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Test report

P 7197a-1-E

Commission:	**Tests on composite system of the waterproofing kit based on** **ISOFLEX-PU 500** **according to the guideline European technical approval for "liquid applied roof waterproofing kit" (LARWK) – ETAG 005**
Customer:	**ISOMAT S.A.** **BUILDING CHEMICALS AND MORTARS** **17th km Thessaloniki-Ag. Athanasios** **57003, Agios Athanasios** **Greece**
Persons in charge:	**J. Magner** **Dipl.-Ing. (FH) A. Kruse**
test period:	**January 2012 – February 2014**
Date of the test report:	**2014-02-19**
This test report comprises:	**25 pages incl. 1 annex** **1 attachment with 5 pages**

This test report replaces P 7197-1-E dated 2014-01-28.

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C O N T E N T S

1 SUBJECT

Polymer Institut was charged by ISOMAT S.A. BUILDING CHEMICALS AND MORTARS, Agios Athanasios, Greece, to carry out tests on the waterproofing system based on

ISOFLEX-PU 500

according to

ETAG Nr. 005
Version march 2000
Guideline for the European technical approval
for
liquid applied roof waterproofing kits
Part 1 - General
Part 6 – Special provisions for kits based on polyurethane

The test program was agreed with the client.

General

The ETAG Nr. 005 guideline requires the proof of performance characteristics as a guide for the assessment of usefulness of the „liquid applied roof waterproofing kit“ (LARWK).

- Classification for use by the client:

Useful life:	category W3, expected useful life 25 years
Climate zones:	category S, extreme climate
	category TL4, extreme low temperature
	category TH4, extreme high temperature
User load:	category P4, special

2 RECEIPT OF SAMPLES

The following substances were delivered to Polymer Institut by a forwarding agency:

Overview: Substances

7197/	Substance	Batch	Dimensions (l x w) [mm]	Mass [kg]
1, 2, 16, 17	PRIMER-PU 100	Not specified	-	Each 1
3 – 10, 14, 15	ISOFLEX-PU 500	Not specified	-	Each 1
11	POLYESTER CLOTH	Not specified	600 x 800	-
12	POLYESTER CLOTH	Not specified	1600 x 600	-
13	POLYESTER CLOTH	Not specified	900 x 750	-

Substances 1 - 10 were delivered at the 2012-10-17
Substances 11 - 13 were delivered at the 2012-11-21
Substances 14 - 16 were delivered at the 2013-08-28

The following specimens were delivered to Polymer Institut by a forwarding agency:

Overview: Test specimens

Test specimens – No. 7197/PK…	Type of specimen	Number	Dimensions (l x w x h) [mm]
12.1, 12.2, 12.9, 12.10	Film	4	400 x 300x 2
12.3 – 12.8, 12.11	Film	7	400 x 300x 3
13	EPS plate	1	300 x 300 x 52
14	Bituminous sheeting applied on concrete slab	1	300 x 300 x 43
15	Mineral wool	1	300 x 300 x 64
16	Steel plate	1	300 x 300 x 8
17, 19	Concrete slab	2	300 x 300 x 40

Spe*cimens were delivered at 2012-10-17*

3 DESCRIPTION OF THE COMPOSITE SYSTEM

Overview: Composition of the specimens

Components of the kit	Trade name	Description of the substance*
Primer	PRIMER-PU 100	One component, polyurethane primer. It ensures the proper adhesion of the liquid applied, elastomeric membrane ISOFLEX-PU 500, when waterproofing roofs with porous substrates. By penetrating inside the pores of the substrate, it acts as a bonding layer between ISOFLEX-PU 500 and the substrate.
Fleece (120 g/m^2)	POLYESTER CLOTH	Polyester cloth for reinforcing waterproofing layers
Waterproofing layer	ISOFLEX-PU 500	One component, polyurethane waterproofing liquid membrane for roofs. After hardening it forms a continuous, elastic, waterproof, vapour-permeable sealing layer, without forming seams or joints.

