EUROPEAN ASSESSMENT DOCUMENT

EAD 030378-00-0605

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FULLY BONDED, PRE-APPLIED FLEXIBLE SHEET FOR WATERPROOFING

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This European Assessment Document (EAD) has been developed taking into account up-to-date technical and scientific knowledge at the time of issue and is published in accordance with the relevant provisions of Regulation (EU) No 305/2011 as a basis for the preparation and issuing of European Technical Assessments (ETA).

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1 SCOPE OF THE EAD

1.1 Description of the construction product

Fully bonded, pre-applied flexible sheet for waterproofing made of plastic or rubber (e. g. polyolefins, PVC, EPDM,…) [1] comprises at least two laminated layers with one smooth side and one rough side (see Figure 1.1.1). The layer facing the water functions as a barrier to water ingress and the opposite layer facing the concrete provides the full and permanent bond to concrete and protects from lateral water migration. The product is capable for crack bridging as well.

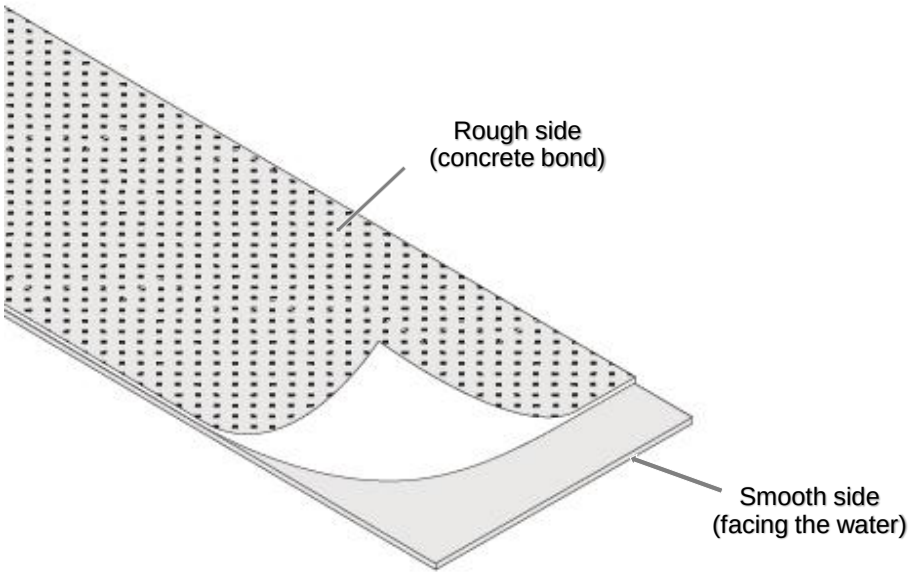


Figure 1.1.1: An example of fully bonded, pre-applied flexible sheet for waterproofing

In addition, the following components can be part of the product:

- Jointing components such as adhesive tapes, self-adhesive strips, or glues
- Sealing details such as moulded corners or strips

The precise description of the product (e. g. build-up, type of materials, total weight per unit area, jointing/ overlapping, sealing details and accessories) will be given in the ETA.

The building envelope in contact with the ground is covered with the fully bonded, pre-applied flexible sheet for waterproofing.

For horizontal applications, the membrane is rolled out flat on top of the plane and smooth substrate. Lateral seams are either overlapped or put against each other (butt joint) and sealed with self-adhesive edge strips /special self-adhesive tapes or by other sealing methods. Splicing is carried out by overlapping and jointing using double-sided adhesive tapes / factory applied adhesive strips or by other splicing methods. Vertical installation methods are specific to the formwork. Jointing and splicing is carried out as described above.

The product is not fully covered by a harmonised European standard (hEN) EN 13967 [2].

The reason is the hEN is defined for a different intended use. Waterproofing sheet is not applied on the already hardened concrete, but the product is installed prior to concreting and bonded with the fresh concrete. Hence, additional characteristics and amendment to characteristics are implemented.

[1] The layer facing the concrete could be made of other kind of materials, e.g. pre-applied adhesive coating with special granules.

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

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 fully bonded, pre-applied flexible sheet for waterproofing is intended to be used for:

- envelope seal as waterproofing barrier *(basement tanking)*
- crack bridging and waterproof sealing of cracks
- prevention of lateral water migration between barrier seal and concrete substrate
- the product is applied to a structure executed with waterproof concrete

The intended use does not cover bridge deck waterproofing.

Note: All above listed phrases form together one intended use und shall not be seen as different or separate intended uses.

Additionally, some types of the product are intended to be used in situations where contact with bitumen is expected.

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 fully bonded, pre-applied flexible sheet for waterproofing for the intended use of 50 years when installed in the works, provided that the fully bonded, pre-applied flexible sheet for waterproofing is subject to appropriate installation, (see 1.1). These provisions are based upon the current state of the art and the available knowledge and experience.

When assessing the product the intended use as foreseen by the manufacturer shall be taken into account. The real working life may be, in normal use conditions, considerably longer without major degradation affecting the basic requirements for works[3].

The indications given as to the working life of the construction product cannot be interpreted as a guarantee neither given by the product manufacturer or his representative nor by EOTA when drafting this EAD nor by the Technical Assessment Body issuing an ETA based on this EAD, but are regarded only as a means for expressing the expected economically reasonable working life of the product.

[3] 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 the working life referred to above.

2 ESSENTIAL CHARACTERISTICS AND RELEVANT ASSESSMENT METHODS AND CRITERIA

2.1 Essential characteristics of the product

Table 2.1.1 shows how the performance of the fully bonded, pre-applied flexible sheet for waterproofing is assessed in relation to the essential characteristics.

Table 2.1.1: Essential characteristics of the product and methods and criteria for assessing the performance of the product in relation to those essential characteristics

№	Essential characteristic	Assessment method	Type of expression of product performance
Basic works requirement 2: Safety in case of fire			
1	Reaction to fire	2.2.1	Class
Basic works requirement 3: Hygiene, health and the environment			
2	Mechanical strength - Tensile strength	2.2.2	Level
3	Elongation at maximum tensile force	2.2.3	Level
4	Resistance to static loading	2.2.4	Level
5	Resistance to impact	2.2.5	Level
6	Watertightness	2.2.6	Level, Description
7	Watertightness of joint with adhesive tape	2.2.7	Level, Description
8	Artificial ageing by long term exposure to elevated temperature	2.2.8	Level, Description
9	Water vapour transmission property	2.2.9	Level
10	Alkali resistance in high pH solution	2.2.10	Level
11	Acid resistance	2.2.11	Level
12	Compatibility with bitumen	2.2.12	Level
13	Shear resistance of joints	2.2.13	Level
14	Resistance to tearing (nail shank)	2.2.14	Level
15	Elongation at maximum tensile force and maximum tensile force at low temperatures (at – 45 °C ± 2 °C)	2.2.15	Level
16	Crack bridging ability	2.2.16	Level, Description
17	Peel-resistance (180-degree peel)	2.2.17	Level
18	Peel-resistance (180-degree peel) after immersion in water	2.2.18	Level
19	Peel-resistance (180-degree peel) after exposure to elevated temperature (70 °C)	2.2.19	Level
20	Peel-resistance (180-degree peel) after cleaning	2.2.20	Level
21	Resistance to damage – water creep at leakage	2.2.21	Level
22	Resistance to damage – water creep at leakage after cleaning	2.2.22	Level
23	Watertightness of T-joints	2.2.23	Level, description

