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Test Report

Referred to:	AAMA 2604-13, Voluntary Specification, Performance Requirements and Test Procedures for High Performance Organic Coatings on Aluminum Extrusions and Panels
Client:	IGP Pulvertechnik AG Industrie Stelz, Ringstraße 30 9500 Wil Schweiz
Job number:	15312-3
Samples receipt:	2016-08-29
Start of testing:	2016-09-06
End of testing:	2017-02-21
Creation date:	2024-05-10
Number of pages:	17 pages

The expanded measurement uncertainty is not taken into account in the conformity assessment unless otherwise agreed. Irrespectively, the measurement uncertainty is stated if possible.

DAkkS Deutsche Akkreditierungsstelle D-PL-11086-01-00

Accredited by DAkkS (Deutsche Akkreditierungsstelle GmbH) according to German Industrial Standard DIN EN ISO/IEC 17025 accredited test laboratory.
The accredited test methods are marked with an **asterisk ***.

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CONTENTS Page

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1 FORMULATION

The Institute was instructed by the client to perform all necessary tests acc. to AAMA 2604-13, Chapter 8.1 to 8.9.

1.1 Status and type of samples/sampling

Label / No.:	Number:	Material / Surface:
Aluminium Q-Panels (Co. Q-Lab)	41 pieces	Aluminum / Powder coated Powder: IGP HWFsuperior 5703 Color: RAL 7021
Aluminium Q-Panels (Co. Q-Lab)	41 pieces	Aluminum / Powder coated Powder: IGP HWFsuperior 5703 Color: RAL 9005

The preparation of the aluminum samples and the coating was performed as follows:

Aluminium substrate:	Aluminium Q-Panels (Co. Q-Lab)
Pre-treatment:	Cr-(VI)
Paint System:	Supplier: IGP Product: HWFsuperior 5703 Color: RAL 7021, RAL 9005
Coater:	Company: IGP Curing: 180 °C / 15 min
Coating date:	2016-08-18 RAL 7021 2016-08-22 RAL 9005
Date testing started:	2016-09-06
Date testing completed:	2017-02-21

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2 TEST RESULTS

2.1 AAMA 2604-13, Chapter 8.1 – Color Uniformity

2.1.1 Procedure according to AAMA 2604-13, Chapter 8.1.1

- Check random samples visually under a uniform light source. Viewing should be done at multiple angles.

2.1.2 Requirements according to AAMA 2604-13, Chapter 8.1.2 and Results

- Color uniformity maximum deviation is 2 ΔE.

RAL 7021:	Results:
Sample 1	ΔE = 0.77
Sample 2	ΔE = 0.77
Sample 3	ΔE = 0.79

RAL 9005:	Results:
Sample 1	ΔE = 0.79
Sample 2	ΔE = 0.86
Sample 3	ΔE = 0.55

2.2 AAMA 2604-13, Chapter 8.2 – Specular Gloss

2.2.1 Procedure according to AAMA 2604-13, Chapter 8.2.1

- Gloss measurement according to ASTM D 523 using a 60-degree gloss meter
- Samples must meet minimum dry film thickness requirements

2.2.2 Requirements according to AAMA 2604-13, Chapter 8.2.2 and Results

- Gloss values shall be within ± 5 units of the manufacturer's specification

RAL 7021:	Manufacturer´s value:	Results:
Sample 1	25-35	38.3
Sample 2		39.7
Sample 3		32.5

RAL 9005:	Manufacturer´s value:	Results:
Sample 1	25-35	27.8
Sample 2		29.4
Sample 3		28.7

2.3 AAMA 2604-13, Chapter 8.3 – Dry Film Hardness

2.3.1 Procedure according to AAMA 2604-13, Chapter 8.3.1

- Pencil hardness test according to ASTM D 3363

2.3.2 Requirements according to AAMA 2604-13, Chapter 8.3.2 and Results

- Grade F minimum hardness: No rupture of film according to ASTM D 3363

RAL 7021:	Results:
Sample 1	Pencil hardness F and no rupture of the film
Sample 2	Pencil hardness F and no rupture of the film
Sample 3	Pencil hardness F and no rupture of the film

RAL 9005:	Results:
Sample 1	Pencil hardness F and no rupture of the film
Sample 2	Pencil hardness F and no rupture of the film
Sample 3	Pencil hardness F and no rupture of the film