** declaration of the producer*

4 PREPARATION OF THE TEST SPECIMENS

If not specified otherwise the mixture and the application of the system as stated above were done at standard temperature by a representative of the client according DIN EN 23270.

4.2 Preparation of the test specimens

Overview: Consumption mean values

Substrate [mm x mm]	**Consumption mean values of [g/m²]***		**Test specimens – No. 7197/PK…**
	PRIMER-PU 100	**ISOFLEX-PU 500**	
Concrete slab [400 x 400] "1 mm gap"	198	2503	24, 30
Concrete slab [400 x 400] "End to End"	198	2503	31
Concrete slab [400 x 400]	198	2503	32
Concrete slab [300 x 300]	200	2400	17, 18
Bituminous sheeting applied on concrete slab [300 x 300]	-	2400	14
Mineral wool [300 x 300]	-	2400	15
EPS plate [300 x 300]	-	2400	13
Steel plate [300 x 300]	-	2400	16
Film [300 x 300]	-	2400	12.1 – 12.11
Film [470 x 270]	-	2470	33, 34

* *The waiting time between the Primer and the first layer was about 2 - 3 hours ISOFLEX- PU 500 was applied in 4 layers of a consumption of about 900, 500, 500, 500 g/m² and a waiting time of about 12 hours between each layer. (declaration of the producer)*

5 TESTS

If not specified otherwise, all in the overview listed tests were done at standard temperature according DIN EN 23270.

Overview: Tests at the LARWK

Chapter	Object
5.1	Identification of components
5.2	Water vapour transmission
5.3	Watertightness
5.4	Resistance to bond strength
5.5	Resistance to dynamic indentation
5.6	Resistance to static indentation
5.7	Determination of the resistance to fatigue movement
5.8	Resistance to low temperatures
5.9	Resistance to crack bridging
5.10	Resistance to high temperatures
5.11	Resistance to heat ageing
5.12	Resistance to UV - ageing
5.13	Resistance to water ageing
5.14	Minimal / maximal application temperature
5.15	Effect of day joints

The test results are summarized in the annex 1.

5.1 Identification of components

5.1.2 Infrared spectrum

The infrared spectra were recorded in accordance with DIN EN 1767:09-1999 "*Products and systems for the protection and maintenance of concrete structures - test methods - infrared analysis*" with FTIR spectrometer from Varian 3600 and FT-IR Excalibur each in ATR technique in the wavenumber range 4000-500 cm^{-1}.

The substances were measured as delivered.
The diagrams are included in the attachment, figure 1, 2.

5.1.3 Density

The density was determined according to DIN EN ISO 2811-2:06-2011 *"Coating substances - determination of density - Part 2: Immersed body method"'* in two separate tests with a solid sphere (10 cm^3) in each instance at 23 °C. The results are summarized in the following table.

Table 1 : Density

Substance	**Density [g/cm³]**	
	Individual values	**Mean value**
PRIMER-PU 100 7197/ 1	0,984 0,984	**0,984**
ISOFLEX-PU 500 7197/ 3	1,425 1,423	**1,424**

5.1.4 Dynamic viscosity

The dynamic viscosity was determined using a rotational viscosimeter of the company Anton Paar with a ball-plate system according to DIN ISO 3219:10-1994 *"Plastic - polymer/resins in liquid state or as emulsions or dispersions - determination of viscosity using a rotational viscosimeter with defined shear rate"* at a test temperature of 23 °C. The measurement was carried out twice. The shear rate is 500 1/s.
The results are summarized in the following table and the diagrams are included in the attachment, figure 3, 4.

Table 2 : Dynamic viscosity

Substance	Dynamic viscosity [mPa*s]	
	Individual values	Mean value
PRIMER-PU 100 7197/ 1	131 131	**131**
ISOFLEX-PU 500 7197/ 3	3260 3200	**3230**

** rounded to three value indicating digits*

5.1.5 Ash content

The solid content of the mixed substances was determined according to DIN EN ISO 3451-1:11-2008 *"Plastics - determination of ash"* after 24-hour storage in normal climate DIN 23270 and subsequent 3-hour drying time at 550 °C.
The results are summarized in the following table.

