Ask the Experts sponsored by Gema

Your questions answered by PCI member experts.

You have questions, we have answers. In each issue of PCT, our extensive network of powder coating experts 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!

Contrasting Colors

We are a custom coater and have received a quote request from a new potential customer who provides parts to our state Department of Transportation (DOT). In their specifications, they refer to the PCI Recommended Procedure #3. Can you explain what this is?

The PCI Recommended Procedure #3 refers to the contrast ratio of powder coatings. In other words, this provides the method for comparing the hiding power of similar coatings. A coating must be opaque to hide variations in substrate color. It is also important to know at what film thickness the coating attains opacity so that it may be applied at the minimum film thickness for adequate hiding power. The procedure is an instrumental method of determining the contrast ratio of a coating at a given film thickness. This test method is of primary use to powder coating suppliers and powder end users such as custom coaters and OEMs.

The procedure begins with creating half black/half white 12-gauge panels. Calibrate a thickness gauge to the panels. Note and record the different thickness of the existing uncoated black and white films on the panels. The uncoated panels should first be conditioned in an oven for five minutes at the cure temperature of the test coating to remove any volatile materials on the panel surface. Next, coat the panels as specified by the products being tested, and cure accordingly. Then, find areas on the coated black and white sections that are exactly the same film thickness.

The tristimulus value, a system for visually matching color under standardized conditions against the three primary colors—red, green, and blue—must be determined. A spectrophotometer or a colorimeter can be used to obtain these values, where the Y value equals a sample's reflectivity. The contrast ratio can be calculated using the following formula:

$$CR = \frac{100 \times \text{Y value over Black area @ X mils}}{\text{Y value over White area @ X mils}}$$

The contrast ratio is to be reported as a percentage of a given film thickness. For example, CR = 98% at 1.5 mils. In the specification sent to you by your customer, they should have listed a minimum contrast ratio that the coater must meet.

Step on the Scale

My Midwest manufacturing company recently installed a new laser cutting system which has greatly improved our manufacturing capabilities and efficiencies. However, we have noticed we have many more defects in our powder coated products, especially where the edges of the steel were laser cut. I am sure we are not the first company to powder coat such parts. What do we need to do to eliminate this issue?

As the popularity of laser cutting machines has increased over the past several years, manufacturers have been faced with the necessary evil of removing the scale created during the cutting process. There are two methods for removing laser scale: physical and chemical.

To physically remove laser scale, abrasives, such as those used in grinding or sanding, are effective but have limited application. A part with a complicated geometry will be difficult to grind, if not impossible. In addition, abrasive methods are usually manual, so there is potential to remove excessive material from the workpiece and bring it out of dimensional tolerance. Shot peening is particularly useful on hot-milled steels, which have surface finishes that may already require improvement. The disadvantages of this method include the amount of time it requires, its inability to hold part tolerance, and its ineffectiveness on complex part geometries.

Acidic chemistry is most successful since ferrous oxide is much less soluble in alkali cleaners than acid. Phosphoric acid-based cleaning solutions are effective in spray and immersion systems. The disadvantage of phosphoric acid is the significant volume of resulting iron-phosphate

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sludge. Additional filtration is typically needed to be added to the system. In some instances, blends of acids are the most effective chemical approach. These are commercially available, and it is best to review options with your pretreatment supplier. Depending on how many process tanks your pretreatment system has and what material they are constructed from, it may be necessary to rearrange them and add an additional tank to the system.

Growth Sparks a Question

We have been powder coating for several years using manual powder guns and due to increasing demand we need to increase our production. To achieve this, we will be installing some automatic fixed powder guns in the existing powder booth. Besides the new application equipment, is there anything else we need to consider?

In addition to the new application equipment, you should consider the National Fire Protection Association's NFPA 33 standard. NFPA 33 specifies that all automatic, or fixed, powder coating systems must be equipped with flame or spark detection devices and must have automatic shutdown of all system components should the detection device be triggered. These devices must react within 0.5 seconds to shut down all fuel sources within the system (powder guns and transfer pumps) as well as arrest all airflow and stop parts from being conveyed. Detection devices fall into three different categories—ultraviolet (UV), infrared (IR), or a combined UV/IR.

A UV spark detection system will react when it "sees" the spark, which is a source of ultraviolet light. When UV light or sufficient energy is detected, the system will immediately shut down, cutting off the powder flow, compressed air, and electrical supply. The IR system will not "see" UV light and will not react until infrared light is present, or when a flame is visible. To overcome nuisance interruptions, a combination of UV/IR system was developed. This system will react only when energy from both sources is high enough to cause a potential fire. All of them use eyes or sensors mounted with unobstructed vision inside the booth area. It is essential that these sensors be kept clean and are not covered in any way.

Tracking Rejections

I was recently promoted to be the quality control manager for our custom coater shop. I have been working in the shop for fifteen years in various positions and feel I have a good working knowledge of our powder coating operations and the personnel working here. What should I focus on to improve our overall quality and reduce defects and rework?

One basic but helpful process you can implement is reject tracking. If you don't already have one, create a reject tracking sheet. It is best to have separate forms for each customer, line (if more than one), date, shift number, and part number as there are differences between them all. Recording the total percentage of rejected parts is important but often is not sufficient for quality tracking or improvement. A more practical approach to reject tracking is to record the type and cause in addition to the number of rejects. This will enable the coater to pinpoint recurring quality problems and more rapidly institute corrective actions on the most frequently occurring problems. The use of this reject tracking sheet can greatly simplify record keeping for quality purposes.

Impactful Situation

I am an operator in a powder booth and have heard the term "impact fusion" mentioned by several people. What is this and what can be done to prevent it from happening?

Impact fusion is the packing or partial melting of powder particles occurring when they make contact with a surface during application or transfer. As powder material travels through the powder pumps, hoses, and guns, it can gain some charge due to heat from friction in the delivery system. This frictional heat along with the constricted areas causes the powder to pack together in a fused or semi-fused state. The packed powder can start as a small obstruction that continues to grow, restricting powder flow. It can also break loose and cause a finishing defect.

Any area of the delivery equipment within the powder path that will allow for the powder particles to impinge upon themselves is a potential site for impact fusion. These areas include the powder pump or injector, delivery hose, and powder gun. Good practice suggests minimizing the opportunity for potential powder impingement. Examples include:

- Keep powder hoses as short as possible and minimize sharp bends, which reduce friction and heat.
- Perform routine maintenance on the spray equipment, especially worn items.
- Balance the powder flow and atomizing air pressures of the system (more is not always better). High flow and high atomizing pressures increase the powder volume and can be a contributing factor in the amount of impact fusion experienced.

Have a question for our powder coating experts? Send it to asktheexperts@powdercoating.org.

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