2.4 AAMA 2604-13, Chapter 8.4 – Film Adhesion

2.4.1 Procedure according to AAMA 2604-13, Chapter 8.4.1

- Dry Adhesion and tape pull-off according to AAMA 2604-13, Chapter 8.4.1.1
- Wet Adhesion and tape pull-off according to AAMA 2604-13, Chapter 8.4.1.2
- Boiling Water Adhesion and tape pull-off acc. to AAMA 2604-13, Chapter 8.4.1.3

2.4.2 Performance according to AAMA 2604-13, Chapter 8.4.2 and Results

- No removal of film under the tape
- No blistering anywhere on the test specimen

RAL 7021:	Results:
Sample 1	No removal of film under the tape, No blistering
Sample 2	No removal of film under the tape, No blistering
Sample 3	No removal of film under the tape, No blistering

RAL 9005:	Results:
Sample 1	No removal of film under the tape, No blistering
Sample 2	No removal of film under the tape, No blistering
Sample 3	No removal of film under the tape, No blistering

2.5 AAMA 2604-13, Chapter 8.5 – Impact Resistance

2.5.1 Procedure according to AAMA 2604-13, Chapter 8.5.1

- Impact testing according to AAMA 2604-13, Chapter 8.5.1

2.5.2 Requirements according to AAMA 2604-13, Chapter 8.5.2 and Results

- No removal of film from substrate

RAL 7021: Results:

Sample 1	No removal of the film from the substrate
Sample 2	No removal of the film from the substrate
Sample 3	No removal of the film from the substrate

RAL 9005: Results:

Sample 1	No removal of the film from the substrate
Sample 2	No removal of the film from the substrate
Sample 3	No removal of the film from the substrate

2.6 AAMA 2604-13, Chapter 8.6 – Abrasion Resistance

2.6.1 Procedure according to AAMA 2604-13, Chapter 8.6.1

- Falling sand test according to ASTM D 968

2.6.2 Requirements according to AAMA 2604-13, Chapter 8.6.2

- Abrasion Coefficient Value V/T of the coating shall be 20 minimum.

RAL 7021:	Results:
Sample 1	V/T = 69 l/mil
Sample 2	V/T = 84 l/mil
Sample 3	V/T = 89 l/mil

RAL 9005:	Results:
Sample 1	V/T = 77 l/mil
Sample 2	V/T = 76 l/mil
Sample 3	V/T = 58 l/mil

2.7 AAMA 2604-13, Chapter 8.7 – Chemical Resistance

2.7.1 Procedure according to AAMA 2604-13, Chapter 8.7.1 to 8.7.5

- Muriatic Acid Resistance (15-Minute Spot test) acc. to AAMA 2604-13, Ch. 8.7.1.1
- Mortar Resistance (24-Hour Pat test) acc. to AAMA 2604-13, Chapter 8.7.2.1
- Nitric Acid Resistance acc. to AAMA 2604-13, Chapter 8.7.3.1
- Detergent Resistance (72-Hour Immerse test) acc. to AAMA 2604-13, Ch. 8.7.4.1
- Window Cleaner Resistance acc. to AAMA 2604-13, Chapter 8.7.5.1

2.7.2 Requirements according to AAMA 2604-13, Chapter 8.7.1 to 8.7.5 and Results

- Muriatic Acid Resistance requirements acc. to AAMA 2604-13, Chapter 8.7.1.2:
  - No blistering when examined by the unaided eye
  - No visual change in appearance when examined by the unaided eye

- Mortar Resistance requirements acc. to AAMA 2604-13, Chapter 8.7.2.2:
  - Mortar shall dislodge easily
  - Any residue shall be removable with a damp cloth
  - Any lime residue should be easily removed with the 10% muriatic acid solution
  - No loss of film adhesion
  - No visual change in appearance

- Nitric Acid Resistance requirements acc. to AAMA 2604-13, Chapter 8.7.3.2:
  - No color change ΔE greater than 5 calculated according to ASTM D 2244

- Detergent Resistance requirements acc. to AAMA 2604-13, Chapter 8.7.4.2:
  - Solution prepared according to ASTM D 2248
  - Pull off of the tape according to ASTM D 3359
  - No loss of adhesion of the film
  - No blistering
  - No significant visual change in appearance

- Window Cleaner Resistance requirements acc. to AAMA 2604-13, Chapter 8.7.5.2:
  - No blistering
  - No visual change in appearance
  - No removal of film

