THE SHAPE MAKERS®

A Publication of the Aluminum Extruders Council

EXTRUSION SPOTLIGHT

COATINGS

Coatings for Aluminum Extrusions

WHAT ARE COATINGS?

Powder Coatings

Powder coatings are applied electrostatically from an air fluidized hopper.

The primary powder ingredients are as follows:

1. ***Binders*** consist of the resin, polymer, and crosslinker. This ingredient provides the powder with its fundamental film properties.
2. ***Prime Color Pigments*** can be either organic or inorganic and provide the paint with its color.
3. ***Additives*** serve numerous functions but generally affect fluidization and application properties.

There are tremendous economic and environmental advantages in the use of powder coatings for a broad range of factory manufactured products.

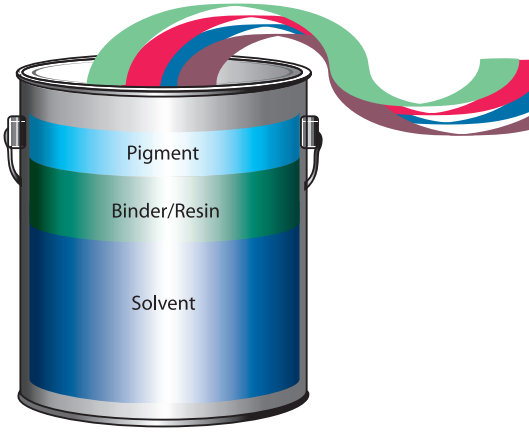
Liquid Coatings

Liquid coatings are fluid materials that, when applied to a surface, form an adhering film to protect and beautify the substrate.

Liquid coatings are composed of three primary ingredients:

1. ***Resin***, referred to as binder, is the polymeric substance that forms the film. Binder is the backbone of the coatings system.
2. ***Pigments*** are the particles that give the coating color, hiding power, gloss control and some corrosion protection.
3. ***Solvents*** act to fluidize the coating and control application characteristics.

Some liquid coatings have a fourth ingredient generically referred to as additives. These additives are chemicals present in coatings to give a special effect. They may have either wet or dry film properties. Wet film properties include viscosity, forming, skinning and emulsion stability. Dry film properties include gloss, hiding power, color, strength and hardness. Pigment and binder are the “solids” components that make up the hardened film and provide the required performance characteristics. Solvents normally evaporate entirely after application of the coating. The solvent portions plus minor amounts of chemical reaction by-products, less any water or exempted solvent, comprise the volatile organic compounds (VOC).



WHY COAT ALUMINUM EXTRUSIONS?

Aluminum is coated for two primary reasons: First, to control the appearance for color coordination, uniformity or visual appeal, and enhance the substrate. Second, to protect the substrate from environmental damage (e.g., acid rain, sulfur pollution, salt corrosion, and oxidation).

CURRENT ALUMINUM EXTRUSION COATING PROCESSES

Aluminum extrusions are coated on two types of lines, vertical and horizontal. Both processes offer quality coated products and can handle a variety of shapes and sizes. Both systems share the following basic stages for successful coating applications:

COATING APPLICATION STAGES

Pretreatment: The pretreatment of aluminum lays the foundation for the coating and allows the paint film to properly adhere to the substrate. Typically, pretreatment is a 5-7 stage process (either immersion or in-line spray). These stages clean the metal and properly prepare it for the coating application. The prevalent chemical pre-treatment processes are chrome-phosphate, chrome-chromate or chrome-free pretreatment systems.

Dry: After pretreatment, it is essential that the aluminum is dry and free of contamination before it is coated. Any foreign matter on the substrate will cause coating problems.

Coating Application: The most efficient way to coat aluminum extrusions is by electrostatic spray application. It is a law of physics that materials carrying unlike electrical charges attract one another, and those carrying like electrical charges repel one another. In electrostatic spray coating, paints are atomized by the combined influence of a mechanical device (e.g., air gun, turbo disc) and a high voltage field; the finely atomized, highly charged particles of paint are attracted to a grounded, conductive workpiece and deposited under the action of the electrostatic field. This attraction enhances the coating of edges and less accessible areas, minimizing the loss by overspray. The result is a much higher transfer efficiency, utilization of paint and labor, than a purely mechanical system can achieve. Also, the coating film thickness is more uniform over the part without the inconvenience of turning the object repeatedly to paint from every angle. The recognition of these facts has resulted in the use of electrostatic application for virtually all aluminum extrusion coatings.

Cure: The paint cure is achieved by baking the coated parts for a specified time at a specified temperature. The degree of cure can often be judged by pencil hardness and/or solvent resistance. The proper cure helps to ensure that the desired coating performance characteristics are met. The quality of the teamwork between the pretreatment, the paint, and the cure becomes evident in this second-to-last stage.

Unloading: After the bake cycle, the aluminum extrusions are given time to cool down and are unloaded. The coated extrusions are then either fabricated or loaded for shipping.

Packaging: Semi Automatic packaging of the painted extrusions to avoid shipping damage is an integral part of the painting process. New packaging techniques also minimize the amount of packaging waste and associated disposal costs.