Table 3 : Ash content

Substance	Ash content [M.-%]	
	Individual values	Mean value
PRIMER-PU 100 7197/ 1	0,0 0,0	**0,0**
ISOFLEX-PU 500 7197/ 3	45,2 45,2	**45,2**

5.2 Water vapor permeability

The determination of the water vapor permeability was carried out according to DIN EN 1931:03-2001 *„Flexible sheets for waterproofing – Bitumen, plastic and rubber sheets for roof waterproofing – Determination of water vapour transmission properties"*
The test bodies (diameter 90 mm) were drilled from the film and conditioned for 24 hours at standard conditions according to DIN EN 23270.
Then they were bonded steam tight in a diffusion cup which contains waterfree Calciumchloride to get a relative humidity of 0 %.
The cups were weighed and stored in a desiccator which contains saturated Natriumchloride to get a relatic humidity of 75%. They were weighed until they reached a steady state. The determination of water vapor permeability was carried out over a measurement period of 36 days. The results are summarized in the following table.

Table 4: Water vapour permeability

PK - No.:	Moister flow density g [g/(m²*d)]	Diffusion-equivalent air layer thickness s_d [m]	Mean layer thickness d [mm]	Water vapour diffusion resistance factor μ []
7197/ 12.1 - 1	10,07	3,55	2,02	1756
7197/ 12.1 - 4	10,06	3,55	1,99	1783
7197/ 12.1 - 5	9,53	3,75	2,01	1865
Mean value	**9,88**	**3,61**	**2,01**	**1801**

5.3 Watertightness

The watertightness of the system ISOFLEX-PU 500 was tested according to the Technical Report TR-003:05-2004 *„Determination of the watertightness“*. The test specimen were impinged on the upper side with a head of water of 1000 mm which corresponds to 0,1 bar at 23°C. As a hygroscopic indicator a mixture of bromophenol blue (0,5 %) with powdered sugar (99,5 %) was used. Before the test the mixture was sieved with a 0,063 mm diameter sieve and stored in a desiccator.
The hygroscopic indicator was embedded between two filter papers, which lays between the upper side of the test specimen and the test apparatus. The test is passed, when no discoloration is detected.

Test specimen: 7197/ PK12.1
Layer thickness: 2,0 mm

Result:

All three test specimens out of 7197/ PK 12.1 were watertight. No discoloration detected.

5.4 Bond strength

Procedure

The bond strength of the system has been tested following the Technical Report TR-004:05-2004 *„Determination of the resistance to delamination“*.
Differing from TR 004 the coating of the test specimens was drilled wet with a core driller at 5 testing areas (∅ 50 mm) to a depth of 10 mm into the substrate. Afterwards the surplus water was removed and the testing areas were cleaned.
Before testing, the bond strength stamps were bonded with a 2 component PU-adhesive on the drilled surface. After a cure time of about 20 hours the test took place at a temperature of 23 °C with a calibrated testing machine.

Testing conditions

Testing machine:	Bond strength machine of firm Wennigsen Easy M, Type F10D, max. force 10 kN
Testing speed:	300 N/s
Bond strength stamp:	steel stamp (∅ 50 mm)
Adhesive:	2-component PU-adhesive
Testing temperature:	23 °C

The results of the bond strength test are summarized in the following table.

Table 5: *Bond strength following TR-004*

Substrate: PK - No.:	**Bond strength [kPa]**		**Area of failure**
	Individual values	**Mean value**	
Concrete slab 7197/ 19	700 690 640 640 720	**680**	100% adhesion between primer and first layer
Bituminous sheeting applied on concrete slab 7197/ 14	430 730 370 410 390	**470**	100 % cohesion in the bituminous sheeting
EPS slab 7197/ 13	130 70 80 90 80	**90**	100 % cohesion in EPS plate
Steel slab 7197/ 16	1000 860 820 880 1040	**920**	4x 100 % adhesion between first layer and fleece 1x 70 % adhesion between first layer and fleece and 30 % cohesion in the first layer
Mineral wool 7197/ 15	50 60 50 50 50	**50**	100 % cohesion in mineral wool

5.5 Dynamic indentation

This test was carried out using test specimens of ISOFLEX-PU 500 with steel, concrete and polystyrene as substrates according to EOTA TR 006:05-2004 "*Determination of the resistance to dynamic indentation*".

