COT bv
Independent advice, research and management for construction and industry

Civil projects
Corrosionprotection
Laboratory

Jan Tademaweg 40
2031 CV Haarlem
P.O. Box 2113
2002 CC Haarlem
The Netherlands
T +31 23-5319544
F +31 23-5277229
E info@cot-nl.com
I www.cot-nl.com

REPORT

Testing of the system
ZINGA (60-80 µm) / Zingaceram ZM EP MIO HS (120 µm) /
Zingaceram ZM EP TOP (60 µm) according to ISO 12944-6 C5-I High

Haarlem, 4 June 2014

Client	:	Zingametall bvba Industriepark - Rozenstraat 4 B - 9810 Eke (Belgium) Contact person : Mr. Eng. J. vanden Abeele
Project number	:	20140016
Report number	:	LAB14-0206-REP Revision 2
Handled by	:	Mr. Ing. A.R. van Marion

CONTENTS

1 INTRODUCTION 3
1.1 Order 3
1.2 General information 3

2 PAINT APPLICATION 3

3 PROCECURE 4
3.1 Dry film thickness 4
3.2 Adhesion 4
3.3 Neutral Salt Spray 4
3.4 Condensation test 5
3.5 Chemical immersion test 5

4 RESULTS 6
4.1 Reference Adhesion test 6
4.2 Neutral Salt Spray test 6
4.3 Condensation test 6
4.4 Chemical Immersion test 7

5 CONCLUSION 8

ANNEX: Photographs

1 INTRODUCTION

1.1 Order

By order of Zingametall bvba in Eke, Belgium, the Centrum voor Onderzoek en Technisch advies (COT bv) in Haarlem, The Netherlands, has tested the system ZINGA (60-80 µm) / Zingaceram ZM EP MIO HS (120 µm) / Zingaceram ZM EP TOP (60 µm) according to ISO 12944-6 C5-I High.

The tests are described in the e-mail of 15 October 2013 16:06.
The order has been given with the Bestelbon 2013/179/JVA/GW of 16-10-2013.

1.2 General information

Table 1: Samples

COT sample number	Samples	Received
14-01-14/0021	31 coated steel panels*, dimensions 100 x 150 mm	14-01-2014

* Panels coded by COT

Test specification : ISO 12944-6
Corrosivity category : C5-I
Durability range : High, Industrial

2 PAINT APPLICATION

The coating system has been applied by the client according to specifications.

Table 2: System build-up

Layers	Product	No. Coats	DFT (µm)	Colour
1	ZINGA	1	60-80	Zinc
2	Zingaceram ZM EP MIO HS	1	120	Grey
3	Zingaceram ZM EP TOP	1	60	White
System	Total system thickness		240-260	White

3 PROCECURE

3.1 Dry film thickness

The dry film thickness of the coating has been measured in accordance with ISO 2808, method 7C using a digital gauge (COT E004) with magnetic induction probe. From a minimum of five measurements per specimen panel, the minimum, maximum, average and corresponding standard deviation have been reported, corrected for medium roughness (25 micrometers).
In deviation of report procedure of ISO 2808, individual measurements are not reported here.

3.2 Adhesion

Adhesion value is determined for unexposed reference panels as well as for exposed panels, which have been acclimated for 24 hours at 23 ± 2 °C and 50 ± 5 % RH.

For systems with a nominal coating thickness (nDFT) less than 250 micrometers, the adhesion of the coating system is determined by cross-cut test with the use of a single blade cutting tool in accordance with ISO 2409.

For systems with a nDFT above 250 micrometers, the adhesion of the coating is determined by pull-off test, employing a pneumatic adhesion tester (COT A006) in accordance with ISO 4624. The coating surface and the dolly are sanded lightly and degreased with neat ethanol. An epoxy adhesive is employed and allowed to cure overnight. Prior to testing the coating is scribed around the dollies down to the substrate. The average corrected reading of performed measurements is reported.

The method most suited is employed with systems which nDFT is close to 250 µm.

