

Coating Performance – Not as Simple as it would Appear

Overview

When ordering a coating (finish) for the building panels, you would think that the biggest choice would be color. Not true. There are many differences between panel coatings. Characteristics like color and gloss are easily spotted. Others like film thickness, adhesion, and resistance to change are more difficult to identify. It can take a coatings expert to know all of the in's and out's of coating performance. Fortunately, there are a number of very good publications available to the public that discuss performance and what to expect from several of the popular levels of panel finish.

Background

Panel systems rely on a number of different types of coating systems. Steel faced panels may use additional primers for optimal performance. High pressure laminate panels often use a high quality, high performance polyester system, and aluminum panels generally use fluoropolymer coatings. While each of these coatings can provide a high quality product, this paper will focus on the fluoropolymer coatings widely used on aluminum coil for architectural construction in North America. Fluoropolymer coatings generally meet one of the three AAMA standards identified as AAMA 2603, 2604, or 2605. The question remains, “What is the difference in these three AAMA standards and how can I be assured that I am getting the performance that is expected?”

The American Architectural Manufacturer's Association (AAMA) developed these three performance standards in 1998 to define three different levels of performance: Good (AAMA 2603), High (AAMA 2604), and Superior (AAMA 2605). Since that time, the standards have been revised regularly to reflect the changing coating technology and performance.

Discussion

While there are three individual AAMA standards, there are several common performance requirements in each. These common performance criteria include:

- Coatings shall be visibly free from flow lines, streaks, blisters or other surface imperfections in the dry film state when observed at a distance of 3 m (10 ft) at an angle of 90° to the surface.
- Gloss shall remain within ± 5 units of recommended values
(Example: If coatings manufacturer's gloss value specification is a range of 25-35, the ± 5 units allowance would permit a gloss value range of 20 – 40 at the production line quality control.)

Specific differences between the standards are listed below.

AAMA 2603 – Good Coating Performance

The current version of AAMA 2603 is dated 2015 (2603-15). The scope of this standard includes aluminum panels with a factory applied coating. The standard does not specifically define the application method; however, spray coating is called out in Section 4.0. The Appendix addresses modifications for coatings applied using a coil coating line where the primary difference with coil coating is a change in dry film thickness.

The key performance requirements for a coating conforming to AAMA 2603 include:

- **Dry Film Thickness (Spray)**
 - ≥ 20 microns (0.8 mil) on exposed surfaces
 - 80% of measurements ≥ 20 microns (0.8 mil)
 - All measurements shall be ≥ 17 microns (0.68 mil) or 85% of film thickness
- **Dry Film Thickness (Coil Coat) (Appendix)**
 - 80% of measurements ≥ 23 microns (0.9 mil)
 - No more than 5% of readings on exposed surfaces shall be below 19 microns (0.75 mil) or 83% of film thickness specified
- **Humidity Resistance Testing** – 1500 hour exposure with no more than “few” blisters Size No. 8
- **Salt Spray Corrosion Resistance** – 1500 hour exposure with minimum rating of 7 on scribe or cut edge and minimum blister rating of 8.
- **Outdoor weather exposure testing in South Florida for at least 1 year**
- **Color Retention** – “Slight fading” after one year exposure in South Florida
- **Chalk Rating** – “Slight chalking” after one year exposure in South Florida

An interesting point in AAMA 2603-15 is that there are no performance requirements for many aspects such as gloss retention or erosion resistance after weather exposure for one year one South Florida; abrasion resistance; or coating flexibility (for spray applied coatings).

AAMA 2604 - High Performing Coatings

The current version of AAMA 2604 is dated 2013 (2604-13). The scope of this standard is similar to AAMA 2603 and includes aluminum panels with a factory applied coating. The standard does not specifically define the application method; however, the same references to coil coating are made in the appendix.

An important difference is that AAMA 2604-13 is intended to address high performance coatings where AAMA 2603-15 addresses a “good level of performance”. The following key performance levels are required in AAMA 2604-13:

- **Dry Film Thickness (Spray)**
 - 80% of measurements ≥ 30 microns (1.2 mil) on exposed surfaces
 - Individual readings may be as low as 25 microns (1.0 mil)
 - No more than 5% of readings on exposed surfaces shall be below 25 microns (1.0 mil) or 85% of film thickness
- **Dry Film Thickness (Coil Coat) (Appendix)**
 - 80% of measurements ≥ 23 microns (0.9 mil)
 - No more than 5% of readings on exposed surfaces shall be below 19 microns (0.75 mil) or 83% of film thickness specified

