S&C Ultradur® II Outdoor Finish: The Ultimate Paint-Finishing System. Meticulously Engineered and Automated to Achieve Unprecedented Levels of Performance, Durability, and Consistently

Performance and Durability of Prime Importance

S&C Electric Company's exceptional Ultradur II Outdoor Finish for S&C Metal-Enclosed Switchgear products (Metal-Enclosed Switchgear, PME and PMH Pad-Mounted Gear, Pad-mounted style Vista® Underground Distribution Switchgear, pad-mounted style Vista® SD Underground Distribution Switchgear, and the pad-mounted IntelliRupter® PulseCloser® Fault Interrupter) provides the ultimate paint finish for today's environment.

Exposure to atmospheric contaminants and the vulnerability to vandalism demand outstanding performance. And now it does it with a significantly reduced environmental impact. The new Ultradur II Outdoor Finish contains no volatile organic compounds (VOCs), supporting our commitment to cleaner air.

In developing the Ultradur II Outdoor Finish, S&C has meticulously engineered a high-performance finish and a process to apply it with consistency. Each protective coating used in the system provides unsurpassed performance and combines with the other coatings for a totally complementary and compatible finish.

The Ultradur II Outdoor Finish embodies the finest in finishing materials and is applied using state-of the-art finishing-equipment technology. The resulting protective finish is uniform in color; free of blemishes, runs, blotches, and sags; and far exceeds all industry standard requirements on finish performance.

Figure 1. The Ultradur II Outdoor Finish comes in standard grey but can also be ordered in a wide array of custom colors, all with the same superb finish characteristics.

The performance features and benefits the Ultradur II Outdoor Finish bring to metal-enclosed switchgear include:

Repels moisture. Realistically, every finish will, with continuous immersion over an extended period, be penetrated by moisture. However, the superior finish-to-metal bond achieved with the Ultradur II Outdoor Finish is the most durable moisture barrier available. Even when penetrated, the Ultradur II Outdoor Finish will not blister or peel away.

Withstands severe weathering. The Ultradur II Outdoor Finish will withstand continuous exposure to harsh atmospheric conditions, such as salt-laden coastal environments, humidity, and ultraviolet radiation. No chalking (finish erosion) occurs, and the Ultradur II Outdoor Finish retains outstanding gloss and superior color stability.

Achieves maximum adhesion. The Ultradur II Outdoor Finish's tough, hard surface resists scratching and penetration to the substrate. Its dense, resilient film is impact-resistant, and it will not chip or crack. It continuously protects the metal to prevent exposure of bare areas vulnerable to corrosion.

Endures abrasion. The Ultradur II Outdoor Finish resists the wear caused by the abrasive effects of wind-blown particles. It also withstands the perils encountered during assembly, shipment, and installation, such as rubbing from retaining straps. By inhibiting finish erosion to the substrate, the Ultradur II Outdoor Finish extends the service life of equipment.

Resists corrosion. All the many superlative features of the Ultradur II Outdoor Finish have a common goal: corrosion resistance. No other finish available in the industry surpasses the ability of the Ultradur II Outdoor Finish to resist the development and propagation of corrosion.

Environmentally responsible. The Ultradur II Outdoor Finish provides a durable finish without VOC-containing chemicals.

The superior performance of the Ultradur II Outdoor Finish makes it the most lasting finish available. And it uses a unique process to achieve these results consistently.

Ultradur II Outdoor Finish: An In-Depth Review of the Process

1. The cosmetic effect and protective capabilities of a finish are dependent not only on the finishing system itself, but also on the type and condition of the metal to be protected. All enclosures for S&C Metal-Enclosed Switch gear are fabricated from 11-gauge steel sheet metal that meets S&C's exacting specifications for flatness, formability, and freedom from surface blemishes. Furthermore, the enclosures are carefully designed to eliminate corrosion-prone areas, such as places that trap and hold water and painted metal parts that rub or pivot on one another. The use of exposed sheared edges is also minimized.

Figure 2. The Ultradur II Outdoor Finish is ideal for outdoor industrial applications. It resists weathering and repels moisture.

2. Welding, which is primarily at the seams and corners of the enclosure's structural members and doors, adds to the completeness of the finishing system. S&C uses a gas-metal-arc welding process that eliminates alkaline residue and minimizes distortion and spatter. All exterior seams and corner welds in S&C Metal Enclosed Switchgear are carefully ground smooth, another of the many special steps taken to produce the beauty and performance of the Ultradur II Outdoor Finish .
3. By automating the cleaning process of the Ultradur II Outdoor Finish, every enclosure part receives a highly consistent and thorough treatment, eliminating fluctuations and deviations in the three factors that control chemical processes: reaction time, reaction temperature, and concentration of chemicals:
   (a) An electronically controlled automatic conveyor system keeps the cycle time constant, controlling reaction time.
   (b) Temperature sensors in all chemical baths and bake-ovens activate electronic controllers that modulate gas burners, ensuring positive, precise control of temperatures.
   (c) Automatic chemical-proportioning pumps in the critical conversion-coating process inject materials to achieve the precise concentrations necessary to promote the desired reactions.