COATING SPECIFICATIONS

AAMA 2603, 2604 and 2605 Specifications: The American Architectural Manufacturers Association (AAMA) has developed three specifications to assist in the selection of coatings for a given application.

AAMA 2603 — This specification is for coatings that are applied to many products including residential and light commercial windows, storm doors and light fixtures.

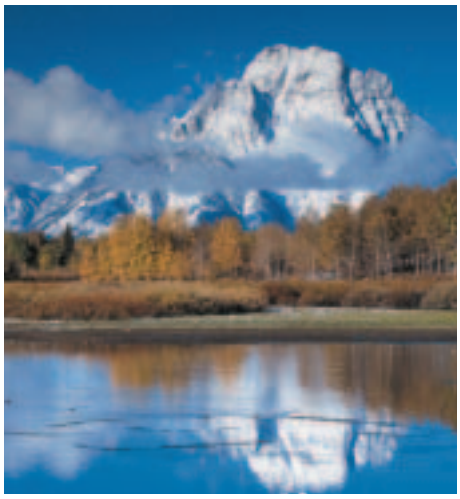
AAMA 2604 — This specification covers high performance coatings that are used on architectural products where extended durability is required.

AAMA 2605 — This specification covers high performance coatings that are used on architectural products where superior durability is required.

ENEMIES TO COATINGS

The major enemies to coatings are sunlight, moisture, temperature changes, aggressive environments and physical damage.

UV Radiation — Ultraviolet radiation degrades chemical bonds in the binder and organic pigments, resulting in color fade, chalking and film erosion.



Moisture — The presence of moisture contributes to the breakdown of binder on the film's surface. Moisture can also penetrate the film and cause adhesion loss or substrate corrosion.

Temperature — Higher temperatures can accelerate the effects of ultraviolet radiation and moisture on the paint film. Wide swings in temperature can increase stresses that lead to loss of film integrity or adhesion.

Aggressive Environments — Acid rain, industrial pollutants and salt can all affect film appearance or corrosion protection.

Physical Damage — Scratches and other damage during transit or installation of coated aluminum can lead to corrosion sites, as well as creating a poor surface appearance.

Load and unload area on a vertical paint line.

TYPICAL COATING PROCESSES

Typical dip tank pretreatment for cleaning material prior to applying coatings.

Load and unload area on a horizontal paint line.

COATING COMPARISON

Resin Type	VOC	Color Range	# of Coats	Performance*	Advantages	Applications
Polyester	low	wide selection	1	AAMA 2603	good film integrity good color retention good exterior durability wide gloss range	primary and replacement windows, light fixtures, miscellaneous extruded aluminum shapes (profiles)
Acrylic	high	wide selection	1	AAMA 2603	good film integrity good color retention good exterior durability wide gloss range	primary and replacement windows, light fixtures, miscellaneous extruded aluminum shapes (profiles)
50% Fluoropolymer	high	limited	2	AAMA 2604	good durability, good color life	store fronts, schools, hospitals, high rise condominiums
70% Fluoropolymer	high	limited	2 (3 or 4) color dependent	AAMA 2605	best durability, longest color life, best corrosion resistance, flexibility, chemical resistance	spandrel panels, curtain wall, store fronts, windows, column covers, louvers, mullions, high exposure areas

**** Not all coatings will meet the above performance characteristics.***

SPECIFICATION COMPARISON

Item	AAMA 2603	AAMA 2604	AAMA 2605
Dry Film Thickness — in exposed areas	0.8 mils min.	1.2 mils min.	1.2 mils min. (2 coat)
Chemical Pretreatment	multistage	multistage	multistage chrome
Color Change	slight fade	no more than 5 delta E	no more than 5 delta E
Outdoor Exposure Time	1 year south Florida exposure	5 years south Florida exposure	10 years south Florida exposure
Chalking Resistance	slight chalking	no more than chalk rating #8	no more than chalk rating #8 no more than chalk rating #6 for whites
Film Adhesion	dry and wet adhesion	dry and wet adhesion/ boiling water	dry and wet adhesion/ boiling water
Abrasion Resistance	no requirement	falling sand test 20 liters min.	falling sand test 40 liters min.
Chemical Resistance	muriatic acid/mortar resistant	muriatic acid/mortar resistant/nitric acid	muriatic acid/mortar resistant/nitric acid
Corrosion Resistance	1500 hours salt spray 1500 hours 100% humidity	3000 hours salt spray 3000 hours humidity	4000 hours salt spray 4000 hours 100% humidity

Coating Performance	Acrylic	Polyester	Fluoropolymer (PVDF)
Application	1	2-3	1
Solvent Resistance	2	2	1
Chemical Resistance	2	2	1
Corrosion Resistance	2	2	1
Exterior Durability	3	3	1
Hardness	2	1	2-3
Adhesion	2	2	2
Flexibility	2	2-3	1
Mar Resistance	1	2	3
Color/Gloss Retention	3	3	1
	Thermosetting	Thermosetting	Thermoplastic

Ratings: 1=Excellent 2=Good 3=Fair 4=Poor

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