NANO-CERAMIC®

WWW.NANO-CERAMIC.COM INDUSTRIAL PROTECTIVE COATINGS

Test Report EN 1504-2

TECHNICKÝ A SKÚŠOBNÝ ÚSTAV STAVEBNÝ, n. o.
Test laboratory
Studená 3, 821 04 Bratislava

Reg. No. 004/S-045

Laboratory branch in: Štefánikova 24, 059 41 Tatranská Štrba, Slovak Republic, tel. +421-52-4484 471, fax: +421-52-4484 472, e-mail: kazar@tsus.sk

TEST REPORT No. 90-14-0025

JOB

No.: 90130243

Client: PT NANO CERAMIC INDONESIA
The Central 88, Kemayoran, (The Linq)
Jl. Trembesi Blok D3 N0. 378
14410, Pademangan, Jakarta
Indonesia

OBJECT OF TESTING

Product: **Permanent Coating System (PCS) CONCRETE**

- coating for principles 1, 5, 6 - methods 1.3, 5.1, 6.1 of EN 1504-2

Manufacturer: manufacturer is the client

Standard of product: EN 1504-2: 2004 Products and systems for the protection and repair of concrete structures. Definitions, requirements, quality control and evaluation of conformity. Part 2: Surface protection systems for concrete

PRODUCT SAMPLE

Description of sample: Permanent Coating System (PCS) CONCRETE
two-component coating material - component C1 in a can on the volume of 3000 ml, component C2 in a can on the volume of 400 ml

Designation of sample by client: Permanent Coating System (PCS) CONCRETE

Sampler: client

Place and date of delivery: Laboratory branch in Tatranská Štrba, on 23rd September 2017

Designation of sample by lab.: 173/13

TESTS

Preparation and coating: Permanent Coating System (PCS) CONCRETE was prepared and applied in accordance with the manufacturer's instructions. Components C1 and C2 of product were mixed in volume ratio 7,5 : 1. Coating was applied to clean and dry substrate, application by roller in a single layer.
The used substrates are specified below under the relevant tests.
Concrete substrates were prepared and cured according to EN 1766. The surface was sandblasted prior to treatment.
Determination of dry film thickness was carried out in accordance with EN 2808, wedge cut method.

Cross cut test - accredited test

Test procedure: EN ISO 2409: 2013 Paints and varnishes. Cross-cut test

Description of test specimens: one treated concrete slab with dimensions of 300 mm x 300 mm, thickness 50 mm, the coating applied to one face
- test substrate: concrete Type MC (0,40)
- application of coating: as described above
- curing time after application: 7 days at (23±2)°C and (50±5)% relative humidity

Test specimens prepared by: Jozef Kukliš

Test conditions:
- laboratory environment
- using cutting tool: 1c
- distance of cuts: 4 mm according to EN 1504-2, Table 5

Deviations from the standard: none
Date of test: 14th November 2017
Test personnel: Jozef Kukliš

Carbon dioxide permeability - accredited test

Test procedure: EN 10626: 2003 Paints and varnishes. Coating materials and coating systems for exterior masonry and concrete. Part 6: Determination of carbon dioxide permeability

Description of test specimens: three treated circular test specimens with a diameter of 90 mm, the coating applied on one face
- test substrate: unglazed ceramic tiles with a thickness of 6 mm
- application of coating: as described on page 1
- curing time after application: 7 days at (23±2)°C and (50±5)% relative humidity
- conditioning prior to testing: in accordance with EN 1062-11, Clause 4.3. (The test specimens were subjected to three cycles comprising 24 h storage in water at (23± 2)°C and 24 h drying at (50± 2)°C). Afterwards the test pieces were dried over desiccant to constant mass.)
- sealing compound: paraffin SASOLWAX 7837 (Manufacturer: Sasol Wax, Hamburg, Germany) mixed with refined crystalline paraffin
- In parallel, the diffusion resistance was determined against a CO2 reference film. Parallel measurement has been established without deviations from the predetermined tolerance.

