

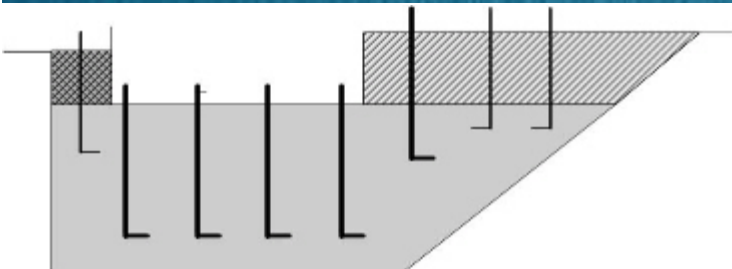
November/December 2008 --

This will be my last haul out in the SF Bay area, and also my last major project. This time, it's the keel. It's a long story, but my keel has always been a concern. I think that the leading edge was weakened when the [mast step cracked](#), long before I bought the boat. That put an extraordinary load on the smaller leading bolts, which worked a bit and let water into the joint. Then, in 2004 I got seriously stuck in the mud while the tide was going out, and I powered out of it. After that, I had a leak. Three years ago, I did a temporary repair, but knew that the repair trapped salt water around the bolts. Stagnant sea water turns acidic and can cause deep crevice corrosion in stainless steel. I have seen this. So, I need to take it apart and make it right.



Above, the keel after power washing. I'm really pleased, as [all the work I did three years ago](#) has held up. I really hate to mess with it, but I know it was just a superficial repair. Three years ago, I wrapped the ends of the keel with fiberglass and packed some epoxy in the joint, to provide some support. I also took the keel down to the lead and primed it again, because it was failing all over. That has held up well, and there isn't a single failed spot.



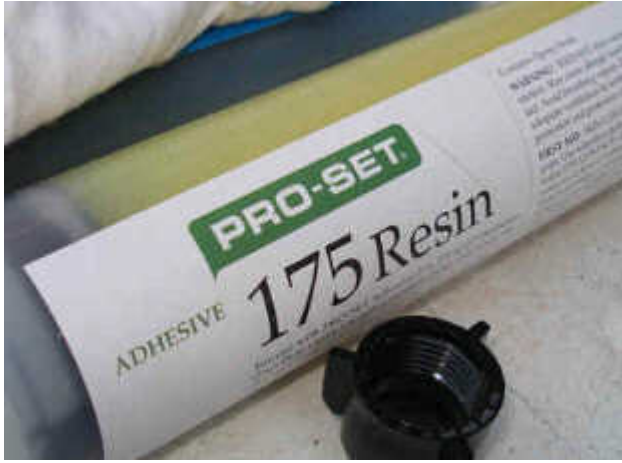


















To the left is the strut and prop. Paint never sticks to the strut, but I've been having fun playing with primers to see which holds up best. In 2003 I used Interlux 2000E. In 2006 I used Pro-Line two part metal primer. The Pro-Line held up better than the 2000E. This year I'm going to use Petit two part, because I have some leftover from [the fuel tank](#) and I need to use it up. It's fun to experiment, when failure is irrelevant.

I was also pleased to see that the Quikfair epoxy fairing compound was still solid around the base of the strut. I had thought I might need to take the Autostream prop off, and replace the cutlass bearing, because I was sure something would be tweaked after the [repower](#). However, the bearing is rock solid.

During this haul, I had an insurance survey done so I could get offshore/international insurance, and the surveyor thought I'd just replaced the bearing. I guess my engine alignment is right on. **This picture is from [the 2006 haul](#).**

I'm including it here to justify the work that follows. In 2006, water ran out of this crack for four weeks, and it was clear that salt water had worked deep into the boat. Besides, I had large 1/4" salt crystals inside the hull. That was a clue. (grin) My keel should not have a "smile." Some keel configurations are prone to cracks at the leading edge, but my keel is not swept back. It's a big 6,500 pound hunk of lead with a wide flat bottom.

So I'm going to rebed the keel. First, the entire keel joint was exposed, by wet sanding with my right angle die grinder. That was wet and messy, but the hose kept the toxic dust down. Sitting on a bucket with a hose and an air grinder, in 50F weather, is really not fun.