3.3 Neutral Salt Spray

From January 31st 2014 to April 1st 2014, for a total of 1440 hours exposure, the resistance to neutral salt spray has been tested on three scribed test panels in accordance with ISO 9227 NSS. The scribe mark has been made through the coating down to the substrate using a sharp knife.

General data

Apparatus number	:	COT S006
Type of water	:	Demineralised water (< 1 µS)
Salt	:	Sodium chloride (NaCl) p.a.
Test temperature	:	35 °C
Collected salt solution	:	1.0 – 2.0 ml/hour/80 cm^2
pH of the collected salt solution	:	6.5 – 7.2
Salt concentration of the collected solution	:	50 ± 5 g/l

Immediately after the test, the panels have been examined for defects according to ISO 4628. The adhesion has been determined after 24 hours reconditioning at 23 ± 2 °C and 50 ± 5 % RH.

3.4 Condensation test

From January 28th 2014 to February 27th 2014, for a total of 720 hours exposure, the resistance to water condensation has been tested on three test panels in accordance with ISO 6270-1.

General data

Apparatus	:	Cleveland condensation tester (COT C001)
Temperature of the air space	:	38 ± 2 °C
Temperature environment	:	23 ± 2 °C
Exposition angle	:	approx. 60° to the horizontal

Immediately after the test, the panels have been examined for defects according to ISO 4628. The adhesion has been determined after 24 hours reconditioning at 23 ± 2 °C and 50 ± 5 % RH.

3.5 Chemical immersion test

From January 30th 2014 to February 6th 2014, for a total of 168 hours exposure, the resistance to chemical immersion has been tested on three test panels for each chemical in accordance with ISO 2812-1. The immersion chemicals are 10 % aqueous H_2SO_4, 10 % aqueous NaOH and a mineral spirit with 18 % aromatics.

In each solution three test panels have been immersed for 60 %. The test temperature was 23 ± 2 °C.

Immediately after the test, the panels have been examined for defects according to ISO 4628. The adhesion has been determined after 24 hours reconditioning at 23 ± 2 °C and 50 ± 5 % RH.

4 RESULTS

4.1 Reference Adhesion test

Table 3: Adhesion reference test

Reference No exposure		**COT sample number 14-01-14/0021**			**Requirements**
		Panel 1	**Panel 2**	**Panel 3**	
DFT (µm)	Min. - max.	284 - 305	257 - 300	237 - 317	
	Mean	296 ± 9	278 ± 15	279 ± 36	≤ 300 µm
ISO 2409	Classification	1	0	0	0 or 1
ISO 4624	(MPa)	9.0 ± 1.3	7.6 ± 1.0	7.0 ± 0.1	≥ 5 MPa or
	Break area (%)	100% B	100% B	100% B	no A/B break

4.2 Neutral Salt Spray test

Table 4: Assessment after neutral salt spray test

Exposure: Neutral salt spray ISO 9227, 1440 hours		**COT sample number 14-01-14/0021**			**Requirements**
		Panel 16	**Panel 17**	**Panel 18**	
DFT (µm)	Min. - max.	257 - 293	198 - 278	239 - 351	
	Mean	276 ± 16	239 ± 36	287 ± 41	≤ 300 µm
Blistering	ISO 4628-2	0 (S0)	0 (S0)	0 (S0)	0(S0)
Rusting	ISO 4628-3	Ri 0	Ri 0	Ri 0	Ri 0
Cracking	ISO 4628-4	0 (S0)	0 (S0)	0 (S0)	0(S0)
Flaking	ISO 4628-5	0 (S0)	0 (S0)	0 (S0)	0(S0)
Corrosion from scribe (mm)		0	0	0	≤ 1 mm
ISO 2409	Classification	1	1	1	0 or 1
ISO 4624	(MPa)	7.8 *	7.1 *	7.7 *	≥ 5 MPa or
	Break area (%)	100% B	100% B	100% B	no A/B break

