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European Assessment Document for

Liquid applied bridge deck waterproofing kits

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This European Assessment Document (EAD) has been developed taking into account up-to-date technical and scientific knowledge at the time of issue and is published in accordance with the relevant provisions of Regulation (EU) 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

Liquid Applied Bridge Deck Waterproofing Kits consist of a material or a combination of materials, where at least the main component is liquid form, applied on concrete and/or steel bridge decks.

The KITS may incorporate components defined by the manufacturer, such as:

- reinforcements (e.g., polyester or glass fabrics), and/or
- other ancillary products (e.g., priming coats, tack coats), and/or
- protective layers (e.g., bituminous or other materials).

The liquid applied materials can be applied by pouring, brushing, spraying or spreading, in single or multi-layers, onto an existing surface of a bridge deck to provide, once cured, a continuous water-tight membrane.

The kits (obtained by installing a liquid applied waterproofing kits) have to be fully bonded to the substrate.

This EAD covers liquid-applied bridge deck waterproofing kits, comprising in-situ applied liquids based on polymers (including resins), such as:

- Flexible unsaturated polyester or Reactive poly(methyl) methacrylate (PMMA).
- Epoxies.
- Polyurethane, Polyurea, Silane modified polymers (SMP), Thermoplastic block copolymer and Water dispersible polymers and Polyaspartic.

The product is not fully covered by the harmonised European standard EN 14695 “Flexible sheets for waterproofing - Reinforced bitumen sheets for waterproofing of concrete bridge decks and other trafficked areas of concrete - Definitions and characteristics”, since it addresses only Reinforced bitumen sheets which is not applied in liquid form and whose chemical composition is very different. Nevertheless, the intended use is partially the same of the product covered by the present EAD and some assessments methods can be taken on board from EN 14695. So, due to these differences between the liquid waterproof products and the bitumen membranes, this EAD has incorporated:

- additional ageing tests to the included in EN 14695 (Heat ageing and Compatibility by heat conditioning), to assess the effect of different agents in contact with these products (see table 2.1.1),
- different performed tests before and after to the ageing test included in EN 14695 (see table 2.1.1). This standard included two tests: 1) Flow property (EN 1110), it is mainly relevant for mastic bituminous and 2) Cold bending (EN 1109), it is only relevant for bitumen membranes with internal reinforcement.

The product is not covered by the following EADs:

- EAD 030019-00-040 “Liquid applied roof waterproofing on the basis of polysiloxane”.

- EAD 030350-00-0402 – “Liquid applied roof waterproofing kits”.

- EAD 030352-00-0503 – “Liquid applied watertight covering kits for wet room floors and/or walls”.

These three EADs address waterproofing liquid applied products, but with different intended uses and their specific assessment methods are not at all appropriate for the product covered by this EAD whose intended use is waterproofing of the concrete and/or steel deck of the bridge.

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 Liquid Applied Bridge Deck Waterproofing Kits is the waterproofing of the concrete and/or steel deck of the bridge preventing or controlling the passage of water to the support.

These kits are made of non-load bearing construction elements. It does not contribute directly to the stability of the bridge on which is installed, but it can contribute its durability by providing enhanced protection from the effect of weathering.

Liquid applied bridge deck waterproofing kits are not intended to receive direct vehicular traffic in service and in this case will always be used beneath overlays of asphalt or concrete which may have a protective character and/or additional waterproofing function. These overlays do not form part of the scope of this EAD but these will be taken into account in so far as they may affect, or are affected by, the performance of the waterproofing layer. Bridge deck waterproofing kits may remain uncovered when subject to pedestrian or cyclist traffic only or when used in non-trafficked areas. So, in order to facilitate the assessment, process the areas of use are categorised as follows:

- (A) With overlay and intended to receive vehicular traffic:
    - A.1 Overlay of asphalt concrete applied at (160 ± 10) °C (CBM).
    - A.2 Overlay of mastic asphalt applied from 220 °C to 250 °C (MA).
    - A.3 Non-asphaltic overlays (tests with overlay are not relevant).
- (B) Without overlay (exposed) and intended to receive only pedestrian or cycle traffic.
- (C) Without overlay (exposed) and un-trafficked (including special case of un-ballasted rail bridges).

These kits can be applied in vertical surface to solve singular points. In these cases, the manufacturer could slightly modify the waterproof membrane by addition of a thixotropic component.

Kits used beneath ballast are not covered under the scope of this EAD.

Kits based on bitumen and polymer-modified mortars and kits with polymeric overlays are not covered under the scope of this EAD.

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 25 years, when installed in the works (provided that the product is subject to appropriate installation (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].

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 (TAB) issuing an ETA based on this EAD, but are regarded only as a means for expressing the expected economically reasonable working life of the product.

[1] The real working life of a product incorporated in a specific works depends on the environmental conditions to which that works is subject, as well as on the particular conditions of the design, execution, use and maintenance of that works. Therefore, it cannot be excluded that in certain cases the real working life of the product may also be shorter than referred to above.

1.3 Specific terms used in this EAD

1.3.1 Particular definitions / descriptions

Asphalt concrete: see EN 13375[2].

Finish Layer (applies only to exposed kits): one or more layers of material (e.g., slate chips, or solar protective coating, etc.) applied as a component of the liquid applied bridge deck waterproofing kits, i.e., as a top layer of the kits. The finish layer may have several functions, e.g., protection of the product against the effects of weathering or as an aesthetic finish.

Free film: a sample of the waterproofing layer prepared without any support, used for testing.

Internal Layer: a layer of fabric scrim, non-woven mat of synthetic material, glass fibres or other material used as a component of the liquid applied bridge deck waterproofing kits. This layer may constitute a reinforcement.

Liquid material: a material or a combination of materials that can be poured, spread or sprayed.

Manufacturer's Technical Dossier: a collection of documents consisting of the design rules, the Manufacturer's installation instructions and the directions concerning maintenance and repair of the kits, on-site quality measures etc., relevant to a particular product or a range of products.

Mastic asphalt: see EN 13375.

Overlay: the layer applied directly over the kits, designed to receive vehicular traffic, provide protection or provide an additional waterproofing function.

Priming coat (primer): a layer applied to the surface of a support in order to promote adhesion between it and the waterproofing layer.

Protection layer: one or more layers of materials applied on top of the waterproofing to control the effects of physical, mechanical and/or chemical stresses. Examples are surface treatment and separation sheet.

Reinforcement: a layer (e.g., a mesh or fleece) incorporated within the waterproofing layer to provide enhanced physical properties.

Sample: for the purposes of this EAD a sample can be either:

- in the case of Type 1, Type 3 or Type 4 Specimens, the waterproofing layer applied to the support, or
- in the case of Type 2 Specimens a free film of the waterproofing layer from which a test piece is taken.

Sealing Coat: a priming coat (primer) that has the additional function of penetrating and sealing the support surface to prevent the passage of moisture and / or gases.

Support: the concrete and steel surface to which the kits are applied, including (where applicable) any repair or levelling treatments applied to the support surface.

Surface treatment: one or more components that can be used to provide e.g., improved connection between the kits and the overlay, to provide a key, to enhance slip or shear or as a protection (e.g., protection layer or finish layer).

Tack coat: an additional layer applied as a top layer of the kits in order to promote adhesion between the kits and the overlay.

Test categories: test categories are defined and summarized in Annex C. They are related to the conditions for sample preparation (P), with stress conditions before testing (S) and with temperature conditions for testing (T). The Member States national regulations may refer to test categories.

Test Specimen: shall be prepared in accordance with EN 13375: *Flexible sheets for waterproofing, Waterproofing of concrete bridge decks and other concrete surfaces trafficable by vehicles Specimen preparation (Annex A):*

- Type 1: Liquid applied waterproofing layer bonded to the support;
- Type 2: Free film liquid applied waterproofing layer;
- Type 3: Liquid applied waterproofing layer bonded to the support and asphalt concrete overlay applied at (160 ± 10) °C (CBM).

[2] All undated references to standards or to EADs in this EAD are to be understood as references to the dated versions listed in chapter 4

- Type 4: Liquid applied waterproofing layer bonded to the support and mastic asphalt overlay applied from 220 to 250 ± 10 °C (MA).

Waterproofing layer: one or more cured layers of liquid applied components of a kits that provide the primary function of preventing the transmission of moisture into the support.

1.3.2 General definitions / descriptions of the materials

Kits based on Polyurethane, Polyurea, Silane modified polymers (SMP), Thermoplastic block copolymer and Water dispersible polymers and Polyaspartic

Polyurethane: Elastomeric polymer formed by reacting a di- or poly-isocyanate with a polyol.

Polyurea: Elastomeric polymer formed by reacting a di- or poly-isocyanate with a polyamine.

Hybrid polyurea: Elastomeric polymer formed by reacting a di- or poly-isocyanate with a mixture of polyamines and polyols.

Water dispersible polymers: In water dispersible binder based on polymers (e. g. acrylic, vinyl-acrylic, styrene-acrylic, styrene-butadiene copolymers).

Silane modified polymers (SMP): This family includes:

- Silane modified polyurethane. Manufactured by polyaddition of isocyanate-functional prepolymer with amino-functional silanes or polyaddition of polyurethane-polymers with silanes with NCO group.
- Silane modified polyether. A silane-modified polyether is formed via the polyaddition of an isocyanate group containing silane with a polyether, or the polymer group is formed via hydrosilylation of alkoxyhydrosilane to a double bond of the polyether.

Thermoplastic block copolymer: A single part, solvent-based, homogeneous blend of styrene ethylene butylene styrene copolymer (SEBS), fillers, UV stabilizers and other additives.

Polyaspartic: Aliphatic polyurea because it is derived from the reaction product of an aliphatic polyisocyanate component and a polyaspartic ester component.

Kits based on Flexible unsaturated polyester or Reactive poly(methyl) methacrylate (PMMA)

Flexible unsaturated polyester: Liquid or solid resins with high molecular weight and low unsaturation, to improve flexibility dissolved in a reactive monomer, e.g., styrene.

Reactive poly(methyl) methacrylate (PMMA): Produced by the polymerisation of the liquid monomer methyl methacrylate (MMA) via a free radical polymerisation mechanism.

Kits based on Epoxy resin

Epoxy resin: Base materials for epoxy matrix are low-molecular-weight organic liquid resins containing a number of epoxide groups. The most common base material used is di-glycidylether of bisphenol A. Other ingredients may be mixed with the base liquid, such as diluents to reduce its viscosity or flexibiliziers to improve the impact strength of the cured epoxy matrix. Epoxies are cured by a "hardener". Amines are the most commonly used curing agents.

