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ToolKit

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A Publication of the National Coil Coating Association

National Coil Coating Association

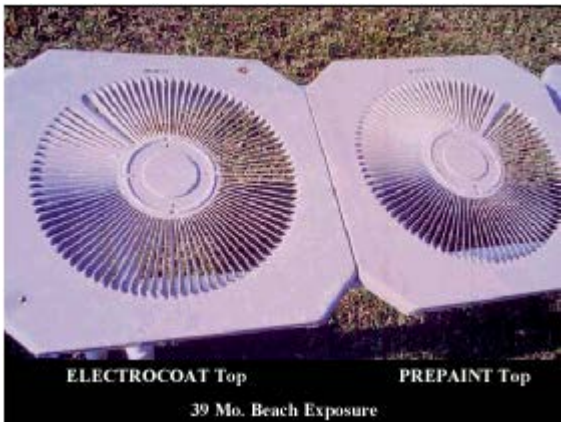
Cut Edge Protection Using Prepainted Sheet

Foreword

The National Coil Coating Association (NCCA) would like to thank Laurie Dana, Kim Brandhorst, and Jack Knuttilla of PPG Industries, Inc. for their hard work and dedication to this project. Credit should also be given to North American Zinc-Aluminum Coaters Association (NamZAC) for their assistance in compiling this document. The Association would also like to recognize all of the volunteers who have given their time and input into the discussion on Cut Edge as well as those individuals within the industry who have worked to dispel the misconceptions.

Section One

Introduction



Prepainted metal sheet has touched every aspect of daily life over the past 30 years. Its versatility allows it to be used almost everywhere – on building exteriors and interiors, appliances, HVAC, furniture, automotive, etc. It is functional and durable, and can be combined with high performance paint systems with an unlimited spectrum of colors and an array of properties. Designs can be eye-appealing - simple or complex, without affecting long term durability, corrosion and mar resistance, and functionality.

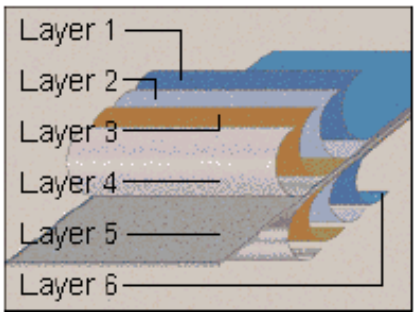
Prepainted sheet is a proven performer for handling, manufacturing (blanking, punching, forming, welding and laminating), fastening, installation and maintenance. Prepainted sheet integrates easily with Kanban (Just-in-time) Inventory Control Systems and eases material movement and space limitations in manufacturing facilities. This outstanding performance has resulted in exponential growth in the use of prepainted metals through the 1990's. These conversions to cost-effective, quality enhanced, prepainted products occur almost daily from costly, labor intensive and inefficient postpaint systems (electrocoat, spray and powder).

Long term durability is a key property of any painted metal product. In particular, protection of a cut or exposed edge is critical, no matter what type of paint application method. This brochure describes the enhanced quality of a prepainted finish. Due to the uniformity of cleaning and pretreatment, and the typical two-coat prepaint system, a prepainted finish provides superior corrosion resistance/protection when compared to other paint application methods at cut and exposed edges, louvers and fins.

Section Two

Prepaint = Quality and Uniformity

Layer 1 – Durable, beautiful finishes – acrylics, polyesters siliconized, polyesters, fluoropolymers, plastisols – in almost any color you want.



Layer 2 – High-performance primers are key to long-term corrosion resistance and paint adhesion.

Layer 3 – Pretreatments provide excellent corrosion resistance and adhesion.

Layer 4 – Possible metal coating to fight corrosion.

Layer 5 – Uniform metal sheet properties are a result of modern technology.

Layer 6 – Backer coats to enhance corrosion resistance and minimize abrasion damage.

Prepainted metal sheet is described as “painted before forming with a factory-applied, baked-on finish.” Metal coils are shipped to a continuous coil line where they are processed. First they are uncoiled, and then while still in its flat form, the metal is uniformly (edge-to-edge) cleaned, pretreated, sealed with a corrosion inhibiting rinse. Next either one or both sides are primed using a high-performance primer and are painted with one or more top coats. The painted coil is then recoiled and is ready to be shipped, slit, embossed, blanked or formed.

Cleaning and pretreating is accomplished using a multistage, high-efficiency system, specific for the substrate being painted. The high temperature (alkaline) cleaner removes any mill oils, oxides, dirt or other contaminates, to increase surface reactivity of the metal, so that it bonds tightly to the pretreatment. This tight adhesion to the pretreatment furthers optimum corrosion resistance. The pretreatment is substrate-specific and promotes adhesion between the primer and the metal coating, which adds another layer of corrosion resistance.

The high performance primer is applied to the pretreated surface uniformly across the strip. These primers, which usually contain corrosion and UV inhibitors, are formulated to enhance protection from cuts, scratches and bends, as well as to bond tightly to the top coats.