* Single measurement

4.3 Condensation test

Table 5: Assessment after condensation test

Exposure: Neutral salt spray ISO 6270-1, 720 hours		**COT sample number 14-01-14/0021**			**Requirements**
		Panel 19	**Panel 20**	**Panel 21**	
DFT (µm)	Min. - max.	304 - 325	264 - 332	251 - 298	
	Mean	313 ± 9	294 ± 25	270 ± 18	≤ 300 µm
Blistering	ISO 4628-2	0(S0)	0(S0)	0(S0)	0(S0)
Rusting	ISO 4628-3	Ri0	Ri0	Ri0	Ri 0
Cracking	ISO 4628-4	0(S0)	0(S0)	0(S0)	0(S0)
Flaking	ISO 4628-5	0(S0)	0(S0)	0(S0)	0(S0)
ISO 2409	Classification	1	1	1	0 or 1
ISO 4624	(MPa)	6.5 ± 0.4	7.7 ± 1.5	6.5 ± 0.5	≥ 5 MPa or
	Break area (%)	100% B	100% B	100% B	no A/B break

4.4 Chemical Immersion test

Table 6: Assessment after immersion test, 10 % NaOH.

Exposure: **Immersion, 10 % NaOH** **ISO 2812-1, 168 hours**		**COT sample number** **14-01-14/0021**			**Requirements**
		Panel 22	**Panel 23**	**Panel 24**	
DFT (µm)	Min. - max.	261 - 329	249 - 288	247 - 296	
	Mean	285 ± 27	271 ± 15	270 ± 20	≤ 300 µm
Blistering	ISO 4628-2	0(S0)	0(S0)	0(S0)	0(S0)
Rusting	ISO 4628-3	Ri0	Ri0	Ri0	Ri 0
Cracking	ISO 4628-4	0(S0)	0(S0)	0(S0)	0(S0)
Flaking	ISO 4628-5	0(S0)	0(S0)	0(S0)	0(S0)
ISO 2409	Classification	1	1	1	0 or 1
ISO 4624	(MPa)	8.4 *	10.1 *	9.2 *	≥ 5 MPa or
	Break area (%)	100% B	100% B	100% B	no A/B break

* Single measurement

Table 7: Assessment after immersion test, 10 % H_2SO_4.

Exposure: **Immersion, 10 % H_2SO_4** **ISO 2812-1, 168 hours**		**COT sample number** **14-01-14/0021**			**Requirements**
		Panel 25	**Panel 26**	**Panel 27**	
DFT (µm)	Min. - max.	248 - 322	269 - 317	226 - 280	
	Mean	274 ± 29	289 ± 18	257 ± 23	≤ 300 µm
Blistering	ISO 4628-2	0(S0)	2(S1)	0(S0)	0(S0)
Rusting	ISO 4628-3	Ri0	Ri0	Ri0	Ri 0
Cracking	ISO 4628-4	0(S0)	0(S0)	0(S0)	0(S0)
Flaking	ISO 4628-5	0(S0)	0(S0)	0(S0)	0(S0)
ISO 2409	Classification	1	1	1	0 or 1
ISO 4624	(MPa)	9.1 *	8.1 *	8.2 *	≥ 5 MPa or
	Break area (%)	100% B	100% B	100% B	no A/B break

** Single measurement*

Table 8: Assessment after immersion test, mineral spirit.

Exposure: **Immersion, mineral spirit** **ISO 2812-1, 168 hours**		**COT sample number** **14-01-14/0021**			**Requirements**
		Panel 28	**Panel 29**	**Panel 30**	
DFT (µm)	Min. - max.	230 - 264	263 - 313	224 - 318	
	Mean	243 ± 13	283 ± 25	280 ± 39	≤ 300 µm
Blistering	ISO 4628-2	0(S0)	0(S0)	0(S0)	0(S0)
Rusting	ISO 4628-3	Ri0	Ri0	Ri0	Ri 0
Cracking	ISO 4628-4	0(S0)	0(S0)	0(S0)	0(S0)
Flaking	ISO 4628-5	0(S0)	0(S0)	0(S0)	0(S0)
ISO 2409	Classification	1	1	0	0 or 1
ISO 4624	(MPa)	8.1 *	7.2 *	7.4 *	≥ 5 MPa or
	Break area (%)	100% B	100% B	100% B	no A/B break

** Single measurement*

5 CONCLUSION

The system ZINGA (60-80 µm) / Zingaceram ZM EP MIO HS (120 µm) / Zingaceram ZM EP TOP (60 µm), applied to blasted steel panels (COT sample number 14-01-14/0021), meets all requirements of ISO 12944-6 C5-I High.