2 ESSENTIAL CHARACTERISTICS AND RELEVANT ASSESSMENT METHODS AND CRITERIA

2.1 Essential characteristics of the product

Table 2.2.1 shows how the performance of Liquid applied bridge deck waterproofing kits are 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 *(level, class, description)*
Basic Works Requirement 1: Mechanical resistance and stability				
1	Bond strength (kits to support)		2.2.1	Level
2	Capacity to bridge cracks		2.2.2	Level
3	Resistance to chloride ion penetration		2.2.3	Level
4	Resistance to dynamic actions	Resistance to perforation	2.2.4.1	Class
		Resistance to compaction of asphalt concrete	2.2.4.2	Description
5	Resistance to heat impact		2.2.5	Level
6	Compatibility by heat conditioning		2.2.6	Level
7	Water-tightness		2.2.7	Level
8	Resistance to high and low service temperatures		2.2.8	Level
9	Capacity to penetrate pores in the support		2.2.9	Level
10	Resistance to flow (associated with the application to non-horizontal surfaces)		2.2.10	Level
11	Dry film thickness		2.2.11	Level
12	Resistance to the effects of climatic conditions on application		2.2.12	Level
13	Resistance to the effects of the quality of the support (SC)		2.2.13	Level
14	Resistance to water contact (Wa)		2.2.14	Level
15	Resistance to alkali solution contact (Al)		2.2.15	Level
16	Resistance to oil, petrol or diesel contact		2.2.16	Description
17	Resistance to Bitumen contact (Bi)		2.2.17	Level
18	Resistance to Heat ageing (HA)		2.2.18	Level
19	Resistance to UV radiation (exposed kits only) (UV)		2.2.19	Level
20	Shear resistance		2.2.6	Level
21	Tensile strength		2.2.5, 2.2.18, 2.2.19	Level
22	Cold bending behaviour		2.2.20	Level
Basic Works Requirement 3: Hygiene, health and the environment				
23	Content, emission and/or release of dangerous substances		2.2.21	Description
Basic Works Requirement 4: Safety and accessibility in use				
24	Bond strength (kits to overlay)		2.2.22	Level
25	Slipperiness		2.2.23	Level
26	Resistance to abrasion / Wear		2.2.24	Level
Aspect of durability (BWR 1 and 4 (high and low temperatures))				
27	Resistance to Freeze Thaw (FT)		2.2.25	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.

Testing will be limited only to the essential characteristics, which the manufacturer intends to declare. If for any components covered by harmonised standards or European Technical Assessments the manufacturer of the component has included the performance regarding the relevant characteristic in the Declaration of Performance, retesting of that component for issuing the ETA under the current EAD is not required.

It is necessary to make use of “test categories“, when assessing some aspects of serviceability and durability. The categories reflect differences in the test parameters for:

- conditions relating to sample preparation (P),
- sample conditioning (stress conditions) prior to testing (S),
- temperature at which the test is carried out (T).

Test categories are defined in Annex C and specimens´ types in Annex A.

2.2.1 Bond strength (kits to support)

In order to maintain its integrity as a waterproofing layer, the kits shall have sufficient adhesion to the support (concrete and/or steel) to resist the forces acting upon it.

This test is required for all use categories using test specimens´ Type 1 (1.3.1).

The bond strength between the waterproofing layer and the concrete and/or steel[3] support shall be determined in accordance with EN 13596. The test shall be performed on a Type 1 specimen prepared in accordance with Annex A (modified EN 13375) under application conditions (P1).

After a curing time specified by the manufacturer, the test shall be carried out under test conditions (T5).

The general modes of failure are described following EN ISO 4624. The mode of failure is expressed as the percentage area and site of fracture in the kits under test, in terms of adhesive, cohesive or adhesive/cohesive failure.

The mode of failure may be described as follows:

A = Cohesive failure of support
A/B = Adhesive failure between support and first coat
B = Cohesive failure of first coat
B/C = Adhesive failure between first and second coat
-/Y = Adhesive failure between final coat and adhesive
Y = Cohesive failure of adhesive
Y/Z = Adhesive failure between adhesive and test cylinder

The mean value of at least three tests and the mode of failure shall be stated in the ETA.
The bond strength between the waterproofing layer and the support shall be ≥ 1.0 MPa.

2.2.2 Capacity to bridge cracks

In order to maintain its integrity as a waterproofing layer, the kits shall have sufficient strength to resist the forces and movement associated with cracks within the support and the overlay.

The test is required for all use categories using test specimens´ 1, also can be used test specimens 4 and these results can be considered equivalent.

[3] The preparation of the surface of a steel sample will be made according to manufacturer instructions and it can include the application of anti-corrosive treatment(s).

The capacity to bridge cracks in the support shall be determined in accordance with EN 14224[4].

The test shall be performed on specimens´ type prepared in accordance with Annex A under application conditions (P1) with stress conditioning before testing as defined below according to the use categories as follows:

Use category A: With overlay and intended to receive vehicular traffic

Specimen Type 1, before the crack bridging test: Heat impact according to clause 2.2.5 indirect method followed by heat ageing according to clause 2.2.18.

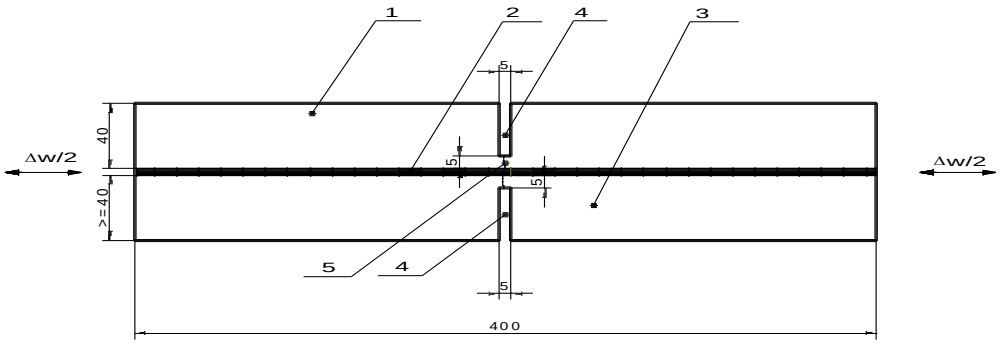
Or with specimens Type 4, before the crack bridging test: Heat impact according to clause 2.2.5 direct method followed by heat ageing according to clause 2.2.18. A Type 4 specimen is used where the mastic asphalt overlay has an additional waterproofing function. In this case an additional saw cut shall be made in the upper side of the overlay corresponding with the saw cut in the base specimen (Fig 1 below).

Use category B: Without overlay (exposed) and intended to receive only pedestrian or cycle traffic**.** With specimens´ Type 1, before crack bridging test: UV Radiation according to clause 2.2.19.

Use category C: Without overlay (exposed) and untrafficked (including the special case of unballasted rail bridges)**.** See (B) above.

The test shall start at – 30 °C or at temperature specified in Manufacturer's Product Installation Instructions (MPII). If the crack bridging ability is not achieved the temperature shall be increased for next step (e.g., -20 °C) and test shall be repeated until crack bridging ability is achieved.

Tests at lower temperatures cover tests at higher temperatures. Tests with a mastic asphalt overlay (on specimens Type 4) cover tests without an overlay (specimens´ Type 1).



Note: All dimensions in mm

Figure 2.2.2.1 — Type 4 specimens with additional saw cut in the mastic asphalt overlay

Key to Figure 2.2.2.1:

1. Asphalt overlay with additional waterproofing function, i.e., mastic asphalt (MA) applied at up from 220º to 250 ˚C (Type 4 specimen).
2. Waterproofing layer.
3. Concrete support.
4. Saw cuts.
5. Induced crack.
6. $\Delta w/2$: Half amplitude.

The temperature at which the ability to bridge cracks and remain watertight shall be stated in the ETA. The specimens´ type and any pre-conditioning shall be stated in the ETA.

2.2.3 Resistance to chloride ion penetration

The kits shall protect the bridge deck by preventing the passage of chloride ions.

This test is applicable for use categories (A) and (B) using specimens' Type 1.

The resistance to the penetration by chloride ions of the waterproofing layer bonded to a concrete support (specimens´ Type 1 in accordance with Annex A under application conditions (P1) shall be determined in accordance with ANNEX B.5.

[4] During the test, the test specimen shall be observed every 2000 cycles (see EN 14224/4.4.5).

The increase in chloride ion concentration in the concrete shall be stated in the ETA. This increase shall be less than 0,04 %.

2.2.4 Resistance to dynamic actions

In order to maintain its integrity as a waterproofing layer, the kits shall be capable of resisting the dynamic actions acting on it during application of overlays and in use. The actions to be taken into account include; actions due to traffic (compaction, compression, perforation) and actions due to the movement of the bridge deck and/or overlay (fatigue, movement, cracking).

2.2.4.1 Resistance to perforation

This test is required for use categories A, B and C and carried out on specimens´ Type 1 in accordance with Annex A under application conditions (P1) except that the substrate shall be steel.

The resistance of the kit to dynamic indentation is expressed by the type of indentor as of the Table B.1.1 and impact energy used by which the product keeps watertightness.

2.2.4.2 Resistance to compaction of asphalt concrete

This test is required for use category A.1 using specimens´ Type 2. The free film is overlaid directly with asphalt concrete (EN 13375 (7.1.3) for the definition of asphalt concrete).

The resistance to compaction of an asphalt concrete shall be determined in accordance with EN 14692 (Method 2) with specimen described in EN 14692 in accordance with Annex A under application conditions (P1).

The compaction of the asphalt concrete shall be carried out in accordance with EN 13375 (7.2).

According to EN 14692 clause 4.4.2 – Method 2, after the test the presence of perforations has to be observed. The possible presence of perforations or, in alternative, the absence of perforations shall be stated in the ETA.

2.2.5 Resistance to heat impact

For kits that will be subject to a hot-applied overlay (asphalt concrete or mastic asphalt) the effect of the heat impact resulting from the application of the overlay shall be verified.

This test is required for use category A (A.1, A.2 and A.3).

The heat impact shall be applied using, depending on the tests to follow, an indirect or direct method as described below:

Indirect method (specimens Type 1 or 2 in accordance with Annex B under application conditions (P1) depending on the monitoring test). The heat impact is simulated using e.g., a ventilated oven, hot sand or hot oil. The following temperature profiles shall be applied:

a) Heat impact to simulate the application of asphalt concrete at 160 ºC (CBM). The surface temperature of the waterproofing layer is raised to (140 ± 5) ºC within ten minutes. This temperature is held for ten minutes followed by cooling to 40 ºC, over two hours.

b) Heat impact to simulate the application of mastic asphalt at from 220 ºC to 250 ºC (MA). The surface temperature of the waterproofing layer is raised to the maximum temperature minus 80 ºC (140-170 ± 5 ºC) within ten minutes. This temperature is held for ten minutes followed by cooling to 50 ºC, over five hours.

The following tests shall be carried out after the heat impact is applied to comply with the appropriate thermal profile described under a) or b) above. Heat impacts at higher temperatures cover lower temperatures:

- bond strength to the support on specimens Type 1 (2.2.1),
- tensile characteristics (tensile stress and elongation at tensile strength) on five specimens' Type 2 according to EN ISO 527-2 (specimens´ 1B) without reinforcement.
  These tests shall be performed on samples without ageing and after ageing. The mean value before, as well as, after exposure to heat shall be stated in the ETA,
- for Capacity to bridge cracks on specimens´ Type 1 after additional heat ageing (2.2.2) (A).

Direct Method (specimens' Type 3 or 4 depending on the monitoring tests). Where specimens of Type 3 or 4 are prepared for the tests listed below i.e., when an overlay is applied to the waterproofing layer at one of the overlay temperatures according to a) or b) above, the heat impact conditioning required prior to testing the specimens shall be deemed to have been satisfied:

- resistance to shear to support and overlay on specimens' Type 3, 4 (2.2.6 without heat conditioning),
- bond strength to overlay on specimens' Type 3, 4 (2.2.22),
- capacity to bridge cracks on specimens´ Type 4 after additional heat ageing (2.2.2) (A). This method can be used and the results are equivalent to the obtained with specimens´ Type 1 method indirect.

2.2.6 Compatibility by heat conditioning

In order to maintain its integrity as a waterproofing layer, the kits shall be capable of resisting the shear forces between the kits and support-overlay due (for example) to traffic or differential thermal movement.

This test is required for use category A using specimens´ Types 3 or 4.