№	Essential characteristic	Assessment method	Type of expression of product performance
24	Watertightness under intended use conditions (Tank-test)	2.2.24	Level, description
25	Bond strength after water and thermal aging	2.2.25	Level, description
26	Dimensional stability	EN 1107-2	Level
27	Shear resistance of joints after water aging (50 °C)	2.2.27	Level

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

This chapter is intended to provide instructions for TABs. Therefore, the use of wordings such as “shall be stated in the ETA” or “it has to be given in the ETA” shall be understood only as such instructions for TABs on how results of assessments shall be presented in the ETA. Such wordings do not impose any obligations for the manufacturer and the TAB shall not carry out the assessment of the performance in relation to a given essential characteristic when the manufacturer does not wish to declare this performance in the Declaration of Performance.

2.2.1 Reaction to fire

Testing of the reaction to fire of the fully bonded, pre-applied flexible sheet for waterproofing and additional components using the test method(s) relevant for the corresponding reaction to fire class according to EN 13501-1 in order to be classified according to Commission Delegated Regulation (EU) 2016/364 in connection with EN 13501-1.

2.2.2 Mechanical strength - Tensile strength

The tensile strength of the fully bonded, pre-applied flexible sheet for waterproofing shall be determined according to procedure A, EN 12311-2 at 23 °C ± 2 °C.

Testing shall be carried out on 5 specimens in the longitudinal and 5 specimens in the transverse direction.

Mean value of tensile strength (arithmetic average of the 5 values of maximum tensile force obtained in the test) in longitudinal direction and in transverse direction shall be stated in [N/50 mm] in the ETA.

2.2.3 Elongation at maximum tensile force

Elongation at maximum tensile force of fully bonded, pre-applied flexible sheet for waterproofing shall be determined according to procedure A, EN 12311-2 at 23 °C ± 2 °C.

Testing shall be carried out on 5 specimens in the longitudinal and 5 specimens in the transverse direction.

Mean value of elongation at maximum tensile force in longitudinal direction and in transverse direction shall be stated as [%] in the ETA.

Additionally, mean value of elongation at break obtained in the same test can be stated as [%] in ETA

2.2.4 Resistance to static loading

Resistance to static loading shall be determined according to procedure B, EN 12730.

Testing shall be carried out on 3 specimens for each load level.

The resistance to static loading of the fully bonded, pre-applied flexible sheet for waterproofing (drop weight) shall be stated in [kg] in the ETA.

2.2.5 Resistance to impact

Resistance to impact shall be determined according to procedure A, EN 12691.

Testing shall be carried out on 5 specimens.

The resistance to impact (drop height) in [mm] shall be stated in the ETA.

2.2.6 Watertightness

Water tightness of fully bonded, pre-applied flexible sheet for waterproofing shall be determined according to procedure B, EN 1928 at 23 °C ± 5 °C, at the pressure of at least 60 kPa (Type T as of (hEN) EN 13967, clause 4 and clause 5.6).

The watertightness including reference to actual water pressure of the fully bonded, pre-applied flexible sheet for waterproofing shall be stated in the ETA.

The fully bonded, pre-applied flexible sheet for waterproofing shall be watertight [4].

Testing shall be carried out on 3 specimens.

2.2.7 Watertightness of joint with adhesive tape

The joint sealed with adhesive tape shall be tested regarding water tightness as follows:

1. The two fully bonded, pre-applied flexible sheet for waterproofing shall be jointed and spliced in accordance with manufacturer's instructions, i. e. overlapped with the inserted adhesive tape in-between (3-layer-overlapped area).

2. The tight bond shall be made by rolling over the overlapped area.

3. Afterwards the watertightness shall be tested according to procedure B, EN 1928 at 23 °C ± 5 °C, at the pressure of at least 60 kPa (Type T) [5]with the joint in the middle.

Testing shall be carried out on 3 specimens of each type of joints.

Based on the test technology used, especially, the dimensions of test apparatus of EN 1928, procedure B, this assessment method may not be applicable to all types of joints (It is originally developed for narrow overlaps with an inserted adhesive tape in-between (3-layer-overlapping) or with factory applied self-adhesive edge strips. Wider joints can alternatively be assessed in accordance with assessment method 2.2.23

It is stated in the ETA as description if the adhesive tape joints are watertight or not, including reference to actual test water pressure.

2.2.8 Artificial ageing by long term exposure to elevated temperature

Artificial ageing by long term exposure to elevated temperature of fully bonded, pre-applied flexible sheet for waterproofing shall be determined according to EN 1296 in the heating cabinet adjusted at the temperature of 70 °C ± 2 °C and, if relevant depending on the specific type of the product (to distinguish between changes due to the sensitivity of the product to high temperature and changes due to accelerated aging under elevated temperature), at the temperature of 40 °C ± 2°C. Duration of the exposure to the elevated temperature shall be 4, 8, 16 and 24 weeks.

Table 2.2.11.1: Specimens for artificial aging test by long term exposure to elevated temperature

t in weeks	**0[1)]**	**4[1)]**	**8[1)]**	**16[1)]**	**24[1)]**	**24[2)]**
Temperature	Specimens					
23 °C ± 2 °C	5/3	5/3	5/3	5/3	5/3	3
40 °C ± 2 °C		5/3	5/3	5/3	5/3	3
70 °C ± 2 °C		5/3	5/3	5/3	5/3	3

[1)] Testing of 5 samples for tensile characteristics (tensile strength, elongation at maximum tensile force and modulus of elasticity) / 3 samples for OIT

[2)] Testing of 3 samples for watertightness

After ageing the specimens shall be conditioned at least 24 hours at the 23 °C ± 2 °C and air moisture of 50% ± 10%.

