



*Beratung - Schadensfallaufklärung - Qualitätssicherung - Forschung - Prüfung*

- **Akkreditiertes Prüflabor für Korrosion, Korrosionsschutz und Korrosionsanalytik**  
DAR-Registriernummer: **DAP-PL-1131.00**
- Institut im Verbund der Technischen Akademie Wuppertal e. V.
- Institut an der TU Bergakademie Freiberg

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Institut für Korrosionsschutz Dresden GmbH • Gostritzer Str. 65 • 01217 Dresden

## Test Report

### PB300/255/10

Orderer: ADAPTA COLOR, S. L.  
 Ctra. Nacional 340, Km. 1041.1  
 12589 Peniscola (Castellon)  
 SPAIN

Date of order: 19.05.2010


Receipt of specimens: 26.05.2010


Investigation period: from 01.06.2010 until 12.08.2010

Order: Test of the powder coating system on steel  
 ES-7105  
 RX-9006-XW  
 according to DIN 55633, corrosivity category C5-I, durability high

Laboratory order No.: LA 3/116/10/103116




Pages: 5

Responsible examiner:  Dr. Stephan Zeltner

Head of department:  Dr. Andrea Rudolf

Dresden, 12.08.2010

Institut für Korrosionsschutz Dresden GmbH  
 Gostritzer Straße 65  
 D-01217 Dresden

created: Dr. Stephan Zeltner	checked: Dr. Roland Bentfeld	released: Dr. Andreas Schütz
sign: 	sign: 	sign: 
date: 12.08.2010	date: 13.08.2010	date: 13.08.2010

## 1 Test specimen

The orderer handed over 12 powder coated test plates and provided the following information about the building of layers:

substrat: steel  
treatment: nano-phosphate  
primer coating: ES-7105  
top coating: RX-9006-XW

The powder coating system on steel should be tested for corrosion protection according to DIN 55633, corrosivity category C5-I, durability high.

## 2 Loading

Loading of test plates according to DIN 55633 was carried out basically to ISO 12944-6.

The loading of the test plates was carried out with the following conditions:

### – Condensation of water according to ISO 6270-1

Test plates (fixed in a horizontal angle of 60°) were loaded on one side by condensate water of 38 °C. The back side of the test plates is exposed to laboratory atmosphere (NK 23/50), creating a temperature gradient across the sample.

The loading time was 720 hours.

### – Salt spray according to ISO 9227-NSS

Continuous loading of the specimens by salt spray (50 g/l NaCl, 35 °C) was carried out in a salt spray chamber SC/KWT 1000 (Weiss Umwelttechnik GmbH).

The loading time was 1440 hours.

### – Condensation water saturated atmosphere in the presence of SO<sub>2</sub> according to ISO 3231

Test plates were loaded in 30 cycles. One cycle is:

- 8 hours 40 °C, condensation on the test plates, 0,067 vol.-% SO<sub>2</sub> (0,2 L)
- 16 hours 18 °C to 28 °C, 30 to 70 % relative humidity.

3 test plates were used for each loading.

### 3 Test Procedure

– **Measurement of film thickness (before loading) according to ISO 2808**

test method: 7 C (magnetic induction)

test tool: Fischer DELTASCOPE FMP 10

adjustment: on a smooth steel plate with foils of known thickness

– **Assessment of visual alterations after loading**

immediately after taking out of the apparatus

- degree of blistering ISO 4628-2
- degree of rusting Ri ISO 4628-3
- degree of cracking ISO 4628-4
- degree of flaking ISO 4628-5

– **Cross-cut test**

The cross-cut according to DIN EN ISO 2409 (3 mm cut distance) was carried out with a one-cut tool before and after loading (24 h after taking out of the apparatus and storage at laboratory conditions).