The maximum shear strength between the waterproofing layer and the concrete and/or steel support or overlay shall be determined in accordance with EN 13653. The test shall be performed on specimens´ type prepared in accordance with Annex A (modified EN 13375) under application conditions (P1).

The application temperature of the mastic asphalt overlay shall be at 250 ºC (MA) unless the maximum temperature indicated by the manufacturer is below 250 ºC, then the overlay shall be applied at the temperature maximum indicated by the manufacturer.

The test shall be carried out at conditions (T5) before and after heat condition (EN 14691).

This requirement applies to non-exposed kits with an overlay only. The mean value shall be stated in the ETA.

2.2.7 Water - tightness

The kits shall protect the bridge deck by preventing the passage of water.

This test is required for all use categories using test specimens' Type 2.

The water-tightness of the waterproofing layer shall be determined in accordance with EN 14694 but without any pre-treatment i.e., without impact perforation, in three samples.

The specimens shall be prepared in accordance with Annex A (modified EN 13375) under application conditions (P1).

The water-tightness of a free film of the waterproofing layer shall be stated in the ETA**.**

2.2.8 Resistance to high and low service temperatures

The kits have to maintain its function over the expected in-service temperature range.

The effects of low temperature are covered by the capacity to bridge cracks (2.2.2).

The effects of high and low service temperature may be established by measuring the characteristics:

- bond strength to the support (2.2.1) at +40 ºC, -10 ºC or -20 ºC, and,
- resistance to shear to support (2.2.6 without heat conditioning) at +40 ºC and/or –10 ºC.

The mean value of the performed tests shall be stated in the ETA.

2.2.9 Capacity to penetrate pores in the support

The capacity of a priming coat only to penetrate pores is determined by measuring viscosity in accordance with EN ISO 3219-2 (method 6.3.2.1) at T5, and at the lowest application temperature according to MPII (Manufacturer's Product Installation Instructions).

The viscosity of the priming coat under sample preparation conditions shall be reported.

The mean value of the performed tests shall be stated in the ETA.

2.2.10 Resistance to flow (associated with the application to non-horizontal surfaces)

The ability to apply the components of the kits satisfactorily on non-horizontal surfaces shall be determined using the test described in Annex B2. The mean of the loss in mass shall be stated in the ETA. The loss in mass shall not exceed 10% and there shall be no discernible changes e.g., slump, flow, loss of adhesion or reduction in thickness.

If, to satisfy this test a product is modified e.g., by thixotropic additives; the test tensile strength and elongation on five specimens' Type 2 according to EN ISO 527-2 (specimens´ 1B) without reinforcement shall be carried out to compare against the unmodified product and assess the possible consequences on the performance of the kit. These tensile properties shall be performed on unmodified and modified samples. The mean value shall be stated in the ETA.

The surface roughness of the vertical part of the concrete support shall be prepared in accordance with EN 13375 (5.3).

2.2.11 Dry film thickness

The thickness shall be verified during sample preparation (Annex A).

The verified thickness range of the dry membrane and the method used (EN ISO 2808, Table A.2, the reference method 4A) shall be stated in the ETA.

2.2.12 Resistance to the effects of climatic conditions on application

The effect of severe climate application conditions on curing rates and on the performance of the kits shall be assessed by the bond strength (2.2.1) using specimens prepared at the extremes of range of climatic conditions stated in the ETA (according to MPII)-or at default (extreme) climatic conditions for temperature range uses from -30 °C to 50 ºC and relative humidity from 0 to 99 % (i.e., minimum and/or maximum temperature ± 2 °C in combination with maximum / minimum relative humidity ± 5 %).

The mean value and the mode of failure shall be stated in the ETA (2.2.1) at the different conditions of application.

2.2.13 Resistance to the effects of quality of the support (SC)

2.2.13.1 Moisture Content (MC). The ability of a kits to be applied to concrete with high moisture content or young concrete shall be established by preparation and conditioning in accordance with EN 13578/7). The kit shall be applied to the minimum temperature according to MPII or between 5 °C and 8 °C.

The bond strength to the support shall be tested at T5 in accordance with 2.2.1. The mean value and the mode of failure shall be stated in the ETA.

2.2.13.2 Day Joints (OA). This test is carried out to determine whether an adequate bond can be achieved between two layers of the waterproofing membrane applied one over the other within a short period of time to simulate day joints.

The bond strength shall be determined (2.2.1) except that the test specimen shall include a second waterproofing layer applied between 24 hours and 48 hours of the application of the first layer and include any pre-treatment required by the manufacturer.

The mean value and the mode of failure shall be stated in the ETA.

2.2.13.3 Section Joints (up to six months) (OA). This test is carried out to determine whether acceptable adhesion can be achieved between two layers of the waterproofing membrane applied one over the other between 7 days and six months of the application of the first layer. The test simulates section joints that may occur between waterproofing different sections of a bridge or where patch repairs may be required.

Specimens are prepared on a rigid steel plate (10 mm thick) at P1/P1 conditions and allowed to cure for 7 days at 23 °C. After that the specimen shall be exposed to UV radiation, elevated temperature and water according to EN 1297 for 7 days.

Note: Steel plate is used as the substrate to facilitate the placing of specimens in the QUV weatherometer.

After the exposure a second waterproofing layer shall be applied according to the instructions of the manufacturer.

Following the curing time specified by the manufacturer, the bond strength between the two layers of waterproofing shall be determined in accordance with 2.2.1.

The mean value and the mode of failure shall be stated in the ETA.

2.2.14 Resistance to contact with water (Wa)

This test is required for use category (A):

- the water absorption by mass of a free film of the waterproofing layer (specimen Type 2) shall be determined in accordance with EN 14223. The test shall be repeated with the exception that the cut edges of the specimen are sealed.

  The mean value shall be stated in the ETA with sealed edges and without sealed edges. The water absorption of a free film with sealed edges shall not exceed 2.5 % by mass,
- the micro hardness according to ISO 48-2 (method M) shall be determined on specimens before and specimens after the water absorption test. The change in micro hardness of a free film shall be stated in the ETA. The thickness of the samples shall be in accordance with ISO 48-2/6.2.2.3.

2.2.15 Resistance to alkali solution contact (Al)

This test is required for use category (A)

Three specimens 50 x 50 mm are to be tested. The test is carried out on specimens´ Type 2 in accordance with Annex A under application conditions (P1), following EN ISO 175, (storage in 1% (w/w) aqueous solution of sodium hydroxide) at (55 ± 2) ºC for (28 ± 0.5) days. The samples are dried at (50 ± 2) ºC until constant mass is achieved. The following test shall be performed:

- the micro hardness according to ISO 48-2 (method M) shall be determined on specimens before and specimens after the alkali solution contact test. The change in micro hardness of a free film shall be stated in the ETA. The thickness of the samples shall be in accordance with ISO 48-2/6.2.2.3,
- the mass on specimens exposed to alkali after drying and on specimens not exposed to the alkali solution according to EN ISO 175. The mean change in mass shall be stated in the ETA. This change shall be ≤ 0.5 % (LV).

2.2.16 Resistance to oil, petrol or, diesel contact

This test is required for use category (A).

Three specimens 50 x 50 mm (Type 2 in accordance with Annex A under application conditions (P1)) shall be tested according to ISO 1817. The test shall perform to the maximum temperature of use for (28 ± 0.5) days. The following test shall be performed:

- the micro hardness before and after the contact with the different liquid according to ISO 48-2 (method M). The thickness of the samples shall be in accordance with ISO 48-2/6.2.2.3. The mean change in micro hardness of a free film shall be stated in the ETA,
- the mass on specimens exposed and on specimens not exposed. The mean change in mass shall be stated in the ETA.

2.2.17 Resistance to bitumen contact (Bi).

This test is required for use category (A) and carried out on specimens´ Type 2 in accordance with Annex A under application conditions (P1).

Two specimens approximately 120 x 60 mm are stored in bitumen 50/70 penetration (EN 12591) for (84 ± 0.5) days in a ventilated oven at a temperature of (70 ± 2) ºC. A beaker with a content of 250 cm³ is filled with bitumen that covers the samples by approximately two-thirds. After storing the bitumen is carefully removed with a spatula. The thickness of the samples shall be in accordance with ISO 48-2/6.2.2.3.

The micro hardness shall be determined according to ISO 48-2 (Method M) on specimens before and on specimens after exposure to bitumen.

The mean change in micro hardness of a free film shall be stated in the ETA.

2.2.18 Resistance to heat ageing (HA)

Use category A. This test is required for use categories (A) and carried out on specimens of types depending on the test to be carried out after ageing. The test specimens are prepared in accordance with Annex A under application conditions (P1).

High temperatures cause change of product characteristics (ageing). The heat ageing is carried out according to ANNEX B.3 at a temperature of (70 ± 2) ºC for 12 weeks (EN 14695) on specimens of types depending on the test to be carried out after ageing.

Following heat ageing the following tests shall be carried out:

- capacity to bridge cracks as described in 2.2.2.,
- tensile properties (tensile stress and tensile elongation at tensile strength) in accordance with EN ISO 527-2 (specimens´ Type 1B) before and after heat ageing (x-head speed 1 mm min^{-1} at -10 ºC and 10 mm/min at 23 ºC) without reinforcement. The mean value before, as well as, after exposure to heat shall be stated in the ETA,
- cold bending behaviour as described in 2.2.20.

Additionally, if required, bond strength to the support, as described in 2.2.1, after heat ageing may be determined.

Use categories B and C. In the case of use categories (B) and (C) the heat ageing is covered by the conditions of exposure to UV radiation carried out in accordance with 2.2.19.

2.2.19 Resistance to UV radiation (exposed kits only) (UV)

This test is required for use categories (B) and (C) the specimen used will depend on the test carried out following UV radiation. The specimen shall be prepared in accordance with Annex A under application conditions (P1).

Specimens, including any UV protection layer if required by the manufacturer, shall be exposed in accordance with ANNEX B.4 for a total of 5000 hours to UV radiation using fluorescent tubes (UV-A).

The following tests shall be carried out:

- tensile properties (tensile stress and tensile elongation at tensile strength) in accordance with EN ISO 527-2 (specimens´ Type 1B) before and after UV exposure (x-head speed 1 mm/min at -10 ºC and 10 mm/min at 23 ºC) without reinforcement. The mean value shall be stated in the ETA,
- capacity to bridge cracks (2.2.2),
- water tightness (2.2.7).

2.2.20 Cold bending behaviour

This test is required for category (A) using test specimens' Type 2.

The cold bending behaviour of the waterproofing layer shall be determined in accordance with EN 495-5.

The specimens shall be prepared in accordance with Annex A under application conditions (P1), with the maximum thickness according to MPII and without reinforcement. These are bended forming a loop with upper face in the outside and inside of the loop (in multi-layer systems) and place in the device as the picture.

The cold bending behaviour of free film of the waterproofing layer shall be stated in the ETA.

2.2.21 Content, emission and/or release of dangerous substances

The performance of the product (components of the kits) related to the emissions and/or release and, where appropriate, the content of dangerous substances will be assessed on the basis of the information provided by the manufacturer[5] after identifying the release scenarios (in accordance with GD 14) taking into account the

[5] The manufacturer may be asked to provide to the TAB the REACH related information which he must accompany the DoP with (cf. Article 6(5) of Regulation (EU) No 305/2011). The manufacturer is **not** obliged:

intended use of the product and the Member States where the manufacturer intends his product to be made available on the market.