Test specimens shall be:

- checked for visible defects according to EN 1850-2 on all specimens and following tensile characteristics shall be determined before and after heat ageing:

[4] The required performance originates from EN 13967.
[5] The test parameter originates from EN 13967

- tensile characteristics (tensile strength, elongation at maximum tensile force and modulus of elasticity) according to procedure A, EN 12311-2, testing of 5 specimens in the longitudinal direction
- watertightness according to Clause 2.2.6, testing of 3 specimens
- the oxidation induction time (isothermal OIT) according to EN ISO 11357-6, testing of 3 specimens. Squares are cut from the flexible sheet for waterproofing and aged. OIT specimens are punched out from the squares with a diameter of about 5 mm, maintaining full thickness of the flexible sheet for waterproofing. The punched OIT specimens are trimmed with a scalpel to a mass appropriate for testing. *Note: OIT test is only relevant to sheets made of polyolefins*

Description whether or not the specimens are free of visible defects after artificial aging is given in the ETA.

The changes prior and after aging of tensile characteristics shall be given in percentage.

For OIT the minimum mean value of test results shall be given.

Change of test results in the course of time is described in the ETA.

The fully bonded, pre-applied flexible sheet for waterproofing shall be watertight [6].

2.2.9 Water vapour transmission property

If required, water vapour transmission property shall be determined according to procedure B, EN 1931 at 23 °C ± 1 °C, comprehensive evaluation of water vapour transmission property.
For waterproofing sheets with expected water vapour diffusion equivalent air layer thickness (S_d) > 1.0 m, the simplified calculation of μ in accordance with EN 1931 can be used.

Moisture resistance factor μ of fully bonded, pre-applied flexible sheet for waterproofing shall be stated in the ETA.

Testing shall be carried out on 3 specimens and 1 reference specimen.

2.2.10 Alkali resistance in high pH solution

The alkali resistance of fully bonded, pre-applied flexible sheet for waterproofing shall be determined according to EN 1847 during 28 days. Immersion temperature shall be 23 °C ± 2 °C.

Following characteristics shall be determined before and after alkali ageing:

- tensile characteristics (tensile strength, elongation at maximum tensile force and modulus of elasticity) according to procedure A, EN 12311-2, testing of 5 specimens in the longitudinal direction
- watertightness according to Clause 2.2.6, testing of 3 specimens

The changes of these product characteristics are to be given in percentage.

The specimens shall be watertight after immersion [6].

2.2.11 Acid resistance

The resistance against sulphurous acid shall be determined according to EN 1847 during 28 days. Immersion temperature shall be 23 °C ± 2 °C.

Following characteristics shall be determined before and after immersion in acid:
- tensile strength according to procedure A, EN 12311-2, testing of 5 specimens in the longitudinal direction
- elongation at maximum tensile force according to procedure A, EN 12311-2, testing of 5 specimens in the longitudinal direction
- modulus of elasticity according to procedure A, EN 12311-2, testing of 5 specimens in the longitudinal direction
- watertightness according to Clause 2.2.6, testing of 3 specimens

The changes of these product characteristics are to be given in percentage.

The specimens shall be watertight after immersion [6].

2.2.12 Compatibility with bitumen

If the product is intended to be used in situations where contact with bitumen is expected, tolerance against bitumen shall be determined according to EN 1548 and test specimens shall be exposed to bitumen (standard bitumen 85/25 according to EN 13304) influence during the 28 days at 70 °C ± 2 °C. Reference test specimens shall be kept in the heating chamber at 70 °C ± 2 °C at least 28 days before testing and without the contact with

[6] The required performance originates from EN 13967.

bitumen. The other test specimens are in the contact with bitumen. *Both types of specimens (reference specimens and specimens to be exposed) shall be large enough in order to obtain the specimens required for the below mentioned individual tests.*

Following characteristics shall be determined:
- tensile characteristics (tensile strength, elongation at maximum tensile force and modulus of elasticity) according to procedure A, EN 12311-2, testing of two sets of 5 specimens in the longitudinal direction (one set is to be cut out of the reference specimens and the other set of the specimens which have been exposed to bitumen)
- watertightness according to Clause 2.2.6, testing of 3 specimens

The changes of tensile characteristics after exposure to bitumen in comparison with the reference specimens are to be given in percentage in the ETA.

The specimen shall be watertight after exposure to bitumen [7].

2.2.13 Shear resistance of joints

Shear resistance of joints shall be determined according to EN 12317-2.
Testing shall be carried out on 5 specimens of lateral seams and 5 specimens of splices.

Mean value of shear resistance of joints shall be stated in [N/50 mm] in the ETA.

2.2.14 Resistance to tearing (nail shank)

Resistance to tearing shall be determined according to EN 12310-1 at 23 °C ± 2 °C.

Testing shall be carried out on 5 specimens in the longitudinal direction and 5 specimens in the transverse direction.

Mean value of the resistance to tearing shall be stated in [N] for each direction in the ETA.

2.2.15 Elongation at maximum tensile force and maximum tensile force at low temperatures (at – 45 °C ± 2 °C)

Elongation at maximum tensile force and tensile force at the low temperatures shall be determined according to EN 12311-2 at – 45 °C ± 2 °C.
The test specimens shall be prepared according to EN 13416.

Testing shall be carried out on 5 specimens in the longitudinal direction and 5 specimens in the transverse direction.

Mean values of elongation at maximum tensile force in percentage and tensile force at the low temperatures of the fully bonded, pre-applied flexible sheet for waterproofing in [N/50 mm] for each direction shall be stated in the ETA.

2.2.16 Crack bridging ability

The fully bonded, pre-applied flexible sheet for waterproofing shall bridge cracks waterproof of up to 2.0 mm. In order to simulate the crack, two concrete prisms are cast against the membrane.

The test specimens are prism made of concrete:
- C30/37 (EN 206),
- CEM I 32.5 R,
- min. 320 kg/m²,
- coarse aggregate size max. 16 mm - grading 0/16,
- compacted by vibration,
- w/c ≤ 0.55,
- wet curing time 7 days,
- F3 and has minimum dimensions of 1 m x 0.7 m x 0.25 m, see Figure 2.2.16.1.

After 28 days of wet curing, crack width gauges are installed. Subsequently, the two prisms are spread to 2.0 mm crack width at room temperature (23 °C ± 1 °C) using a special wedge tool to ensure an even top-to-bottom opening.

A pressure chamber plate extending at least 50 mm over the cast-in membrane is installed. Water pressure is applied to a minimum 50 mm wide concrete strip to either side of the crack.

The longitudinal ends of the membrane are extended past the pressure chamber (Figure 2.2.16.1.).

