construction of reservoirs and dams	2018
EN 13362	Geosynthetic barriers — Characteristics required for use in the construction of canals	2018
EN 13491	Geosynthetic barriers — Characteristics required for use as a fluid barrier in the construction of tunnels and underground structures	2018
EN 13492	Geosynthetic barriers — Characteristics required for use in the construction of liquid waste disposal sites, transfer stations or secondary containment	2018
EN 13493	Geosynthetic barriers — Characteristics required for use in the construction of solid waste storage and disposal sites	2018
EN 15382	Geosynthetic barriers — Characteristics required for use in transportation infrastructure	2018
EN 16993	Geosynthetic barriers - Characteristics required for use in the construction of storage lagoons, secondary containment (above and below ground) and other containment applications for chemicals, polluted water and produced liquids	2018
UIT-83	Protocollen voor het toepassen van kunststof geomembranen voor bodembescherming en gas- en vloeistofbarrièrelagen - Deel I: Materialen	2018
UIT-84	Protocollen voor het toepassen van kunststof geomembranen voor bodembescherming en gas- en vloeistofbarrièrelagen - Deel II: Aanleg en acceptatie	2018
UIT-85	Protocollen voor het toepassen van kunststof geomembranen voor bodembescherming en gas- en vloeistofbarrièrelagen - Deel III: Lasaanbevelingen	2018
EN 1850-2	Flexible sheets for waterproofing — Determination of visible defects — Part 2: Plastic and rubber sheets for roof waterproofing	2001
EN 1848-2	Flexible sheets for waterproofing — Determination of length, width, straightness and flatness — Part 2: Plastic and rubber sheets for roof waterproofing	2001

Number	Title	Version
EN 1849-2	Flexible sheets for waterproofing — Determination of thickness and mass per unit area — Part 2: Plastic and rubber sheets for roof waterproofing	2019
EN-ISO 527-1	Plastics — Determination of tensile properties — Part 1: General principles	2019
EN-ISO 527-3	Plastics — Determination of tensile properties — Part 3: Test conditions for films and sheets	2018
EN-ISO 527-4	Plastics — Determination of tensile properties — Part 4: Test conditions for isotropic and orthotropic fiber-reinforced plastic composites	2023
EN 14150	Geosynthetic barriers — Determination of permeability to liquids	2019
EN 12691	Flexible sheets for waterproofing — Bitumen, plastic and rubber sheets for roof waterproofing — Determination of resistance to impact	2018
EN-ISO 12236	Geosynthetics — Static puncture test (CBR test)	2006
EN 1107-2	Flexible sheets for waterproofing — Determination of dimensional stability — Part 2: Plastic and rubber sheets for roof waterproofing	2017
EN 495-5	Flexible sheets for waterproofing — Determination of foldability at low temperature — Part 5: Plastic and rubber sheets for roof waterproofing	2013
EN 12310-2	Flexible sheets for waterproofing — Determination of resistance to tearing — Part 2: Plastic and rubber sheets for roof waterproofing	2018
EN 12224	Geosynthetics — Determination of the resistance to weathering	2000
EN 12226	Geosynthetics — General tests for evaluation following durability testing	2000
ISO 4892-1	Plastics — Methods of exposure to laboratory light sources — Part 1: General guidance	2024
ISO 4892-2	Plastics — Methods of exposure to laboratory light sources — Part 2: Xenon-arc lamps	2013
EN 513	Unplasticized poly(vinyl chloride) (PVC-U) profiles for the fabrication of windows and doors — Determination of the resistance to artificial weathering	2018
EOTA TR 010	Exposure procedure for artificial weathering	2004
ISO 176	Plastics — Determination of loss of plasticizers — Activated carbon method	2005
EN-ISO 182-2	Plastics — Determination of tendency of compounds and products based on vinyl chloride homopolymers and copolymers to evolve hydrogen chloride and any other acidic products at elevated temperatures — Part 2: pH method	1999
ISO 62	Plastics — Determination of water absorption	2008
EN 14415	Geosynthetic barriers — Test method for determining the resistance to leaching	2004
EN 14414	Geosynthetic barriers — Test method for determining the chemical resistance	2004
EN 12316-2	Flexible sheets for waterproofing — Determination of peel resistance of joints — Part 2: Plastic and rubber sheets for roof waterproofing	2013
NPR-CEN/TS 14416	Geosynthetic barriers — Test method for determining the resistance to root penetration	2014
EN 12225	Geotextiles and geotextile-related products — Method for determining the microbiological resistance by a soil burial test	2020

(*) The current version of the document applies. The certification body verifies annually whether the normative documents are still up to date. Any changes to the applicable normative documents are published on the services page of the Kiwa website.