CENTRUM VOOR ONDERZOEK
EN TECHNISCH ADVIES (COT bv)

Ing. A.R. van Marion
Laboratory Technician

Dr. B.P. Alblas
Manager Laboratory

ANNEX

Photographs

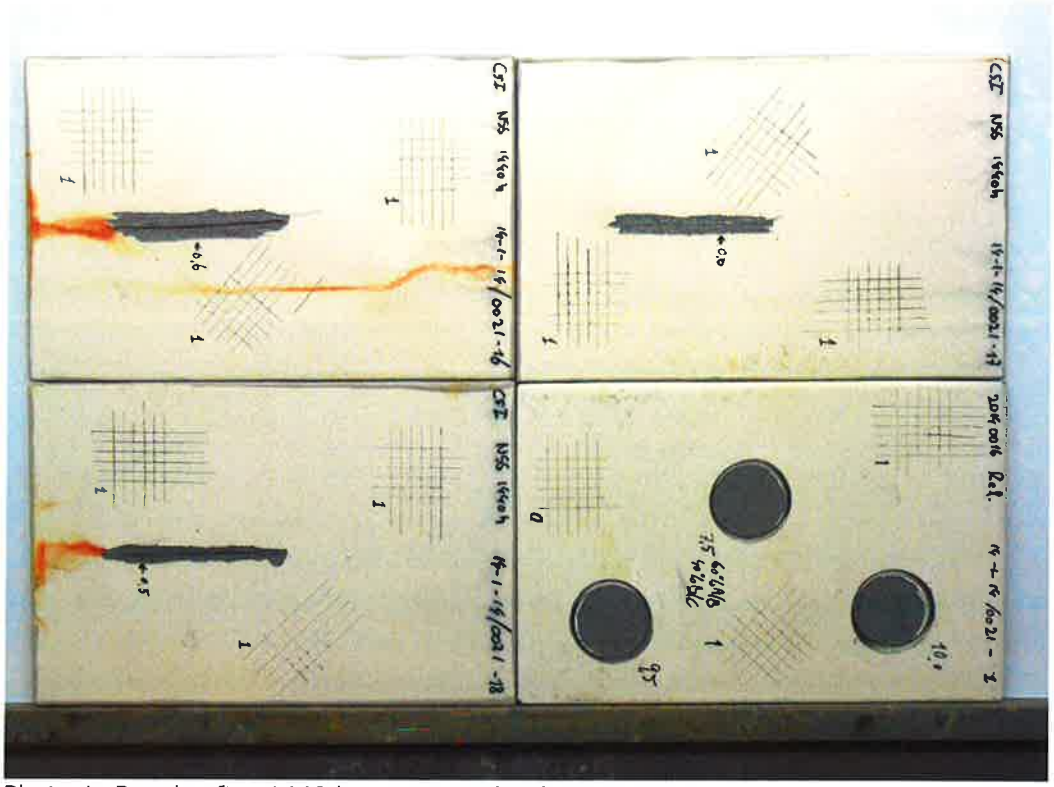

Photo 1: Panels after 1440 hours Neutral Salt Spray Test

Photo 2: Panels after 720 hours Condensation Test.