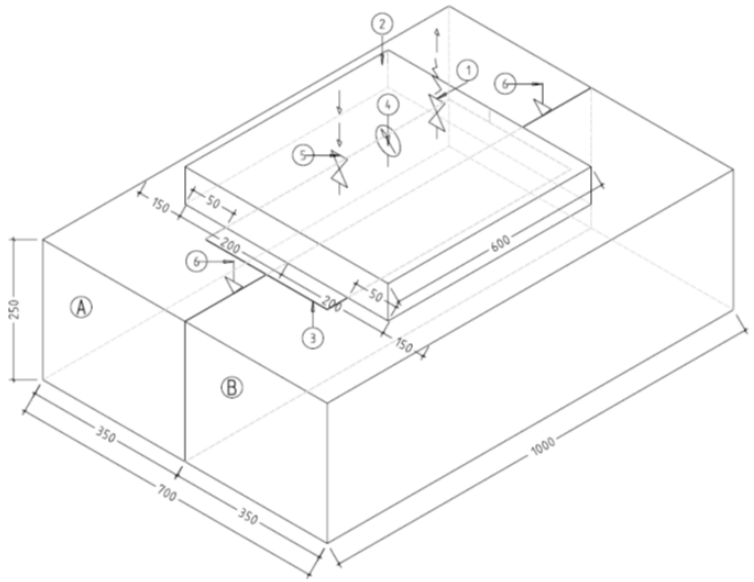
[7] The required performance originates from EN 13967.

After complete installation of the pressure chamber assembly on top of the test specimen, the appropriate hydrostatic load is applied. The test pressure shall be 2.5 times the reference hydrostatic pressure. Reference hydrostatic pressure shall be given in the ETA.

Pressure will remain constant for 28 days. The crack bridging ability shall be assessed by visual inspection. Any visible water leakage occurs and peel off or blistering along the membrane leading edges at the end of the test cycle.

Testing shall be carried out on 2 specimens.

The crack bridging ability with the relevant reference hydrostatic pressure (water head) in [bar] shall be stated in the ETA. The reference hydrostatic pressure (water head) equals the maximum obtained test pressure without leakage and without peel off or blistering along the membrane leading edges divided by a safety factor of 2.5.



Legend:

1. Bleeder valve
2. Steel pressure chamber, anchored with traverse
3. Adhesive sealing
4. Manometer
5. Feed valve
6. Special wedge for controlling crack width up to 2 mm

Dimensions in mm

Figure 2.2.16.1: Test specimen for testing of the crack bridging ability

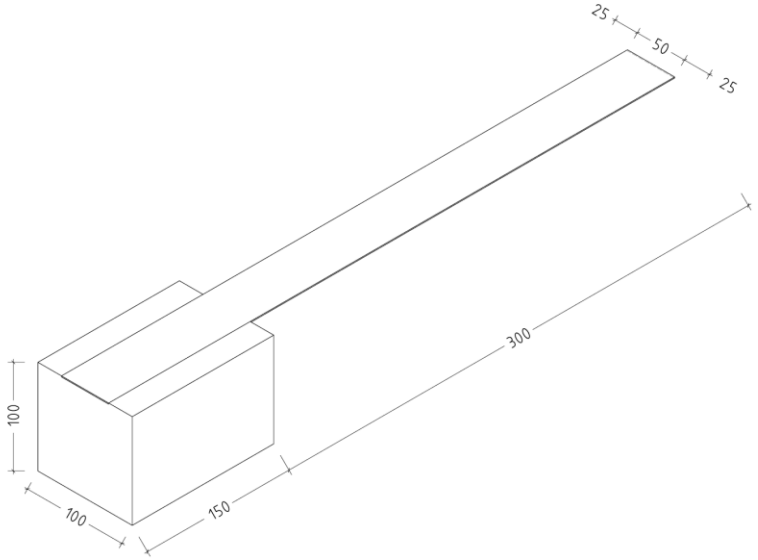
2.2.17 Peel-resistance (180-degree peel)

Peel-resistance of the fully bonded, pre-applied flexible sheet for waterproofing shall be determined according to peel-test described in EN ISO 8510-2 (180-degree peel test). The flexible adherend is the flexible sheet for waterproofing, the rigid one is the concrete:

- C30/37 (EN 206),
- CEM I 32.5 R,
- min. 320 kg/m²,
- coarse aggregate size max. 16 mm - grading 0/16,
- compacted by vibration,
- w/c ≤ 0.55,
- wet curing time 7 days,
- F3

Test specimen is a 100 x 100 x 150 mm rectangular solid.

The length of the strips of the fully bonded, pre-applied flexible sheet for waterproofing shall be ≥ 2 times longer than the length/longest side of rectangular solid. Each of the strips shall have the width of 50 mm. The strips are fully bonded along the full length of the cube and centrically placed in the casting form with the rough side/bonding side facing the concrete to be casted (pre-applied) and with an edge distance of 25 mm (see Figure 2.2.17.1). The flexible adherent is pulled apart at steady rate in the tensile testing machine, starting at the open end of the bond.



Dimensions in mm

Figure 2.2.17.1: Test specimen for the 180-degree peel test

Testing shall be carried out on 5 specimens.

The result is the arithmetic mean of the average peel forces for all the specimens tested.

2.2.18 Peel-resistance (180-degree peel) after immersion in water

Peel-resistance of the fully bonded, pre-applied flexible sheet for waterproofing shall be determined according to Clause 2.2.17 after immersion in water.

Test specimens shall be prepared as described in Clause 2.2.17.

Formwork shall be removed 24 hours after concreting and the specimens immediately immersed in water. Testing of peel resistance shall be performed after 7, 28 and 56 days immersion in water, see Table 2.2.18.1.

Prior to testing the specimens should be conditioned at 20 °C ± 5 °C and 50 % ± 10 % for at least 24 hours.

Table 2.2.18.1: Specimens for peel resistance testing after immersion in water

t in days			**7**	**28**	**56**
Environment	**Temperature**	**Moisture**	**Number of specimens**		
Air	20 °C ± 5 °C	50 % ± 10 %	5	-	5
Water	20 °C ± 5 °C	-	5	5	5

The result is the arithmetic mean of the average peel forces for all the specimens tested.

2.2.19 Peel-resistance (180-degree peel) after exposure to elevated temperature (70 °C)

Peel-resistance of the fully bonded, pre-applied flexible sheet for waterproofing shall be determined according to Clause 2.2.17 after exposure to elevated temperature.

Test specimens shall be prepared as described in Clause 2.2.17 and shall be stored and cured as described in EN 12390-2. Formwork shall be removed 24 hours after concreting and the specimens cured for 28 days at standard conditions in the moisture chamber as described in EN 12390-2. Subsequently the test specimen shall be exposed to elevated temperature in the heat chamber at 70 °C ± 2 °C.

Duration of exposure to the elevated temperature shall be 28 and 56 days, see Table 2.2.19.1.

Prior to testing the specimens should be conditioned at 20 °C ± 5 °C and 50 % ± 10 % for at least 24 hours.