Testing machine and parameters:

Testing machine:	Erichsen impact-testing machine model 304 with 1 kg-body und 1 kg-additional weight
Indentor:	Indentors of steel with - I_2 = 20 mm ∅ - I_3 = 10 mm ∅ - I_4 = 6 mm ∅
Test specimens:	7197/ PK 12.9
Layer thickness:	1,8 mm
Drop height:	30,4 cm
Drop mass:	1,98 kg
Load:	5,9 J (impact energy)
Temperature	23 °C

Detection of watertightness:

Steel substrate:	measuring of conductivity
Concrete substrate:	optical measuring, if doubtful head of 1000 mm water
Polystyrene substrate:	optical measuring, if doubtful head of 1000 mm water

Result:

ISOFLEX-PU 500 was watertight after the indentation test with an indentor I_4 (∅ 6 mm) on all substrates.
The results are summarized in the following table.

Table 6: Dynamic indentation

Substrate of test specimen: **PK - No.:**	**Indentor** **with 5,9 J impact energy**
steel, concrete, polystyrene: 7197/ 12.9	6 mm ∅ = I_4

5.6 Resistance to static indentation

This test was carried out using test specimens of ISOFLEX-PU 500 with steel, concrete and polystyrene as substrates in accordance with EOTA Technical Report TR-007:05-2004 *„Determination of the resistance to static indentation“* under standard conditions according to DIN EN 23270:09-1991, unless shown otherwise. On three marked areas the test specimen gets a load of 150 N, 200 N and 250 N in type of different weight in combination with a spherical steel indentor. In this test 3 spherical indentors with a diameter of 10 mm were used at the same time to transfer the weight.

After the test was finished the detection of watertightness was performed with the help of optical measuring and measuring of conductivity. If the measuring was doubtful, with a head of 1000 mm water.

Testing machine and parameters:

Indentation stamp:	Spherical indentor of steel ∅ = 10 mm
Load:	L_2 = 150 N L_3 = 200 N L_4 = 250 N
Test specimen:	7197/ PK 12.2
Layer thickness:	2,1 mm

The results of the static indentation test on all three substrates are summarized in the following table.

Table 7: Static indentation

Substrate of the test specimen PK – No.:	**Static indentation 24 h**
steel, concrete, polystyrene: 7197/ 12.2	250 N = L_4

Result:

The watertightness of all specimens out of 7197/ 12.2 were detected after applying the load as stated above.
The user load classification is a result of the static and dynamic indentation and is summarized in the following table.

Table 8: User load category ISOFLEX-PU 500

Substrate of the test specimen	**Dynamic indentor with 5,9 J impact energy**	**Static indentation 24 h**	**User load**
steel, concrete, polystyrene	6 mm ∅ = I_4	250 N = L_4	P4, extreme

5.7 Determination of the resistance to fatigue movement

Execution

The test of the resistance to fatigue movement of ISOFLEX-PU 500 was carried out according to Technical Report TR-008:05-2004 *„Determination of the resistance to fatigue movement"* at 3 concrete prisms with the dimensions 300 mm x 50 mm x 50 mm.

To realize a change in the distance of the crack, there was a gap holder of 1 mm thickness between the sawn ends of the concrete test specimens. This gap was sealed up to the bottom.

During the test a tensile load produced a 2 mm gap inside of the concrete test specimens, started from the 1 mm gap. Afterwards the test specimens were compressed to a gap with a width of 0 mm. These both processes were one cycle.
During the test of the determination of the resistance to fatigue movement this cycle were repeated 250, 500 and 1000 times.

After the test ended, the test specimens were examined visual to crack formation or replacements. For this the specimens were lighted from the rear cover with a source of light. If the result was doubtful the watertightness of the roof waterproofing kit was detected using a pipe of sufficient size to impose a head of water of 100 mm during 24 hours.