The identified intended release scenarios for this product and intended use with respect to dangerous substances is S/W2: Product with indirect contact to soil, ground- and surface water.

Leachable substances. For the intended use covered by the release scenario S/W2 the performance of the product concerning leachable substances has to be assessed, if the product contains agents for root penetration. A leaching test with subsequent eluate analysis must take place, each in duplicate. Leaching tests of the membrane contained agents for root penetration are conducted according to CEN/TS 16637-2. The leachate shall be pH-neutral demineralized water and the ratio of liquid volume to surface area must be 25 ± 5 l/m².

The membrane must be applied to a sandblasted glass plate by heating. The edges are sealed. The cut edges of the membrane strip exposed to the eluent should be included in the calculation as a leachable area.

The eluates taken after 6 hours / 1 day / 2 days and 6 hours / 4 days / 9 days / 16 days / 36 days / 64 days shall be analysed for all environmentally relevant parameters, presumably at least the following:

- TOC according to EN 1484.
- pH-value according to EN ISO 10523.
- Electrical conductivity according to EN 27888.
- Agents for root penetration concentration (µg/L), agents for root penetration release [µg/m²] and the cumulative agents for root penetration release (g/m²) according to appropriate test method.

In eluates of 6 hours and 36 days, the following biological tests shall be conducted:

- Acute toxicity test with Daphnia magna Straus according to EN ISO 6341.
- Toxicity test with algae according to EN ISO 8692.
- Luminescent bacteria test according to EN ISO 11348-1, EN ISO 11348-2 or EN ISO 11348-3.
- For each biological test, the ecotoxic effects in accordance with the respective test method for dilution ratios 1:2, 1:4, 1:6, 1:8 and 1:16 shall be determined.

If the parameter TOC is higher than 10 mg/l, the following biological tests shall be conducted with the eluates of 6 hours and 36 days eluates: Biological degradation according to OECD Test Guideline 301 methods A, B or E.

Determined toxicity in biological tests must be expressed in the ETA as the dilution ratios, where no toxicity (in accordance with the respective test methods) is observed. Maximum determined biological degradability must be expressed as …% within …hours/days. The respective test methods for analysis must be specified.

2.2.22 Bond strength (kits to overlay)

The kits shall have sufficient bond strength to overlays specified by the kits manufacturer to avoid detachment in service. This test is required for use category A using test specimens Types 3 and/or 4 (All specified specimens are of Type 3 with respect to EN 13596/4.3 and test specimens 50 x 50 mm shall be cut for this assessment). The bond strength between the waterproofing layer and the overlay shall be determined in accordance with EN 13596. The test shall be performed on three specimens´ type prepared in accordance with Annex A, under application conditions (P1).

The application temperature of the mastic asphalt overlay shall be at 250 ºC (MA), unless the MPII indicates other application maximum temperature of the mastic asphalt, in this case the application temperature of the mastic asphalt shall be at the maximum temperature indicated in MPII, but always ≥ 220 ºC.

The test shall be carried out at conditions (T5).

The general modes of failure are to be described following EN ISO 4624 (2.2.1).

The mean value of at least three tests and the mode of failure shall be stated in the ETA.

- to provide the chemical constitution and composition of the product (or of constituents of the product) to the TAB, or
- to provide a written declaration to the TAB stating whether the product (or constituents of the product) contain(s) substances which are classified as dangerous according to Directive 67/548/EEC and Regulation (EC) No 1272/2008 and listed in the "Indicative list on dangerous substances" of the SGDS.

Any information provided by the manufacturer regarding the chemical composition of the products may not be distributed to EOTA or to TABs.

2.2.23 Slipperiness

The kits, when exposed and with pedestrian or cyclist access, shall have sufficient coefficient of friction under the conditions likely to be found in the works to avoid the risk of pedestrians falling after slipping.

This test is required for use categories (B) or (C) and carried out on specimens´ Type 1 in accordance with Annex A under application conditions (P1).

The coefficient of friction of the exposed waterproofing layer shall be determined in accordance with EN 13036-4 on three samples. The friction coefficient shall be stated in the ETA.

2.2.24 Resistence to abrasion / wear

This test is required for use category (B) using Type 1 test specimens in accordance with Annex A under application conditions (P1).

The resistance to wear shall be determined in accordance with CEN/TS 12633 except that the pendulum test before (2.2.23) and after wear shall be carried out in accordance with the method defined under 2.2.23.

The slip of the waterproofing layer initial and after the test shall be stated in the ETA.

2.2.25 Resistance to freeze/thaw (FT)

Use categories A, B and C. This test is required for all use categories on specimens´ Type 1 prepared in accordance with Annex A under application conditions (P1).

The specimens shall be subjected to 20 cycles in accordance with EN 13687-3 (7.2), except that the bond strength to support test defined in the standard is replaced by the test described in 2.2.1 and the samples will be placed in horizontal position.

Use category A. If required
Specimens´ Types 3 or 4 prepared in accordance with Annex A under application conditions (P1), shall be subjected to 20 cycles in accordance with EN 13687-3, excluding the bond test. Any or all of the following tests shall also be carried out after the freeze thaw cycling:

- resistance to shear to support and overlay (2.2.6 without heat conditioning),
- bond strength to overlay (2.2.22).

3 ASSESSMENT AND VERIFICATION OF CONSTANCY OF PERFORMANCE

3.1 System(s) of assessment and verification of constancy of performance to be applied

For the products covered by this EAD the applicable European legal act is: Decision 2003/722/EC dated 6th October 2003.

The system is **2+**.

3.2 Tasks of the manufacturer

The cornerstones of the actions to be undertaken by the manufacturer of the product in the procedure of assessment and verification of constancy of performance are laid down in Table 3.2.1.

Table 3.2.1 Control plan for the manufacturer; cornerstones

No	Subject/type of control		Test or control method(1)	Criteria, if any	Minimum number of specimens	Minimum frequency of control
Factory production control (FPC) [including testing of samples taken at the factory in accordance with a prescribed test plan]						
1	incoming materials		Identification through documents, according to Control Plan	In accordance with the control plan	According to test or control methods	Every delivery
2	Kits or free film	Hardness	ISO 48-2			Once/ten batches (1/year min)
		Tensile characteristics	EN ISO 527-2			Once/ten batches (1/year min)
		Bond strength to support	2.2.1			One /year
3	Membrane (liquid components)	Viscosity	EN ISO 3219-2			Every batch
		Density	EN ISO 2811-1 to 4			Every batch
		Pot life (2)	EN ISO 9514			Every batch
		Curing time (progress of hardness)	Following the principles of EN ISO 868			Every batch
		Non-volatile matter (3)	EN ISO 3251			Every batch
		Ash content (4)	EN ISO 3451-1			Once/year
		Infrared Spectrometry (5)	EN 1767			Once/ten batches (1/year min)
		Functional Group analysis (NCO, OH, Epoxy, Amine etc)	Documents according to Control Plan			Every batch
4	Primers / Tack coats / Finish layer	Viscosity	EN ISO 3219-2			Every batch
		Density	EN ISO 2811-1 to 4			Every batch
		Non-volatile matter (3)	EN ISO 3251			Every batch / once per year
		Ash content (4)	EN ISO 3451-1			Once/ten batches (1/year min)
		Infrared Spectrometry (5)	EN 1767			Once/ten batches (1/year min)
		Surface dry time / pot life	EN ISO 9514			Every batch
		Functional Group analysis (NCO, OH, Epoxy, Amine etc)	Documents according to Control Plan			Every batch
5	Reinforcement/ Internal layer	Type / nature	Declaration			Every delivery
		Tensile characteristics	EN 29073-3 or ISO 3342			Every delivery
		Weight / area	EN 29073-1			Every delivery
6	Mineral Aggregate	Type / nature	Declaration	In accordance with the control plan	According to test or control methods	Every delivery
		Particle size distribution	EN 933-1 and EN 933-2			Every delivery
		Moisture content	-			Every delivery

Notes:

(1) For incoming materials or finished components delivered by a supplier, the manufacturer of the kits is responsible and has to ensure that the tasks of the Control Plan for the manufacturer shall be respected also by the supplier as far as he is concerned. If not, then the manufacturer of the kits shall fulfil the tasks under the Control Plan.

(2) Pot life: period of time taken by the freshly mixed product to increase in temperature by 15 ºC (or the maximum temperature increase if less than 15 °C).

For acrylics and polyesters, pot life shall be determined with the addition of a given amount of catalyst.

(3) Test conditions: sample quantity (1 ± 0,1) g, temperature (125 ± 2) °C, duration 60 minutes.

(4) Test to be performed if the product contains filler. Test conditions: ash temperature (600 ± 25) °C.

(5) If the products contain mineral filler, the filler is eliminated by centrifuging, but without adding organic solvent.

3.3 Tasks of the notified body

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

Table 3.3.1 Control plan for the notified body; cornerstones for AVCP 2+

No	Subject/type of control	Test or control method (*)	Criteria, if any	Minimum number of specimens	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 of the manufacturer as described in the MTD and the Control Plan relating to the manufacture of the components of the kits: - Incoming materials - Process controls - Inspection and testing - Calibration of equipment - Training - Complaints	As defined in control plan	As defined in control plan	As defined in control plan	Initial inspection and when starting a new production process and/or line
Continuous surveillance, assessment and evaluation of factory production control					
2	Surveillance, assessment and approval of the factory production controls of the manufacturer(s) as described in the Control Plan relating to the manufacture of the components of the kits: - Incoming materials - Process controls - Inspection and testing - Calibration of equipment - Training - Complaints	As defined in control plan	As defined in control plan	As defined in control plan	Once per year

