



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



REPORT

Testing of system
WG-FERROGALVANIC / WG-WELEFLEX / WG-WELESILVER
according to Norsok M-501, Rev. 5, System 7

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

Haarlem, June 7th, 2011

Client : Rheinheim S.A.
3, Rue du Mont-Blanc,
1201 Geneva, Switzerland
Contact person: Mr. P. Lebedev

Project number : 20100080

Report number : LAB11-0462-REP

Handled by : Mr. N. Blokker

Copy Right This report contains 7 numbered pages and is property of COT bv (Netherlands). No part of this report may be copied, distributed, inserted in any text document, or reproduced in any other way or published, without written permission of COT bv (Netherlands). This report is not transferable to any person or body, serves only to take cognisable and gives in no way the rights on this report, neither can lay a claim to any in this report discussed product or method. Use of information from this report is not permitted without written permission of COT bv. When not agreed in the by COT bv provided order confirmation, our Rules of Service are applicable.



CONTENTS

1	INTRODUCTION.....	3
1.1	Order.....	3
1.2	General information.....	3
2	PERFORMANCE TESTS.....	4
2.1	Seawater immersion.....	4
2.2	Ageing test.....	4
2.3	Cathodic Disbonding.....	4
2.4	Adhesion test.....	4
3	REQUIREMENTS.....	5
3.1	Seawater immersion test.....	5
3.2	Ageing test.....	5
3.3	Cathodic disbonding.....	5
4	RESULTS.....	6
4.1	Original adhesion value.....	6
4.2	Seawater immersion.....	6
4.3	Ageing test.....	6
4.4	Cathodic Disbonding.....	6
5	CONCLUSION.....	7



1 INTRODUCTION

1.1 Order

By order of Rheinheim S.A. in Geneva, Switzerland, the Centrum voor Onderzoek en Technisch advies (COT bv) in Haarlem, The Netherlands, has tested the system WG-Ferrogalvanic / WG-Weleflex / WG-Welesilver according to Norsok M-501, Rev. 5, System 7.

The order has been given by Mr. P. Lebedev in the letter of October 20th, 2010 and the email message of October 22nd, 2010.

1.2 General information

COT sample number	Sample	Received
29-10-10/0715	12 steel panels with complete system, Dimensions 75 x 150 x 5 mm	27 October 2010
02-11-10/0720	WG-Ferrogalvanic	29 October 2010
02-11-10/0719	WG-Weleflex	29 October 2010
02-11-10/0721	WG-Welesilver	29 October 2010

Surface preparation:

Sand blasted to Sa 2½ (ISO 8501-1) and roughness "medium (G)" (ISO 8503-1).

System and specified dry film thickness:

WG-Ferrogalvanic : 80 µm
WG-Weleflex : 100 µm
WG-Welesilver : 60 µm

The system has been applied to the test panels by Rheinheim S.A.



2 PERFORMANCE TESTS

2.1 Seawater immersion

The fully cured coating system has been scribed horizontal down to the bare metal. The scratch line is 2 mm wide and 50 mm long. The panels have been immersed in synthetic seawater (according to ISO 15711) at 40°C during 4200 hours according to ISO 2812-2.

The start of the immersion was 10 November 2010; the test has been ended on 4 May 2011.

2.2 Ageing test

The fully cured coating system has been scribed horizontal down to the bare metal. The scratch line is 2 mm wide and 50 mm long. The panels have been exposed to the following cycle according to ISO 20340 Annex A:

72 hours	UV-A 340 nm weatherometer in accordance with ISO 11507 Method A (4 hours UV-light at 60 °C / 4 hours condensation at 50 °C)
72 hours	Salt Spray test according to ISO 9227 NSS
24 hours	Exposure to low temperature (-20 °C)

The total exposure time is 4200 hours.

The start of the ageing test was 12 November 2010; the test has been ended on 6 May 2011.

2.3 Cathodic Disbonding

Cathodic disbonding has been determined according to ISO 20340 (ISO 15711). After 4200 hours exposure time the maximum disbonding has been measured.

The start of the test was 23 November 2010; the test has been ended on 17 May 2011.

2.4 Adhesion test

The adhesion before and after the seawater immersion and after the ageing test have been determined by a pneumatic adhesion tester in accordance with ISO 4624. The coating surface and the dolly have been sanded lightly and the epoxy adhesive has been applied. After curing of the adhesive and prior to testing the coating and the adhesive have been drilled around the dolly down to the bare metal. Three trials on the unexposed panel and two trials on each of the tested panels have been done and the average has been reported.

