INSTITUT FÜR KORROSIONSSCHUTZ DRESDEN GMBH

Privatwirtschaftliche Forschungsstelle

Beratung - Schadensfallaufklärung - Qualitätssicherung - Forschung - Prüfung

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Test report

PB300/152/05

Customer:	Emil Frei GmbH & Co. Herr Jochen Keller Am Bahnhof 6 78199 Bräunlingen
Order:	Testing of blast-cleaned and powder-coated steel specimens in accordance with DIN EN ISO 12944 Part 6, corrosivity category C 5-I, high durability
Tested system:	Epoxy resin priming powder Polyester finishing powder
Test result:	The tested powder-coating system passed the test in accordance with DIN EN ISO 12944 Part 6, corrosivity category C 5-I, high durability.
Number of pages:	6

Person responsible for testing /
Head of testing department: sgd. Dr. Wolf-Dieter Kaiser

Dresden, 2005-08-15

Translation according to original test report PB300/152/05

Dresden, 14.06.2011

Head of testing department

Rudolf

Dr. Andrea Rudolf

1 Powder system

The powder system of the manufacturer Emil Frei GmbH & Co. has been tested:

Priming powder FREOPOX-coating powder, Tribo PE1204A

Finishing powder FREIOTHERM-coating powder, Tribo, PP1004A

2 Preparation of test panels

The powder coating of the test panels including the surface preparation of the specimens made of structural steel St 52 by blast-cleaning to the surface preparation grade Sa 2½ in accordance with DIN EN ISO 12944 Part 4 or ISO 8501 Part 1 has been carried out by WOBEK Oberflächenschutz GmbH Stollberg.

3 Stress application

The stress application of the test panels took place in accordance with DIN EN ISO 12944-6:

- Condensation of water vapour in accordance with ISO 6270
  Duration of stress: 720 hours
  Number of specimens: 3

- Salt spray (fog) in accordance with ISO 7253
  Duration of stress: 1440 hours
  Number of specimens: 3

- Condensation with SO_2 (Kesternich test) in accordance with ISO 3231
  Duration of stress: 30 cycles
  Number of specimens: 3

4 Test

4.1 Prior to stress application

- Measuring of the film thickness in accordance with ISO 2808 (magnetic induction principle)
  Measuring device: Fischer DELTASCOPE MP 3
  Calibration: on smooth steel reference standard

- Pull-off strength in accordance with ISO 4624
  Testing device: Testing machine AGS-10 KNG, company Hegewald & Peschke Mess- und Prüftechnik GmbH, Nossen
  Adhesive: Cyanoacrylate
  At least 3 test cylinders have been adhered to each test panel. The indicated pull-off strengths are the mean values of these single values.

  The failure patterns have the following relevance:

A/B	Adhesion failure between steel and 1st coat
C	Cohesion failure in the 2nd coat
C/Y	Adhesion failure between 2nd coat and adhesive

  In case the failure pattern C/Y predominates, the characteristic value is being marked with the symbol >.

- Cross-cut characteristic values in accordance with ISO 2409

4.2 After stress application

- Visual evaluation immediately after the end of the stress application:
  Degree of blistering in accordance with ISO 4628-2
  Degree of rusting in accordance with ISO 4628-3
  Degree of cracking in accordance with ISO 4628-4
  Degree of flaking in accordance with ISO 4628-5

- Pull-off strength in accordance with ISO 4624
  The pull-off strength has been determined after conditioning of the specimens under indoor conditions for 24 hours. Testing device, adhesive, and the relevance of the failure patterns have already been described in 4.1.

- Cross-cut characteristic values in accordance with ISO 2409

In this case, the specimens have also been conditioned under indoor conditions for 24 hours.

- Determination of the corrosion from the scratch when the stress application took place in accordance with ISO 7253
  Immediately after the end of the stress application the infiltrated coating has been removed starting from the scratch using a scalpel. The width of the area infiltrated by rust has been measured at 10 measuring points at distances of 10 mm and arithmetically averaged. The corrosion M from the scratch has been calculated using the following equation:

$$M = (C-W)/2$$

C: Width of the area infiltrated by rust (arithmetic mean value)
W: Original scratch width/mm

5 Test results

The results are summarised in the following table.

Table 1: System: Priming powder FREOPOX-powder, Tribo, PE1204A
Finishing powder FREIOTHERM-powder, Tribo, PP1004A

Assessment prior to stress application				
		Test panel 1		
ISO 2808	Film thickness/µm	154 ± 12		
ISO 2409	Cross-cut	0		
ISO 4624	Pull-off strength/MPa	>8,9 ± 2,6		
	Failure pattern/%	100 C/Y		
Assessment after stress application				
		Test panel 2	Test panel 3	Test panel 4
Test 1: ISO 6270 - Condensation of water vapour Duration 720 h				
ISO 2808	Film thickness/µm	148 ± 6	157 ± 9	162 ± 12
ISO 2409	Cross-cut	0	0	0
ISO 4624	Pull-off strength/MPa	>17,1 ± 2,7	-	-
	Failure pattern/%	100 C/Y	-	-
ISO 4628-2	Degree of blistering	0	0	0
ISO 4628-3	Degree of rusting Ri	0	0	0
ISO 4628-4	Degree of cracking	0	0	0
ISO 4628-5	Degree of flaking	0	0	0
Test 2: ISO 7253 - Salt spray (fog) Duration 1440 h		Test panel 5	Test panel 6	Test panel 7
ISO 2808	Film thickness/µm	142 ± 6	147 ± 15	160 ± 14
ISO 2409	Cross cut	0	0	0
ISO 4624	Pull-off strength/MPa	>15,3 ± 0,8	-	-
	Failure pattern/%	100 C/Y	-	-
Corrosion at the scratch	mm	-	0,5	0,5
ISO 4628-2	Degree of blistering	0	0	0
ISO 4628-3	Degree of rusting Ri	0	0	0
ISO 4628-4	Degree of cracking	0	0	0
ISO 4628-5	Degree of flaking	0	0	0
Test 3: ISO 3231 - Condensation water with SO_2 Duration 30 cycles		Test panel 8	Test panel 9	Test panel 10
ISO 2808	Film thickness/µm	144 ± 12	156 ± 17	162 ± 14
ISO 2409	Cross-cut	0	0	0
ISO 4624	Pull-off strength/MPa	>7,7 ± 0,5	-	-
	Failure pattern/%	100 C/Y	-	-
Corrosion at the scratch	mm	-	0,2	0,2
ISO 4628-2	Degree of blistering	0	0	0
ISO 4628-3	Degree of rusting Ri	0	0	0
ISO 4628-4	Degree of cracking	0	0	0
ISO 4628-5	Degree of flaking	0	0	0

6 Evaluation of the test results

In accordance with DIN EN ISO 12944-6 two out of three test panels have to meet the following requirements:

Table 2: Requirements

Test criterion	Requirement	
	Prior to stress application	After stress application
Cross-cut ISO 2409	Gt 0 or 1	Gt 0 or 1
Pull-off strength ISO 4624 (for film thicknesses > 250 µm)	No adhesion failure to the substrate (A/B) permissible, except for pull-off values >5 MPa	No adhesion failure to the substrate (A/B) permissible, except for pull-off values >5 MPa
Corrosion at the scratch (only for ISO 7253)	-	≤ 1 mm
Degree of blistering ISO 4628-2	-	0
Degree of rusting ISO 4628-3	-	Ri 0
Degree of cracking ISO 4628-4	-	0
Degree of flaking ISO 4628-5	-	0

The tested powder-coating system is qualified for the corrosivity category C5-I, high durability. This includes corrosivity category C4 high.