4 REFERENCE DOCUMENTS

OECD Test 301:1992	OECD Guidelines for the Testing of Chemicals.
CEN/TS 12633: 2014	Method of determination of unpolished and polished slip / skid resistance value.
CEN/TS 16637-2: 2014	Construction products - Assessment of release of dangerous substances. Part 2: horizontal dynamic surface leaching test.
EN 197-1: 2011	Cement - Part 1: Composition, specifications and conformity criteria for common cements.
EN 495-5: 2013	Flexible sheets for waterproofing - Determination of foldability at low temperature - Part 5: Plastic and rubber sheets for roof waterproofing.
EN 933-1: 2012	Tests for geometrical properties of aggregates. Part 1: Determination of particle size distribution - Sieving method.
EN 933-2: 2020	Test for geometrical properties of aggregates. Part 2: determination of particle size distribution. Test sieves, nominal size of apertures.
EN 1297: 2004	Flexible sheet for waterproofing. Bitumen, plastic and rubber sheets for roof waterproofing. Method of artificial ageing by long term exposure to the combination of UV radiation, elevated temperature and water.
EN 1484: 1997	Water analysis – Guidelines for the determination of total organic carbon (TOC) and dissolved organic carbon (DOC).
EN 1766: 2017	Products and systems for the protection and repair of concrete structures - Test methods - Reference concretes for testing.
EN 1767: 1999	Products and systems for the protection and repair of concrete structures - Test methods - Infrared analysis.
EN 12591: 2009	Bitumen and bituminous binders - Specifications for paving grade bitumens.
EN 12697-13: 2017	Bituminous mixtures - Test methods - Part 13: Temperature measurement.
EN 13036-4: 2011	Road and airfield surface characteristics - Test methods. Part 4: Method for measurement of slip/skid resistance of a surface - The pendulum test.
EN 13375: 2019	Flexible sheets for waterproofing - Waterproofing of concrete bridge decks and other concrete surfaces trafficable by vehicles - Specimen preparation.
EN 13578: 2003	Products and systems for the protection and repair of concrete structure - Test Method. Compatibility on wet concrete.
EN 13596: 2004	Flexible sheets for waterproofing - Waterproofing of concrete bridge decks and other concrete surfaces trafficable by vehicles - Determination of bond strength.
EN 13653: 2017	Flexible sheets for waterproofing - Waterproofing of concrete bridge decks and other concrete surfaces trafficable by vehicles - Determination of shear strength.
EN 13687-3: 2002	Products and systems for the protection and repair of concrete structures - Test methods - Determination of thermal compatibility - Part 3: Thermal cycling without de-icing salt impact
EN 14223: 2017	Flexible sheets for waterproofing - Waterproofing of concrete bridge decks and other concrete surfaces trafficable by vehicles – water absorption.
EN 14224: 2010	Flexible sheets for waterproofing - Waterproofing of concrete bridge decks and other concrete surfaces trafficable by vehicles - Determination of crack bridging ability.
EN 14692: 2017	Flexible sheets for waterproofing — Waterproofing of concrete bridge decks and other concrete surfaces trafficable by vehicles — Determination of the resistance to compaction of an asphalt layer.
EN 14694: 2017	Flexible sheets for waterproofing - Waterproofing of concrete bridge decks and other concrete surfaces trafficable by vehicles. Determination of resistance to dynamic water pressure after damage by pre-treatment.
EN 27888: 1993	Water quality. Determination of electrical conductivity. (ISO 7888:1985).
EN 29073-1:1992	Textiles. Test methods for nonwovens. Part 1: determination of mass per unit area. (ISO 9073-1: 1989).
EN 29073-3:1992	Textiles. Test methods for nonwovens. Part 3: determination of tensile strength and elongation. (ISO 9073-3: 1989).
EN 14691: 2017	Flexible sheets for waterproofing - Waterproofing of concrete bridge decks and other concrete surfaces trafficable by vehicles - Compatibility by heat conditioning.
EN 1296: 2000	Flexible sheets for waterproofing - Bitumen, plastic and rubber sheets for roofing - Method of artificial ageing by long term exposure to elevated temperature.
EN 14695: 2010	Flexible sheets for waterproofing - Reinforced bitumen sheets for waterproofing of concrete bridge decks and other trafficked areas of concrete - Definitions and characteristics.

EN ISO 175: 2010	Plastics – Methods of test for the determination of the effect of immersion in liquid chemicals.
EN ISO 527-2: 2012	Plastics – Determination of tensile properties. Part 2: test conditions for moulding and extrusion plastics.
EN ISO 868: 2003	Plastics and ebonite - Determination of indentation hardness by means of a durometer (Shore hardness) (ISO 868:2003).
EN ISO 2808: 2019	Paints and varnishes. Determination of film thickness.
EN ISO 2811-1: 2016	Paints and varnishes - Determination of density - Part 1: Pycnometer method (ISO 2811-1:2016).
EN ISO 2811-2: 2011	Paints and varnishes - Determination of density. Part 2: Immersed body (plummet) method (ISO 2811-2:2011).
EN ISO 2811-3: 2011	Paints and varnishes - Determination of density. Part 3: Oscillation method (ISO 2811-3:2011).
EN ISO 2811-4: 2011	Paints and varnishes - Determination of density. Part 4: Pressure cup method (ISO 2811-4:2011).
EN ISO 3219-2 : 2021	Rheology - Part 2: General principles of rotational and oscillatory rheometry (ISO 3219-2:2021).
EN ISO 3251: 2019	Paints, varnishes and plastics - Determination of non-volatile-matter content (ISO 3251:2019).
EN ISO 3451-1: 2019	Plastics - Determination of ash - Part 1: General methods (ISO 3451-1:2008).
EN ISO 4624: 2016	Paints and varnishes - Pull-off test for adhesion.
EN ISO 6341: 2012	Water quality - Determination of the inhibition of the mobility of Daphnia magna Straus (Cladocera, Crustacea) - Acute toxicity test (ISO 6341:2012).
EN ISO 8692: 2012	Water quality - Fresh water algal growth inhibition test with unicellular green algae (ISO 8692:2012)
EN ISO 9514: 2019	Paints and varnishes - Determination of the pot life of multicomponent coating systems - Preparation and conditioning of samples and guidelines for testing (ISO 9514:2005).
EN ISO 10523: 2012	Water quality - Determination of pH (ISO 10523:2008).
EN ISO 11348-1: 2008/A1: 2018	Water quality - Determination of the inhibitory effect of water samples on the light emission of Vibrio fischeri (Luminescent bacteria test) - Part 1: Method using freshly prepared bacteria - Amendment 1 (ISO 11348-1:2007/Amd 1:2018).
EN ISO 11348-2: 2008/A1: 2018	Water quality - Determination of the inhibitory effect of water samples on the light emission of Vibrio fischeri (Luminescent bacteria test) - Part 2: Method using liquid-dried bacteria - Amendment 1 (ISO 11348-2:2007/Amd 1:2018).
EN ISO 11348-3: 2008/A1: 2018	Water quality - Determination of the inhibitory effect of water samples on the light emission of Vibrio fischeri (Luminescent bacteria test) - Part 3: Method using freeze-dried bacteria - Amendment 1 (ISO 11348-3:2007/Amd 1:2018)).
EN ISO 15682:2001	Water quality. Determination of chloride by flow analysis (CFA and FIA) and photometric or potentiometric detection. (ISO 15682:2000).
ISO 48-2: 2018	Rubber, vulcanized or thermoplastic — Determination of hardness — Part 2: Hardness between 10 IRHD and 100 IRHD0.
ISO 3342: 2011	Textile glass - Mats - Determination of tensile breaking force.
ISO 4892-1: 2016	Plastics - Methods of exposure to laboratory light sources - Part 1: General guidance.
ISO 4892-3: 2016	Plastics - Methods of exposure to laboratory light sources - Part 3: Fluorescent UV lamps.
ISO 1817: 2022	Rubber, vulcanized or thermoplastic. Determination of the effect of liquids.

ANNEX A: SPECIMEN PREPARATION

Test specimens shall be prepared in accordance with EN 13375. Flexible sheets for waterproofing, Waterproofing of bridges with concrete deck and other concrete surfaces trafficable by vehicles specimen preparation, with the following exceptions:

Definitions.

Sample: For the purposes of this EAD a sample can be either:

- in the case of Type 1, Type 3 or Type 4 Specimens, the waterproofing layer applied to the support, or
- in the case of Type 2 Specimens a free film of the waterproofing layer from which a test piece is taken.

Specimens:

- Type 1: Liquid applied waterproofing layer bonded to the support.
- Type 2: Free film liquid applied waterproofing layer.
- Type 3: Liquid applied waterproofing layer bonded to the support and asphalt concrete overlay applied at (160 ± 10) °C (CBM).
- Type 4: Liquid applied waterproofing layer bonded to the support and mastic asphalt overlay applied from (220 to 250 ± 10) °C (MA). The temperature of the mastic asphalt shall be 250 ºC, unless the maximum temperature according to MPII is below 250 ºC, then the overlay shall be applied at the temperature maximum according to MPII (≥ 220 ºC).

The temperature of the overlay shall be measured according to EN 12697-13.

Specimens. The first paragraph shall be replaced by: Specimens for the different performance related tests are defined in the relevant test methods given in this EAD.

Sample preparation.

Application of the liquid applied waterproofing layer to the support (Type 1, Type 3 and Type 4 Specimens).

The liquid applied waterproofing layer, including any priming coats, bonding coats or tack coats shall be applied to the support specimen in accordance with the manufacturer's instructions, paying particular attention to required ambient temperature and relative humidity conditions.

Due to the range of conditions of use within Member States, it is necessary to make use of test categories when assessing some aspects of serviceability and durability. The categories reflect differences in the test parameters for:

- conditions relating to sample preparation (P),
- sample conditioning (stress conditions) prior to testing(S),
- temperature at which the test is carried out (T).

The sample shall be allowed to cure under controlled conditions for a period of not less than that specified by the manufacturer and not longer than 28 days.

The required number of test specimens may either be cut from a larger sample or applied to the appropriate number of support specimens. In the latter case it might be advantageous to hold the support specimens together in a rigid frame during application.

After curing, and when required (Type 3 and Type 4 specimens), the asphalt layer shall be applied in accordance with clause 7.2 of EN 13375. Precautions shall be taken to avoid the influence of vibration during compaction, for example the concrete slabs may be laid on flat ground using a soft intermediate layer (e.g., sand).

Preparation of Free Film Samples (Type 2 Specimens). The method of free film sample preparation may differ with the kits under examination and the advice of the manufacturer shall be sought on the most appropriate method to be used with the materials.

A rigid support (e.g., of plywood, glass, plastic coated chipboard or MDF) of sufficient size to provide an even and stable support on which to prepare the sample(s)shall be placed on a firm support ensuring that it is horizontal.

A release agent, to avoid adhesion to the support and to allow subsequent removal of the sample, shall be applied to the support and, where necessary, allowed to dry. Examples of release agents known to work are siliconized paper, spray furniture polish, spray silicone release agent and microcrystalline paraffin wax.

Where sheet release films are used, these shall be firmly fixed to the support without creases or wrinkles.

The liquid applied bridge deck waterproofing kits shall be applied in the appropriate number of coats, including reinforcement, where appropriate, in accordance with the manufacturer's instructions (by spraying, spreading or brushing) to the prepared support.

The waterproofing layer shall be applied at a thickness within the range indicated by the manufacturer.

For crack bridging (2.2.2), compaction (2.2.4.2) and water-tightness (2.2.7) and chloride ion test (2.2.3) the waterproofing layer shall be applied at the minimum thickness specified by the MPII.

For resistance to shear (2.2.6) the waterproofing layer shall be applied at the maximum thickness specified by the MPII.

The mean thickness of the applied membrane shall be controlled in the appropriate manner, for example by means of wet film gauges, film spreaders, film casters, bar coaters or steel frames.

The sample shall be allowed to cure under controlled conditions for a period of not less than that specified by the manufacturer and not longer than 28 days.

After curing the sample shall be removed, without straining, from the support. Any area of free film falling outside the manufacturer's thickness specification shall be rejected.

Measurement of coating thickness. Thickness measurements are carried out in accordance with EN ISO 2808.

Preparation of test specimens to verify the bond strength between the kits and support at the most unfavourable conditions of application of temperature and relative hygrometry called "limiting conditions".

Apart from normal conditions, also standardised conditions for low-end temperatures and high-end temperatures and humidity to cover majority of uses and to get comparable results with an option to add tests under conditions specified by the manufacturer.

The test is carried out in a climatic chamber able to respect the "limiting conditions" with an accuracy of ± 2 °C for the temperature and ± 10 % for the hygrometry.

The support shall be conditioned 7 days in a climatic chamber at the "limiting conditions" which the manufacturer claims for his product.

The components of the kits shall be maintained at the conditions for storage stated by the manufacturer.

Application of each component shall be carried out in the climatic chamber or outside at ambient temperature, avoiding water condensation on the substrate.

The sample shall be allowed to cure at the limiting conditions indicated by the manufacturer for a minimum period specified by him.

After this conditioning, the samples are brought back gradually to the test temperature (23 ± 3) °C by successive steps of 5 °C per 24 hours.

The samples are maintained at ambient temperature and the bond strength test is carried out in accordance with EN 13596.

Storing. The test specimens shall be stored under laboratory conditions as defined in the appropriate standard. The tests shall be commenced in the period between 24 hours and 3 months after the end of the curing period.