- **Humidity Resistance Testing** – 3000 hour exposure with no more than “few” blisters Size No. 8
- **Salt Spray Corrosion Resistance** – 3000 hour exposure with minimum rating of 7 on scribe or cut edge and minimum blister rating of 8.
- **Outdoor weather exposure testing in South Florida for at least five (5) years**
- **Color Retention** – Delta E \leq 5 units (Hunter) after five (5) years exposure in South Florida
- **Chalk Rating** – Chalking shall be no less than No. 8 rating after five (5) years exposure in South Florida.
- **Gloss Retention** – Minimum 30% after five (5) years exposure in South Florida
- **Coating Erosion** – Less than 10% film loss after five (5) years exposure in South Florida

AAMA 2604-13 does have a number of the same performance levels as AAMA 2603-15, however **performance must be achieved after 5 years of exposure rather than 1 year**. Those formulated coatings that do not have at least 5 years of real world exposure in South Florida cannot make the claim to perform to AAMA 2604-13.

AAMA 2605 - Superior Performing Coatings

The current version of AAMA 2605 is also dated 2013. The scope is the same as the other AAMA standards however Coil-Applied Coating is specifically defined in Section 4.1.1. An Appendix for Coil Coating is also included in this standard.

AAMA 2605-13 defines the performance of superior performing coatings requiring higher performance levels than the other AAMA standards in the following areas:

- **Dry Film Thickness (Spray)**
 - 80% of measurements \geq 30 microns (1.2 mil) on exposed surfaces
 - Individual readings may be as low as 25 microns (1.0 mil)
 - No more than 5% of readings on exposed surfaces shall be below 25 microns (1.0 mil) or 85% of film thickness
- **Dry Film Thickness (Coil Coat) (Appendix)**
 - 80% of measurements \geq 23 microns (0.9 mil)
 - No more than 5% of readings on exposed surfaces shall be below 19 microns (0.75 mil) or 83% of film thickness specified
- **Humidity Resistance Testing** – 4000 hour exposure with no more than “few” blisters Size No. 8
- **Cyclic Corrosion Testing** – 2000 hour exposure to cyclic fog/dry testing with minimum rating of 7 on scribe or cut edge and minimum blister rating of 8.
- **Outdoor weather exposure testing in South Florida for at least ten (10) years**
- **Color Retention** – Delta E \leq 5 units (Hunter) after ten (10) years exposure in South Florida

- **Chalk Rating** – Chalking shall be no less than No. 8 rating after ten (10) years exposure in South Florida.
- **Gloss Retention** – Minimum 50% after ten (10) years exposure in South Florida
- **Coating Erosion** – Less than 10% film loss after ten (10) years exposure in South Florida

Note that corrosion testing for AAMA 2605-13 is an entirely different procedure than the previous AAMA 2605 standards. The previous version of AAMA 2605 (2605-11) called for 4000 hours of salt spray corrosion resistance testing. AAMA 2605-13 calls for a shorter exposure time of a more aggressive test standard. Also note that **10 years of exposure to the South Florida environment is required** before many of the performance readings can even be taken. Samples with less than 10 years of exposure cannot comply with AAMA 2605-13 and must use another guideline to determine a level of performance.

SUMMARY

Choosing the right coating is not as simple as just choosing a color. Factory applied coatings are often designated as meeting the AAMA industry standards, however there are different levels of performance with a key indicator being real world Florida test experience defined in years of exposure. Without the proper level of exposure, it is impossible for a coating to be classified as being either a Good Performance, High Performance, or a Superior Performing Coating.

	AAMA 2603-15 Good level of performance coating			AAMA 2604-13 High performance coating			AAMA 2605-13 Superior performing coating		
Attribute	AAMA Sect.	Test		AAMA Sect.	Test		AAMA Sect.	Test	
Visibly free from surface imperfections	5.2		3 m (10 ft) at a 90° angle	5.2		3 m (10 ft) at a 90° angle	5.2		3 m (10 ft) at a 90° angle
Minimum Dry Film Thickness SPRAY APPLIED COATING	5.3	ASTM D7091	≥ 20 microns (0.8mil) on exposed surfaces	5.3	ASTM D7091	80% of measurements ≥ 30 microns (1.2 mil) on exposed surfaces	5.3	ASTM D7091	80% of measurements ≥ 30 microns (1.2 mil) on exposed surfaces
			80% of measurements ≥ 20 microns (0.8 mil)			Minimum individual thickness readings ≥ 25 microns (1.0 mil)			Minimum individual thickness readings ≥ 25 microns (1.0 mil)
			All measurements shall be ≥ 17 microns (0.68 mil) or 85% of film thickness			No more than 5% of readings on exposed surfaces shall be below 25 microns (1.0 mil) or 85% of film thickness			No more than 5% of readings on exposed surfaces shall be below 25 microns (1.0 mil) or 85% of film thickness