Table 2.2.19.1: Specimens for peel resistance testing after exposure to elevated temperature

t in days			***28***	**56**
Environment	**Temperature**	**Moisture**	**Number of specimens**	
Air	20 °C ± 5 °C	50 % ± 10 %	-	5
Heating chamber	70 °C ± 2 °C	-	5	5

The result is the arithmetic mean of the average peel forces for all the specimens tested.

2.2.20 Peel-resistance (180-degree peel) after cleaning

The determination of the peel-resistance after cleaning shall be determined according following steps:

1. The loamy soil shall be spread by roller over the surface of the rough side of the fully bonded, pre-applied flexible sheet for waterproofing until complete coverage is attained. The treated area is at least 1.5 m x 3 m.

2. Leave to dry for at least 2 days at the standard temperature 23 °C ± 2 °C and air moisture of 50 % ± 10 %

3. Clean fully bonded, pre-applied flexible sheet for waterproofing by removing the loamy soil with water jet

4. Prepare test specimens (see Figure 2.2.17.1) from the cleaned fully bonded, pre-applied flexible sheet for waterproofing and cure it according to Clause 2.2.17

5. Perform peel test according to Clause 2.2.17.

Testing shall be carried out on 5 specimens.

2.2.21 Resistance to damage – water creep at leakage

Resistance to damage – water creep at leakage is determined on the basis of EN 12390-8 at 23 °C ± 2 °C.

The test specimen is a concrete cube or prism with the flexible sheet and the sides or testing radius of a minimum 15 cm, see Figure 2.2.21.1 – example for a concrete cube test specimen.

Before testing the specimens shall be cured under water as described in EN 12390-2. After minimum 28 days testing under the water pressure is started.

Dyed water is used for testing.

Test parameters are:

- circular cut-out with diameter ≥ 25 mm of fully bonded, pre-applied flexible sheet for waterproofing**,**
- 500 kPa water pressure and
- 7 days duration of test.

After 7 days the pressure is released and the fully bonded, pre-applied flexible sheet for waterproofing is removed from the concrete. Water creep is measured as the maximum distance of dyed surface measured from the edge of the cut-out. A purpose made gauge with concentric circles with radii in steps of 5 mm facilitates measurements of water creep.

Testing shall be carried out on 5 specimens.
The maximum value of water creep at leakage of all the specimens tested shall be stated in the ETA

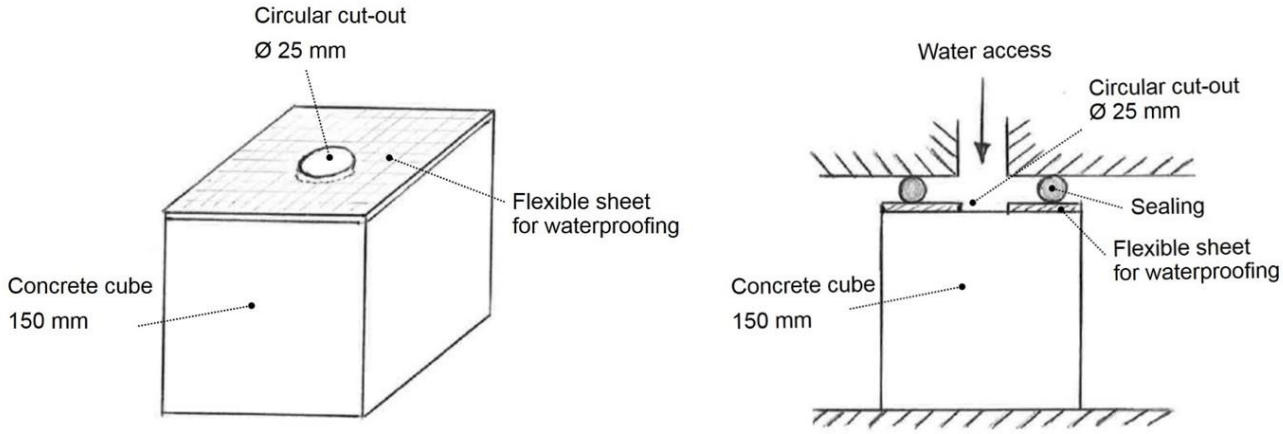


Figure 2.2.21.1: Specimen and principle of the testing of resistance to damage – water creep at leakage - Example with concrete cube

NOTE: Flexible sheet for waterproofing is the fully bonded, pre-applied flexible sheet for waterproofing

2.2.22 Resistance to damage – water creep at leakage after cleaning

Firstly, the fully bonded, pre-applied flexible sheet for waterproofing is treated with loamy soil as specified in Clause 2.2.20–steps 1 to 3. Secondly, after cleaning, resistance to damage – water creep at leakage is determined according to Clause2.2.21.

Testing shall be carried out on 5 specimens.

2.2.23 Watertightness of T-joints

All types of T-joints/wide joints shall be assessed regarding water tightness on the basis of EN 1928, test procedure A as follows:

1. Testing shall be carried out on 3 T-joint/joint specimens for each combination of fully bonded, pre-applied flexible sheet for waterproofing and adhesive tape / overlapping method.
2. Representative T-joint specimens shall be prepared at a climate of (23 °C ± 2 °C / 50 ± 10 % rel. humidity). The T-joint specimen shall be in all direction equal or larger than the outer diameter of the pressure cylinder described in step 4.
3. The specimen shall be placed on an absorbent surface (i.e. porous stones). The absorbent surface shall be equal or larger than the T-joint specimen, thick enough to withstand the test pressure without cracking and capable of passing any wetness or leakage water to the opposite side (observation side).
4. A pressure cylinder with a top cover which has an inner diameter ≥ 20 cm (≥ 30 in case of testing butt joints covered by sealing tapes) shall be placed on the T-joint specimen and shall be fastened to the bottom (the absorbent surface) and sealed in an appropriate way.
5. Afterwards the water tightness shall be tested at 23 °C ± 5 °C, at the pressure of at least 60 kPa (recommended 100 kPa) for 72 h.

The watertightness of T-joints shall be assessed by visual inspection (wetness/water-leakage at the absorbent surface). The description of the results (watertight, water leakage) with reference to the level of testing water pressure in [kPa] for each combination/all combinations shall be stated in the ETA

2.2.24 Watertightness under intended use conditions (Tank-test)

The watertightness under intended use conditions simulates the intended use conditions, e.g. water pressure, basement tanking, construction joints, pre-application of product and the subsequent concreting, etc, as well as, assesses the interworking of the product components under these conditions. It shall be tested as follows:

A tank-shape structure shall be lined with the fully bonded, pre-applied flexible sheet for waterproofing in accordance with Annex A, Figures 1 and 2.