Annex (I) Model certificate

Product certificate
K-XXXXXXX-X



Valid from **Fill in date**

Replaces
Page

Fill in text
1 of xx

PVC-P Geomembrane with or without reinforcement

STATEMENT BY KIWA

With this product certificate, issued in accordance with the Kiwa Regulations for Certification, Kiwa declares that legitimate confidence exists that the products supplied by

Name of business

as specified in this product certificate and marked with the Kiwa®-mark in the manner as indicated in this product certificate may, on delivery, be relied upon to comply with Kiwa evaluation guideline BRL-K519/06 "PVC-P geomembranes with or without reinforcement" dated **YYYY-MM-DD**.

Wim van Loon
Managing Director Nederland

Publication of this certificate is allowed.
Advice: consult www.kiwa.com in order to ensure that this certificate is still valid.



Kiwa Nederland B.V.
Sir Winston Churchilllaan 273
P.O. Box 70
2280 AB RIJSWIJK
The Netherlands
Tel. +31 88 998 44 00
NL.Kiwa.Info@kiwa.com
www.kiwa.com

Certificate holder
Fill in text

Production location
Fill in text

PVC-P Geomembranes with or without reinforcement**TECHNICAL SPECIFICATION**

Plasticized polyvinylchloride (PVC-P) geomembrane(s) with the following specifications:

Product (trade) name	Fill in
Reinforcement	☐ With reinforcement ☐ Without reinforcement
Color	Fill in
Effective thickness (mm)	Fill in
Coating thickness (mm)	*Fill in only for geomembrane with reinforcement
Nominal width (m)	Fill in
Tensile strength	*Fill in only for geomembrane with reinforcement
Tear strength	*Fill in only for geomembrane with reinforcement

Application and use

The products are intended for the application areas indicated the previous section and described below:

Application area	Type designation	Description
☐ 1.2.1	---	General civil engineering applications
☐ 1.2.2	HA	Drinking water containment
☐ 1.2.3	MB	Storage of animal manure For geomembranes without reinforcement ☐ Non-load-bearing applications ☐ Floating covers of tanks and reservoirs For geomembranes with reinforcement ☐ Non-load-bearing applications ☐ Load bearing applications
☐ 1.2.4	BV	Soil protection systems for industrial waste landfills and single-waste landfills
☐ 1.2.5	OB	Separation and semi-permanent storage of mineral-oil-containing media
☐ 1.2.6	UV	Above-ground uncovered applications
☐ 1.2.7	---	Additional application area add description of application. In case of special chemical resistance: The composition of the relevant additional medium shall be stated in the certificate.

Marking

The products are marked with:

- Trade name or registered trademark
- Material (PVC-P)
- Effective thickness
- Applicable type designation (s)
- Batch number
- Production date or production date code (required only if the production date cannot be traced from the batch number).
- Kiwa certification mark: “KIWA” or for HA type  or  or “Kiwa Water Mark”

Method of marking: painting, stenciling, or printing

Place of marking: On the geomembrane at least once every two meters of roll length and on the packaging of each roll.

PVC-P Geomembranes with or without reinforcement

RECOMMENDATIONS FOR THE CUSTOMERS

Check at the time of delivery whether:

- the supplier has delivered in accordance with the agreement;
- the mark and the marking method are correct;
- the products show no visible defects as a result of transport etc.

If you should reject a product on the basis of the above, please contact:

- **Fill in text**

and, if necessary,

- Kiwa Nederland B.V.

Consult the supplier's processing guidelines for the proper storage, handling and transport methods.