Testing machine and parameters:

Testing machine:	servo-hydraulic testing machine S59 with cylinder 2 (100 kN) including a automatic cooling to reach a temperature of –20 °C
Test specimens:	3 prisms: 7197/ PK 30.2a, 30-2.1a, 30-3a
Layer thickness:	2,1 mm
Testing speed:	16 mm/h = 0,001 Hz
Testing temperature:	-10 °C
Starting gap:	1,0 mm = zero value for displacement transducer
Testing cycle and duration:	ramp function with linear process 1,0 mm → 2,0 mm → 0,0 mm → 1,0 mm in 15 minutes
Cycle numbers:	250 → Check → 500 → Check → 1000
Duration/ test specimen:	250 h

Result:

All test specimens were watertight and there are no cracks and no debonding after 1000 cycles. So the system ISOFLEX-PU 500 can be classified into category W3.

5.8 Resistance to low temperatures

This test was carried out using test specimens of ISOFLEX-PU 500 with steel as substrate in accordance with EOTA TR 006:05-2004 *"Determination of the resistance to dynamic indentation"* at a temperature of –30 °C, which means a TL4 classification.

Testing machine and parameter see chapter 5.5

Test specimen: 7197/ PK 12.10
Layer thickness: 2,5 mm

Result:

The watertightness of all specimens out of 7197/ 12.10 was detected for the temperature -30 °C (TL4) and the resistance level I_4 (∅ 6 mm).

5.9 Resistance to crack bridging

The resistance to crack bridging was carried out according to the Technical Report TR-013:05-2004 „Determination of crack-bridging capability" at the temperature of -30 °C.

Used test specimens: 7197/ PK 31.1, 31.2, 31.3 with the dimensions (50 x 290) mm
Layer thickness: 2,2 mm

Execution

The test specimens consists out of two concrete prisms, which were fixed "end to end" and coated afterwards. The prisms were pulled apart with a speed of 0,5 mm/min until the gap reached a width of 1,5 mm. This gap was hold for 5 minutes.
Afterwards the test specimens were brought to ambient temperature to check the watertightness visual and with a head of water of 100 mm for 24 h.

Result:

All three test specimens did not show any damage, only a constriction of the coat. They were also watertight.

5.10 Resistance to high temperatures

The resistance of ISOFLEX-PU 500 to high temperatures was carried out at a temperature of 90 °C on a steel substrate according to the Technical Report TR-007:05-2004 *„Determination of the resistance to static indentation"*.

Execution, testing machine and parameter see chapter 5.6

Test specimen: steel: 7197/ PK 12.7
Layer thickness: 1,9 mm

Result:

All three test specimens out of 7197/ 12.7 were watertight for the temperature +90 °C (TH4) and the load 250N (L_4).

5.11 Resistance to heat ageing

The effect of the heat ageing to the resistance of ISOFLEX-PU 500 against mechanical damage was classified by the client to the climatic zone "strict" (S) and the working life category W3.

The system applied on concrete slabs and a film were heat aged according to the Technical Report TR-011:05-2004 *„Exposure procedure for accelerated ageing by heat"* for 200 days at a temperature of 80 °C.

5.11.1 Resistance to dynamic indentation at -30 °C

Testing machine and parameter see chapter 5.5

Test specimen: steel: 7197/ PK 12.6b
Layer thickness: 2,5 mm

Result:

The watertightness of all specimens out of 7197/ 12.6b was detected for the temperature -30 °C and the resistance level I_4 (∅ 6 mm).

5.11.2 Determination of the resistance to fatigue movement

The test of the resistance to fatigue movement of ISOFLEX-PU 500 was carried out according to the Technical Report TR-008:05-2004 *„Determination of the resistance to fatigue movement"* at 3 coated concrete prisms with the dimensions 300 mm x 50 mm x 50 mm.