– **Determination of corrosion around a scratch after loading by salt spray according to ISO 9227-NSS**

Immediately after the end of loading the delaminated coating was removed from the scratch with a knife. The maximum size of the corroded area was measured. The size of the corroded area M was calculated by the following formula:

$$M = \frac{c - w}{2}$$

c - total width of the corroded zone

w - width of the original scratch

### 4 Test Results

The results are compiled in table 1.

table 1: tests according to corrosivity category C5-I, durability high

<b>system: steel / ES-7105/ RX-9006-XW</b>				
<b>evaluation before loading</b>				
		test plate 1	test plate 2	test plate 3
DIN EN ISO 2808	film thickness / $\mu\text{m}$	127 $\pm$ 14	149 $\pm$ 24	198 $\pm$ 23
DIN EN ISO 2409	cross-cut	0	0	0
<b>evaluation after loading</b>				
test 1: ISO 6270-1 (condensation of water)				
exposure time 720 h		test plate 4	test plate 5	test plate 6
DIN EN ISO 2808	film thickness / $\mu\text{m}$	146 $\pm$ 14	202 $\pm$ 18	170 $\pm$ 13
DIN EN ISO 2409	cross-cut	0	0	0
DIN EN ISO 4628-2	degree of blistering	0 (S0)	0 (S0)	0 (S0)
DIN EN ISO 4628-3	degree of rusting	Ri0	Ri0	Ri0
DIN EN ISO 4628-4	degree of cracking	0 (S0)	0 (S0)	0 (S0)
DIN EN ISO 4628-5	degree of flaking	0 (S0)	0 (S0)	0 (S0)
test 2: ISO 9227-NSS (salt spray)				
exposure time 1440 h		test plate 7	test plate 8	test plate 9
DIN EN ISO 2808	film thickness / $\mu\text{m}$	126 $\pm$ 12	140 $\pm$ 16	171 $\pm$ 19
DIN EN ISO 2409	cross-cut	0	0	0
corrosion around the scratch	mm	1,3	0,8	0,8
DIN EN ISO 4628-2	degree of blistering	0 (S0)	0 (S0)	0 (S0)
DIN EN ISO 4628-3	degree of rusting	Ri0	Ri0	Ri0
DIN EN ISO 4628-4	degree of cracking	0 (S0)	0 (S0)	0 (S0)
DIN EN ISO 4628-5	degree of flaking	0 (S0)	0 (S0)	0 (S0)
test 3: ISO 3231 (condensation water + 0,2 l SO <sub>2</sub> )				
exposure time 720 h (30 cycles)		test plate 10	test plate 11	test plate 12
DIN EN ISO 2808	film thickness / $\mu\text{m}$	143 $\pm$ 13	173 $\pm$ 16	119 $\pm$ 25
DIN EN ISO 2409	cross-cut	0	0	0
DIN EN ISO 4628-2	degree of blistering	0 (S0)	0 (S0)	0 (S0)
DIN EN ISO 4628-3	degree of rusting	Ri0	Ri0	Ri0
DIN EN ISO 4628-4	degree of cracking	0 (S0)	0 (S0)	0 (S0)
DIN EN ISO 4628-5	degree of flaking	0 (S0)	0 (S0)	0 (S0)

## 5 Conclusions from Test Results

Assessment of the coating system according to DIN 55633 was carried out basically to ISO 12944-6. Coating systems on steel with film thickness < 250 µm pass the test according to ISO 12944-6, if two of three test plates fulfill the following requirements:

before loading:	cross-cut test ISO 2409:	Gt ≤ 1
after loading:	cross-cut test ISO 2409:	Gt ≤ 1
	degree of blistering ISO 4628-2:	0 (S0)
	degree of rusting ISO 4628-3:	Ri 0
	degree of cracking ISO 4628-4:	0 (S0)
	degree of flaking ISO 4628-5:	0 (S0)
	corrosion around a scratch (after salt spray test)	≤ 1 mm

The tested powder coating system fulfills the requirements of ISO 12944-6 according to corrosivity category C5-I, durability high.