ANNEX B: TEST PROCEDURES

B.1 Determination of the resistance to dynamic indentation

Scope. It specifies the method of the determination of the resistance to dynamic indentation installed liquid applied waterproofing kits.

Principle. The resistance to dynamic indentation of installed liquid waterproofing kits on a given substrate is determined by applying an impact energy of 5.9 J by means of a given steel indenter on the exposed side of the installed product. Perforation of the installed product shall be identified, in case of doubt, by determination of the water-tightness.

Apparatus
Hammer device. With indenter adjuster providing an impact energy of 5.9 + 0.1 J (Figure B.1.1).

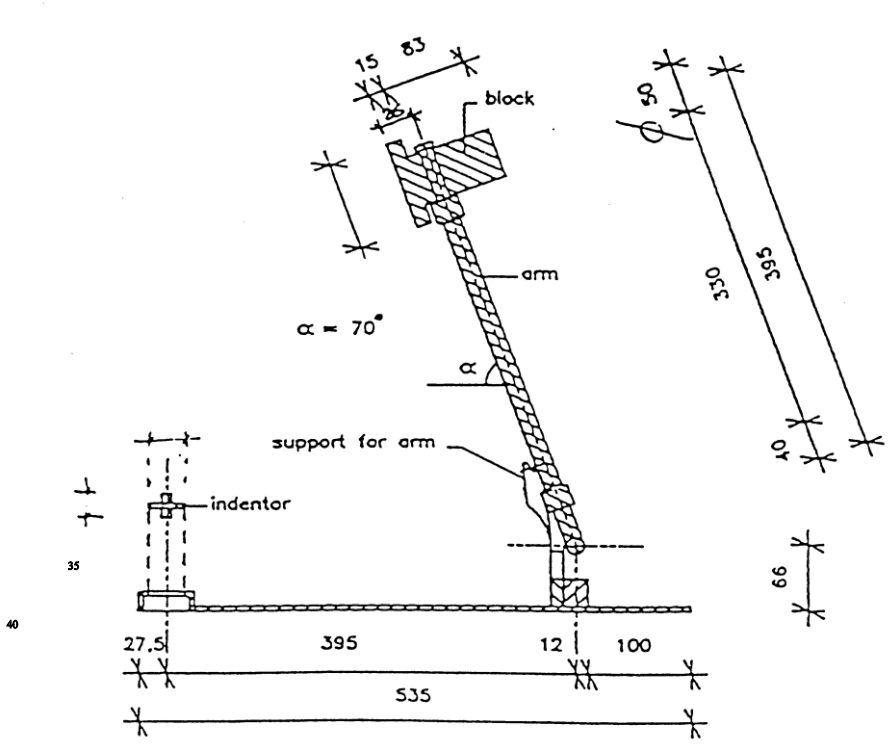


Figure B.1.1. Schematic diagram of the hammer device

Set of steel indenters. According Table B.1.1 and Figure B.1.2.

The edge radius R of the cylinder shall be 0.3 ± 0.1 mm.
The steel shall have a hardness of at least 58 HRC; all surfaces polished.

Table B.1.1- Types of indenters (Dimensions in mm)

Type of indenter				
Indenter	l_4	l_3	l_2	l_1
Ø D	6 ± 0.05	10 ± 0.05	20 ± 0.05	30 ± 0.05
B	10	15	15	15
A	20	15	15	15

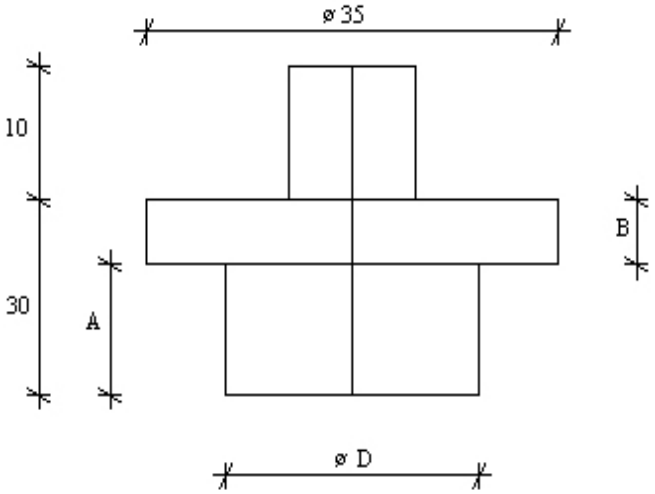


Figure B.1.2 - Shape of the indenter

*Frame. T*o clamp or fix the test specimen with internal dimension between 200 mm x 200 mm and 300 mm x 300 mm.

Rigid flat base plate of sufficient size.

Siliconized paper

Devices for testing watertightness.

a. suitable electrical spark tester (24 volts),
b. cylinder, diameter 50 mm, to apply a head of (coloured) water of at least 100 mm.

Test specimen

Dimensions. The test specimen is the kit or the kit including its substrate. The dimensions of the test specimen shall be based on the frame used but shall have a test area of 200 ± 1 mm x 200 ± 1 mm.

Number of test specimens. Three specimens of the kit shall be tested.

Note: Depending on the type of substrate applied for and its dimensions, it is permissible to use the substrate more than once. If the substrate is damaged as a result of the test, the use of the same substrate is only allowed when the new position is not within 100 mm of any previous indentation or of the internal sides of the frame. In this case, the same piece of substrate can be used for three tests.

Preparation of test specimen. The test specimen shall be the "kit" bonded to a steel plate at least 6 mm thick, which shall be used as a substrate.

Note 1: If the "kit" incorporates an internal layer the test specimen shall not include joints.
Note 2: When the substrate specified is concrete, a steel plate is used as a substrate in order to allow assessment of water-tightness by electrical means e.g., by an electrical spark tester.

Test Procedure

- The test shall be carried out at a temperature of 23 ± 2 º C and a relative humidity of 50 ± 5 %, unless otherwise specified.
- Clamp the test specimen in the frame in such a way that it is fully restrained and supported at the edges.
- Position the apparatus in the centre of the test specimen when using dimensions of 200 mm x 200 mm, or at a distance of at least 100 mm from the internal sides of the framework, when using larger test specimen.
- Adjust the hammer device to the release position.
- Place the indenter l_4 as of the Table B.1.1 in the apparatus resting on the exposed side of the test specimen.
- Apply an impact energy of 5.9 ± 0.1 J on the steel indenter.

Note: If due to the combination of impact energy and rigid substrate the hammer (Hammer device) springs back from the indenter, the movement should be stopped manually as to prevent a second impact on the indenter.

- Remove the test specimen; examine the liquid applied waterproofing kits visually for perforation and (in case of doubt) determine the water-tightness of the "kits" at the place of indentation. By the application of a small amount of salt water to the indentation and the use of an electrical method (e.g., spark tester). The steel plate is then acting as the earth.

  When the "kits" contains conductive material(s) the electrical spark tester cannot be used. The procedure shall be done by the application of a 100 mm column of (coloured) water for a period of 24 hours. After this period the system shall be carefully removed from the substrate and the substrate shall be examined for evidence of water penetration (e.g., by use of UV lamp).
- If penetration is observed repeat tests with another indenter (l_3, l_2, l_1) until watertightness is achieved.
- Record that type of indenter.

Expression of results. Determine whether the test specimen has been perforated by visual examination and by testing the water-tightness. The "kit" is considered "watertight" when all three test specimens pass the test.

Test report. The test report shall include at least the following information:

a. Reference to this procedure.
b. A description of the liquid applied waterproofing kits including dimensions of test specimen and curing conditions.
c. A description of the indenter type used.
d. All visual examinations at the place of indentation.
e. The water-tightness of the three test specimens at the place of the indentation and the method of determination, if relevant.
f. All operating details not specified in this procedure, as well as incidents likely to have influenced the results.

B.2 Determination of the behaviour of liquid applied bridge deck waterproofing kits applied on a vertical surface

Scope. This annex describes a test method for the determination of the behaviour of a liquid-applied bridge deck waterproofing kit, when applied on vertical surfaces. The test is carried out on dry support.

Principle. This test consists of quickly applying the component(s) of the kits to be tested to the horizontal face of a concrete or steel support specimen and then quickly raising it into a vertical position. The ability of the product to resist flow, sagging etc., is assessed by measuring the quantity of product which flows below the bottom of the vertical face at the end of a given period of time starting from the end of the application.

Apparatus and materials

- Climatic chamber with temperature and relative humidity regulated.
- Equipment for preparation of the product in accordance with the manufacturer instructions.
- Product to be tested applied in accordance with the manufacturer's instructions.
- Flexible brush.
- Two base specimens of dimensions in concrete (40 x 300 x 300 mm) or steel (6 x 300 x 300 mm).
- Suitable balance with an accuracy of 0.1 g.
- Plastic film or aluminium foil.
- Sharp knife for trimming the specimen.

Procedure

Conditioning of the support specimens and application of the primer. The support specimens shall be maintained for 7 days in a climatic chamber at a temperature of (23 ± 2) °C and (50 ± 5) % relative humidity.

If a primer is required to be applied, the supports shall be dusted with a suitable flexible brush just before the application of the primer.

The application of the primer shall be carried out under the application conditions and using a coverage rate indicated by the manufacturer.

The manufacturer shall also specify:

- the drying time for the primer (if it is a primer with solvents),
- the time of polymerisation for thermosetting products.

After application of the primer, the specimens shall be protected from dust and any other pollutants and stored at (23 ± 2) °C.

Preparation of the samples. The components of the waterproofing product shall be conditioned in a climatic chamber maintained at (23 ± 2) °C for at least 24 hours before the application.

Application of the waterproofing product. Prepare the quantity of product sufficient for the test according to the instructions of the manufacturer. Precisely weigh the quantity of product prepared and the tools for application which will be used: M.

Apply the product carefully and as soon as possible to the primed (if applicable) support specimen without overflowing over the edges until it is perfectly covered with product. Note the time to the end of this operation.

Immediately raise the coated specimen (specimen A) into the vertical position and suspend it in such a way that the coated face is steady and over a pre-weighed aluminium or plastic sheet (mass M_{1A}). The specimen shall be allowed to stand without interference for a period of (24 ± 2) hours.

Determine the quantity of product applied to the support specimen: $M_1 = M – M'$, in grams, by precisely weighing the remaining quantity of product and the tools following the application: M'.

Repeat the above for the second support specimen (specimen B). Note the masses M_{1B} and M_2.

At the end of (24 ± 2) hours, any material hanging over the bottom edge of the specimen shall be cut using a sharp knife and weighed along with any material that has fallen onto the pre-weighed aluminium or plastic sheet.M_{2A} for the first specimen and M_{2B} for the second.

Expression of results. The results are presented as follows:

- mass in grams of the losses by falling off for sample A: $M_A = M_{2A} - M_{1A}$
- mass in grams of the losses by falling off for sample B: $M_B = M_{2B} - M_{1B}$

Where

M_{1A} and M_{1B} are the mass of aluminium or plastic sheet,

M_{2A} and M_{2B} are the mass of aluminium or plastic sheet including material fallen and/or cut off.

- percentage of losses for sample A: $P_A = M_A / M_1 \times 100$
- percentage of losses for sample B: $P_B = M_B / M_2 \times 100$

Where:

M_1 and M_2 are the differences between the mass M of initial quantity of prepared product + the mass of tools before use and the mass M' of product remaining in the pots and on the tools after use.