Test specimens: 7197/ PK 24b1, 24b2, 24b3
Layer thickness: 2,9 mm

Testing machine and parameter see chapter 5.7

Test temperature: -10 °C

Amount of cycles: 50

After the test ended, the test specimens were examined visual to crack formation or replacements. For this the specimens were lighted from the rear cover with a source of light. If the result was doubtful, the watertightness of the roof waterproofing kit was

detected using a pipe of sufficient size to impose a head of water of 100 mm during 24 hours.

Result:

All three specimens were watertight after 50 cycles and did not show any debondings. So the requirements for the category W3 and climatic zone S are fulfilled.

5.11.3 Testing of the tensile strength

The tensile strength and the elongation at tensile strength of a film were determined according to EN 527-2:06-2012 *"Plastics - Determination of tensile properties - Part 2: Test conditions for moulding and extrusion plastics"*.
The specimens were prepared out of a heat aged film for 200 days at 80 °C.

Testing machine and parameter:

Testing machine:	universal testing machine UPM 1445, Fa. Zwick
Specimen's type:	1B according to EN 527-2
Test temperature:	23°C
Test speed:	200 mm/min
Test specimen:	7197/ PK 12.6b

Five tension bars were tested after and before heat ageing to get a comparison.
The test results for the climatic zone S and the working life category W3 are summarized in the following table.

Table 9: Tensile strength of ISOFLEX-PU 500 after heat ageing (W3)

PK - No.	Tensile stress [N/mm²]*		Maximal Elongation [%]*		Layer thickness [mm]	Figure in attachment
	Individual values	Mean value	Individual values	Mean value		
7197/ 12.7 – 2 (not aged)	6,57 6,31 7,12 7,48 7,56	**7,01**	39,2 44,1 38,5 43,3 41,0	**41,6**	1,98 2,05 1,67 1,84 1,76	5
7197/ 12.6b (heat aged)	5,79 5,15 4,65 5,01 5,34	**5,19**	38,6 31,8 35,4 35,9 32,5	**34,9**	2,72 2,61 2,81 2,80 2,83	6

**Information takes place of three value digits*

5.12 Resistance to UV exposure

Specimens of ISOFLEX-PU 500 were exposed according to the Technical Report TR 010:05-2004 *"Exposure procedure for artificial weathering"* using fluorescent tubes (UV-A) with the following conditions:

Testing machine and parameter:

Device:	Weiss UV-Global UV3-200
Radiation:	1000 MJ/m² (category W3)
Duration:	6943 h (category W3)
Light source type:	fluorescent light source, according to EN ISO 4892-3
Spray cycle:	1 h spraying at 23 °C 5 h dry period at 60 °C and 10 % r.F.

After the UV exposure the following tests were carried out.

5.12.1 Resistance to dynamic indentation at -10 °C

Testing machine and parameter see chapter 5.5

Test specimen:	steel: 7197/ PK 12.3b
Layer thickness:	2,6 mm

Result:

The watertightness of all specimens out of 7197/ 12.3b was detected for the temperature -10 °C and the resistance level I_4 (∅ 6 mm).

5.12.2 Testing of the tensile strength

The tensile strength and the elongation at tensile strength of a film were determined according to EN 527-2:06-2012 *"Plastics - Determination of tensile properties - Part 2: Test conditions for moulding and extrusion plastics"*.
The specimens were prepared out of a film, which got UV exposure (chapter 5.12)

Testing machine and parameter:

Testing machine:	universal testing machine UPM 1445, Fa. Zwick
Specimen's type:	1B according to EN 527-2
Test temperature:	23 °C
Test speed:	200 mm/min
Test specimen:	7197/ PK 12.3b

Five tension bars were tested after and before UV exposure to get a comparison. The test results for the climatic zone S and the working life category W3 are summarized in the following table.