The waterproofing system is installed by the manufacturer or under his supervision in the application procedure in accordance with the installation instruction.

All components which are part of the system and at least one of each overlap type shall be used.

The fully bonded, pre-applied flexible sheet for waterproofing shall be installed in the test specimen in such a way that at least the longitudinal overlap crosses the construction joint at one point.

The tank-shape structure consists of two parts

- Lower part: Bottom plate with upstand (with a part of the walls)
- Upper part: Frame (rest of the walls)

The tank shall be made of concrete C30/37 (EN 206). After curing of the concrete of the lower part for at least 14 days the upper part can be concreted. The setting of the gap between the two parts to a joint width of 1 mm (simulation of a construction joint) shall be done with the help of 4 screws imbedded in the upper part of the structure (see Figure 2)

After that the tank shall be filled with water. The following provisions apply for the tests:

Water pressure: The maximum test water pressure is 500 kPa. The tests shall be performed taking into account the safety factor of 2.5 mentioned in Clause 2.2.19. (e.g. for envisaged reference hydrostatic pressure (water head) of 100 kPa (1 bar), the test pressure is ≥ 250 kPa)

Test procedure

- The initial test water pressure shall be 20 kPa.

- First week: Increasing the test pressure daily by 20 kPa, up to 100 kPa (end of the week).
- Second week: Increasing the test pressure daily in equal steps, up to the intended test pressure at the end of the week (see "Water pressure" above).
- 4 weeks (28 days) holding the test pressure.

The watertightness under intended use condition (Tank-test) shall be assessed by visual inspection (water leakage from the construction joint). Any leakage and corresponding pressure shall be recorded.

Testing shall be carried out on 1 specimen. The watertightness under intended conditions (Tank-test) with the relevant reference hydrostatic pressure (water head) in [bar] shall be stated in the ETA. The reference hydrostatic pressure (water head) equals the maximum obtained test pressure without leakage divided by the aforementioned safety factor (2.5)

2.2.25 Bond strength after water and thermal aging

50 x 25 (30) x 4 [cm] plates made of concrete with the quality as described in 2.2.19 but without any compacting/vibration (only trim of the top of the formwork) shall be produced.

The "fully bonded, pre-applied flexible sheet for waterproofing" shall be placed in the formwork before the concreting. The sheets shall have the same dimensions of the test plates.

Afterwards, the specimens shall be protected from drying out for two days (covering with a plastic foil, without water ponding).

The following tests/aging conditions shall be conducted:

1. Testing the bond strength after 2 days of constructing the samples (early removal of formwork)
2. Testing the bond strength after 7 days conditioning at standard atmosphere, 23 ± 2 °C and 50 ± 10 % rel. humidity (reference value)
3. Testing the bond strength after 28 and 56 days of immersion in water at standard temperature, 23 ± 2 °C
4. Testing the bond strength after 28 and 56 days of exposure to elevated temperature in the heat chamber at 70°C ± 2°C.

After conditioning / removing from water, the samples were in water shall be carefully pat dry.

Before testing, a visual inspection must be carried out. If blistering or wrinkling and/ or detachment are detected, the assessment of the bond strength after water and thermal aging is omitted.

Prior to testing, the specimens should be conditioned at 23 °C ± 2°C and 50 % ± 10 % for 24 hours

Testing shall be carried out on 5 specimens for each test/aging condition.

5 rounded pull-plates Ø 50 mm shall be glued on the waterproofing sheet. Before that, the waterproofing sheet shall be cut through to the surface of the concrete slab in a circular manner. The testing of the bond strength shall be conducted on the base of EN 1542 with a rate of load application of 100 N/s (0.05 ± 0.01 MPa/s).

The mean value of bond strength in [MPa] for each test/aging condition and the maximum deviation [± %] of the test results from state of delivery (test 2 in this clause) shall be stated in the ETA.

Change of test results in the course of time is described in the ETA.

2.2.26 Dimensional stability

Dimensional stability of the "fully bonded, pre-applied flexible sheet for waterproofing" shall be assessed in according with EN 1107-2.
Testing shall be carried out on 5 specimens in the longitudinal and the transverse direction.
Dimensional stability in longitudinal and in transverse direction shall be stated as [%] in the ETA.

2.2.27 Shear resistance of joints after water aging (50 °C)

Shear resistance of joints after water aging (50 °C) shall be assessed as follows:

Test specimens of joints prepared at room temperature (23 °C ± 2 °C) shall tested regarding shear resistance after 7, 14, 28 and 56 days of aging in water at 50 °C ± 2 °C. After taking the specimens out of water, they shall be conditioned at 23 ± 2 °C / 50 ± 10 % relative humidity for one day and then tested in accordance with EN 12317-2.

Testing shall be carried out on 5 specimens of each type of joints (e.g. lateral seams, splices,…).

The maximum deviation [± %] of the shear resistance of joints after water aging (50 °C) of each type of joints from state of delivery (results of tests acc. to Clause 2.2.16) shall be stated in the ETA.

3 ASSESSMENT AND VERIFICATION OF CONSTANCY OF PERFORMANCE

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

For the products covered by this EAD the applicable European legal act is Commission Decision 1999/90/EC as amended by Decision 2001/596/EC of 8 January 2001 and corrected by Corrigendum, OJ L 83, p.80 (1999/90/EC).

The system is 2+ for any use except for uses subject to regulations on reaction to fire performance.

For uses subject to regulations on reaction to fire the applicable AVCP systems regarding reaction to fire are 1, or 3, or 4 depending on the conditions defined in the said Decision.

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	Criteria, if any	Minimum number of samples [8)]	Minimum frequency of control [8)]
Factory production control (FPC) [including testing of samples taken at the factory in accordance with a prescribed test plan					
1	Incoming material	As defined in control plan[2)]	As defined in control plan [2)]	As defined in control plan	As defined in control plan
2	Reaction to fire	2.2.1	As defined in control plan [2)]	2.2.1	Once per year [6)]
3	Visual inspection (Visible defects) [3)]	EN 1850-2 [4)]	As defined in control plan [4)]	100 %	Continuously
4	Mechanical strength - Tensile strength	2.2.2	As defined in control plan [2)]	2.2.122	Once each production lot [5)]
5	Elongation at maximum tensile force	2.2.3	As defined in control plan [2)]	2.2.123	Once each production lot [5)]
6	Resistance to static loading	2.2.4	As defined in control plan [2)]	2.2.124	Twice a year
7	Resistance to impact	2.2.5	As defined in control plan [2)]	2.2.125	Twice a year
8	Watertightness	2.2.6	As defined in control plan [2)]	2.2.126	Twice a year
9	Watertightness of joint with adhesive tape	2.2.7	As defined in control plan [2)]	2.2.127	Twice a year
10	Shear resistance of joints	2.2.13	As defined in control plan [2)]	2.2.1213	Twice a year
11	Resistance to tearing (nail shank)	2.2.14	As defined in control plan [2)]	2.2.1214	Twice a year

