Ask the Expert

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By Steve Ladatto, PCI technical director

You have questions, we have answers. In each issue of PCT, our powder coating expert, Steve Ladatto, provides information to help you with your powder coating challenges. Let us know what's keeping you awake at night, and we'll do our best to help you get a good night's sleep!

The Test Panel Lied

Our company manufactures metal hardware used in various sub-assemblies. We routinely pass crosshatch adhesion, impact and even salt spray, yet parts are failing after months in service. Customers insist we "did everything right," but the coating is still breaking down. What's going wrong? Are there other tests that we can perform to help better predict field performance?

This is one of the most common and most misunderstood failure scenarios in powder coating. The core issue is that most standard lab tests measure isolated properties, not real-world exposure. Adhesion tests confirm initial bond strength. Salt spray evaluates corrosion creep under constant, artificial conditions. Neither test accounts for ultraviolet (UV) exposure, thermal cycling, abrasion, chemical cleaning or mechanical damage during handling and installation.

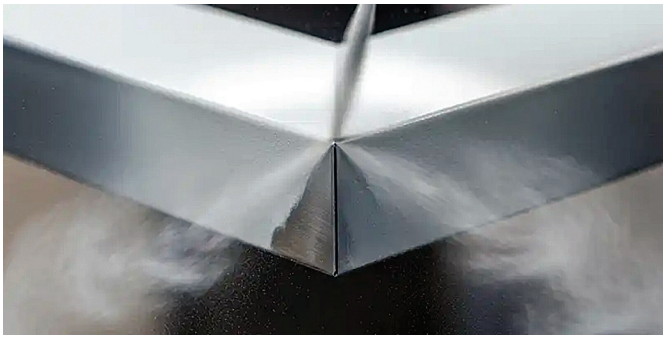
In the real world, coatings fail where multiple stresses overlap. Sharp edges, fasteners, welds and seams experience thinner film builds and higher mechanical stress. Minor damage during transport or installation can breach the coating, enabling corrosion to initiate underneath, even when the coating "passed" every lab test.

The solution starts with resetting expectations. Testing should be used to compare systems, not predict service life. If outdoor durability is critical, cyclic corrosion testing and UV exposure should be considered, and coating thickness requirements should be clearly defined at edges and joints. Additionally, different "wet" adhesion test methods can be employed, which can be much more indicative of adhesion strength.

Establishing effective communication will greatly improve managed expectations. Customers need to understand what tests can and cannot predict. Powder coating is a *system*: substrate, pretreatment, application, cure, part design and service environment all matter. When failures occur, they are rarely the result of one variable alone.

Living on the Edge

I am a Process Engineer at an architectural metal fabrication plant. Flat surfaces on our parts coat just fine, but edges, corners and tight radii consistently come out thin. We've tried slowing the line and applying more powder, but coverage at the edges never seems to improve. Why does this keep happening?



Faraday cage effects reduce powder penetration into and around sharp corners, demanding optimized gun settings and application techniques for uniform coverage. Photo courtesy of ucpowder.com.

What you're seeing is a textbook electrostatic behavior issue, not an application effort problem. Powder coating is driven by electrostatic attraction, and electric fields naturally concentrate on broad, flat, grounded surfaces. At sharp edges, corners and recessed areas, those fields distort and collapse. Instead of pulling powder in, they push it away. This phenomenon is commonly referred to as the Faraday cage effect.

The instinctive response is to increase voltage and apply more powder, but that usually makes things worse. Higher kV intensifies the electric field imbalance, causing powder to wrap aggressively onto flat faces while further starving edges and corners. The result is thicker coatings where you don't need them and continued thin film where you do.

The solution is counterintuitive yet proven, as lowering voltage reduces field distortion and enables powder to migrate

more evenly. Increasing gun distance softens the electrostatic force, while slowing part travel gives particles time to settle into edge areas. Many successful lines use a staged approach: lower kV "fill" passes specifically aimed at edges and radii, followed by higher kV passes for general coverage.