Test specimens prepared by: Jozef Kukliš

Test conditions:

- method A: Gravimetric method	
- exposed area of the test specimen **A**	0,005 m^2
- time interval between two weighings of the test specimens	24 h
- used sodium hydroxide granulated for elemental analysis	
- test temperature	23°C
- test concentration of carbon dioxide in chamber	10 % (V/V)
- mean barometric pressure during test $\mathbf{p}_{amb}$	101,7 kPa
- the diffusion coefficient of carbon dioxide in air D_{CO2}	1,38 m^2/d
- the difference in concentration of carbon dioxide $\|\Delta c\|$	180 g/m^3

Deviations from the standard: none
Date of test: from 11th to 22nd November 2017
Test personnel: Jozef Kukliš

Permeability to water vapour - accredited test

Test procedure: EN ISO 7783: 2012 Paints and varnishes. Determination of water-vapour transmission properties. Cup method

Description of test specimens: three treated circular test specimens with a diameter of 90 mm, the coating applied on one face
- test substrate: unglazed ceramic tiles with a thickness of 6 mm
- application of coating: as described on page 1
- curing time after application: 7 days at (23±2)°C and (50±5)% relative humidity
- conditioning prior to testing: in accordance with EN ISO 7783, method B (The test specimens were subjected to three cycles comprising 24 h storage in water at (23± 2)°C and 24 h drying at (50± 2)°C))
- sealing compound: paraffin SASOLWAX 7837 (Manufacturer: Sasol Wax, Hamburg, Germany) mixed with refined crystalline paraffin

Test specimens prepared by: Jozef Kukliš

Test conditions:

- measuring: wet cup method	
- exposed area of the test specimen **A**	0,005 m^2
- time interval between two weighings of the test specimens	24 h
- used saturated aqueous solution - $NH_4H_2PO_4$	
- test temperature	23°C
- relative humidity in climate chamber	50%
- relative humidity in test cup	93%
- water vapour pressure difference $\Delta\mathbf{p}_v$	1207 Pa
- standard barometric pressure $\mathbf{p}_0$	1013,25 hPa
- mean barometric pressure during test **p**	1014,9 hPa
- gas constant of water vapour $\mathbf{R}_v$	462 Nm/(kg.K)
- test temperature **T**	296 K
- water-vapour transmission rate of the substrate	409,6^0 $g/(m^2.d)$

Deviations from the standard: none
Date of test: from 11th to 21th November 2017
Test personnel: Jozef Kukliš

Capillary water absorption and water permeability water - accredited test

Test procedure: EN 1062-3: 2008 Paints and varnishes – Coating materials and coating systems for exterior masonry and concrete. Part 3: Determination of liquid water permeability

Description of test specimens: three treated test specimens with dimensions of approximately 150 mm x 150 mm, thickness 30 mm, coating applied to one face
- test substrate: calcium silicate bricks
- application of coating: as described on page 1
- curing time after application: 7 days at (23±2)°C and (50±5)% relative humidity
- the reverse side and the edges of the test specimens were sealed with two layers of two- component epoxy varnish, subsequently drying for further 7 days at (23±2)°C and (50±5)% relative humidity
- conditioning prior to testing: in accordance with EN 1062-3, Clause 6.4.2 (The test specimens were subjected to three cycles comprising 24 h storage in water at (23± 2)°C and 24 h drying at (50± 2)°C))

Test specimens prepared by: Jozef Kukliš

Test conditions: laboratory environment

Deviations from the standard: none

Date of test: from 7th to 08th November 2017

Test personnel: Jozef Kukliš

Thermal change compatibility - Thunder-shower cycling (thermal shock) and Freeze-thaw cycling with de-icing salt immersion - accredited test

Test procedure: EN 13687-2: 2002 Products and systems for the protection and repair of concrete structures. Test methods. Determination of thermal compatibility. Part 2. Thunder-shower cycling (thermal shock)
EN 13687-1: 2002 Products and systems for the protection and repair of concrete structures. Test methods. Determination of thermal compatiblity. Part 1: Freeze-thaw cycling with de-icing salt immersion

Description of test specimens: two treated concrete slabs with dimensions of 300 mm x 300 mm, thickness 100 mm, the coating applied to one face
- test substrate: concrete Type MC (0,40)
- application of coating: as described on page 1
- curing time after application: 7 days at (23±2)°C and (50±5)% relative humidity
- all surfaces of the specimens except the 300 mm x 300 mm test face were sealed with thermosetting resin, subsequently drying for further 7 days at (23±2)°C and (50±5)% relative humidity

