

Chapter 25: Filling Pinholes and Scratches

"Pin holes must be filled, not bridged."

Step 5: Filling the Pinholes and Scratches

It's time to cover the scratches left over from the sandpaper and fill the hundreds of pinholes that formed in the dry micro. If these aren't found and fixed, they will show up CLEARLY in the final paint. Scratches will be magnified and pinholes will cause fisheyes in the final paint. So it is well worth the effort to completely fill the scratches and pinholes now.

Scratches are easy to fix. Any high-quality automotive primer will cover and hide the scratches. Pinholes are not so easy to fix. Pinholes are the tiny voids, bubbles, and pits caused by air that got mixed into the dry micro. Many are seemingly invisible until you spray the first coat of primer. Then they suddenly appear by the hundreds. Unfortunately, primer is very thick and does a horrible job of filling pinholes. You've no doubt heard the horror stories of builders spraying coat after coat of primer trying to get rid of them. The bottom line is, you cannot fill the pinholes with primer. Yes, if you keep spraying long enough, they will eventually disappear, but they will not be filled. They will be bridged. Eventually, the air trapped inside a bridged pinhole will expand and break through the final paint. Your paint job will be covered with tiny bumps that look like pimples.

In the old days (i.e., per the plans), the builder found and fixed the pinholes AFTER applying the primer. The drill was to examine the surface up close trying to find and fill all these little pinholes while hoping you didn't miss any. Many builders went blind doing this. :-) Then when they sanded the primer, they'd open up even more pinholes and the finding and filling would begin anew. It was a very vicious, seemingly never-ending cycle. (This is affectionately called the "Pinhole Dance.") Many builders chased pinholes all the way to final paint!

There's a better way!! And that is to fix virtually all scratches and fill all the pinholes BEFORE applying the primer.

A few of us have adopted a process known as the raw epoxy finishing technique. It is not addressed in the plans, but it is the cat's meow! The contoured surface is covered with very thin coats of raw epoxy. Being runny, the raw epoxy flows readily into scratches. The epoxy completely fills the pinholes instead of just bridging them like primers do. Epoxy is also lighter than high build primer. Since we must fill the pinholes and scratches anyway, why not use raw epoxy instead of primer? The epoxy also hardens the top shell of the micro, thus making it more durable. Plus, if you got too aggressive and exposed some of the fiberglass while contouring, the raw epoxy covers that area and seals it, too. While it's been around a while, the technique gained alot of attention after Cory Bird won the 2004 Oshkosh Grand Championship with Symmetry.

The technique is really all about saving the time and trouble of finding and filling pinholes. No more "pinhole dance." No more chasing pinholes to final paint.

The Skim Coat Process

1. Clean the contoured surface thoroughly. I used my air compressor and blasted the surface with a high pressure stream of air. The blast of air accomplishes three things -- (a) it blasts away the dust and

debris from scratches, dings, and gouges; (b) it breaks open any pinholes that may have been bridged; and (c) removes any micro that didn't adhere tenaciously to the surface. It's VERY disheartening when that happens, but better to find out about it now and fix it than for it to happen after the final paint's been applied. Some people swear that a pressure washer does a better job of this than an air compressor. Just be aware that the dry micro will soak up a lot of moisture. Ensure the surface is COMPLETELY dry before moving on. I finish up by vacuuming the surface thoroughly.

2. Fill all the really big scratches, dings, and gouges first. Here is one place where a commercial filler like Superfill can come in handy. Or, you can make your own. One make-it-yourself filler is called "microlight". It is made by taking WEST epoxy and mixing in their 410 Microlight low-density filler to a soft, creamy consistency. The other is a mixture of equal parts of your favorite epoxy, cabosil, and micro-balloons. Whatever you choose to use, you're aiming for a mixture with very smooth consistency. Take your putty knife and spread the mixture over the big scratches and press it into the big dings and gouges. Then scrape away all excess flush with the surface. You don't want to leave any excess on the surface. Else, you'll have to wait for full cure in order to sand it back off. You'll also run the risk of screwing up the surface's contour. Let the filled spots cure for a few hours before moving on. Don't worry about trying to fill the smaller scratches. They will get filled with the raw epoxy technique in the next step. In this picture, I've used Microlight to fill in the larger scratches and pinholes. The strake looks like it is splotted with calamine lotion. :-)



Note: It is really, really tempting to fill the scratches and pinholes with dry micro. Don't do it! Dry micro has too coarse a consistency for this application. It will tend to skip across scratches and not fill them completely. It is almost impossible to completely fill a pinhole with dry micro. The micro is not fluid enough to allow the air within the pinhole to escape. Pressing the micro into the pinhole will only trap the air and cause a bridging issue.

