White Paper: Lectrus Enclosures Protected by Extremely Durable Surface Protection System

Protecting Metal Enclosures

Industry professionals who design and build electrical enclosures and modular metal buildings understand the importance of paint and coating systems in determining long-term performance. Used in a variety of extreme outdoor environments and industries, such structures must function well for many years with little or no maintenance, and sustain an attractive finished appearance during their lifespan.

Advanced coating technologies are front and center at Lectrus Corporation, where engineers have tasked themselves with periodically re-evaluating their paint systems for peak efficiency. Knowledge of a product's performance in extreme conditions such as harsh environments can lead to a more educated decision about the most suitable protection. For example, deliverables deployed in high-moisture areas must possess a high degree of protection from rust and corrosion. Within Lectrus' design and build protocol, standards exist that direct and guide in the formulation, testing and application of the most effective outdoor coatings. The purpose of this paper is to highlight these various aspects.

Powder Coating

In recent years, powder coating has gained in popularity as a metal finishing method of choice for many industries. It is performed by spraying powdered, pigmented plastic resins onto a metal substrate. Comparatively, for the purpose of this paper, powder coating of metal products uses thermoset polymers which incorporate a cross-linker into the formulation. Powdered thermosetting resins are (typically) electrostatically sprayed onto a prepared, grounded metal substrate, and then baked in an oven. As the powder is baked, it reacts with the hardener in a polymeric cure. It is often touted as the most environmentally friendly method; nevertheless, polymers do emit polyisocyanates during cure.

Electrostatically-charged, Wet-Applied Spray Painting

This highly-efficient technology uses an ionizing electrode, typically located at the paint gun atomizer tip, causing solvent-borne paint particles to pick up additional electrons and become negatively charged. At the same time, the metal substrate is electrically grounded. As the coating is deposited on the metal surface, the charge dissipates through the ground and returns to the power supply, completing the circuit. The electrostatic field influences the path of the paint particles, and because the charged particles are attracted to the grounded surface being painted, overspray is significantly reduced. Any paint not applied to the metal surface is captured in the emission control system and ultimately disposed of as non-hazardous waste. The transfer efficiency for electrostatic paint spray systems ranges from 75% to 98% which minimizes waste. This technology is particularly efficient for

the application of difficult to disperse, high-solids paints, such as those used by Lectrus. Additionally, since very little paint material is allowed into the air, this method makes the Low Volatile Organic Content (Low-VOC) polymeric components even more environmentally friendly.

Lectrus, after serious consideration of powder coating within the scope of its manufacturing processes, chose the optimal route: Lectrus employs electrostatically-charged, wet-applied spray technologies for their advanced paint systems. This paper touches on just why they made that choice, and compares the two methods.

Wet-Applied Vs. Powder Coating

Lectrus' exclusive coatings technology delivers highly-durable, protective DuPont Industrial Coatings. DuPont Corlar® modified polyamide epoxies and Imron® Direct-To-Metal (DTM) polyurethanes are used in three paint systems that are applied as ordered by the customer, and as required for long-lasting performance in the end-use environment. While powder coating possesses some excellent characteristics, Lectrus has chosen wet-applied as the optimum surface protection for their enclosures. Table 1 shows comparative pros and cons for the two methods.

	Powder Coating	Liquid Coating
ADVANTAGES	· Highly durable · Mar resistant · Corrosion Protection · More single coat film thickness · Environmentally friendly · Covers well on fabricated sharp edges	· Highly durable · Mar resistant · Corrosion protection · Retains high gloss over time · Easy to touch up · More aesthetically pleasing · More color options · More substrate options · Shorter lead time on custom colors · Thickness easily controlled
DISADVANTAGES	· Doesn't mask well (i.e. threads, tape dots, tec.) · Difficult to touch up · "Orange Peel" · Costly for small volumes/special colors · Longer lead time to get special color powder from coating manufacturer	· Environmental concerns · Lower single film thickness build