Test specimens prepared by: Jozef Kukliš

Test conditions: Tests of the thermal change compatibility according to EN 13687-1 and EN 13687-2 were carried out on the same test samples pursuant to the requirements of EN 1504-2, Table 5. The test samples were subjected to 10 cycles of the thunder-shower and then to 20 cycles of the freeze-thaw cycling with de-icing salt immersion.
One cycle of the thunder-shower took 6 h and comprised the following stages:
- storage under radiant heat at (60±5)°C for 5 h and 45 min
- dousing with water at a temperature of (12±3)°C for 15 min

One cycle of the freeze-thaw cycling lasted for 4 h and comprised the following stages:
- immersion in the tank containing saturated sodium chloride solution at a temperature (-15±2)°C for 2 h
- storage in the water tank at a temperature of (21±2)°C for 2 h

After every 10 cycles and after the end of the exposure was evaluated:
- degree of blistering, method according to EN ISO 4628-2;
- degree of cracking, method according to EN ISO 4628-4;
- degree of flaking, method according to EN ISO 4628-5.

7 days after the end of the exposure was evaluated adhesion strength by pull-off test.

Deviations from the standard: none

Date of test:
- exposure: from 14th to 26th November 2017
- pull-off test: 3rd December 2017

Test personnel: Jozef Kukliš

Thermal change compatibility – Freeze-thaw cycling without de-icing salt impact - accredited test

Test procedure: 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

Description of test specimens: two treated concrete slabs with dimensions of 300 mm x 300 mm, thickness 100 mm, the coating applied on one face
- test substrate: concrete Type MC (0,40)
- application of coating: as described on page 1
- curing time after application: 7 days at (23±2)°C and (50±5)% relative humidity
- all surfaces of the specimens except the 300 mm x 300 mm test face were sealed with thermosetting resin, subsequently drying for further 7 days at (23±2)°C and (50±5)% relative humidity

Test specimens prepared by: Jozef Kukliš

Test conditions: The test samples were subjected to 20 cycles of the freeze-thaw cycling according to EN 13687-3, Clause 7.2.
One cycle took 24 h and comprised the following stages:
- 2 h water storage at (21±2)°C
- 3 h cooling with air at (-15±2)°C
- 4 h storage at (-15±2)°C:
- 15 min heating with water at (21±2)°C
- 1h 15 min water storage at (21±2)°C
- 1 h 30 min heating air at (60±2)°C
- 10 h air storage at (60±2)°C
- 15 min cooling with water at (21±2)°C
- 1 h 45 min water storage at (21±2)°C

After 10 cycles and after the end of the exposure were evaluated:
- degree of blistering, method according to EN ISO 4628-2;
- degree of cracking, method according to EN ISO 4628-4;
- degree of flaking, method according to EN ISO 4628-5.

7 days after the end of the exposure was evaluated adhesion strength by pull-off test.

Deviations from the standard: none

Date of test:
- exposure: from 14th November to 05th December 2017
- pull-off test: 12th December 2017

Test personnel: Jozef Kukliš

Thermal change compatibility – ageing at 70°C - accredited test

Test procedure: EN 1062-11: 2002 Paints and varnishes. Coating materials and coating systems for exterior masonry and concrete Part 11: Methods of conditioning before testing

Description of test specimens: two treated concrete slabs with dimensions of 300 mm x 300 mm, thickness 100 mm, the coating applied on one face
- test substrate: concrete Type MC (0,40)
- application of coating: as described on page 1
- curing time after application: 7 days at (23±2)°C and (50±5)% relative humidity

Test specimens prepared by: Jozef Kukliš

Test conditions: The test samples were subjected to aging at temperature 70°C over a period 7 days.

Immediately after the end of the exposure was evaluated:
- degree of blistering, method according to EN ISO 4628-2;
- degree of cracking, method according to EN ISO 4628-4;
- degree of flaking, method according to EN ISO 4628-5.

7 days after the end of the exposure was evaluated adhesion strength by pull-off test.