The top coats are usually colorful, durable paints specifically selected for performance requirements for the forming/bending/fastening end-use. Typical top coats include acrylics, polyesters, siliconized polyesters, fluoropolymers and plastisols. Generally, prepaint is specially formulated to be able to form without the use of forming lubricants.

Typically, the back side of the strip is painted with a primer and a backer coat to enhance performance and appearance by minimizing abrasion during shipping and handling.

All this is accomplished in a cost-effective, continuous, steady-state process at fast line speeds.

		Generic Coating Type (Topcoat only)							
Physical and Resistance Properties	ASTM Method	Plastisol	Solution Acrylic	Polyester		Silicone Polyester	Poly (vinylidene) Fluoride (PVDF)	Acrylic Latex	Polyurethane
				Interior Use Only	Exterior Use				
Impact Resistance	D2794	5	2	3-5	3	3	4	3	4
Mar Resistance	D3363, D2197	3	4	4	4	4	3	3	3
Metal Marking Resistance	No method	3	4	4	4	4	3	4	3
Resistance to Pressure Mottling in Coil	D3003	3	4	4	4	4	3	3	3
Solvent (MEK) Resistance	D5402	N/A	4	3-5	5	5	3	4	3
Grease and Oil Resistance	D5402, D1308	4	3	3-5	4	4	4	3	3
Stain Resistance	No method	3	4	3-5	4	4	4	3	3
Resistance to Acidic/Caustic Conditions	D2248, D1308	5	3	3-4	3	3	4	4	3
Resistance to Water Immersion	D870	4	4	4	4	4	4	2	3
Humidity Resistance	D1735, D2247, D4585, G60	4	4	4	4	4	4	2	4
Abrasion Resistance	D4060, D968	5	3	3-5	3	3	4	3	3
Resistance to Industrial Pollution	D1308, G87	5	3	3	3	3	4	3	3
Corrosion Resistance (Salt Spray)	B117, G85	4	3	4	4	4	3	3	4
Flexibility / Drawability	D2794, D3281, D4145, D522, D4146	5	2	3-5	3	2	4	3	4
Dry Heat Resistance	No method	5	3	4	4	4	4	4	5

Weathering Properties	ASTM Method	Pastisol	Solution Acrylic	Polyester		Silicone Polyester	Poly (vinylidene) Fluoride (PVDF)	Acrylic Latex	Polyurethane
				Interior Use Only	Exterior Use				
Gloss Retention 10 years Florida, 45° South	G7, D1014, D523	2-3	3	N/A	3-4	4	5	3-4	3-4
Chalk 10 years Florida, 45° South	G7, D1014, D4214	2-3	3	N/A	3-4	4	5	3-4	3-4
Color Retention 10 years Florida, 45° South	G7, D1014, D2244	2-3	3	N/A	3-4	4	5	3-4	3-4

5=Excellent, 4=Very Good, 3=Good, 2=Fair, 1=Poor
Chart should only be used in combination with description page.

Section Three

Post Paint Systems = Batch Processed, Non-uniform, Inefficient

Post painted metal is described as metal coated "after forming" and is generally a labor-intensive, batch process, whereby several formed parts are hung on racks for processing together. These parts generally contain forming lubricants, mill oils, dirt and metal filings which, because the parts are hanging on a rack, are not easily removed during cleaning from bends and formed areas. These contaminants become trapped in bends and crevices because cleaners and rinses can not reach all surfaces to clean uniformly. This results in non-uniform pretreatment and variability in corrosion resistance.

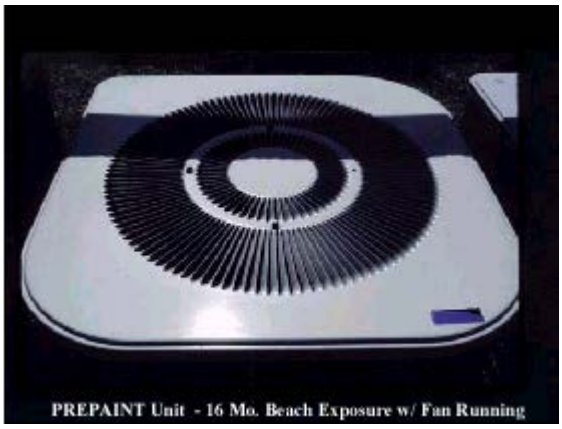
Additionally, post paint facilities occupy large amounts of factory space. Consequently, only one pretreatment is usually available and must be used for many substrates. Because of this space limitation, many times mixed metals are put on the same rack. The pretreatment is not optimized for a specific substrate, which reduces the bond strength between the metal and the pretreatment. Oxides left on any surface result in improper or insufficient pretreatment and a non-optimized (decreased) primer adhesion.

Spray application of formed parts is usually non-uniform in film thickness – bends and drawn areas typically have lower film thickness than flat areas. This is also true of powder systems, in which Faraday effects are a concern. The recycling of the powder usually results in increasing particle size and decreasing uniformity of film thickness. Proper ramping is essential for sufficient film deposition, which may not be efficient using mixed metals.

Areas of lower film thickness will have an increased propensity for corrosion. Non-optimized and non-uniform pretreatment deposition will not have continuous corrosion protection.