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## Test Report

### PB300/255/10

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 Ctra. Nacional 340, Km. 1041.1  
 12589 Peniscola (Castellon)  
 SPAIN

Date of order: 19.05.2010


Receipt of specimens: 26.05.2010


Investigation period: from 01.06.2010 until 12.08.2010

Order: Test of the powder coating system on steel  
 ES-7105  
 RX-9006-XW  
 according to DIN 55633, corrosivity category C5-I, durability high

Laboratory order No.: LA 3/116/10/103116




Pages: 5

Responsible examiner:  Dr. Stephan Zeltner

Head of department:  Dr. Andrea Rudolf

Dresden, 12.08.2010

Institut für Korrosionsschutz Dresden GmbH  
 Gostritzer Straße 65  
 D-01217 Dresden

created: Dr. Stephan Zeltner	checked: Dr. Roland Bentfeld	relaesed: Dr. Andreas Schütz
sign: 	sign: 	sign: 
date: 12.08.2010	date: 13.08.2010	date: 13.08.2010

## 1 Test specimen

The orderer handed over 12 powder coated test plates and provided the following information about the building of layers:

substrat: steel  
treatment: nano-phosphate  
primer coating: ES-7105  
top coating: RX-9006-XW

The powder coating system on steel should be tested for corrosion protection according to DIN 55633, corrosivity category C5-I, durability high.

## 2 Loading

Loading of test plates according to DIN 55633 was carried out basically to ISO 12944-6.

The loading of the test plates was carried out with the following conditions:

### – Condensation of water according to ISO 6270-1

Test plates (fixed in a horizontal angle of 60°) were loaded on one side by condensate water of 38 °C. The back side of the test plates is exposed to laboratory atmosphere (NK 23/50), creating a temperature gradient across the sample.

The loading time was 720 hours.

### – Salt spray according to ISO 9227-NSS

Continuous loading of the specimens by salt spray (50 g/l NaCl, 35 °C) was carried out in a salt spray chamber SC/KWT 1000 (Weiss Umwelttechnik GmbH).

The loading time was 1440 hours.

### – Condensation water saturated atmosphere in the presence of SO<sub>2</sub> according to ISO 3231

Test plates were loaded in 30 cycles. One cycle is:

- 8 hours 40 °C, condensation on the test plates, 0,067 vol.-% SO<sub>2</sub> (0,2 L)
- 16 hours 18 °C to 28 °C, 30 to 70 % relative humidity.

3 test plates were used for each loading.

### 3 Test Procedure

– **Measurement of film thickness (before loading) according to ISO 2808**

test method: 7 C (magnetic induction)

test tool: Fischer DELTASCOPE FMP 10

adjustment: on a smooth steel plate with foils of known thickness

– **Assessment of visual alterations after loading**

immediately after taking out of the apparatus

- degree of blistering ISO 4628-2
- degree of rusting Ri ISO 4628-3
- degree of cracking ISO 4628-4
- degree of flaking ISO 4628-5

– **Cross-cut test**

The cross-cut according to DIN EN ISO 2409 (3 mm cut distance) was carried out with a one-cut tool before and after loading (24 h after taking out of the apparatus and storage at laboratory conditions).

– **Determination of corrosion around a scratch after loading by salt spray according to ISO 9227-NSS**

Immediately after the end of loading the delaminated coating was removed from the scratch with a knife. The maximum size of the corroded area was measured. The size of the corroded area M was calculated by the following formula:

$$M = \frac{c - w}{2}$$

c - total width of the corroded zone

w - width of the original scratch

### 4 Test Results

The results are compiled in table 1.



