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# Ask Joe Powder

## Something Fishy Here?

**Q** Dear Joe,

Waterjet metal cutting uses silica sand (silicon dioxide  $\text{SiO}_2$ ). Will this type of silicon cause adhesion problems and fish eyes? I have adhesion problems around edges of steel that has been cut this way. The flat areas are fine, no issues with cure and adhesion, just the edges—the steel cut edges—are 10 mm thick and peeling off. The metal was washed with hot iron phosphate water solution, rinsed, dried and primed before the top coat. It was not rusty and came from the waterjet cutter clean and rust-free and was powder coated the same day.

David B.

**A** Hi David,

Thank you for your question regarding abrasive waterjet cutting and its effect on the surface of metal. It requires a bit of digging to understand what could be the cause of the adhesive failures and fish eyes in your powder coating. On the surface (pun intended), what could be a problem? Water shouldn't cause an issue with adhesion or cratering. In addition, silicon dioxide is inert and is not known to cause fish eyes or craters. And you report that the surface is not corroded when you apply the powder coatings.

Here's where I would look for the root cause and hopefully the eventual solution: dispersion of the  $\text{SiO}_2$  in the water most probably requires

the use of a surfactant, otherwise the silicon dioxide would not mix well into the water and the process would be ineffective. In addition, the use of a surfactant to disperse the abrasive may require a defoamer to minimize foaming. Surfactants and defoamers are known to cause adhesion and cratering issues in powder coatings. The use of a high-pressure stream of abrasive slurry would only exacerbate the problem by embedding the surfactant/defoamer into the steel surface.

I would guess that the surfactant cannot be eliminated from the slurry. Perhaps there is an alternate surfactant that doesn't cause this problem, but I would not expect this to be the case. Consequently, you will need to identify a method that can aggressively remove residual surfactant on the machined edges. Two paths are possible: (1) use mechanical means to abrade the edges (sanding, grinding, etc.) or (2) use a strong acid to etch the edges.

The mechanical approach is either labor intensive or costly to automate. The chemical approach will cost money and require the handling of a dangerous material. No easy answers here. Alternately, you can consider using a different cutting technique, but you're probably also aware that laser cutting can cause similar adhesive failures for a different reason.

Good luck digging around for a solution. Let me know if you have any other ideas or questions.

— Joe Powder

## A Chip Off the Ole Part

**Q** Dear Joe,

I would like to know why the paint is chipping on these fixtures. Please see the attached photos. (See photos on next page—Ed.)

Regards,  
Alex P.

**A** Dear Alex,

Thank you for your message and the photos. From what you are showing me, these appear to be outdoor lighting fixtures made from cast aluminum parts. You haven't mentioned how

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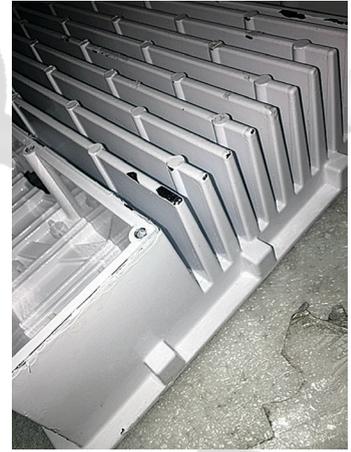
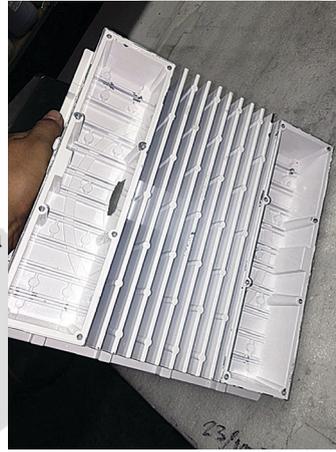
the metal was cleaned or pretreated or what type of powder coating and process conditions are being used to apply and cure the powder. Regardless, it is obvious you have serious coating adhesion issue. Here is what I recommend you do:

1. Ensure that the coating is completely cured. A quick and reasonable test is to evaluate solvent resistance (ASTM D5402). This is probably a polyester based powder so I would use a blend of 90 percent Xylene and 10 percent MEK (methyl ethyl ketone) as the solvent. Both solvents are readily available at your local DIY. Follow the test method using a double thickness cotton cloth saturated in this solvent blend. No coating should be transferred after 50 double rubs. If the coating softens and transfers to the cloth it is an indication of less than complete cure. Undercured powders have a tendency to chip and lose adhesion.

2. If the coating appears to be fully cured, then measure the film thickness and perform adhesion tests per ASTM D3359. You can use a utility knife with a fresh blade to make the crosshatch described in the test method. This test will probably correlate to the failures depicted in the photos. Under magnification examine the underside of the film excised from your part. Is this surface clean or discolored? If discolored it indicates the presence of a contaminant on the surface of the part. If clean, you may still have a problem with cleaning/pretreatment.

3. Look at the parts that are currently being processed. Are they adequately cleaned in the first step of your cleaning/pretreatment process? A quick assessment on cleanliness is the "water break" test. Does water sheet off the surface after the cleaning stage or does it bead up? If it beads up then an oily residue is present on the surface. Unclean aluminum will not pretreat sufficiently. Fixing a cleaning problem may entail increasing the temperature of your cleaner, adjusting the pH to be more alkaline, changing the solution in your system if it has become too dirty or increasing the time of exposure of your part to the cleaner. Poor impingement of the solution could also be a problem.

4. If you are convinced that the cleaning is adequate, then investigate your rinsing and pretreatment stages. Do you adequately remove the



Photos depict adhesion failures on cast aluminum outdoor lighting fixtures that had been powder coated.

cleaner from the surface prior to the pretreatment step? Is your rinse water clean? Next determine if your pretreatment is the right chemistry and the process is in control. Some failures I see in the field occur because the pretreatment chemicals were not suited for the substrate. Check with your chemical supplier to ensure that the chemistry is designed for your specific grade of metal. Too often I see people trying to pretreat aluminum with a phosphate material designed for ferrous metals. Traditional pretreatment for aluminum entails a chromate process. Toxicity concerns have led to alternatives to hexavalent chrome that are based on zirconium, silanes, trivalent chrome and nano-materials. You must have the proper pretreatment chemistry to achieve adequate adhesion.

In summary, first check to ensure that the powder coating is fully cured then investigate if the cleaning and pretreatment processes are suitable for this substrate and in control.

Good luck with your troubleshooting.

— Joe Powder

Joe Powder is our technical editor, Kevin Biller. Please send your questions and comments to Joe Powder at [askjoepowder@yahoo.com](mailto:askjoepowder@yahoo.com).

**Editor's Note:** Letters to and responses from Joe Powder have been edited for space and style.

### Not Your Average Joe...

Each issue, we take the padlock off the PCI® Test-Lab door for a few minutes so our favorite technical editor and "powder guru" Joe Powder can run in the yard. When he's not gnawing on a rawhide bone, he loves to answer readers' questions. Go ahead and send him one at [askjoepowder@yahoo.com](mailto:askjoepowder@yahoo.com)... he doesn't bite. Maybe it'll end up in the next issue!