Table 1. Powder Coating vs. Liquid Coating – Advantages and Disadvantages

Lectrus Metals and Paint Systems

Lectrus' standard equipment centers include outer walls constructed of interlocking panels of G-90 Galvaneal, zinc-coated, hot-dipped, galvanized steel. Preparation of the surfaces, done in accordance with the Society of Protective Coatings (SSPC) Paint Manual, consists of a solvent wipe. This is followed by a light but complete scoring of the substrate using ScotchBrite pads to provide proper adhesion of the primer coats. Exterior surfaces are then primed and finished using one of the following three Lectrus solvent-borne paint systems:

System #1 (Standard Duty):
Primer: 1 coat of DuPont® Corlar® 825P
Topcoat: 1 coat of DuPont® Imron® 3.5-HG™ high gloss polyurethane

System #2 (Severe Duty)
Primer: 4 coats of DuPont® Corlar® 825P
Topcoat: 1 coat of DuPont® Imron® 3.5-HG™ high gloss polyurethane

System #3 (Severe Duty)
Primer: 2 coats of DuPont® Corlar® 2.1-ST™ high solids epoxy mastic
Topcoat: 1 coat of DuPont® Imron® 3.5-HG™ high gloss polyurethane

The Severe Duty system is used where buildings will be subject to highly corrosive marine and/or saltwater environments. Also, when a Severe Duty system is called for, the outer walls may be constructed of 304 or 316 stainless steel. Finally, for the harshest of marine environments, aluminum may be used.

Testing the Lectrus Paint Systems

Lectrus engineers recently elected to “raise the bar” on the quality of their products by exceeding the most rigorous industry standards for coatings and paint systems on their metal structures. A rigorous, 4000-hour testing program was conducted by DuPont, through Marshall R&D Laboratories, to evaluate the film properties of their three Paint systems on pre-painted G-90 steel panels.

The three (3) ASTM test standards selected in the study included: Dry Film Build: Initial Adhesion (Crosshatch and X-Hatch) per ASTM D3359; Humidity Adhesion per ASTM D2247; and Salt Spray Resistance per ASTM B117/ASTM D1654. Table 2 shows results obtained through testing the three Lectrus Paint Systems.

Test Results Report WR-31-09	System #1 825P30020 1 Coat	System #2 825P30020 4 Coats	System #3 Corlar 2.1-ST 3 Coats
Avg. Total DFT	5.5 mils	12.4 mils	14.9 mils
Initial Adhesion (ASTM D3359)	5A/5B	5A/5B	5A/5B
Humidity Adhesion (ASTM D2247)			
250 hour	5A/5B	5A/5B	5A/5B
500 hour	5A/5B	5A/5B	5A/5B
Salt Spray (ASTM B117/D1654)			
1500 hour	5 mm	0 mm	0 mm
2000 hour	8 mm	1 mm	0 mm
4000 hour	17 mm	0 mm	0 mm

Conclusions: All 3 systems passed initial and humidity adhesion testing with no failure. After 4000 hours of salt spray, System 1 passed with only minimal corrosion; System 2 and 3 showed virtually no corrosion.

Table 2. Test Results. Note: DFT is a measurement of Dry Film Thickness

ASTM D3359—used to evaluate adhesion of coatings at various thicknesses, involving Crosshatch Adhesion tests. Here a grid of squares is cut into the coated panels and a pressure sensitive tape is applied over the grid, and then rapidly peeled away. The number of squares remaining on the panel gives a relative percentage value of adhesion.

ASTM D2247—Humidity Test or Water Resistance Test; conducted using a Cleveland Condensation Tester. In a cabinet, samples are exposed to 100% relative humidity via a water only fog at 120°F. ASTM Methods A and B were used in conducting both Initial Adhesion and Humidity Adhesion testing. "A" represents an X-scribe and "B" represents a Grid Scribe that is normally 25 or 100 squares. The number represents the failure rating with 5 being excellent and 0 being poor. Therefore, the 5A and 5B rating reflects neither degradation of paint film nor removal of same from the substrate.