Deviations from the standard: none

Date of test:
- exposure: from 14th to 21st November 2017
- pull-off test: 28th November 2017

Test personnel: Jozef Kukliš

Resistance to temperature shock - accredited test

Test procedure:	EN 13687-5: 2002 Products and systems for the protection and repair of concrete structures. Test methods. Determination of thermal compatibility. Part 5: Resistance to temperature shock
Description of test specimens:	two treated concrete slabs with dimensions of 400 mm x 400 mm, thickness 50 mm, the coating applied on one face - test substrate: concrete Type MC (0,40) - application of coating: as described on page 1 - curing time after application: 7 days at (23±2)°C and (50±5)% relative humidity
Test specimens prepared by:	Jozef Kukliš
Test conditions:	- Testing liquid: silicone oil - Test temperature: +150°C Immediately after the end of the exposure was evaluated: - degree of blistering, method according to EN ISO 4628-2; - degree of cracking, method according to EN ISO 4628-4; - degree of flaking, method according to EN ISO 4628-5. 48 h after the end of the exposure was evaluated adhesion strength by pull-off test.
Deviations from the standard:	none
Date of test:	- exposure: 19th November 2017 - pull-off test: 21st November 2017
Test personnel:	Jozef Kukliš

Resistance to severe chemical attack - accredited test

Test procedure:	EN 13529: 2003 Products and systems for the protection and repair of concrete structures. Test methods. Resistance to severe chemical attack
Description of test specimens:	one treated concrete slab with dimensions of 300 mm x 300 mm, thickness 50 mm, the coating applied on one face - test substrate: concrete Type C (0,45) with a maximum size of aggregate of 8 mm - application of coating: as described on page 1 - curing time after application: 7 days at (23±2)°C and (50±5)% relative humidity
Test specimens prepared by:	Jozef Kukliš
Test conditions:	- laboratory environment - the test duration: Class I: 3 days without pressure - used testing liquids: a) testing liquid for group 1. Petrol Composition of testing liquid in accordance to EN 13529, Table A1: - 47,5 % Vol.-% toluene - 30,4 % Vol.-% isooctane - 17,1 % Vol.-% n-heptane - 3,0 % Vol.-% methanol - 2,0 % Vol.-% tert.-butanol b) chlorinated water Testing solution was prepared according to EN 14891 with the addition of 200 mg/l sodium chloride and 200 mg/l sodium sulphate to fresh water. Immediately after the end of the exposure was evaluated: - degree of blistering, method according to EN ISO 4628-2; - degree of cracking, method according to EN ISO 4628-4; - degree of flaking, method according to EN ISO 4628-5 24 h after removal of the testing liquids the hardness was measured by Buchholz indentation test according to EN ISO 2815.
Deviations from the standard:	none
Date of test:	- exposure: from 22nd to 25th November 2017 - Buchholz indentation test: 26th November 2017
Test personnel:	Jozef Kukliš

Impact resistance - accredited test

Test procedure:	EN ISO 6272-1: 2004 Paints and varnishes – Rapid-deformation (impact resistance) tests. Part 1: Falling-weight, large-area indenter
Description of test specimens:	one treated concrete slab with dimensions of 300 mm x 300 mm, thickness 50 mm, the coating applied on one face - test substrate: concrete Type MC (0,40) - application of coating: as described on page 1 - curing time after application: 14 days at (23±2)°C and (50±5)% relative humidity
Test specimens prepared by:	Jozef Kukliš
Test conditions:	laboratory environment
Deviations from the standard:	none
Date of test:	14th November 2017
Test personnel:	Jozef Kukliš

Adhesion strength by pull-off test - accredited test

Test procedure:	EN 1542: 1999 Products and systems for the protection and repair of concrete structures. Test methods. Measurement of bond strength by pull-of
Description of test specimens:	one treated concrete slab with dimensions of 300 mm x 300 mm, thickness 100 mm, the coating applied on one face - test substrate: concrete Type C (0,70) - application of coating: as described on page 1 - curing time after application: 7 days at (23±2)°C and (50±5)% relative humidity
Test specimens prepared by:	Jozef Kukliš
Test conditions:	laboratory environment
Deviations from the standard:	none
Date of test:	19th November 2017
Test personnel:	Jozef Kukliš