	AAMA 2603-15 Good level of performance coating			AAMA 2604-13 High performance coating			AAMA 2605-13 Superior performing coating		
Minimum Dry Film Thickness COIL COATED	A3.0	ASTM D7091	80% of measurements ≥ 23 microns (0.9 mil) on exposed surfaces	A3.0	ASTM D7091	80% of measurements ≥ 23 microns (0.9 mil) on exposed surfaces	A3.0	ASTM D7091	80% of measurements ≥ 23 microns (0.9 mil) on exposed surfaces
			No more than 5% of readings on exposed surfaces shall be below 19 microns (0.75 mil) or 83% of film thickness			No more than 5% of readings on exposed surfaces shall be below 19 microns (0.75 mil) or 83% of film thickness			No more than 5% of readings on exposed surfaces shall be below 19 microns (0.75 mil) or 83% of film thickness
Sealants used	5.6	AAMA 800	Compatible with coating	5.6	AAMA 800	Compatible with coating	5.6	AAMA 800	Compatible with coating
Pretreatment	7.2	ASTM D5723	Minimum coating weight 323 mg/m ³ (30 mg/ft ²) or according to supplier's recommendations	7.2	ASTM D5723	Minimum coating weight 323 mg/m ³ (30 mg/ft ²) or according to supplier's recommendations	7.2	ASTM D5723	Minimum coating weight 431 mg/m ³ (40 mg/ft ²) or according to supplier's recommendations
Color Uniformity	8.1		Consistent within color range	8.1	ASTM D2244	SUGGESTED maximum is 2 Delta E	8.1	ASTM D2244	SUGGESTED maximum is 2 Delta E
Specular Gloss	8.2	ASTM D523	±5 units of the manufacturer's specification	8.2	ASTM D523	±5 units of the manufacturer's specification	8.2	ASTM D523	±5 units of the manufacturer's specification
Dry Film Hardness	8.3	ASTM D3363	Grade H minimum hardness	8.3	ASTM D3363	Grade F minimum hardness	8.3	ASTM D3363	Grade F minimum hardness
Film (Coating) Adhesion	8.4		Dry, Wet, and Boiling water exposure - No coating removal using tape	8.4		Dry, Wet, and Boiling water exposure - No coating removal using tape	8.4		Dry, Wet, and Boiling water exposure - No coating removal using tape
Impact Resistance	8.5		No coating removal after impact (minute cracking allowed)	8.5		No coating removal after impact (minute cracking allowed)	8.5		No coating removal after impact (minute cracking allowed)
Abrasion Resistance (Falling sand)			No specification	8.6	ASTM D968	Abrasion Coefficient Value ≥ 20	8.6	ASTM D968	Abrasion Coefficient Value ≥ 40
Chemical Resistance									
Muriatic Acid	8.6.1		No blistering or visual change with unaided eye	8.7.1		No blistering or visual change with unaided eye	8.7.1		No blistering or visual change with unaided eye
Mortar	8.6.2		Removable with no loss of adhesion or visual change with unaided eye	8.7.2		Removable with no loss of adhesion or visual change with unaided eye	8.7.2		Removable with no loss of adhesion or visual change with unaided eye
Nitric Acid			No specification	8.7.3		Delta E shall be ≤ 5 units (Hunter) after exposure	8.7.3		Delta E shall be ≤ 5 units (Hunter) after exposure