Annex (II) Model IQC Scheme

Inspection subjects	Inspection aspects.	Inspection method	Inspection frequency	Inspection registration
Raw materials (entry control)				
Production process including process and batch tests				
Finished products including finished product tests				
Control of nonconforming and/or rejected products				
Inspection with regard to packaging, storage and transportation of the finished product				
Calibration of measuring and testing equipment				

Annex (III) Calculating exposure time for the accelerated UV aging process

This annex explains the method of calculating the exposure time for the UV accelerated test described in (4.19.1)

The exposure duration shall be determined using the following equation:

$$t = [H * f(uv) * f(T)] / [E(app) * 3600]$$

where:

t = exposure duration, in hours;

H = global solar radiation dose, measured during outdoor exposure at an angle of 45° to the horizontal plane and facing south, under Dutch climatic conditions;

f(uv) = proportion of UV radiation (280–400 nm) in sunlight;

f(T) = correction factor to compensate for the difference in surface temperature between the outdoor exposure and the accelerated UV aging test; and

E(app) = time-averaged UV intensity (280–400 nm) during the accelerated UV aging test.

The effect of the artificial weathering shall be equivalent to the effect of an outdoor exposure, as described above, for a period of five years. The corresponding average value of the global solar radiation dose H is 21 GJ/m².

The factor f(uv) shall be taken as 0.06.

In deviation from Annex C of EN 12608, the factor f(T) shall be taken as 0.41 (the value applicable to the Netherlands; see Note 1).

Based on the above equation, an exposure duration t of 2500 hours is sufficient for this artificial weathering procedure.

Measurements carried out by TNO of the values applicable to the Netherlands (the corresponding average global solar radiation dose H of 21 GJ/m² and the factor f(T) = 0.41) have made it possible to use these values. If these values for f(T) had not been available, the estimated value f(T) = 0.67, as specified in the EOTA guideline, would have had to be used in the calculation. In that case, the following values would apply: a global solar radiation dose H of 4.2 GJ/m² (representing one year of outdoor exposure in the Netherlands), f(uv) = 0.06, the European estimated value f(T) = 0.67, representing the more severe climatic conditions prevailing elsewhere in Europe, and E(app) = 57 W/m². This results in a calculated exposure duration t of 822 hours, equivalent to one year of outdoor exposure. Consequently, for the European requirement of a five-year equivalent under the more severe climatic conditions prevailing elsewhere in Europe, the required exposure duration is approximately 4000 hours.

In view of the above, it has been decided to specify an exposure duration t of 4000 hours for the artificial weathering procedure described. This exposure duration (4000 hours) applies to specially UV-stabilized geomembranes.

Note 1

The above equation is consistent with the approximate calculation method given in Annex C of EOTA TR 010. In principle, different values for H and f(T) should be used, reflecting the moderate European climatic conditions applicable to the Netherlands.

The rationale for using these alternative values is as follows:

A comparative study was carried out based on standardized outdoor exposure on the one hand and accelerated UV aging in a Ci4000 Weather-Ometer on the other. This study established an experimentally determined annual equivalent for the accelerated UV aging test.

Accordingly, the value used for H was derived from the average annual global solar radiation dose measured under the specified outdoor exposure conditions using a solarimeter, amounting to 4.2 GJ/m^2 . Furthermore, the estimated value of f(T) given in EN 12608 (0.67) was reduced to 0.41, thereby aligning the calculated exposure duration with the exposure duration corresponding to the experimentally determined annual equivalent.

Note 2

If the manufacturer wishes to demonstrate the suitability of the product by another method (i.e. using different weathering equipment), where this is permitted by European standards, the certification body may, following evaluation of the test results, still recognize the suitability of the product.

As a general rule, however, the Ci4000 Weather-Ometer shall be used as the preferred test equipment.

Annex (IV) Test media for chemical resistance

This annex explains the composition of the test medium for the chemical resistance test described in (4.23)

Test medium	Description and composition
Test medium 1	Ammonium hydroxide (5%)
Test medium 2	Acetic acid (1/10 molar or 1/10 normal)
Test medium 3	Sulfuric acid (5-6%)
Test medium 4	Synthetic fertilizer made as following: 10 grams of each of the following acids mixed in 1 liter of demineralized water: • Acetic acid • Propionic acid • Valerian acid • Isovaleric acid This solution is then neutralized with concentrated ammonia to pH 7-8.
Test medium 5	Mixture of mineral oils made as following: • 35% (v/v) diesel oil • 35% (v/v) paraffin (e.g. paraffin afk. Merck 7174) • 30% (v/v) lubricating oil (15W-40 engine oil)
Additional media	Testing shall only be performed using media agreed in advance between Kiwa and the certificate holder. The composition of the test medium shall be clearly defined and documented.