Section Four

Edges



Cut or sheared edges expose the metal to the environment, thereby creating a reactive area at which corrosion can begin. The degree to which corrosion will occur depends on the type of metal, the thickness of the sheet, the pretreatment system and uniformity, the paint system and thickness, application method and the environment, as well as the angle of exposure (vertical or horizontal). Areas where moisture is retained generally have the most severe corrosion. The moisture allows the ingress of contaminants (chemicals, salts, debris, etc.), which will attack the metal. The initial sign of corrosion is usually visible as microblistering on the surface of the painted panel/part. With time, this microblistering causes the paint to creep back from the cut edge. The pretreated metal is exposed as the paint creeps back. The pretreatment is the final defense for corrosion resistance:

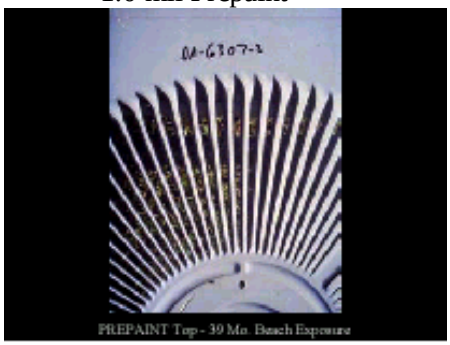
Microblistering with Paint Creep back, Prepaint and Spray, 16 month exposure:

1.0 mil Prepainted Louvers after 16 months Daytona Beach exposure (fan running)

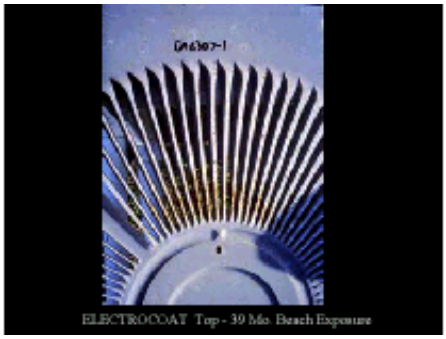
1.0 mil Spray Painted Louvers after 16 months Daytona Beach Exposure (fan running):

39 Months Daytona Beach Exposure (Prepaint and Electrocoat):

1.0 mil Prepaint



1.0 mil Electrocoat



Once corrosion has been initiated, it usually continues at a steady rate, progressing through a metallic coating (if present) and into the metal.

44 Months Daytona Beach Exposure (Powder, Spray and Prepaint)

1.5 + mils Powder on G-90 Hot-Dipped Galvanized:

1.0 mil Spray on G-90 Hot-Dipped Galvanized (44 months):

The enhanced corrosion resistance observed when using prepainted sheet as compared to other post painted methods of application is so significant, that in many cases metallic coating weights may be reduced. The photos below show the differences between a prepainted, G-60 hot-dipped galvanized part as compared to a spray, post painted, G-90 hot-dipped galvanized part after 44 months exposure at Daytona Beach:

1.0 mil Prepaint on **G-60** Hot-Dipped Galvanized (44 months):

1.0 mil Powder on **G-90** Hot-Dipped Galvanized (44 months):

The significant differences in corrosion resistance observed between the three application methods are related directly to the quality and uniformity of the painting process. Painting after forming is most often accomplished with parts hanging on racks. This frequently results in insufficient and non-uniform cleaning and pretreatment with minimal paint overspray onto the back side of the part. Sprays and powder do not adequately protect the cut edge, because in many configurations, these methods cannot sufficiently coat because of impingement, etc.

Prepainted sheet is continuously, efficiently and uniformly cleaned, pretreated and painted as a flat surface, so that the edge to edge and side to side variability is virtually eliminated. The prepainted part has two coats of paint, tightly bonded to the metal as compared to a post painted part, which generally has only one coat of paint. In most cases, the prepainted part has paint (one or two coats) on the backside as compared to the post painted part which at best has a minimal amount of overspray. Uniform pretreatment and paint on the back side of a part increases the corrosion resistance of the part, enhancing long-term durability. This can easily be observed in the 68 months Daytona Beach exposure photos below:

1.0 mil Spray **G-90:**

1.0 mil Prepaint **G-60:**

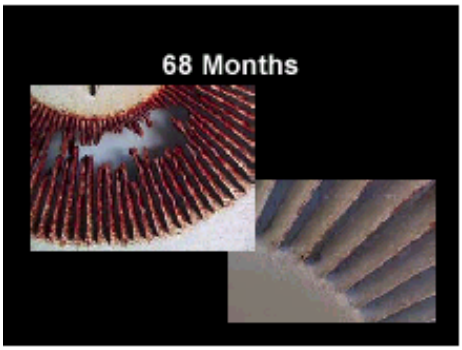
Section Five

Summary

Cut Edge Protection of prepainted parts has repeatedly proven to be significantly better than post painted ones because of the uniformity of treatment and film thickness.

With proper selection of paint and substrate, a prepainted part should provide a superior, cost-effective product in corrosion resistance, appearance, and durability as compared to parts painted using other paint application methods.

Which would you rather have?



For further information regarding this report please contact the National Coil Coating Association, (216) 241-7333 or by e-mail at ncca@coilcoating.org.