table 1: tests according to corrosivity category C5-I, durability high

<b>system: steel / ES-7105/ RX-9006-XW</b>				
<b>evaluation before loading</b>				
		test plate 1	test plate 2	test plate 3
DIN EN ISO 2808	film thickness / $\mu\text{m}$	127 $\pm$ 14	149 $\pm$ 24	198 $\pm$ 23
DIN EN ISO 2409	cross-cut	0	0	0
<b>evaluation after loading</b>				
test 1: ISO 6270-1 (condensation of water)				
exposure time 720 h		test plate 4	test plate 5	test plate 6
DIN EN ISO 2808	film thickness / $\mu\text{m}$	146 $\pm$ 14	202 $\pm$ 18	170 $\pm$ 13
DIN EN ISO 2409	cross-cut	0	0	0
DIN EN ISO 4628-2	degree of blistering	0 (S0)	0 (S0)	0 (S0)
DIN EN ISO 4628-3	degree of rusting	Ri0	Ri0	Ri0
DIN EN ISO 4628-4	degree of cracking	0 (S0)	0 (S0)	0 (S0)
DIN EN ISO 4628-5	degree of flaking	0 (S0)	0 (S0)	0 (S0)
test 2: ISO 9227-NSS (salt spray)				
exposure time 1440 h		test plate 7	test plate 8	test plate 9
DIN EN ISO 2808	film thickness / $\mu\text{m}$	126 $\pm$ 12	140 $\pm$ 16	171 $\pm$ 19
DIN EN ISO 2409	cross-cut	0	0	0
corrosion around the scratch	mm	1,3	0,8	0,8
DIN EN ISO 4628-2	degree of blistering	0 (S0)	0 (S0)	0 (S0)
DIN EN ISO 4628-3	degree of rusting	Ri0	Ri0	Ri0
DIN EN ISO 4628-4	degree of cracking	0 (S0)	0 (S0)	0 (S0)
DIN EN ISO 4628-5	degree of flaking	0 (S0)	0 (S0)	0 (S0)
test 3: ISO 3231 (condensation water + 0,2 l SO <sub>2</sub> )				
exposure time 720 h (30 cycles)		test plate 10	test plate 11	test plate 12
DIN EN ISO 2808	film thickness / $\mu\text{m}$	143 $\pm$ 13	173 $\pm$ 16	119 $\pm$ 25
DIN EN ISO 2409	cross-cut	0	0	0
DIN EN ISO 4628-2	degree of blistering	0 (S0)	0 (S0)	0 (S0)
DIN EN ISO 4628-3	degree of rusting	Ri0	Ri0	Ri0
DIN EN ISO 4628-4	degree of cracking	0 (S0)	0 (S0)	0 (S0)
DIN EN ISO 4628-5	degree of flaking	0 (S0)	0 (S0)	0 (S0)

## 5 Conclusions from Test Results

Assessment of the coating system according to DIN 55633 was carried out basically to ISO 12944-6. Coating systems on steel with film thickness < 250 µm pass the test according to ISO 12944-6, if two of three test plates fulfill the following requirements:

before loading:	cross-cut test ISO 2409:	Gt ≤ 1
after loading:	cross-cut test ISO 2409:	Gt ≤ 1
	degree of blistering ISO 4628-2:	0 (S0)
	degree of rusting ISO 4628-3:	Ri 0
	degree of cracking ISO 4628-4:	0 (S0)
	degree of flaking ISO 4628-5:	0 (S0)
	corrosion around a scratch (after salt spray test)	≤ 1 mm

The tested powder coating system fulfills the requirements of ISO 12944-6 according to corrosivity category C5-I, durability high.



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### Test Report PB300/256/10

Orderer: ADAPTA COLOR, S. L.  
 Ctra. Nacional 340, Km. 1041.1  
 12589 Peniscola (Castellon)  
 SPAIN

Date of order: 19.05.2010

Receipt of specimens: 26.05.2010

Investigation period: from 01.06.2010 until 12.08.2010

Order: Test of the coating system on galvanized steel  
 ES-7105  
 RX-9006-XW  
 according to DIN 55633, corrosivity category C5-I, durability high

Laboratory order No.: LA 3/116/10/103116




Pages: 4

Responsible examiner:  Dr. Stephan Zeltner

Head of department:  Dr. Andrea Rudolf

Dresden, 12.08.2010

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created: Dr. Stephan Zeltner	checked: Dr. Roland Bentfeld	relaesed: Dr. Andreas Schütz
sign: 	sign: 	sign: 
date: 12.08.2010	date: 13.08.2010	date: 13.08.2010

## 1 Test specimen

The orderer handed over 6 powder coated test plates and provided the following information about the building of layers:

substrat: galvanized steel  
treatment: nano-phosphate  
primer coating: ES-7105  
top coating: RX-9006-XW

The powder coating system on galvanized steel should be tested for corrosion protection following DIN 55633, corrosivity category C5-I, durability high. However galvanized steel is out of the scope of DIN 55633.

