# Ask the Expert

sponsored by Gema

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!*

## Same Powder, Different Outcome

***We use the same powder, the same color and similar application equipment across multiple facilities, yet finishes don't always match from plant to plant. Why is consistency so difficult to achieve across locations?***

When finishes don't match across facilities, the powder is rarely the problem. Powder coatings are extremely sensitive to process conditions, and small differences between plants accumulate quickly into visible variation.

Application settings are one of the biggest contributors. Differences in gun-to-part distance, voltage and microamp limits, powder flow and booth airflow all influence film build and surface texture. Even when equipment models are similar, calibration and maintenance practices often differ between locations. A setting that works well in one plant might behave differently in another due to booth design, grounding quality or environmental conditions.

Reclaim practices are another major driver. Reclaim ratios that vary from plant-to-plant change particle size distribution and pigment balance. Over time, this affects color strength, gloss and surface texture. One facility might be running mostly virgin powder, while another relies heavily on reclaim without realizing how much it has drifted. The result are finishes that look "close," but are not identical.

Cure variation compounds the issue, as cure schedules based on oven air temperature and belt speed do not guarantee identical results when part mass, loading density or oven performance differs. Subtle differences in part metal temperature can shift gloss or color just enough to be noticeable when parts from different plants are compared side by side.

The solution is not changing powder suppliers or reformulating colors. Consistency across plants must be engineered. Critical parameters need to be locked and documented, not interpreted locally. Shared reference panels, standardized reclaim limits and documented cure windows provide objective benchmarks. Routine cross-plant audits help catch drift before it becomes visible.

## Chippin' Away

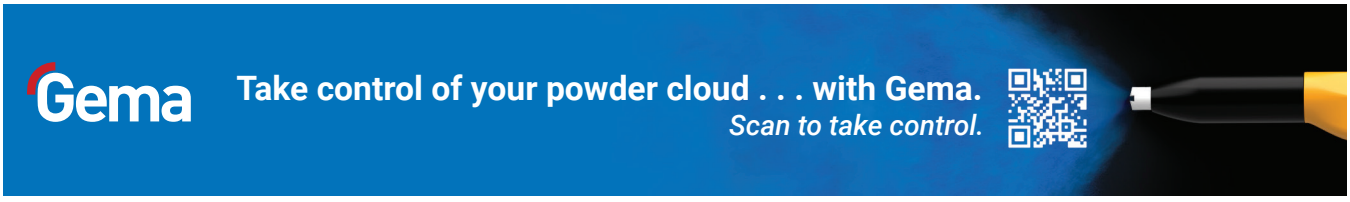
***We currently powder coat a variety of parts, mostly steel. Our cleaning methods include abrasive blasting or a three-stage hand wash. Recently, we've seen a few field failures where the coating easily chips off of certain parts. Do you know what causes this type of chipping?***



*Preventing chips begins with substrate-specific preparation, proper pretreatment, compatible powder selection, complete cure and careful handling that preserves adhesion throughout production, installation and long-term service. Photo courtesy of Denver Powder Coating.*

Chipping failures are often blamed on the powder itself, but in most cases the real issue lies in surface preparation and coating system balance. When a powder coating chips easily, it's usually a sign that the coating is either too brittle, poorly bonded or both.

Let's start with cleaning. Abrasive blasting can be effective, but only if it's controlled. Overly aggressive blasting can peen the surface, smear contaminants or create sharp surface peaks that reduce the effective contact area. On the other end of the spectrum, hand wash systems often lack consistency. If oils,



mill scale or blasting residue remain, even in small amounts, adhesion can be compromised in ways that don't show up immediately.

Another key contributor is film build and cure. Excessive film thickness increases internal stress within the coating, making it more prone to chipping under impact. Over-curing compounds this problem by increasing crosslink density and reducing flexibility. A coating that is too hard might pass adhesion tests but still fail in service when struck or handled.

Substrate geometry plays a critical role in chipping performance, because edges, corners and extruded profiles naturally receive thinner film builds due to electrostatic field behavior during application. These same features also experience the highest levels of mechanical abuse during handling, packaging, transport and installation, where impacts and abrasion are concentrated. When reduced coating thickness is combined with repeated or localized mechanical stress, the coating is far more likely to chip even though flat surfaces continue to perform well.

The solution requires a system-level approach, starting with an evaluation of whether surface preparation is consistent and appropriate for the substrate. For steel, a properly controlled chemical pretreatment often provides more uniform adhesion than blasting or hand washing alone. Next, verify actual part metal temperature during cure to avoid over- or under-curing. Finally, film thickness should be controlled, especially on edges, to balance durability and flexibility.

## No Do-Overs

***Customers often ask us why powder coatings can't be touched up or blended like paint. From their perspective, a scratch is a scratch. Why is powder different?***

The difference primarily lies in the chemistry of the coatings. Most powder coatings are thermoset systems, meaning they chemically crosslink during the curing process to form a hard, durable film. Once fully cured, that film is permanently set and will not melt or reflow when reheated. Liquid paints, by comparison, generally rely on solvent or water evaporation and can often be blended, feathered or reflowed more effectively during touch-up.

When additional powder is applied over a cured powder coating, it does not simply fuse into the original finish. The existing coating has already crosslinked and formed a closed surface, which limits bonding and prevents the two layers from becoming one continuous film. Even liquid touch-up paints formulated to approximate the original color will rarely match the gloss, texture, metallic orientation, weathering performance or overall durability perfectly.

The real issue often isn't the scratch itself; it's the expectation surrounding the repair. Customers might understandably assume that all coatings behave in a similar way and that a small, damaged area can be repaired invisibly. Without clear communication, they might expect a seamless result that is not technically realistic for most powder coated finishes.

The best solution is to define expectations proactively. Touch-up methods, acceptable repair areas and their limitations should be discussed early in the project and clearly documented in the specifications. This helps align the expected appearance and performance with the intended service environment. Minor repairs may be acceptable in low-visibility or noncritical areas, but prominent surfaces should be protected through thoughtful product design, appropriate packaging, proper storage and careful handling rather than relying on touch-up after damage has occurred.

Powder coatings excel in durability, consistency and long-term performance, but they also require respect for their technical limitations. Clear specifications and realistic expectations help prevent dissatisfaction, rework and costly disputes.

## Pressure Under the Surface

***I am a quality assurance technician for a custom castings company. Our parts look smooth and defect-free when they enter the oven, but once cured, pinholes appear across the surface. We've checked gun settings and powder quality, but the problem keeps coming back. What's causing this?***

Pinholes are almost always the result of gases escaping from the substrate during cure. Even though the surface might look clean and properly coated before curing, internal contamination can still be present. When the part heats up in the oven, trapped air, moisture, oils or other volatiles expand and force their way through the molten powder film, leaving behind small craters or pinholes once the coating solidifies.

Common sources include castings, galvanized steel, laser-cut edges, welds and poorly cleaned substrates. Porous materials are especially prone to this issue because they trap gases below the surface. Increasing film thickness to "bury" the problem only makes it worse by sealing gases in and increasing internal pressure during cure.

The most effective solution is to address the problem before powder is applied. Pre-baking parts can drive off trapped gases before coating. Improving cleaning and pretreatment processes is critical, particularly for oily or porous substrates. Reducing film thickness can also help by enabling gases to escape before the powder fully gels.

Powder selection matters as well. Some formulations are designed to be more forgiving of outgassing, offering longer flow times or venting behavior. However, these powders are not a substitute for proper substrate preparation.

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


**Reproduced with permission from the Powder Coating Institute**