Behaviour after artificial atmospheric agents - accredited test

Test procedure:	EN 1062-11: 2002 Paints and varnishes. Coating materials and coating systems for exterior masonry and concrete. Part 11: Methods of conditioning before testing
Description of test specimens:	three treated test specimens with dimensions of 300 mm x 300 mm, coating applied to one face - test substrate: fibre cement board - application of coating: as described on page 1 - curing time after application: 14 days at (23±2)°C and (50±5)% relative humidity
Test specimens prepared by:	Jozef Kukliš
Test conditions:	The test samples were subjected for total exposure duration 2000 hours to UV-A radiation and humidity in accordance with STN EN 1062-11, Clause 4.2. Exposure consisted of the following cycles: - 4 h UV irradiation (dry phase) at a Black Standard Temperature (BST) of (60 ± 3)°C. Used laboratory light source: fluorescent lamps type 2 UV-A (340 nm) - 4 h wetting without UV radiation at a Black Standard Temperature (BST) of (50 ± 3)°C After 2000 h of the exposure were evaluated: - degree of blistering, method according to EN ISO 4628-2; - degree of cracking, method according to EN ISO 4628-4; - degree of flaking, method according to EN ISO 4628-5.
Deviations from the standard:	none
Date of test:	from 11th November 2017 to 4th February 2018
Test personnel:	Jozef Kukliš

Applied instrumentation:

ID	Name	Range	Unit	Division
M900007	Calliper	(0 - 250,00)	mm	0,01
M900008	Pull-off tester ERICHSEN 417	0 až 47,00	MPa	0,5
M900009	Balance Kern PRJ 6200-2NM	0 až 6200	g	0,01
M900011	Stopwatch	(0 - 1800)	s	0,1
M900018	Analytical balance Sartorius BP 300 S	(0 - 303,00)	g	0,0001
M900031	Digital calliper	(0 - 150,00)	mm	0,01
M900037	Coating thickness gauge PIG	0 až 2	mm	0.02
M900044	Automatic recorder of temperature and humidity	((-25) - 45)	°C	0,1
		(15 - 95)	%	1,0
Z900001	Climatized chamber Vötsch VC 4034	-40 až +180	°C	0,1
Z900002	Laboratory ventilated oven STERIMAT 354.3	+20 až +250	°C	1
Z900015	Aluminium cups with free test area of 0,005 m²			
Z900021	Falling-weight apparatus			
Z900023	Barometer	960 až 1040	hPa	1
Z900024	Desiccator			
Z900028	Test chamber CO_2	+20 až +250	°C	1
Z900026	Buhholz hardness Tester			
Z900030	Equipment with radiant surface heater			
Z900029	Equipment for water sprinkler			
Z900034	Apparatus for artificial ageing Q-U-V tester			
Z600037	Programmable climatic cabinet			
Z900040	Steel-cylinder			
Z900045	Moulds for preparing concrete plates			
Z900047	Concrete mixer 125 l			
Z900050	Scarecrows electric table for compacting concrete			
Z900053	Magnifying glass - with a magnification of 10 x			
	Hot plate			

TEST RESULTS

1) Cross cut test

Number of measurement	Thickness of coating (µm)	Classification degree
1	38	1
2	42	1
3	40	1

- complied the classification degree 1

2) Carbon dioxide permeability

Test specimen No.	Mean value of the test specimen thickness ***s*** (m)	Mass difference of two weighings at constant change of mass ***d_m*** (g)	Carbon dioxide permeability ***i*** (g/(m².d))	Diffusion-equivalent air layer thickness ***s_d*** (m)	Diffusion resistance number ***m*** (-)
1	0,000044	0,0107	2,10	117,76	$2,68.10^6$
2	0,000048	0,0149	2,93	84,54	$1,76.10^6$
3	0,000048	0,0123	2,42	102,43	$2,13.10^6$
Average	0,000047	0,0126	2,48	**101,57**	$2,19.10^6$
Extended uncertainty U			0,54	21,72	$0,57.10^6$

3) Permeability to water vapour

Test specimen No.	Mean value of the test specimen thickness ***d*** (m)	Mass difference of two weighings at constant change of mass (g)	Rate of flow of water vapour ***G_{CS}*** (g/h)	Water-vapour transmission rate ***V*** (g/(m².d))	Water-vapour diffusion-equivalent air layer thickness ***s_d*** (m)	Water-vapour resistance factor ***m*** (-)
1	0,000042	0,0095	$3,9583.10^{-4}$	1,9120	10,670	254040
2	0,000048	0,0093	$3,8750.10^{-4}$	1,8715	10,900	227088
3	0,000042	0,0088	$3,6667.10^{-4}$	1,7705	11,522	274343
Average	0,000044	0,00920	$3,8333.10^{-4}$	1,8513	**11,031**	251824
Extended uncertainty U					1,215	37194,02