The adhesion of the coating system has been determined at the end of May 2011.

3 REQUIREMENTS

3.1 Seawater immersion test

After exposure to the specified time, the test panels shall comply with the following requirements:

Method		Requirements
--	Corrosion creep from scribe*	≤ 3.0 millimetres
ISO 4628-2	Blistering	0(S0)
ISO 4628-3	Rusting	Ri 0
ISO 4628-4	Cracking	0(S0)
ISO 4628-5	Flaking	0(S0)
ISO 4624	Adhesion	minimum 5.0 MPa and maximum 50 % reduction from original value

- * The corrosion creep is calculated from the equation: $M=(C-W)/2$, where
 M = corrosion creep (mm)
 C = average of the nine measurements (mm)
 W = the original width of the scribe (mm)

3.2 Ageing test

After exposure to the specified time, the test panels shall comply with the following requirements:

Method		Requirements
--	Corrosion creep from scribe*	≤ 3.0 millimetres
ISO 4628-2	Blistering	0 (S0)
ISO 4628-3	Rusting	Ri 0
ISO 4628-4	Cracking	0 (S0)
ISO 4628-5	Flaking	0 (S0)
ISO 4624	Adhesion	minimum 5.0 MPa and maximum 50 % reduction from original value

- * The corrosion creep is calculated from the equation: $M=(C-W)/2$, where
 M = corrosion creep (mm)
 C = average of the nine measurements (mm)
 W = the original width of the scribe (mm)

3.3 Cathodic disbonding

After exposure to the specified time, the test panels shall not show disbonding around the holiday with an equivalent diameter < 20 mm.

4 RESULTS

4.1 Original adhesion value

Test	Panel 5	Panel 11
Dry film thickness (μm)	215 \pm 11	189 \pm 4
Adhesion value (MPa)	12.8 \pm 2.0	11.3 \pm 0.9

4.2 Seawater immersion

Exposure time: 4200 hours

Method	Panel 4	Panel 6	Panel 7
-- Dry film thickness (μm)	215 \pm 6	239 \pm 17	206 \pm 15
ISO 4628-2 Blistering	0(S0)	0(S0)	0(S0)
ISO 4628-3 Rusting	Ri 0	Ri 0	Ri 0
ISO 4628-4 Cracking	0(S0)	0(S0)	0(S0)
ISO 4628-5 Flaking	0(S0)	0(S0)	0(S0)
-- Corrosion creep from scribe (mm)	0.2	0.2	1.0
ISO 4624 Adhesion (MPa)	11.0 \pm 0.1	8.8 \pm 0.8	9.9 \pm 0.5

4.3 Ageing test

Exposure time: 4200 hours

Method	Panel 1	Panel 2	Panel 3
-- Dry film thickness (μm)	196 \pm 12	212 \pm 10	192 \pm 8
ISO 4628-2 Blistering	0(S0)	0(S0)	0(S0)
ISO 4628-3 Rusting	Ri 0	Ri 0	Ri 0
ISO 4628-4 Cracking	0(S0)	0(S0)	0(S0)
ISO 4628-5 Flaking	0(S0)	0(S0)	0(S0)
-- Corrosion creep from scribe (mm)	0.6	0.4	5.1
ISO 4624 Adhesion (MPa)	11.9 \pm 2.0	10.9 \pm 2.0	9.1 \pm 0.1

4.4 Cathodic Disbonding

Exposure time: 4200 hours

Method	Panel 8	Panel 9	Panel 10
-- Dry film thickness (μm)	207 \pm 14	214 \pm 17	192 \pm 7
ISO 15711 Equivalent diameter disbonding (mm)	10.1	10.2	10.2



5 CONCLUSION

The system WG-Ferrogalvanic / WG-Weleflex / WG-Welesilver, dry film thickness 80/100/60 μm , with COT sample number 29-10-10/0715 meets the requirements of the pre-qualification of Norsok M-501, Rev. 5, System 7.

CENTRUM VOOR ONDERZOEK
EN TECHNISCH ADVIES (COT bv)

A blue ink signature of Dr. B.P. Alblas, written in a cursive style.

Dr. B.P. Alblas
Manager Laboratory

A blue ink signature of N. Blokker, written in a cursive style.

N. Blokker
Laboratory Technician