Table 10: Tensile strength of ISOFLEX-PU 500 after UV exposure (W3)

PK - No.	Tensile stress [N/mm²]*		Maximal Elongation [%]*		Layer thickness [mm]	Figure in attachment
	Individual values	Mean value	Individual values	Mean value		
7197/ 12.7 – 2 (not aged)	6,57 6,31 7,12 7,48 7,56	**7,01**	39,2 44,1 38,5 43,3 41,0	**41,6**	1,98 2,05 1,67 1,84 1,76	5
7197/ 12.3b (UV aged)	5,05 4,85 4,77 4,90 4,95	**4,90**	31,3 39,1 36,9 31,3 35,8	**34,9**	2,77 2,74 2,79 2,70 2,76	7

** Information takes place of three value digits*

5.13 Resistance to water ageing

The effect of the water ageing to the system ISOFLEX-PU 500 was tested according to the working life category W3 and the Technical Report TR-012:05-2004 *„Exposure procedure for accelerated ageing by hot water“*.
For the stress period of 180 days the system was stored in water at a temperature of 60 ± 2 °C.

5.13.1 Resistance to static indentation at 90 °C

Testing machine and parameter see chapter 5.6

Test specimen: steel: 7197/ PK 12.5b
Layer thickness: 1,9 mm

Result:

The watertightness of all specimens out of 12.5b was detected for the temperature +90 °C and the resistance level L_4 (∅ 6 mm).

5.13.2 Resistance to bond strength

The bond strength of the System was tested following the Technical Report TR-004:05-2004 *„Determination of the resistance to delamination“*.

Testing machine and parameter see chapter 5.4

The results for the working life category W3 are summarized in the following table.

Table 11: Bond strength of ISOFLEX-PU 500 after water ageing W3

Substrate: PK - No.:	**Bond strength [kPa]**	
	Individual values	**Mean value**
Concrete: 7197/ PK 18 (water aged)	580 490 710 650 840	**650**

Area of failure:

1) 100% adhesion between Primer-PU 100 and ISOFLEX-PU 500.
2) 50% adhesion between Primer-PU 100 and ISOFLEX-PU 500.
   50% cohesion of ISOFLEX-PU 500
3) 40% adhesion between Primer-PU 100 and ISOFLEX-PU 500.
   60% cohesion of ISOFLEX-PU 500
4) 80% adhesion between Primer-PU 100 and ISOFLEX-PU 500.
   20% cohesion of ISOFLEX-PU 500
5) 10% adhesion between Primer-PU 100 and ISOFLEX-PU 500.
   90% cohesion of ISOFLEX-PU 500

5.14 Minimal / Maximal application temperature

In order to check if it’s possible to get a satisfactory bonded system also at the minimal and maximal application temperature which was given by the client.
Comparative tests to the tensile strength and the dynamic indentation were done.

Manufactured test specimens:

Application temperature:	Minimal +5 °C	Maximal +30°C
Test specimens:	7197/ PK 34	7197/ PK 33
Layer thickness:	2,1 mm	2,1 mm

5.14.1 Resistance to dynamic indentation at -10 °C

Testing machine and parameter see chapter 5.5

Test specimens: steel: 7197/ PK 33, 34
Layer thickness: 2,1 mm

Result:

The watertightness of all specimens was detected for the temperature –10 °C and the resistance level I_4 (∅ 6 mm).

5.14.3 Testing of the tensile strength

The tensile strength and the elongation at tensile strength of a film were determined according to EN 527-2:06-2012 *"Plastics - Determination of tensile properties - Part 2: Test conditions for moulding and extrusion plastics"*.
The specimens were prepared out of a film applied at minimal and maximal application temperature (chapter 5.14).

Testing machine and parameter:

Testing machine:	universal testing machine UPM 1445, company Zwick
Specimen's type:	1B according to EN 527-2
Test temperature:	23 °C
Test speed:	200 mm/min
Test specimens:	7197/ PK 33, 34

The test results are summarized in the following table.