4) Capillary water absorption and water permeability water

Test specimen No.	Thickness of coating (µm)	Width of the test area (mm)	Length of the test area (mm)	Initial weight (g)	Weight after immersion test (g)	Weight increase (g)	Liquid water permeability ***w*** (kg/(m².$h^{0,5}$))
1	30	132	150	1299,46	1300,20	0,74	0,008
2	39	135	150	1246,62	1247,28	0,66	0,007
3	34	130	154	1210,28	1211,13	0,85	0,009
Average	34	132	151	1252,12	1252,87	0,75	**0,008**
Extended uncertainty U							0,001

5) Thermal change compatibility
Thunder-shower cycling (10 cycles) and Freeze-thaw cycling with de-icing salt immersion (20 cycles)

5a) Visual assessment after exposure

Test specimen No.	Degree of blistering STN EN ISO 4628-2	Degree of cracking STN EN ISO 4628-4	Degree of flaking STN EN ISO 4628-5
after 10 cycles of thunder-shower			
1	0 (S0)	0 (S0)	0 (S0)
2	0 (S0)	0 (S0)	0 (S0)
after 10 cycles of thunder-shower and 10 cycles freeze-thaw with de-icing salt immersion			
1	0 (S0)	0 (S0)	0 (S0)
2	0 (S0)	0 (S0)	0 (S0)
after 10 cycles of thunder-shower and 20 cycles freeze-thaw with de-icing salt immersion			
1	0 (S0)	0 (S0)	0 (S0)
2	0 (S0)	0 (S0)	0 (S0)

5b) Adhesion strength by pull-off test after exposure

Test specimen No. 1

Number of measurement	Adhesion strength by pull-off (N/mm^2)	Type of Failure
1	2,6	A 100 %
2	2,7	A 100 %
3	2,4	A 100 %
4	2,4	A 100 %
5	2,8	A 100 %
Average	**2,6**	-
Extended uncertainty U	0,2	

Note:
A - cohesion failure in concrete substrate

Test specimen No. 2

Number of measurement	Adhesion strength by pull-off (N/mm^2)	Type of Failure
1	2,3	A 100 %
2	2,6	A 100 %
3	2,8	A 100 %
4	2,7	A 100 %
5	2,5	A 100 %
Average	**2,6**	-
Extended uncertainty U	0,2	

Note:
A - cohesion failure in concrete substrate

Average value of adhesion strength by pull-off test after exposure of two test specimens	**2,6 N/mm^2**

6) Thermal change compatibility
Freeze-thaw cycling without de-icing salt impact (20 cycles)

6a) Visual assessment after exposure

Test specimen No.	Degree of blistering STN EN ISO 4628-2	Degree of cracking STN EN ISO 4628-4	Degree of flaking STN EN ISO 4628-5
after 10 cycles of freeze-thaw without de-icing salt immersion			
1	0 (S0)	0 (S0)	0 (S0)
2	0 (S0)	0 (S0)	0 (S0)
after 20 cycles of freeze-thaw without de-icing salt immersion			
1	0 (S0)	0 (S0)	0 (S0)
2	0 (S0)	0 (S0)	0 (S0)

6b) Adhesion strength by pull-off test after exposure

Test specimen No. 1

Number of measurement	Adhesion strength by pull-off (N/mm^2)	Type of Failure
1	2,9	A 100 %
2	2,5	A 100 %
3	3,3	A 100 %
4	2,7	A 100 %
5	2,8	A 100 %
Average	**2,8**	-
Extended uncertainty U	0,3	

Note:
A - cohesion failure in concrete substrate

Test specimen No. 2

Number of measurement	Adhesion strength by pull-off (N/mm^2)	Type of Failure
1	2,5	A 100 %
2	2,5	A 100 %
3	2,6	A 100 %
4	2,4	A 100 %
5	2,5	A 100 %
Average	**2,5**	-
Extended uncertainty U	0,1	

Note:
A - cohesion failure in concrete substrate

Average value of adhesion strength by pull-off test after exposure of two test specimens	**2,7 N/mm^2**

7) Thermal change compatibility – ageing at 70°C for 7 days

7a) Visual assessment after exposure

Test specimen No.	Degree of blistering STN EN ISO 4628-2	Degree of cracking STN EN ISO 4628-4	Degree of flaking STN EN ISO 4628-5
1	0 (S0)	0 (S0)	0 (S0)
2	0 (S0)	0 (S0)	0 (S0)