No	Subject/type of control	Test or control method	Criteria, if any	Minimum number of samples [8)]	Minimum frequency of control [8)]
12	Peel-resistance (180-degree peel)	2.2.17	As defined in control plan [2)]	2.2.1217	Once each production lot [5)]
13	Resistance to damage – water creep at leakage	2.2.21	As defined in control plan [2)]	2.2.1221	Once per year
14	Artificial ageing by long term exposure to elevated temperature	Referred to 2.2.8, but only for 16 weeks and at 70 °C. OIT- only for 0 weeks and for 16 weeks.	As defined in control plan [2)]	2.2.128	Once per year [7)]
15	Alkali resistance in high pH solution	2.2.10	As defined in control plan [2)]	2.2.1210	Once per year [7)]
16	Acid resistance	2.2.11	As defined in control plan [2)]	2.2.1211	Once per year [7)]
17	Compatibility with bitumen	2.2.12	As defined in control plan [2)]	2.2.1212	Once per year [7)]
18	Dimensional stability	EN 1107-2	As defined in control plan [2)]	As defined in control plan	As defined in control plan
19	Bond strength	EN 1542	As defined in control plan [2)]	As defined in control plan	As defined in control plan
20	Jointing tapes (geometry, material, tensile properties)	As defined in control plan[2)]	As defined in control plan [2)]	As defined in control plan	As defined in control plan

NOTE

1) For two specified numbers of samples, the higher number applies.

2) According to product specifications (Control plan).

3) Successful visual inspection does not need to be documented.

4) Visual inspection means e.g. main dimensions, correct assembly, appropriate performance, surface etc. according to the material specification.

5) Production lot means maximum 10000 m^2 fully bonded, pre-applied flexible sheet for waterproofing, manufactured from one batch of raw material. Deviating definition can be given by the TAB depending on the specific product to be assessed and its particular manufacturing processes

6) In case of AVCP system 1 it is recommended to have a minimum frequency of control within the FPC of at least once per year.

7) If control of incoming material and the other controls listed in Table 5 except the ones defined in rows16-19 gave no indication of change of material or properties of the product which has been assessed in the ETA, this control could be left out in the FPC.

8) Due to extending of scope of the EAD, different minimum number of samples and/or different minimum frequency of control can be set by the TAB depending on the specific product to be assessed and its particular manufacturing processes.

3.3 Tasks of the notified body

The cornerstones of the actions to be undertaken by the notified body in the procedure of assessment and verification of constancy of performance for the fully bonded, pre-applied flexible sheet for waterproofing (except for reaction to fire) are laid down in Table 3.3.1.

Table 3.3.1:Control plan for the notified body; cornerstones - under AVCP system 2+

No	Subject/type of control	Test or control method	Criteria, if any	Minimum number of samples	Minimum frequency of control
Initial inspection of the manufacturing plant and of factory production control *(for system 2+ only)*					
1	The notified product certification body shall verify the ability of the manufacturer for a continuous and orderly manufacturing of the product according to the Manufacturer's Control Plan. In particular, the following items shall be appropriately considered. – personnel and equipment – the suitability of the factory production control established by the manufacturer – full implementation of the prescribed test plan	By inspection	According to documentation (Control plan)	-	When starting the production or a new production line
Continuous surveillance, assessment and evaluation of factory production control *(for system 2+ only)*					
2	The notified product certification body shall verify that – the manufacturing process – the system of factory production control – the implementation of the prescribed test plan are maintained. It shall especially take care of the fulfilment of all tasks as covered by table 3.2.1.	By inspection	According to documentation (Control plan)	-	Once per year

The intervention of the notified body under AVCP system 1 is only necessary for reaction to fire for products/materials for which a clearly identifiable stage in the production process results in an improvement of the reaction to fire classification (e.g. an addition of fire retardants or a limiting of organic material).

In this case the cornerstones of the tasks to be undertaken by the notified body under AVCP system 1 are laid down in Table 3.3.2.

Table 3.3.2: Control plan for the notified body, cornerstones - under AVCP system 1

No	Subject/type of control	Test or control method	Criteria, if any	Minimum number of samples	Minimum frequency of control
Initial inspection of the manufacturing plant and of factory production control carried out by the manufacturer regarding the constancy of performance related to reaction to fire and taking into account a limiting of organic material and/or the addition of fire retardants. *(for system 1 only)*					
1	Initial inspection of the manufacturing plant and of factory production control carried out by the manufacturer considering the constancy of performances of reaction to fire and taking into account the limit of the addition of fire retardants.	By inspection	According to documentation (Control plan)	-	When starting the production or a new production line
Continuing surveillance, assessment and evaluation of factory production control carried out by the manufacturer regarding the constancy of performance related to reaction to fire and taking into account a limiting of organic material and/or the addition of fire retardants. *(for system 1 only)*					
2	Continuing surveillance, assessment and evaluation of factory production control carried out by the manufacturer considering the constancy of performances of reaction to fire and taking into account the limit of the addition of fire retardants.	By inspection	According to documentation (Control plan)	-	Once per year