Table 12: Tensile strength of ISOFLEX-PU 500 Min/ Max application temperature

PK - No.	Tensile stress [N/mm²]*		Maximal Elongation [%]*		Layer thickness [mm]	Figure in attachment
	Individual values	Mean value	Individual values	Mean value		
7197/ 12.7 – 2 (not aged)	6,57 6,31 7,12 7,48 7,56	**7,01**	39,2 44,1 38,5 43,3 41,0	**41,6**	1,98 2,05 1,67 1,84 1,76	5
7197/ 34 (Minimal application temperature)	6,87 6,56 7,48 6,31 6,69	**6,78**	43,3 44,5 43,3 44,1 43,0	**43,9**	1,76 1,82 1,67 1,67 1,93	8
7197/ 33 (Maximal application temperature)	7,56 6,74 7,12 6,81 7,40	**7,12**	41,0 39,4 38,5 37,2 40,8	**39,4**	2,01 1,83 1,84 2,05 1,98	9

** Information takes place of three value digits*

5.15 Effect of day joints

For the test of the effect of day joints a concrete slab got applied two times. Between both layers there was a waiting period of 28 days. Afterwards the test of the bond strength was determined following the Technical Report TR-004:05-2004 *„Determination of the resistance to delamination“*.

Testing machine and parameter see chapter 5.4

The results are summarized in the following table.

Table 13: Bond strength of the recoat ability of ISOFLEX-PU 500

Substrate: PK – No.:	**Bond strength [kPa]**	
	Individual values	**Mean value**
Concrete: 7197/ PK 32	850 900 770 840 790	**830**

Area of failure:

1 - 3) 30% adhesion between PRIMER-PU 100 and ISOFLEX-PU 500.
70% cohesion of ISOFLEX-PU 500

4 - 5) 50% adhesion between PRIMER-PU 100 and ISOFLEX-PU 500.
50% cohesion of ISOFLEX-PU 500

6 SUMMARY

On behalf of ISOMAT S.A. BUILDING CHEMICALS AND MORTARS, Agios Athanasios, Greece, Polymer Institut executed tests on the waterproofing system based on

ISOFLEX-PU 500

according to

ETAG Nr. 005
Version march 2000
Guideline for the European technical approval
for
liquid applied roof waterproofing kit
Part 1: General
Part 6: Special provisions for kits based on polyurethane

The results of the tests are written in the chapters above and contained as a summary in annex 1.

General

The ETAG Nr. 005 guideline requires the proof of performance characteristics as a guide for the assessment of usefulness of the „liquid applied roof waterproofing kit“ (LARWK).

- Fulfilled requirements for Classification:

Useful life:	category W3, expected useful life 25 years
Climate zones:	category S, extreme climate
	category TL4, extreme low temperature
	category TH4, extreme high temperature
User load:	category P4, special

Flörsheim-Wicker, 2014-02-19

Head of the institute

J. Magner

Kiwa Polymer Institut kiwa

Person in charge

Dipl.-Ing. (FH) A. Kruse

Annex 1

Summarized results for P 7197

Chapter	Object	Requirements	Results
5.1	Identification of components	values	values
5.2	Water vapour transmission	value	μ= 1801
5.3	Watertightness	watertight	watertight
5.4	Resistance to bond strength	≥ 50 kPa	Passed see table 9
5.5	Resistance to dynamic indentation	watertight	watertight I_4
5.6	Resistance to static indentation	watertight	watertight L_4
5.7	Resistance to fatigue movement	watertight, max. deboning 75 mm, 50 mm on one site	watertight, no debonding
5.8	Resistance to low temperatures	watertight	watertight I_4
5.9	Resistance to crack bridging	no cracks or debonding	watertight, slightly constriction
5.10	Resistance to high temperatures	watertight	watertight I_4
5.11	Resistance to heat ageing	watertight	watertight I_4
		tensile strength value	RM: 5,19 N/mm^2 AM: 34,9 %
		watertight, max. deboning 75 mm, 50 mm on one site	watertight, no debonding
5.12	Resistance to UV - ageing	watertight	watertight I_4
		tensile strength value	RM: 4,90 N/mm^2 AM: 34,9 %
5.13	Resistance to water ageing	watertight	watertight L_4
		bond strength >50 kPa	650 kPa
5.14	Minimal / maximal application temperature	watertight	watertight I_4
		tensile strength value	Min: RM: 6,78 N/mm^2 AM: 43,9 % Max: RM: 7,12 N/mm^2 AM: 39,4 %
5.15	Effect of day joints	>50 kPa	830 kPa

RM = tensile stress
AM = maximal elongation