With these exacting automatic controls, the variations inherent in manual-application cleaning systems are eliminated.

4. Before any protective coatings are applied, a multi-station pretreatment prepares the metal for finishing:
   (a) Specially formulated cleaning agents remove all oils, dirt, and other contaminants.
   (b) Additives are introduced to prevent the precipitation of potentially harmful salts, formed from minerals in water, onto metal surfaces.
   (c) Other additives vigorously activate the metal to establish chemically attractive forces on the surface that promote adhesion of the subsequent conversion coating, which is the interface between the metal and the finish.
   (d) A phosphate solution is applied, depositing a dense, endurable phosphate-conversion coating that bonds tightly to metal. The inorganic crystalline structure of this coating provides a rough interface, without puddling or streaking, onto which the initial finish coating bonds tightly.
   (e) A chemically compatible sealer is applied to fill the crystalline interstices of the conversion coating, forming a solid film. The resulting coating is a virtually impenetrable, inert, uniform, and continuous moisture barrier that resists blistering, inherently inhibits corrosive action, and vastly improves finish adhesion.
   (f) Interspersed rinses remove all unreacted chemicals and prevents contamination of successive processes.
   (g) Drying removes all moisture.
   (h) Cooling ensures positive control of the film thickness of subsequent coatings.
   (i) This pretreatment process produces a film that acts as a chemically and anodically neutral conversion coating to enhance the finish-to-metal bond, resist penetration, and restrict underfilm propagation of corrosion.
5. Application of the initial finish coating and the topcoat are specifically tailored to ensure the most effective and complete coverage for the metal-enclosed gear. Complex shapes, exceptionally large sections, and complete enclosure weldments are separately processed through a manual application system to ensure finish penetration to all corners, joints, and blind spots. Doors, panels, and essentially flat components without complex forming are processed through an automatic application system.
6. The exceptional durability of the Ultradur II Outdoor Finish is derived from the initial finish coating that consists of a remarkably tough epoxy powder. The powder has been selected for its proven ability to endure a wide variety of grueling conditions and is a dramatic improvement in corrosion resistance over conventional liquid finishes and other powders.

   The Ultradur II Outdoor Finish's epoxy powder is a specially formulated and finely ground material. It is applied to all exterior and interior surfaces by an electrostatic process that results in tight adhesion.

   By using electrostatics, the accumulation of charged particles on the surface of the metal neutralizes the attractive forces and repels other similarly charged particles. This prevents further deposition that would cause drips, runs, and sags, and it yields a coating that has a remarkably uniform film thickness.

   Use of electrostatics also ensures complete surface coverage consistently. Any recesses difficult to penetrate because of the Faraday-cage effect receive special attention.
7. Baking the enclosure parts after application of the powder in electronically controlled ovens melts the particles, which then flow to complete fusion of the powder into a continuous, tightly bonded coating.
8. An extremely durable triglycidyl isocyanurate (TGIC) powder topcoat is applied with the same electrostatic process as the initial finish coating. This final coat provides excellent protection from weathering. S&C selected it for toughness, color stability, and gloss retention, including the ability to withstand exposure to ultraviolet rays without chalking.
9. The TGIC topcoat is baked in electronically controlled ovens and gives the Ultradur II Outdoor Finish the attractive, high-quality lustrous finish with the long life needed to endure even the most rigorous weathering conditions.

Ultradur II Outdoor Finish: Unequaled Performance Demonstrated Through Exhaustive Testing

To demonstrate the unprecedented levels of performance the Ultradur II Outdoor Finish achieves over conventional finishes, S&C has exhaustively tested it through a battery of industry-standard tests and recognized ASTM tests designed to evaluate the capabilities of protective coatings.

Here are some highlights of the test methods used and the results obtained:

Salt spray testing. In accordance with ASTM B 117, this testing subjects a sample panel scribed to bare metal with an "X" to a continuous mist of 5% salt solution at a temperature of 95°F (35°C).