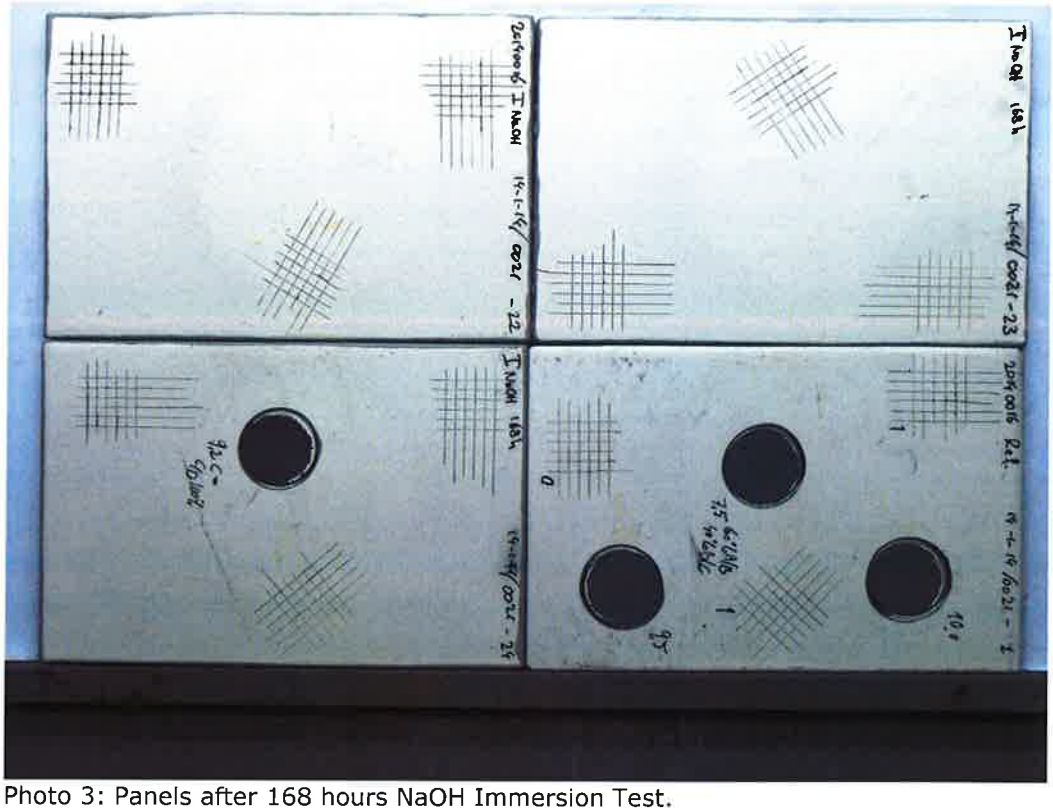

Photo 3: Panels after 168 hours NaOH Immersion Test.