The mean loss for the two samples is expressed as a percentage using the following equation:

$$P = (P_A + P_B)/2$$

Test report. The test report shall include at least the following information:

a. All details necessary to identify the product tested and identification of the whole waterproofing kits and application temperature, type and quantity of the primer.
b. A reference to this annex and any deviation from it.
c. Information on preparation of test specimens and prepared by and witnessed by which organization.
d. The test result.

B.3 Exposure procedure for accelerated ageing by heat

Scope. It specifies the exposure procedure for accelerated ageing by heat, equipment and the procedure for conditioning samples of kit(s) of liquid applied waterproofing kits, in order to determine the possible effect of this exposure on various characteristics of the "kits", by comparative testing.

Principle. The conditioning of samples is performed by exposing the samples to a defined temperature during a specified period.

Apparatus. EN 1296.

Test specimen. The test specimens defined as required for the specific test (2.2.18), applied and cured waterproofing kits, from which the test specimens are obtained after exposure.

Test Procedure

- Bring the oven to the required temperature.
- Place the test specimen on its supporting frame in the oven.
- Maintain the required temperature during the specified period.
- After the exposure period remove the sample from the oven; bring it back to ambient temperature and maintain it at that temperature for 24 h before further testing.
- Prepare the test specimens according to the appropriate test method(s) for evaluation of any exposure effects on the relevant products characteristics.

Expression of results

- Examine visually unexposed and exposed test specimens and record any occurred exposure effects.
- Observe, compare and record the differences in appearance of the unexposed and exposed test specimens as regards their relevant characteristics.

Test report. The test report shall include at least the following information:

a. Reference to this procedure.
b. Date/period of exposure.
c. Description of the kits, including shape/dimensions.
d. Type of exposure, temperature and period of time.
e. All visual observations.
f. Results of evaluation of exposure effects.
g. All operating details, not specified in this procedure, as well as incidents likely to have influenced the process.

B.4 Exposure procedure for UV radiation artificial weathering

This exposure procedure for artificial weathering of kit(s) of liquid applied waterproofing kit(s) is based on ISO 4892 - Parts 1 and 3 and EN 1297.

Scope. It specifies exposure procedures, for artificial weathering, for the apparatuses and the conditions for exposing test specimens, being a cured kits of a liquid applied waterproofing kits, to laboratory light sources, elevated temperature, humidity and wetting conditions.

Principle. Test specimens, being a cured kits of a liquid applied waterproofing kits, are exposed in a fluorescent UV artificial weathering apparatus at a specified irradiance, Black and White Standard Temperature, relative humidity, and spray cycles. After defined UV radiant dose the changes in characteristics, to be specified by the nature of the cured kits, are determined.

Apparatus. *Artificial weathering apparatus*. With a fluorescent UV light source. The apparatus shall comply with ISO 4892 - Parts 1 and 3, EN 1297.

Test specimen. According to EN 1297.

Test Procedure

Exposure condition in accordance EN 1297.

Exposure procedure

- Expose the test specimens for the weathering tests with the upper surface towards the light source in the artificial weathering apparatus for a radiation dose. The remaining reference test specimens are stored in the dark.
- The exposure procedure shall be in accordance with ISO 4892-3 and EN 1297, respectively with the following modifications. Before placing the test specimens, prepare the artificial weathering apparatus as follows:
    1. Install the devices for the determination of the radiant exposures defined above.
    2. Install the Black Standard thermometer and the White Standard thermometer in such a position that its temperature measurements will be representative for the test chamber.
    3. Set the test chamber relative humidity to 10% RH for fluorescent UV light source apparatus.
    4. Set the spray cycle.
    5. Set the test chamber air temperature to a constant value to achieve the Black Standard Temperature (BST).
    6. Check the White Standard Temperature (WST).
- Mount the test specimens in the holders with the upper surface towards the light source.

Note 1: When the test specimens do not completely fill the racks, the empty spaces shall be filled with blank panels to maintain the test conditions within the test chamber.
Note 2: It is not recommended to expose specimens of different nature simultaneously in order to avoid interaction of any kind.

- Start the exposure procedure, control and record:
    - The air temperature in the test chamber.
    - The Black Standard temperature.
    - The White Standard temperature.
    - The relative humidity.

Note: It is difficult to specify minimum recording intervals due to differences in equipment and laboratory procedures. The test laboratory should record at intervals that are appropriate to maintain the test conditions in the particular laboratory on a particular apparatus.

- At regular intervals check and record the irradiance in accordance with fluorescent UV light source.
- The exposure is completed when the specified amount of radiant exposure is reached.
- Take the test specimens holder from the test chamber and the specimens from the holders and condition them for a period of at least 16 h at a temperature of (23 ± 2) ºC and at (50 ± 5) % relative humidity.
- Examine the test specimens visually and note any visible exposure effects.
- Prepare the test specimens for evaluation of any exposure effects on the relevant products characteristics.

Expression of results

- Examine visually unexposed and exposed test specimens and record any occurred exposure effects.
- Observe, compare and record the differences in appearance of the unexposed and exposed test specimens as regards their relevant characteristics.

Test report. The test report shall give at least the following information:

a. Reference to this procedure.
c. Date / period of exposure.
d. A description of the kits, including dimensions, curing and conditioning.
e. Type filter "kits" used, if any.
f. Type of temperature measurements and description.
g. Set value of the relative humidity in the test chamber.
h. Spray cycle used.
i. Conditions of test specimen rotation, if any.
j. UV radiant exposure in MJ/m^2.
k. Exposure time in hours (h).
l. All visual observations.
m. Results of evaluation of exposure effects.
n. All operating details not specified in this procedure, such as deviations from the test procedure, as well as incidents likely to have influenced the results.

B.5 Determination of the resistance to the passage of chloride ions through a waterproofing layer subjected to indentation by aggregate

Scope. Method for determining the resistance to the passage of chloride ions through a liquid applied bridge deck waterproofing membrane following simulated indentation by hot aggregate resulting from the compaction of asphalt concrete.

Principle. Specimens of membrane bonded to concrete substrate are subjected to simulated aggregate indentation. The retention of waterproofing properties following the aggregate indentation is determined by exposing the specimens to a saturated solution of sodium chloride for a defined period of time. The concrete is sampled and the chloride ion concentration is determined by means of chloride specific electrodes. The level of chloride ions passing through the waterproofing kits are determined by reference to the original chloride ion concentration of the concrete prior to exposure.

Apparatus

- Aggregate indentation apparatus complying with Figure B.5.2 incorporating a heating element and capable of maintaining a temperature at the tip of the indenter of 125 °C.
- Dial gauge suitable for measuring the thickness of the test specimens to ± 0.1 mm.
- Concrete blocks for use as a standard substrate, prepared in accordance with B.5.1.
- Glass vessel to hold a saturated salt solution in contact with the waterproofing layer. The vessel shall be an open-ended cylinder with internal diameter (100 ± 2) mm and of sufficient volume to hold at approximately 1.5 litres of salt solution, (Figure B.5.3).
- Silicone sealing compound used to bond the glass vessel to the surface of the test specimen and to create a watertight seal.
- Low speed grinding machine used to sample the upper surface of the concrete substrate.
- Balance capable of weighing to an accuracy of ± 0.005 g.
- Ion specific electrodes or potentiometric titration apparatus capable of detecting chloride ion concentrations of solutions to an accuracy of ± 0.01 % by weight of dry sample.

Test specimens

- Dimensions. Specimens shall be prepared on concrete blocks (170 ± 3) mm by (170 ± 3) mm by (55 ± 3) mm.
- Number of test specimens. Three test specimens shall be tested.
- Preparation of the test specimen. The test specimen shall comprise the complete kits bridge-deck waterproofing applied to the surface of the concrete blocks. Application of the waterproofing kits shall be in accordance with the manufacturer's instructions.
- Curing and conditioning. The test specimens shall be cured at a temperature of (23 ± 2) ºC for the period prescribed by the manufacturer.

Note: Include a min / max curing period.

Procedure

Simulated aggregate indentation at 125 ºC. This conditioning is carried out to verify that the waterproofing kits are suitable for directly overlaying with asphalt concrete i.e., without the need for a sand asphalt protection layer.

Three concrete blocks (170 x 170 x 55) mm made in accordance with B.5.1 and with the kit fully bonded shall be used for this test.

Before application of the kits, the thickness of each concrete block shall be measured within the central 75 mm diameter test area at four separate locations using the template and dial gauge (Figure B.5.1). The kits shall then be applied and, when cured, the block re-measured at the same four locations, identified using the template, to determine the total thickness.

The kits thickness at each location shall be calculated by subtracting the measured concrete block thickness from the total thickness. The thickness at each location shall comply within ± 10 % of the manufacturers indicated nominal thickness. The mean thickness of the applied kits shall also be calculated from the four results.

The resistance to aggregate indentation shall be carried out using the heated steel indenter in the shape of a truncated cone, with the cone angle at 90°, the diameter at the truncation 8 mm and the diameter at the base 25 mm (Figure B.5.2).

The specimens shall be pre-conditioned for at least 4 hours at (50 ± 3) °C and maintained at this temperature throughout the test procedure. The indenter shall be electrically heated to a temperature of (125 ± 3) °C. Indentation shall be produced by forcing the truncated end of the indenter into the kits using a test machine that can apply and measure the force and displacement simultaneously. The test shall be carried out at a temperature of (50 ± 3) °C.

Indentations shall be made at each of the four locations where the thickness measurements were made. Each indentation shall be made by driving the indenter into the kits at a rate of 5 mm per minute. Indentation shall be stopped when the force applied reaches 1000 N. The load shall be removed at the same rate. The samples shall then be allowed to recover by conditioning at (23 ± 2) °C for 24 hours.

The recovered thickness at each location shall be measured using the template and dial gauge. Individual thickness measurements shall then be determined by subtracting the concrete block thickness from the recovered thickness.

Indentation after the recovery period shall not exceed 50 % of the initial thickness of the applied kits. If the indentation penetrates more than the 50 % of the thickness, the test shall be repeated under the same conditions.

The chloride ion test shall be carried out in accordance with "Determination of the resistance to the passage of chloride ions".

Determination of the resistance to the passage of chloride ions. Following the simulated aggregate indentation, the resistance to the passage of chloride ions shall be determined as follows:

The glass vessel shall be bonded to the upper surface of the test specimen using a silicone sealant (or similar sealing compound), such that a watertight seal is created, and the sealant shall be allowed to cure (Fig. B.5.3).

Note: Care must be taken to ensure that there is no possibility that the sealant used will leach chloride ions into the concrete.

The kits shall be placed on a level surface in a temperature-controlled environment at (23 ± 2) ºC. A saturated sodium chloride solution (approximately 1.5 litres) shall be added to the glass vessel so that it is in full contact with the upper surface of the waterproofing membrane. The original level of the solution shall be marked on the

glass vessel for reference. The level shall be 30 mm below the top of the vessel. The open end of the glass vessel shall be loosely covered to minimise evaporation of the solution.

The kits shall be stored in the temperature-controlled environment for a period of (28, –0, +0.5) days. Throughout this period the test specimen shall be examined periodically for signs of loss of solution by penetration, absorption or by 'wicking' (i.e., horizontal movement to the edge of the test specimen at interfaces). Any such phenomena shall be recorded.

At the end of the 28-day period any drop in the level of the solution shall be recorded to the nearest millimetre. The salt solution shall be carefully poured away, the glass vessel removed and the surface of the test specimen shall be washed with potable water to remove all traces of salt solution. Care shall be taken during this process to avoid accidental contamination of the concrete block.

The waterproofing layer(s) shall then be carefully removed to expose the surface of concrete substrate. The blocks shall be dried in a ventilated oven at (103 ± 2) ºC for approximately 16 hours.