7b) Adhesion strength by pull-off test after exposure

Test specimen No. 1

Number of measurement	Adhesion strength by pull-off (N/mm^2)	Type of Failure
1	2,8	A 100 %
2	3,1	A 100 %
3	2,8	A 100 %
4	2,9	A 100 %
5	3,0	A 100 %
Average	**2,9**	-
Extended uncertainty U	0,2	

Note:
A - cohesion failure in concrete substrate

Test specimen No. 2

Number of measurement	Adhesion strength by pull-off (N/mm^2)	Type of Failure
1	2,8	A 100 %
2	3,0	A 100 %
3	2,6	A 100 %
4	2,9	A 100 %
5	2,8	A 100 %
Average	**2,8**	-
Extended uncertainty U	0,2	

Note:
A - cohesion failure in concrete substrate

Average value of adhesion strength by pull-off test after exposure of two test specimens	**2,9 N/mm^2**

8) Resistance to temperature shock
- Test temperature: +150°C

8a) Visual assessment after exposure

Test specimen No.	Degree of blistering STN EN ISO 4628-2	Degree of cracking STN EN ISO 4628-4	Degree of flaking STN EN ISO 4628-5
1	0 (S0)	0 (S0)	0 (S0)
2	0 (S0)	0 (S0)	0 (S0)

8b) Adhesion strength by pull-off test after exposure

Test specimen No. 1

Number of measurement	Adhesion strength by pull-off (N/mm^2)	Type of Failure
1	2,3	A 100 %
2	2,4	A 100 %
3	2,6	A 100 %
4	2,6	A 100 %
5	2,4	A 100 %
Average	**2,5**	-
Extended uncertainty U	0,2	

Note:
A - cohesion failure in concrete substrate

Test specimen No. 2

Number of measurement	Adhesion strength by pull-off (N/mm^2)	Type of Failure
1	2,7	A 100 %
2	2,9	A 100 %
3	2,4	A 100 %
4	2,6	A 100 %
5	2,5	A 100 %
Average	**2,6**	-
Extended uncertainty U	0,2	

Note:
A - cohesion failure in concrete substrate

Average value of adhesion strength by pull-off test after exposure of two test specimens	**2,6 N/mm^2**

9) Resistance to severe chemical attack

- 3 days without pressure

9a) Testing liquids: group 1. Petrol according to EN 13529

Visual assessment

Number of measurement	Degree of blistering STN EN ISO 4628-2	Degree of cracking STN EN ISO 4628-4	Degree of flaking STN EN ISO 4628-5
1	0 (S0)	0 (S0)	0 (S0)

Buchholz indentation test

Number of measurement	Thickness of coating (µm)	Before exposure		After exposure	
		Length of indentation *l* (mm)	Resistance to indentation α_B (-)	Length of indentation *l* (mm)	Resistance to indentation α_B (-)
1	52	0,6	166,7	0,6	166,7
2		0,6	166,7	0,7	142,9
3		0,5	200,0	0,6	166,7
4		0,6	166,7	0,7	142,9
5		0,5	200,0	0,6	166,7
Average		0,6	**180,0**	0,6	**157,2**
Extended uncertainty U		0,05	16,9	0,05	12,1

9b) Testing liquids: chlorinated water

Visual assessment

Number of measurement	Degree of blistering STN EN ISO 4628-2	Degree of cracking STN EN ISO 4628-4	Degree of flaking STN EN ISO 4628-5
2	0 (S0)	0 (S0)	0 (S0)

Buchholz indentation test

Number of measurement	Thickness of coating (µm)	Before exposure		After exposure	
		Length of indentation *l* (mm)	Resistance to indentation α_B (-)	Length of indentation *l* (mm)	Resistance to indentation α_B (-)
1	52	0,6	166,7	0,6	166,7
2		0,6	166,7	0,6	166,7
3		0,6	166,7	0,6	166,7
4		0,5	200,0	0,6	166,7
5		0,6	166,7	0,6	166,7
Average		0,6	**173,4**	0,6	**166,7**
Extended uncertainty U		0,05	13,9	0,04	0,03