4 REFERENCE DOCUMENTS

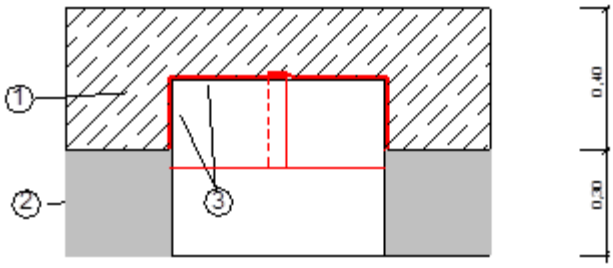
EN 1848-2: 2001	Flexible sheets for waterproofing - Determination of length, width, straightness and flatness - Part 2: Plastic and rubber sheets for roof waterproofing
EN 1849-2: 2009	Flexible sheets for waterproofing - Determination of thickness and mass per unit area - Part 2: Plastic and rubber sheets
EN 1850-2: 2001	Flexible sheets for waterproofing - Determination of visible defects - Part 2: Plastic and rubber sheets for roof waterproofing
EN 12730: 2015	Flexible sheets for waterproofing - Bitumen, plastic and rubber sheets for roof waterproofing - Determination of resistance to static loading
EN 12691: 2018	Flexible sheets for waterproofing - Bitumen, plastic and rubber sheets for roof waterproofing - Determination of resistance to impact
EN 1548: 2007	Flexible sheets for waterproofing – Plastic and rubber sheets for roof waterproofing – Method for exposure to bitumen
EN 1928: 2000	Flexible sheets for waterproofing - Bitumen, plastic and rubber sheets for roof waterproofing - Determination of watertightness
EN 1931: 2000	Flexible sheets for waterproofing - Bitumen, plastic and rubber sheets for roof waterproofing - Determination of water vapour transmission properties
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 12310: 1999	Flexible sheets for waterproofing - Part 1: Bitumen sheets for roof waterproofing - Determination of resistance to tearing (nail shank)
EN 12311-2: 2013	Flexible sheets for waterproofing - Determination of tensile properties - Part 2: Plastic and rubber sheets for roof waterproofing
EN 12317-2: 2010	Flexible sheets for waterproofing - Determination of shear resistance of joints - Part 2: Plastic and rubber sheets for roof waterproofing Add to basket
EN 12390-8: 2019[8]	Testing hardened concrete - Part 8: Depth of penetration of water under pressure
EN 13416: 2001	Flexible sheets for waterproofing - Bitumen, plastic and rubber sheets for roof waterproofing – rules for sampling
EN 13967: 2012	Flexible sheets for waterproofing — Plastic and rubber damp proof sheets including plastic and rubber basement tanking sheet — Definitions and characteristics
EN 1847: 2009	Flexible sheets for waterproofing - Plastics and rubber sheets for roof waterproofing - Methods for exposure to liquid chemicals, including water
EN 13304: 2009	Bitumen and bituminous binders — Framework for specification of oxidised bitumens
EN 206: 2013 + A1: 2016	Concrete — Specification, performance, production and conformity
EN 12390-2: 2009	Testing hardened concrete — Part 2: Making and curing specimens for strength tests
EN ISO 11357-6: 2018	Plastics — Differential scanning calorimetry (DSC) — Part 6: Determination of oxidation induction time (isothermal OIT) and oxidation induction temperature (dynamic OIT)
EN ISO 8510-2: 2010	Adhesives - Peel test for a flexible-bonded-to-rigid test specimen assembly - Part 2: 180 degree peel

[8] Dated reference is made to EN 12390-8:2019. However, it should be noted that tests performed based on EN 12390-8:2009-02 are technically equivalent, as there are no technical changes which affect the assessment method(s) of this EAD.

EN 13501-1:2018	Fire classification of construction products and building elements - Part 1: Classification using test data from fire reaction to fire tests
EN 1107-2:2001	Flexible sheets for waterproofing - Determination of dimensional stability - Part 2: Plastic and rubber sheets for roof waterproofing
EN 1542:1999	Products and systems for the protection and repair of concrete structures - Test methods - Measurement of bond strength by pull-off

ANNEX A

Test sample in the first construction phase – vertical section

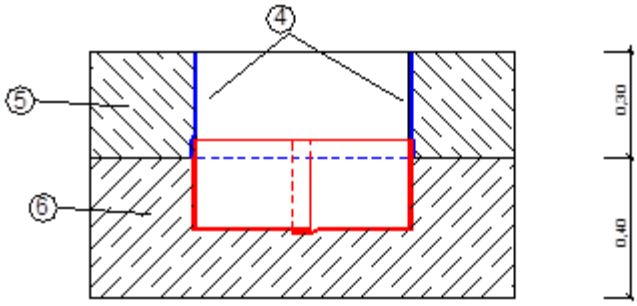


① 1st concreting stage (plate with recess)

② Shuttering formwork

③ Fully bonded, pre-applied flexible sheet for waterproofing (1st part applied to formwork)

Test sample in the first construction phase – vertical section



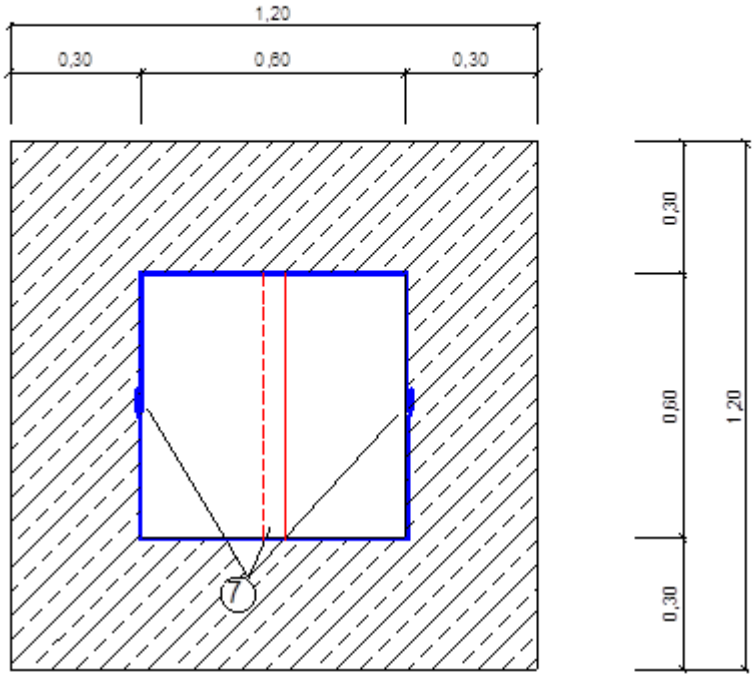
④ Fully bonded, pre-applied flexible sheet for waterproofing (2nd part applied to formwork; vertical overlapping staggered by 90°)

⑤ 2nd concreting stage (frame)

⑥ Turned plate with upstand

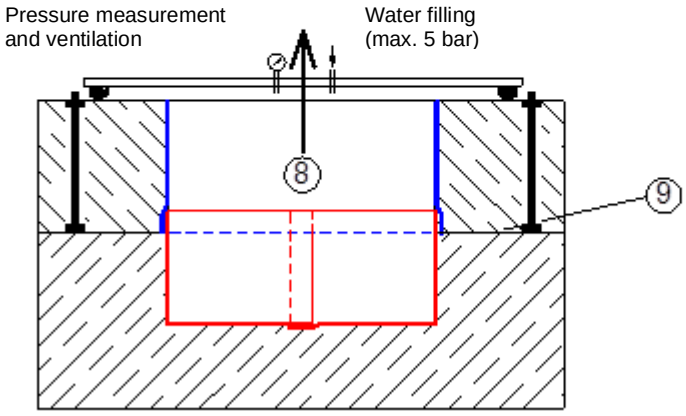
Figure 1 Test sample – construction phase

Test sample in testing phase – horizontal section



7 Overlapping / jointing

Test sample in testing phase – vertical section



8 Enlargement of the gap (construction joint)

9 Widened construction joint

Figure 2 Test sample – testing phase