Muriatic Acid Resistance according to AAMA 2604-13, Chapter 8.7.1:

RAL 7021:	Results:
Sample 1	No blistering, no visual change
Sample 2	No blistering, no visual change
Sample 3	No blistering, no visual change

RAL 9005:	Results:
Sample 1	No blistering, no visual change
Sample 2	No blistering, no visual change
Sample 3	No blistering, no visual change

Mortar Resistance according to AAMA 2604-13, Chapter 8.7.2:

RAL 7021:	Results:
Sample 1	Requirements fulfilled; No loss of film adhesion, no visual change in appearance
Sample 2	Requirements fulfilled; No loss of film adhesion, no visual change in appearance
Sample 3	Requirements fulfilled; No loss of film adhesion, no visual change in appearance

RAL 9005:	Results:
Sample 1	Requirements fulfilled; No loss of film adhesion, no visual change in appearance
Sample 2	Requirements fulfilled; No loss of film adhesion, no visual change in appearance
Sample 3	Requirements fulfilled; No loss of film adhesion, no visual change in appearance

Nitric Acid Resistance requirements according to AAMA 2604-13, Chapter 8.7.3:

RAL 7021:	Results:
Sample 1	ΔE = 0.14

RAL 9005:	Results:
Sample 1	ΔE = 0.28

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Detergent Resistance requirements according to AAMA 2604-13, Chapter 8.7.4:

RAL 7021:	Results:
Sample 1	No loss of adhesion of the film, no blistering, no significant visual change in appearance
Sample 2	No loss of adhesion of the film, no blistering, no significant visual change in appearance
Sample 3	No loss of adhesion of the film, no blistering, no significant visual change in appearance

RAL 9005:	Results:
Sample 1	No loss of adhesion of the film, no blistering, no significant visual change in appearance
Sample 2	No loss of adhesion of the film, no blistering, no significant visual change in appearance
Sample 3	No loss of adhesion of the film, no blistering, no significant visual change in appearance

Window Cleaner Resistance requirements according to AAMA 2604-13, Chapter 8.7.5:

RAL 7021:	Results:
Sample 1	No blistering, no visual change in appearance, no removal of film
Sample 2	No blistering, no visual change in appearance, no removal of film
Sample 3	No blistering, no visual change in appearance, no removal of film

RAL 9005:	Results:
Sample 1	No blistering, no visual change in appearance, no removal of film
Sample 2	No blistering, no visual change in appearance, no removal of film
Sample 3	No blistering, no visual change in appearance, no removal of film

2.8 AAMA 2604-13, Chapter 8.8 – Corrosion Resistance

2.8.1 AAMA 2604-13, Chapter 8.8.1 – Humidity Resistance

2.8.1.1 Procedure according to AAMA 2604-13, Chapter 8.8.1.1

- Constant humidity test for 3,000 h according to ASTM D 2247

2.8.1.2 Requirements according to AAMA 2604-13, Chapter 8.8.1.2 and Results

- No formation of blisters to extent greater than “Few” blisters Size No. 8, as shown in ASTM D 714, Figure No. 4

RAL 7021:	Results:
Sample 1	No blisters
Sample 2	No blisters
Sample 3	No blisters

RAL 9005:	Results:
Sample 1	No blisters
Sample 2	No blisters
Sample 3	No blisters

2.8.2 AAMA 2604-21, Chapter 8.8.2 – Cyclic Corrosion Testing

2.8.2.1 Procedure according to AAMA 2604-21, Chapter 8.8.2.2

- Cyclic Corrosion test for 1500 h according to ASTM G85 Annex A5, dilute electrolyte cyclic fog/dry test using a 0.05% sodium chloride with 0.35% ammonium sulfate solution

2.8.2.2 Requirements according to AAMA 2604-21, Chapter 8.8.2.3 and Results

- Minimum rating of 7 on scribe or cut edges
- Minimum blister rating of 8 within the test specimen field

RAL 7021: Results:

Sample 1	Rating of failure at scribe: 10 Rating of unscribed areas: 10
Sample 2	Rating of failure at scribe: 10 Rating of unscribed areas: 10
Sample 3	Rating of failure at scribe: 10 Rating of unscribed areas: 10

RAL 9005: Results:

Sample 1	Rating of failure at scribe: 10 Rating of unscribed areas: 10
Sample 2	Rating of failure at scribe: 10 Rating of unscribed areas: 10
Sample 3	Rating of failure at scribe: 10 Rating of unscribed areas: 10

2.9 AAMA 2604-13, Chapter 8.9 – Weathering

2.9.1 AAMA 2604-13, Chapter 8.9.1 – South Florida Exposure

2.9.1.1 Procedure according to AAMA 2604-13, Chapter 8.9.1.1, 8.9.1.2, 8.9.1.3, 8.9.1.4, 8.9.1.5

- On-fence testing Florida exposure South of latitude 27 degrees North at a 45-degree angle facing South for a minimum of five years and operated in accordance with ASTM G7.
- Color Retention procedure acc. to AAMA 2604-13, Chapter 8.9.1.2.1:
  Color change shall be measured on the exposed painted surface which has been cleaned of external deposits with clear water and a soft cloth and corresponding values shall be measured on the original retained panel or the unexposed flap area of the panel. A portion of the exposed panel may be washed lightly to remove surface dirt only. Heavy scrubbing or any polishing to remove chalk formation or restore the surface is not permitted where color measurements are made.
- Chalk Resistance procedure acc. to AAMA 2604-13, Chapter 8.9.1.3.1: Chalking shall be measured on an exposed, unwashed painted surface.
- Gloss Retention procedure acc. to AAMA 2604-13, Chapter 8.9.1.4.1:
  Gloss measurement according to ASTM D 523 using a 60-degree gloss meter of exposed and unexposed areas after weathering exposure. The exposure panel may be washed lightly with clear water and a soft cloth to remove loose surface dirt. Heavy scrubbing or any polishing to restore the surface is not permitted where gloss measurements are made.
- Resistance to Erosion procedure acc. to AAMA 2604-13, Chapter 8.9.1.5.1:
  Measure dry film thickness of exposed and adjacent unexposed areas of exposure panels using an Eddy Current meter as defined in ASTM B 244.

2.9.1.2 Requirements according to AAMA 2604-13, Chapter 8.9.1.2.1, 8.9.1.3.1, 8.9.1.4.1, 8.9.1.5.1 and Results

- Color Retention requirements acc. to AAMA 2604-13, Chapter 8.9.1.2.1:
  No color change more than 5 ΔE units calculated according to ASTM D 2244
- Chalk Resistance requirements acc. to AAMA 2604-13, Chapter 8.9.1.3.1:
  Chalking shall be greater than or equal to that represented by a No. 8 rating based on ASTM D4214, Test Method A.
- Gloss Retention requirements acc. to AAMA 2604-13, Chapter 8.9.1.4.2:
  Gloss retention shall be a minimum of 30 % after the exposure
- Resistance to Erosion requirements acc. to AAMA 2604-13, Chapter 8.9.1.5.2:
  Less than 10 percent film loss after the exposure test

RAL 7021: Results:

Sample 1	Color retention: Chalk resistance: Gloss retention: Film loss:	ΔE = 0.28 Rating No. 10 85 % 3 %
Sample 2	Color retention: Chalk resistance: Gloss retention: Film loss:	ΔE = 0.29 Rating No. 10 85 % 12 %
Sample 3	Color retention: Chalk resistance: Gloss retention: Film loss:	ΔE = 0.28 Rating No. 10 82 % -9 %

RAL 9005: Results:

Sample 1	Color retention: Chalk resistance: Gloss retention: Film loss:	ΔE = 1.36 Rating No. 10 66 % 3 %
Sample 2	Color retention: Chalk resistance: Gloss retention: Film loss:	ΔE = 1.30 Rating No. 10 63 % 11 %
Sample 3	Color retention: Chalk resistance: Gloss retention: Film loss:	ΔE = 1.36 Rating No. 10 69 % -4 %

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3 RESULTS

The samples fulfill the requirements acc. to AAMA 2604-13, Chapter 8.1 to 8.8.1.
The samples fulfill the requirements acc. to AAMA 2604-21, Chapter 8.8.2.

The samples fulfill the requirements of the Weather Exposure acc. to AAMA 2604-13, Chapter 8.9.1.1 to 8.9.1.4.2.
One of three samples of each color do not fulfill the requirements acc. to AAMA 2604-13, Chapter 8.9.1.5.2 “Resistance to Erosion”.

Schwaebisch Gmuend,
2024-05-10

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– End of Test Report –