ASTM B117/D1654—tests water resistance of coatings using controlled condensation in test chambers, measuring performance of products in continuous salt spray conditions by using a

controlled, corrosive environment. After exposure to salt, the panel is scraped and a measurement taken in millimeters (mm) to show distance from the scribe line to actual area of corrosion, where the paint failed. As shown, System 2 with multiple coats fared very well with minimal corrosion after 2000 hours—and no corrosion after 4000 hours. System 3, formulated for harsh, corrosive environments, passed all testing with no adhesive failures and no corrosion after 4000 hours. Added benefit: Test conditions are actually more corrosive than usual real-world exposure; therefore, results are highly effective as a marker in determining ability of coating systems to protect metal enclosures and lengthen their service lives.

More Suitable

In conducting these standard ASTM tests, most coated metal building products begin to show signs of corrosion at approximately 2,000 hours of exposure to salt spray. Lectrus and DuPont have developed 4000-hour paint systems that not only pass all tests, but exceed the real-world requirements for long-lasting electrical enclosures and modular metal buildings. In addition, the comparable durability and quality-of-finish aspects of Lectrus coating technologies over powder coating are clearly evident. DuPont's Ken Haese explains, "Imron® 3.5-HG tested out similar to all our other higher-end products as far as durability, longevity and UV screening. It also tests out comparable in durability to our powder coating products. While powder coating is promoted as the more durable coating, when we tested them out side by side, they came out of the testing comparably. And whereas powder tends to fade out over time, with wet-applied Imron® you get the high gloss—and it retains the gloss for longer in the field."

Green Considerations with Lectrus' Solvent-Borne Coatings

State environmental laws in the states in which Lectrus operates are stringent regarding the use of even low-VOC coatings. Although Lectrus Paint systems emit cyanates during spray application and cure, EPA-approved pollution control devices and breathing apparatus during application are regularly used, mitigating any related hazards. As to the environment, high transfer efficiency helps conserve paint.

Conclusions

Every critical element that goes into the fabrication of an advanced-technology electrical equipment center must earn its way onto the engineers' list of design criteria. For over a quarter-century, Lectrus Corporation has been defining the state of the industry in the design and manufacture of electrical equipment centers. And because a key component of the Lectrus culture is their quest for constant, never-ending improvement, they have once again raised their own standard-setting dictates by optimizing thoroughly-tested paint systems—that protect the exterior of every equipment center like no other industrial coatings can. Lectrus electrical equipment centers serve in every conceivable industrial and climatic environment, with extremely-durable polymeric coatings that are easily maintained and keep their high gloss over long years in the field. Lastly, Lectrus paint systems are as customizable as the company's enclosures, allowing clients to choose a myriad of aesthetically appealing colors.

References:

1. “Testing Your Knowledge,” Metal Construction News, May 2009.

2. Robinson, Frank and Dennis Stephens, "Understanding Electrostatic Finishing," Industrial Finishing, September 1990, p 34-37.

3. ASTM B117-09: Standard Practice for Operating Salt Spray (Fog) Apparatus, ASTM International, 2009

4. ASTM D2247-02: Standard Practice for Testing Water Resistance of Coatings in 100% Relative Humidity, ASTM International, 2009

5. ASTM D3359: Standard Test Methods for Measuring Adhesion by Tape Test, ASTM International, 2009

6. Foecking, N. J., "Cleveland Condensing Type Humidity Cabinet," Official Digest, December 1963, Vol 35, No. 467, pp. 1318–1327; and Higgins, W. A., "Cleveland Condensing Type Humidity Cabinet: II," Official Digest, November 1965, Vol 37, No. 490, pp. 1392–1404.

7. "Cleveland Condensing Type Humidity Cabinet: II," Official Digest, November 1965, Vol 37, No. 490, pp. 1392–1404.

8. Lectrus Paint Specifications and Testing, 2001, 2005, 2010.

9. DuPont Paint & Coatings for Metal Exterior, 2010; DuPont Industrial Coatings, 2008.

10. U.S. EPA, Manual: Pollution Prevention in the Paints and Coatings Industry, September 1996.