After prolonged exposure to this extremely corrosive environment, the test panel is removed, dried, and inspected for underfilm propagation of corrosion and loss of paint adhesion along the scribe. Tape is applied along the scribe and then removed to check adhesion of the finish-to-metal bond. This test procedure evaluates the relative corrosion resistance of finishing systems under severely corrosive conditions, as well as the ability of the finishing system to protect areas of bare metal when the paint is scratched.

The Ultradur II Outdoor Finish withstands a minimum of 4,000 hours of continuous exposure to this punishing environment while limiting underfilm propagation of corrosion to less than 1/32-inch (0.8 mm) from the scribe and loss of adhesion from bare metal to less than 1/8-inch (3 mm) from the scribe.

Humidity testing. Per ASTM D 2247, this test subjects sample panels to 100% relative humidity at 100°F (38°C). Contrary to popular belief, paint films are not moisture barriers. Moisture, in the form of high humidity or standing water, will penetrate any finish given adequate time. The purpose of humidity testing is to check how well the finishing system resists moisture penetration and, once penetrated, how well the finish adheres to the metal. Any blistering that occurs is evaluated according to ASTM D 714, which is a comparative standard for blistering of finishes.

After 1,000 hours of exposure to this test, the Ultradur II Outdoor Finish exhibited no blistering.

Accelerated weathering testing. As specified in ASTM G 53, this testing exposes sample panels to repeated cycles of ultraviolet light, water condensation, and changing temperatures to evaluate the relative abilities of finishing systems to resist weathering. After exposure, two checks are performed. The degree of chalking is evaluated per ASTM D 659 to determine whether the finish has chalked.

As a second check, the specular gloss of the sample is measured according to ASTM D 523. This measurement is compared to a gloss measurement made before exposure. The degree of chalking and the reduction in gloss are measures of the ability to withstand weathering.

After 500 hours of this testing, the Ultradur II Outdoor Finish exhibited no chalking and less than a 15% reduction in gloss.

Adhesion Testing. This testing evaluates the finishing system's integrity and ability to withstand damage attributable to scratching and chipping during assembly and shipment as well as in the field. The following two methods for evaluating adhesion were used:

- Crosshatch adhesion testing per ASTM D 3359 Method B checks the finishing system's resistance to scratching. This test specifies that six regular cuts be scribed in the finish at 2-millimeter (0.08-inch) intervals. A second set of cuts is then made perpendicular to the first set. This divides the area into 25 squares, each 2 millimeters (0.08 inches) on a side. A tape, which is also specified in ASTM D 3359, is then applied over this area and removed. Any finish removed with the tape indicates poor adhesion.

  When tested in this manner, the Ultradur II Outdoor Finish shows no loss of finish.

- Impact adhesion testing per ASTM D 2794 checks the finishing system's resistance to chipping. This test subjects sample panels to an impact of 160 inch-pounds by a pointed weight, deforming the metal and stressing the finish. Any cracks or chips indicate poor adhesion.

  Samples of the Ultradur II Outdoor Finish subjected to this impact show no chipping or cracking.

Scab corrosion testing. This testing (for severe environments such as coastal areas) exposes a scribed sample panel to a cycle consisting of 15 minutes exposure to a continuous mist of 5% salt solution, 75 minutes exposure to room temperature, and 22.5 hours exposure to 85% relative humidity. After every five such cycles, the panel is continuously exposed to 48 hours of 85% relative humidity, followed by 60 minutes at a temperature of 60°C (140°F) and finally 30 minutes at 0°C (32°F). After being subjected to 35 cycles, the test panel is removed, rinsed, subjected to the air blow-off adhesion test per ASTM D1654, and rated for corrosion creep-back.

The Ultradur II Outdoor Finish achieves a rating of 7 or above, which translates to a creepage from the scribe of less than 1/16 inch (2 mm). The test panel is also visually inspected for any unusual surface failure, such as loss of adhesion or blistering, of which there is none with the Ultradur II Outdoor Finish.

Oil-resistance testing. This test subjects two sample panels to a 72-hour immersion bath in mineral oil—one panel in a bath at 20°C to 25°C (68°F to 77°F), and one panel in a bath at 100°C to 105°C (212°F to 221°F).

The Ultradur II Outdoor Finish withstands this exposure with no shift in color, no streaking, no blistering, and no loss of hardness.

Abrasion-resistance testing. This test subjects sample panels to 3,000 cycles of abrasion per ASTM D 4060 to check finish wear.

The Ultradur II Outdoor Finish withstands this abrasion without penetration to the substrate.

As proven by the ability to withstand these severe tests, the Ultradur II Outdoor Finish provides the ideal finish for metal-enclosed gear of all types. Its uniquely rugged performance provides the most lasting protection yet developed for outdoor metal-enclosed gear.