## 2 Loading

Loading of test plates according to DIN 55633 was carried out basically to ISO 12944-6.

The loading of the test plates was carried out with the following conditions:

### – Condensation of water according to ISO 6270-1

Test plates (fixed in a horizontal angle of 60°) were loaded on one side by condensate water of 38 °C. The back side of the test plates is exposed to laboratory atmosphere (NK 23/50), creating a temperature gradient across the sample.

The loading time was 720 hours.

3 test plates were used for each loading.

## 3 Test Procedure

### – Measurement of film thickness (before loading) according to ISO 2808

test method: 7 C (magnetic induction)  
test tool: Fischer DELTASCOPE FMP 10  
adjustment: on a smooth steel plate with foils of known thickness

– **Assessment of visual alterations after loading**

immediately after taking out of the apparatus

- degree of blistering           ISO 4628-2
- degree of rusting Ri         ISO 4628-3
- degree of cracking           ISO 4628-4
- degree of flaking             ISO 4628-5

– **Cross-cut test**

The cross-cut according to DIN EN ISO 2409 (3 mm cut distance) was carried out with a one-cut tool before and after loading (24 h after taking out of the apparatus and storage at laboratory conditions).

**4 Test Results**

The results are compiled in table 1.

table 1: tests according to corrosivity category C5-I, durability high

<b>system: galvanized steel / ES-7105/ RX-9006-XW</b>				
<b>evaluation before loading</b>				
		test plate 1	test plate 2	test plate 3
DIN EN ISO 2808	film thickness* / $\mu\text{m}$	198 $\pm$ 18	147 $\pm$ 10	146 $\pm$ 23
DIN EN ISO 2409	cross-cut	0	0	0
<b>evaluation after loading</b>				
test 1: ISO 6270-1 (condensation of water)				
exposure time 720 h		test plate 4	test plate 5	test plate 6
DIN EN ISO 2808	film thickness* / $\mu\text{m}$	210 $\pm$ 19	114 $\pm$ 12	133 $\pm$ 15
DIN EN ISO 2409	cross-cut	0	0	0
DIN EN ISO 4628-2	degree of blistering	0 (S0)	0 (S0)	0 (S0)
DIN EN ISO 4628-3	degree of rusting	Ri0	Ri0	Ri0
DIN EN ISO 4628-4	degree of cracking	0 (S0)	0 (S0)	0 (S0)
DIN EN ISO 4628-5	degree of flaking	0 (S0)	0 (S0)	0 (S0)

\* including galvanized zinc layer

## 5 Conclusions from Test Results

Assessment of coating system according to DIN 55633 was carried out basically to ISO 12944-6. Coating systems on **hot-dip galvanized steel** with film thickness < 250 µm pass the test according to ISO 12944-6, if two of three test plates fulfill the following requirements:

before loading:	cross-cut test ISO 2409:	Gt ≤ 1
after loading:	cross-cut test ISO 2409:	Gt ≤ 1
	degree of blistering ISO 4628-2:	0 (S0)
	degree of rusting ISO 4628-3:	Ri 0
	degree of cracking ISO 4628-4:	0 (S0)
	degree of flaking ISO 4628-5:	0 (S0)

The tested powder coating system (**coating system on galvanized steel**) fulfills the requirements of ISO 12944-6 for a coating system on hot-dip galvanized steel according to corrosivity category C5-I, durability high.

Attachment to PB300/256/10

## **Photographic Documentation to PB300/256/10**


**2 Pages**



Fig. 1: test specimens after loading with condensation of water

Dresden, 09.09.2010

Institut für Korrosionsschutz Dresden GmbH

  
i. V. Dr. Andrea Rudolf  
Head of department

  
i. A. Dr. Stephan Zeltner  
scientific employee

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