3. Mix up some raw epoxy and skim coat the entire surface. "Skim coating" is applying a very thin layer of raw epoxy onto a part. (Note: Just so I don't confuse anyone, "epoxy" by definition is resin + hardener. "Raw epoxy" is resin + hardener with no other additives. It is not "just resin". "Just resin" with no hardener will obviously never cure.) I roll the epoxy on to large surfaces and brush it on to smaller surfaces. The coat should be fairly thin, but with enough epoxy there to flow into scratches and pinholes. The goal is basically just to wet out the surface. Give the epoxy a few minutes to soak in, then scrape off the excess epoxy with a squeegee. Once this coat begins to green (i.e., gets tacky), skim coat the surface again. Apply as many coats as you think you need until all pinholes and scratches are filled. Let the skim coats cure completely.

Cory Bird talked about using five skim coats. I found that to be too many coats. After 5 coats, my surfaces had that bowling alley finish. Even though I scraped the excess off, the skim coats built up to enough of a thickness that it took me quite a bit of work to sand most of it back off. (In all fairness to Cory, he was using this technique for an entirely different purpose than just filling pinholes. He applied 5 coats to build up a shell of epoxy thick enough so he could contour the "shell" perfectly and optically flat.) I found it only took two coats to cover scratches left by 80 grit. Cory also recommends waiting 2 hours between coats. I was too impatient to wait two hours between coats. I let the one coat get tacky (20-30 minutes) before applying the next. Seemed to work equally as well.

A couple of notes:

- A word of caution: Some epoxies do not cure well and will remain gummy when applied as thin coats. These are not suitable for this technique. If in doubt, use WEST System epoxy.
- Don't be dismayed if the first skim coat doesn't completely fill everything. That's why we use multiple coats. Repeat the skim coating and the scraping until the pinholes and scratches are filled.
- The skim coats are not meant to "flow out" perfectly flat. And don't be alarmed by ridges and ripples that may form in the skim coats. These are caused by the squeegee. These will sand out easily after cure.

Here are some pictures to show you how well this technique works! Notice that the raw epoxy has totally filled pinholes of all sizes, from moon craters to rash. The exposed fiberglass is sealed and protected, too. In retrospect, I should have filled the really big craters with microfill to help out the skim coating as much as possible. But this just goes to show how well the raw epoxy works at filling pinholes. I should say that you don't normally get pinholes this large. The moon-sized craters were caused by VERY BAD technique on my part when I was first learning to spread the micro. I was trying the "peak and valley" method of spreading the dry micro with a notched trowel. Air got trapped into the valleys when I applied the second layer of micro. Since then, I do the prefilling and big filling using the flat trowel and processes explained on my website. I don't get pinholes this big anymore.







4. When cured, re-contour the surface until the skim coats are optically flat with all the glossies sanded away. George recommends using 100 grit. Cory uses 150 grit. I start with 80 grit, then switch to 120 grit. In truth, you sand about 99% of the WEST off, leaving just the thinnest of coat. No sense leaving it looking like a bowling alley or the top of the table at your favorite Hooters restaurant. The sanding goes pretty quick because the skim coats are thin to begin with. (Uhm.... adding cabosil makes the epoxy mucho tough and mucho harder to sand off. See notes below.) Try not to expose any dry micro. The sanding/fairing doesn't need to be perfect. Any surface imperfections in the skim coats will be hidden once the [high build primer](#) is applied.