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	AAMA 2603-15 Good level of performance coating			AAMA 2604-13 High performance coating			AAMA 2605-13 Superior performing coating		
Attribute	AAMA Sect.	Test		AAMA Sect.	Test		AAMA Sect.	Test	
Chemical Resistance									
Detergent	8.6.3	ASTM D2248	No loss of adhesion or blistering. No visual change with unaided eye	8.7.4	ASTM D2248	No loss of adhesion or blistering. No visual change with unaided eye	8.7.4	ASTM D2248	No loss of adhesion or blistering. No visual change with unaided eye
Window Cleaner Resistance			No specification	8.7.5		No loss of adhesion or blistering. No visual change with unaided eye	8.7.5		No loss of adhesion or blistering. No visual change with unaided eye
Humidity Resistance	8.7.1	ASTM D2247 ASTM D4585	1500 hour exposure - No forming of blisters greater than "Few" blisters Size No. 8 as shown in Figure No. 4 ASTM D714	8.8.1	ASTM D2247 ASTM D4585	3000 hour exposure - No forming of blisters greater than "Few" blisters Size No. 8 as shown in Figure No. 4 ASTM D714	8.8.1	ASTM D2247 ASTM D4585	4000 hour exposure - No forming of blisters greater than "Few" blisters Size No. 8 as shown in Figure No. 4 ASTM D714
Salt Spray Corrosion Resistance	8.7.2	ASTM B117	1500 hour exposure - Minimum rating of 7 on scribe or cut edges. Minimum blister rating of 8 in accordance with Table 1 and 2 (ASTM D1654)	8.8.2	ASTM B117	3000 hour exposure - Minimum rating of 7 on scribe or cut edges. Minimum blister rating of 8 in accordance with Table 1 and 2 (ASTM D1654)			REPLACED BY CYCLIC CORROSION TESTING
Fog/Dry Cyclic Corrosion Resistance			No specification			No specification	8.8.2	ASTM G85	2000 hour exposure - Minimum rating of 7 on scribe or cut edges. Minimum blister rating of 8 in accordance with Table 1 and 2 (ASTM D1654)
Outdoor Weathering	8.8.1.1	ASTM G7	1 year (min) Exposure in South Florida	8.9.1.1	ASTM G7	5 year (min) Exposure in South Florida	8.9.1.1	ASTM G7	10 year (min) Exposure in South Florida
Color Retention (After Weathering)	8.8.1.2		Only slight fading allowed after exposure	8.9.1.2	ASTM D2244	Delta E shall be no more than 5 units (Hunter) after 5 year exposure. New color, using same pigment and resin need not be tested if within 10 Hunter Units in lightness (L).	8.9.1.2	ASTM D2244	Delta E shall be no more than 5 units (Hunter) after 10 year exposure. New color, using same pigment and resin need not be tested if within 10 Hunter Units in lightness (L).

	AAMA 2603-15 Good level of performance coating			AAMA 2604-13 High performance coating			AAMA 2605-13 Superior performing coating		
Attribute	AAMA Sect.	Test		AAMA Sect.	Test		AAMA Sect.	Test	
Chalk Resistance (After Weathering)	8.8.1.2		Only slight chalking allowed after exposure	8.9.1.3	ASTM D4214	Chalking shall be no less than No. 8 rating after 5 year exposure	8.9.1.3	ASTM D4214	Chalking shall be no less than No. 8 rating for colors and No. 6 rating for whites after 10 year exposure
Gloss Retention (After Weathering)			No specification	8.9.1.4	ASTM D523	Gloss retention shall be a minimum of 30% after 5 year exposure	8.9.1.4	ASTM D523	Gloss retention shall be a minimum of 50% after 10 year exposure
Erosion Resistance (After Weathering)			No specification	8.9.1.5	ASTM B244	Less than 10% coating loss after 5 year exposure	8.9.1.5	ASTM B244	Less than 10% coating loss after 10 year exposure
Coating Flexibility - T Bend (Coil Coating Only)	A5.1	ASTM D4145	Minimum 2-T flexibility with no coating pick off	A5.1	ASTM D4145	Minimum 2-T flexibility with no coating pick off	A5.1	ASTM D4145	Minimum 2-T flexibility with no coating pick off
Impact Resistance - Direct Impact (Coil Coating Only)	A5.2.1		Using 15mm diameter round nose impact tester - No coating removal using tape (minute cracking allowed)	A5.2.1		Using 15mm diameter round nose impact tester - No coating removal using tape (minute cracking allowed)	A5.2.1		Using 15mm diameter round nose impact tester - No coating removal using tape (minute cracking allowed)
Impact Resistance - Reverse Impact (Coil Coating Only)	A5.2.2		Same testing as A5.2.1 with impact on non-coated side - No coating removal using tape (minute cracking allowed)	A5.2.2		Same testing as A5.2.1 with impact on non-coated side - No coating removal using tape (minute cracking allowed)	A5.2.2		Same testing as A5.2.1 with impact on non-coated side - No coating removal using tape (minute cracking allowed)
Increased level for High performance coatings						Increased level for Superior performing coatings			

For additional information and to obtain copies of these AAMA standards, please go to the American Architectural Manufacturers Association website: www.aamanet.org. The latest documents are identified as:

- AAMA 2603-15 Voluntary Specification, Performance Requirements and Test Procedures for Pigmented Organic Coatings on Aluminum Extrusions and Panels (with Coil Coating Appendix)
- AAMA 2604-13 Voluntary Specification, Performance Requirements and Test Procedures for High Performance Organic Coatings on Aluminum Extrusions and Panels (with Coil Coating Appendix)
- AAMA 2605-13 Voluntary Specification, Performance Requirements and Test Procedures for Superior Performing Organic Coatings on Aluminum Extrusions and Panels (with Coil Coating Appendix)

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