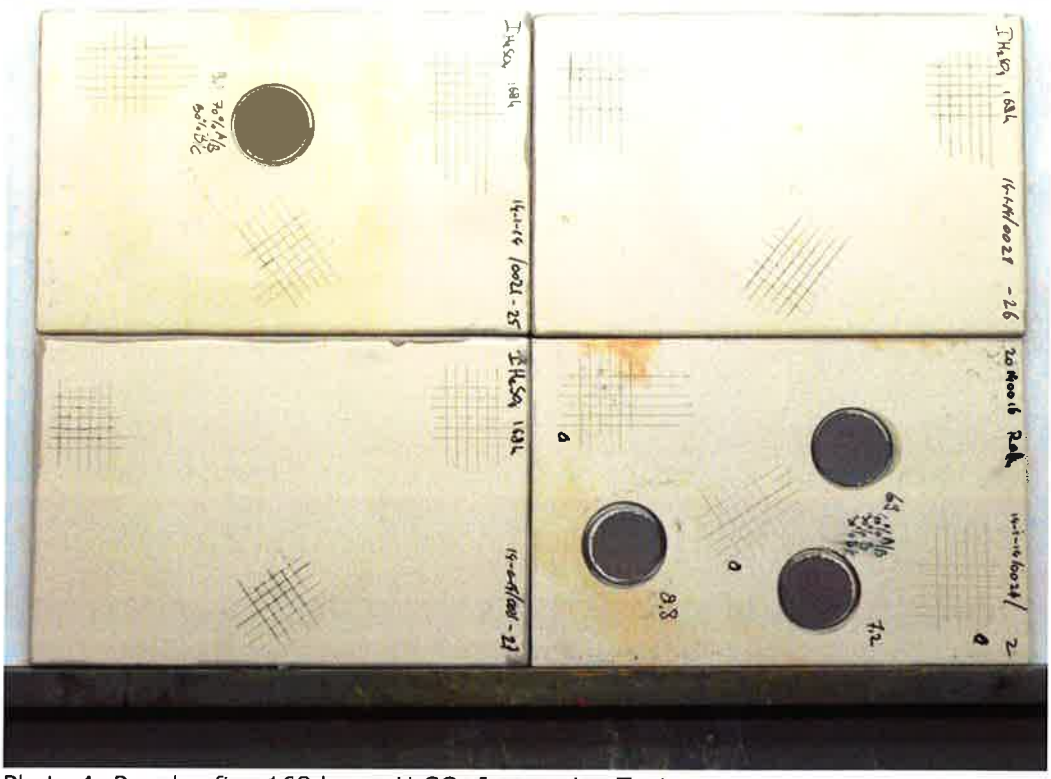

Photo 4: Panels after 168 hours H_2SO_4 Immersion Test.

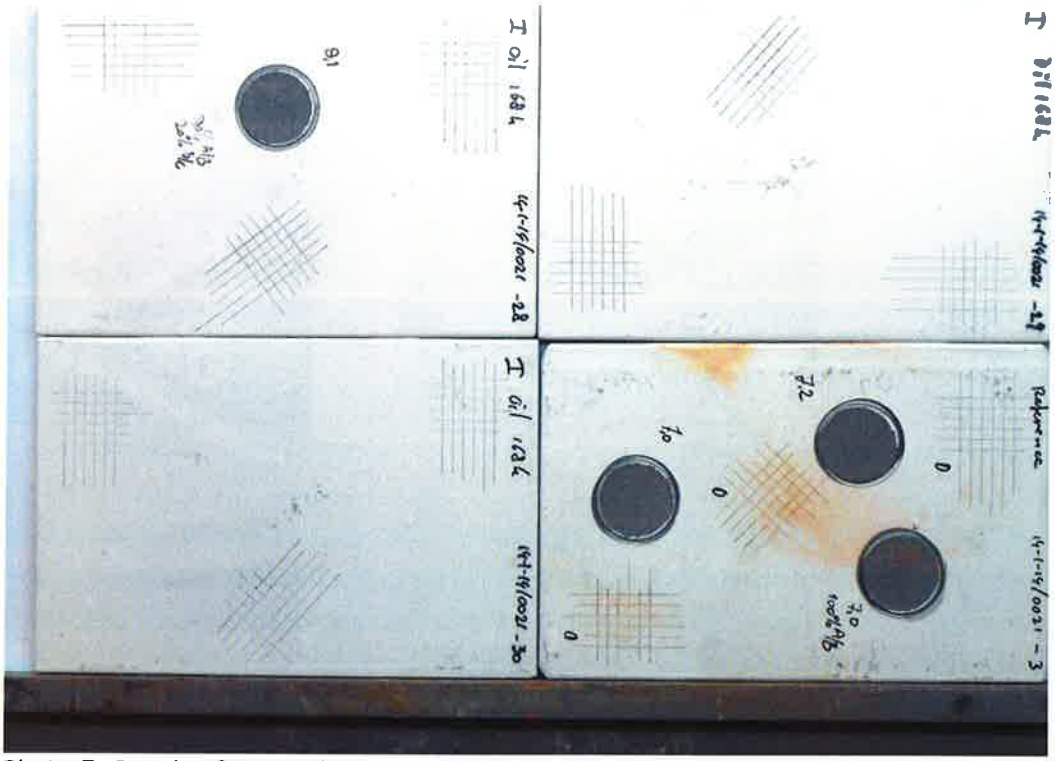

Photo 5: Panels after 168 hours Mineral Spirit Immersion Test.