10) Impact resistance

Number of measurement	Impact resistance - the mass of the falling weight 1000 g		
	Height 60 cm	Height 62,5 cm	Height 65 cm
1	pass	pass	fail
2	pass	pass	fail
3	pass	pass	pass
4	pass	pass	fail
5	pass	pass	pass
Impact resistance: 6,13 Nm			

11) Adhesion strength by pull-off test

Number of measurement	Adhesion strength by pull-off (N/mm^2)	Type of Failure
1	3,4	A 100 %
2	3,1	A 100 %
3	2,9	A 100 %
4	2,9	A 100 %
5	3,5	A 100 %
Average	**3,2**	-
Extended uncertainty U	0,3	

Note:
A - cohesion failure in concrete substrate

12) Behaviour after artificial atmospheric agents

Visual assessment after 2000 hours of UV irradiation and humidity

Test specimen No.	Degree of blistering STN EN ISO 4628-2	Degree of cracking STN EN ISO 4628-4	Degree of flaking STN EN ISO 4628-5
1	0 (S0)	0 (S0)	0 (S0)
2	0 (S0)	0 (S0)	0 (S0)
3	0 (S0)	0 (S0)	0 (S0)

Date of report: 06th February 2014

Prepared by: Ing. Erika Halčinová

Authorized by:

Ing. Pavel Kazár
Head of Laboratory Branch

Technický a skúšobný ústav stavebný, n. o. Bratislava akreditované skúšobné laboratórium pracovisko Tatranská Štrba TSUS

Notes:

- Unless the Test Laboratory makes the sampling, data on the manufacturer, its manufacturing plant and about the sampling are presented according to information provided by the client.
- Testing was carried out according to the Operational procedure No. PP-007 of the Test laboratory in compliance with the listed test procedure.
- The given extended uncertainty U is based on the standard uncertainty multiplied by the coverage factor k = 2, that in case of the normal distribution provides the reliability in the order of 95%.
- Presented results are relevant to the product sample only.
- This report shall not be reproduced except in full without written approval of the Test Laboratory.

End of test report

NANO-CERAMIC®

WWW.NANO-CERAMIC.COM INDUSTRIAL PROTECTIVE COATINGS

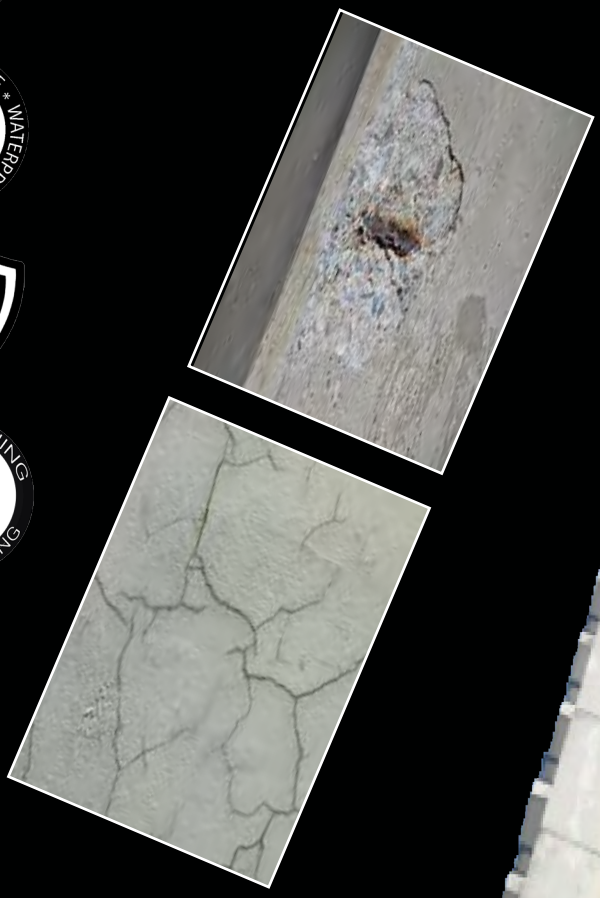
EASY TO APPLY
JUST ROLL-IT OVER

WATERPROOF * WATERPROOF * WATERPROOF
100%

SUPER STRONG

SELF CLEANING
SELF CLEANING

There is no better option than to use NANO-CERAMIC!



The Leader in Durability

Did you know?

That our coatings are made of pure silica sand, which is the most common element on Earth?

Dealer