Part design plays an equally important role. Sharp edges, especially those below a 1/32-inch radius, are inherently difficult to coat uniformly, regardless of operator skill. Powder coatings are films, not liquids, and they will always thin out at knife-edge geometries. When corrosion protection or durability at edges is critical, design changes such as edge rounding, hemmed edges or the use of primers are often necessary.

The key takeaway: powder coating cannot overcome poor geometry or basic electrostatic physics. Thin edges are not a sign of under-application; they're a signal that voltage, technique and design need to be addressed together.

Reclaim, You've Changed

Our reclaim system starts out performing well, but over time we begin to see gloss drift, rough texture and inconsistent appearance. Nothing obvious changes in our process, yet finish quality slowly degrades. What's actually changing?

This phenomenon represents one of the most common and most deceptive reclaim-related issues in powder coating. Reclaim rarely fails suddenly. Instead, it gradually drifts until appearance problems become impossible to ignore.

Each time powder cycles through the booth, its composition changes slightly. Fine particles accumulate, larger particles break down and airborne contamination enters the reclaim stream. Over time, particle size distribution, pigment balance and electrostatic behavior shift. Transfer efficiency declines, the powder cloud becomes less stable and film flow and leveling during cure are affected. Because these changes occur gradually, reclaim problems often seem difficult to diagnose.

Certain finishes magnify these effects. Metallic, low-gloss, textured and other appearance-critical coatings are far less forgiving than solid, high-gloss colors. Metallic finishes are especially sensitive because changes in particle size and electrostatic charge can disrupt metallic flake orientation, creating cloudy, streaked or uneven finishes. Low-gloss coatings can also lose visual uniformity as reclaim causes gloss levels to drift.

Reclaim itself is not the problem. Uncontrolled reclaim is. Many shops treat reclaim as "free powder," continuously feeding it back into production without limits. Once the reclaim-to-virgin ratio becomes too high, the system loses stability and appearance defects increase.

The solution is disciplined control. Establish reclaim ratio limits based on finish sensitivity and restrict or eliminate reclaim for critical colors when necessary. Routine booth and recovery system purging minimizes fines and contamination, while maintaining a high percentage of virgin powder helps preserve visual consistency.

Reclaim is a valuable cost-control tool, but it is not quality-neutral. Managed properly, it reduces material costs without sacrificing appearance. Left unchecked, it gradually degrades finish quality long before the source of the problem becomes obvious.

Shift Happens

We run the same powder on the same line, yet parts coated by different shifts or operators don't always match in appearance or thickness. Why is consistency so difficult to maintain?

Powder coating is far more sensitive to human input than many people expect. While the powder and equipment might be the same, small differences in how operators apply the coating can accumulate quickly and show up as visible variation, especially on appearance-critical work.

Gun-to-part distance, travel speed, overlap pattern, trigger timing and even how each operator defines "coverage" all influence film build and surface texture. These differences may seem minor in isolation, but over the course of a shift they create measurable changes in thickness, gloss and appearance. When multiple operators interpret the process differently, consistency suffers even when everyone is trying to do a good job.

Equipment condition adds another layer of variation. Spray guns gradually wear, electrodes foul, hoses accumulate powder and air pressures drift. Without regular maintenance and verification, operators begin compensating by feel, adjusting voltage, flow or technique to "make it work." Each adjustment might solve a short-term problem, but it also introduces a new variable. Over time, the process becomes operator-driven instead of process-driven.

The solution is standardization, not more supervision. Critical parameters such as gun settings, air pressures, kV and microamp limits, line speed and target film thickness must be documented and locked in. Visual work instructions, which show gun distance, overlap patterns and pass sequence, help remove interpretation from the process. Training should emphasize repeatability and restraint rather than chasing coverage.

Equally important is auditing technique, not just finished parts. If results are inconsistent, observe how the coating is being applied. Consistency requires that inputs stay consistent over time.

Powder coating rewards discipline. When the process is defined, maintained and followed, different operators can produce matching results. Without that structure, variation is inevitable, no matter how good the powder or equipment might be.

Have a question for our powder coating expert? Send it to techdir@powdercoating.org.