Some Notes about Using Cabosil

Several others, including Jeff Russell, have had "one-coat" success by thickening the epoxy with cabosil. If you try this, just ensure you squeegee ALL excess off the surface. Cabosil makes the epoxy cure very hard and it is very difficult to sand off. You'll also get an inordinate amount of "fuzzies" while sanding. I did try this technique a bit when skim-coating the bottom of my fuselage. I didn't like it. The mixture gets thick and the cabo keeps it from flowing and leveling out. It doesn't flow into pinholes as easily either. You have to work it into holes more than with raw. The raw flows right in with little effort other than squeegeeing. Also, the ridges that form off the squeegee while scraping tend to be more pronounced (higher) than raw, and they take more effort to sand off later. Oh, did I already say that cabo makes the epoxy MUCH HARDER to sand off? So I question how much time is really saved with one-coat cabo versus the sanding required afterwards. So, for me, no thanx. I guess I'm not a one-coat cabo kind of guy. I won't use a cabo mix on horizontal surfaces anymore. I'll stick to using cabo only in small quantities to keep the raw from running on vertical surfaces.

Lessons Learned

I had contoured the wings and was on my first round of the "Pinhole Dance" (finding and filling the pinholes) when I learned of the raw epoxy finishing technique. As you might have guessed, I was trying to fill some of the larger pinholes with dry micro. I found out fast that the dry micro would only fill the big holes. It would only bridge the smaller pinholes. On some, the trapped air expanded overnight and blew the not-yet-cured micro out of the pinhole. Since I could foresee this Pinhole Dance taking forever, I decided to switch partners and give the raw epoxy technique a whirl.

Not knowing what to expect, I applied the first skim coat very, very thin and scraped it off right away. I didn't want to overdo it, especially since I had heard that raw WEST cured hard and would become very tough to sand. I was a bit dismayed because the scratches were still there and I could swear I heard laughter coming from the pinholes. So I decided to give the second coat a fighting chance. I applied the second coat a little thicker, working it into the gouges and pinholes as I rolled it out. I left it on a little longer and I didn't squeegee as hard. Wow! There was epoxy in the scratches and the pinholes were becoming partially filled. If it worked that good, why not go on thicker for the third coat? Well, maybe I put on the third coat a little too thick. It started to tack up before I could scrape all the epoxy off. But all the scratches and pinholes got filled! The large moon craters in my micro got filled completely! I couldn't find a pinhole anywhere! Wow, this technique really, really worked. It was simple, fast, and effortless.

I came back the next day to sand down the now-cured epoxy. I could see that I had applied the epoxy a bit too thick, so I had no recourse except to sand 99% of it off. Remarkably, the raw epoxy wasn't all that difficult to sand off. But here's the interesting part! I thought I had done a good job of contouring the micro. But when contouring the WEST, I found a few high spots I didn't realize I had! While my fairing board was merely gliding over the hard WEST coats, it was cutting straight across the tiniest of high spots. By the time I finished sanding off most of the WEST, the wing had a much straighter contour to it. Only a few small areas of micro had become exposed. Being rock hard as compared to micro, the WEST skim coats serve like a guide for the rigid fairing board. A high spot doesn't stand a chance.

To make a long story short, my skim coating technique improved dramatically on the second wing and with the winglets after that. I applied the skim coats a little thinner and left them on a little longer. I continued to be impressed at how well everything got filled. As a testimony to how well the technique works, after spraying the wings with primer I found perhaps 20-30 pinholes per wing. 99% of these pinholes were over areas where I had intentionally cut through the WEST and into the dry micro. Most builders I've talked to are normally chasing literally hundreds of pinholes at this stage of the game.

So, I'm sold, **SOLD, SOLD** on this technique, and I will use it in its entirety on the strakes.
(*Addendum: I had ZERO pinholes on the bottoms of the strakes.*)

A Clarification on a Side Note

I first learned of the raw epoxy finishing technique from a CP article. The CP article left the impression that Cory Bird went from epoxy to final paint and skipped the high build priming and primer/sealer coats. Not so. I emailed Cory and learned the only reason he skim coats the wings (Cory calls it a "resin wipe") is to get rid of pinholes and sanding scratches.

What he does is:

1. Sands the dry micro with 36 grit to within 0.020 inches of perfect contour.
2. Applies 5 skim coats, lets cure, then wet sands with 150 grit. (Again, I found 5 coats to be too many if contoured to 80 grit.)
3. Applies a PPG DP-48 primer/sealer coat and blocks that out with 220 grit wet sand. (Repeated until he obtains an optically perfect surface finish.)
4. Final primer/sealer coat is blocked out with 350 grit wet sand.
5. Then final top coat paint.

So that puts his process more in line with what we already do per Chapter 25. Except, time is saved by skipping some of the contour sanding cycles with 80 and 100 grit and not having to do the Pinhole

Dance.

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