The surface of the concrete shall be sampled by means of low-speed grinding. Grinding shall cover as much of the 100 mm diameter exposure area as possible and shall not exceed 3 mm in depth. A 5 to 10 g sample of powdered concrete shall be collected and thoroughly mixed to ensure a homogenous sample.

A 0.5 to 3.0 g sample of the powdered concrete shall be used for each of two determinations. The chloride ion concentration of the sample shall be determined by means of chloride ion specific electrodes with potentiometric detection, in accordance with EN ISO 15682-4.4.1 and its Annex C, which also envisages the requirements for a calibrated measuring system.

The procedure shall be repeated on the other two test specimens.

Expression of results

- The average value of the two determinations per test specimen shall be taken as the chloride ion concentration of the sample block expressed as % chloride by weight of dry sample.
- The measured chloride ion concentration of each block shall be compared to the background chloride ion concentration of the reference concrete block.

Test report. The test report shall include at least the following information:

a. All details necessary to identify the product tested.
b. A description of the test specimens, including dimensions, curing and conditioning.
c. test conditions.
d. The measured chloride ion concentrations relating to each test specimen.
e. The background chloride ion concentration of the substrate blocks.
f. The mean, and individual, changes in chloride ion concentration.
g. All operating details not specified in this Annex, including any deviations or other incidents likely to have affected the results.

B.5.1 Preparation of concrete blocks

Concrete blocks (170 × 170 × 55) mm, type MC (0,45) according to EN 1766

The concrete shall be levelled and screeded to produce a uniform surface. When the concrete has sufficiently hardened and the bleed water evaporated the surface shall be trowelled to produce a hard-dense surface free from screed marks and exposed aggregate. Finally, the surface shall be lightly textured with a wooden float or equivalent.

Blocks shall be removed from the moulds after 24 hours and stored under wet hessian and polyethylene sheets under ambient laboratory conditions for a further six days. Blocks shall then be stored, uncovered, for a further 21 days.

A minimum of two blocks from each batch prepared shall be selected at random. The chloride ion concentration of these reference blocks shall be determined in accordance with section "Determination of the resistance to the passage of chloride ions" of this Annex. The mean of these results shall be taken as the background chloride ion concentration for all blocks prepared at the same time.

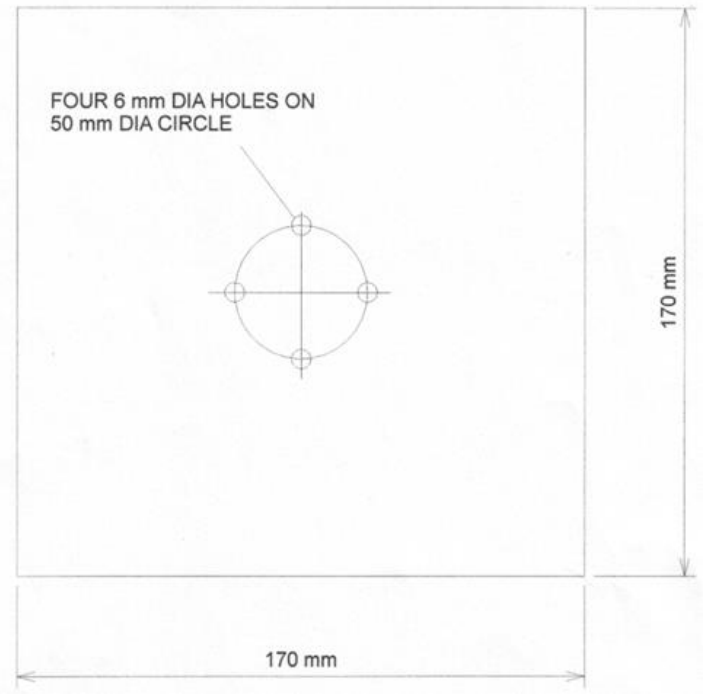


Figure B.5.1. Aggregate indentation template

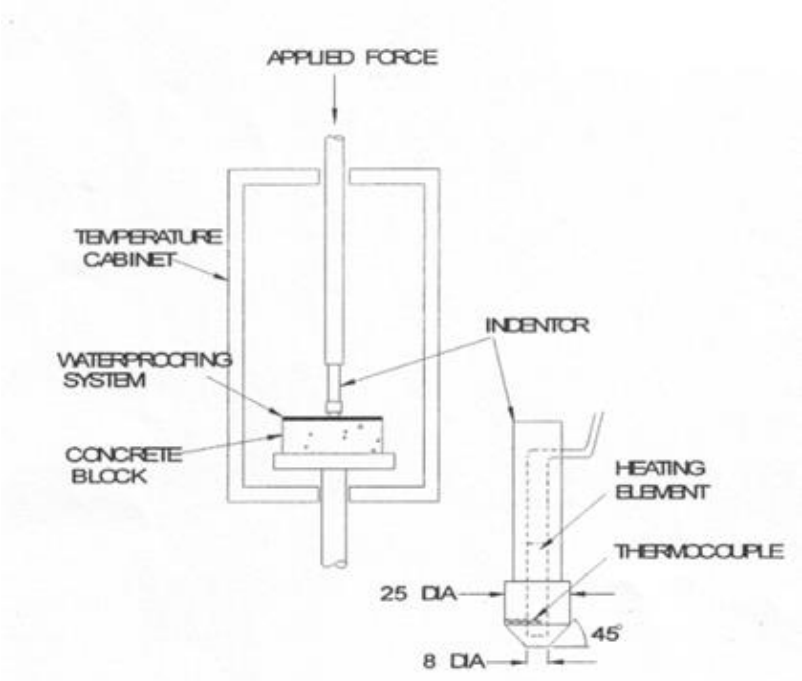


Figure B.5.2. Aggregate indentation. Apparatus (all dimensions in mm)

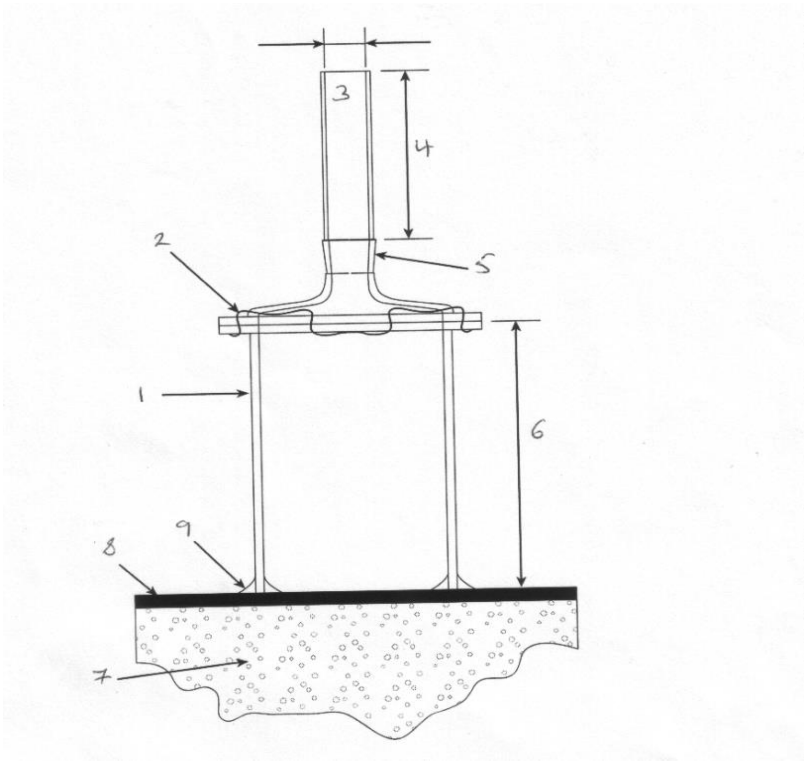


Figure B.5.3. Glass vessel sealed to surface of waterproofing kit

1. Glass cylinder Internal diameter 100 ± 2 mm.
2. Wire Clamp.
3. 24 mm Internal diameter.
4. 105 mm.
5. 29/32 mm diameter.
6. 160 mm.
7. Concrete block.
8. Waterproofing Kit.
9. Sealing Compound.

ANNEX C. TEST CATEGORIES

C.1 General

The following test types of test categories are addressed:

- Five test categories associated with conditions for preparation of samples (P).
- Five test categories associated with stress conditions before testing (S).
- Six test categories associated with temperature conditions for testing (T).

The test categories are defined below.

C.2 Categories of conditions for sample preparation (Pi)

These categories are related to different conditions under which the samples may be prepared.

Normal application (NC) – P1. To realise "normal" application conditions on site the samples will be prepared (coating of the concrete and/or steel or producing a free film) under normal climate conditions, P1 (23 ± 2) ˚C and ((50 ± 10) % RH).

Severe application (SC) – P2. To realise severe application conditions at lower or higher temperatures in combination with high relative humidity on site, the samples shall be prepared (coating of the concrete and/or steel) at the minimum and/or maximum climate conditions to cover majority of climatic conditions uses, P2 (2.2.12).

High moisture content of the substrate (MC) – P3. Special application conditions may be given when the waterproofing kits are applied on concrete with high moisture content e.g., on concrete 7 days in water to the minimum temperature according to MPII (2.2.13.1).

Overlapping areas (OA) – P4. If sub areas are carried out on which a new area is connected by overlapping after a period of weathering (UV) up to 7 days (day joints) or up to six months (Section joints) it may be necessary to prove that these areas have the same adhesion to the support as the surrounding area (2.2.13.2 - 3).

C.3 Categories of stress conditions before testing (Si)

These categories are related to stress conditions which can affect the function of the waterproofing kits. Test may be performed after the following preconditioning.

No stress conditions – S0. To investigate the influences of stress conditions reference tests may also be done also without any stress before testing.

Heat impact- S1. The heat impact (2.2.5) by the application of hot overlays on the applied waterproofing kits is divided in sub categories:

S 1.1. Application of Mastic asphalt at ≥ 220 °C up to 250 °C - (MA).

S 1.2. Compaction of asphalt concrete at 160 °C - (CBM).

Heat ageing (HA) – S2. Ageing of materials under the influence of high temperatures (2.2.18).

Freeze-Thaw (FT) – S3. Freeze-Thaw cycles on the applied waterproofing kits (2.2.25).

UV radiation (UV) – S4. Influences of ambient weather conditions on exposed kits under UV radiation including water spray. (2.2.19).

Materials in contact – S5. Influence of: S 5.1, water (Wa) S 5.2, alkali (Al), S 5.3, bitumen (Bi). On specified product characteristics (2.2.14/15/17).

C.4 Categories of temperature conditions for testing (Ti)

These categories are related to the temperature conditions which may have an influence on the result of the tests. These categories cover a range from high to extreme low temperatures under which the characteristics of the waterproofing kits shall be proved (2.2.8).

Extreme low temperature (-30 °C) – T1. For kits which are in use at extreme low temperatures tests may be performed at -30 °C.

Severe low temperature (-20 °C) – T2. For kits which are in use at severe low temperatures tests shall be performed at -20 °C.

Low temperatures (-10 °C) – T3. For kits which are in use at low temperatures tests shall be performed at -10 °C.

Moderate low temperature (0 °C) – T4. For kits which are in use at moderate low temperatures tests shall be performed at 0 °C.

Normal temperature (23 °C) – T5. Tests are performed at least at normal temperature, 23 °C.

High temperature (40 °C) – T6. For kits which are in use at high temperatures tests shall be performed at 40 °C.