You can see the original bedding compound here. Inside, the Svendsen's team drilled out around the bolts. Half of the bolts are really long, and they had to make a long hole saw that would go all the way through the stub.

This is why I didn't try to do this job myself. The yard guys pounded wedges into the joint. It opened right up.



The first three bolts go through a sealed "crash bulkhead" area, so if I hit something and get a hole there, the boat won't sink. For some reason, the area is filled with wood. It's wet, but not rotten. We're going to leave it, and seal the bolts up so that they never get wet again. Removing the wood filler would take a month, and involve

major structural deconstruction. Here's a picture of the cradle that the Svendsen's guys made to hold the keel steady once we lift the hull off.

I'd always wondered why this yard has a few boat stands welded up with extra steel braces, and now I know. I guess they've done this before. (smile)

Then they pulled the travelift over, and lifted the entire boat off the keel. It came off easily. The keel didn't even try to stick. The boat was moved over to another cradle, so I was taking up two yard slots. Fortunately, yard demand is pretty slow in November/December.

The bolts are fine, and there is no corrosion. We did this job in time, and my fear that the bolts had been sitting in stagnant salt water for years turns out to have been unfounded. It has only been the last three years, and we're fixing it before any crevice corrosion happened.

But, I needed to know it was okay, and make sure it would be okay for the next twenty years. Here's the top of the lead keel. The old bedding compound didn't even try to stick to the lead, and you can see the stains from water penetration. Water had made it into the first two bolts, but it doesn't look like it had penetrated to the first large major bolt. The first two bolts are small 1/2", and the rest are 1".

Here's the bottom of the keel stub, with the old bedding compound still attached. This dramatically shows where water had penetrated the joint. I can see water getting back to the third bolt, although I never saw evidence of leakage around that bolt from the inside. But, when I [rebuilt the mast step](#), I made the inside impenetrable. so who knows.

Now it's back to work that I can do myself.

With the hull in a different cradle, I spent the weekend working on the stub with a hammer and two inch wide chisel, removing all the old bedding compound. The tan material is some kind of epoxy, making the bottom of the stub flat. Where it's chipped away, you can see the actual laminate of the fiberglass keel stub.

I have no idea what that gray stuff is. Who knows. Who cares. Once I had the stub clean, I carefully sanded it flush with a random orbital sander. That removed any sealant that the chisel missed, and scuffed up the stub for the new bedding compound.

With my cleanup labor done, the yard team took control of the job. The next step was to completely tape over the keel stub, and cover it with mold release. Actually, I think the yard used Lanocote, since it cleans off easily. I could have done this myself, but I didn't grok the plan. I was recovering from chiseling off the old sealant, and was moving into "just get it done" mode.

Here's a close up of one of the big bolts. You can see some discoloration where water had worked down from the bilge, but the bolt is sound. There's always a little water in the bilge. To raise the nuts, I made some backing plates from G10 fiberglass, left over from [my engine stringers](#).

G10 is really strong stuff, takes a compression load well, and is very water resistant. I plan to paint them, but don't know if I'll have time. The keel top was really clean, and the yard just lightly sand blasted it to clean the bolts and make the lead ready to accept epoxy. That sandblasting was done minutes before the epoxy was applied.

They used Pro-Set epoxy putty. I've never used it, and I wish I'd known about it when I [recored my cockpit sole](#). It's thick putty, and you use a special gun to shoot out the perfect proportions of resin and hardener. For small amounts, the gun has a nozzle that mixes it together, so you just shoot it into place. For this job, they took the nozzle off, shot the mixture on a board, and used a trowel. Moving fast.

An enormous amount of epoxy putty was laid onto the sandblasted keel. The yard had three guys working on this, because you have to move fast. Next, they picked the hull up again and lined it up over the keel. Here's a picture of Bill, the lead fiberglass guy. I like this guy. He knows his stuff. He's good people.

Grease was smeared over the bolts so they don't get epoxy on them. We're not going to epoxy the lead to the stub. They set the boat back down over the bolts, and carefully lined it up. I was a bit neurotic about lining it up right, so I helped. (grin.) Then they tightened down the keel bolts, and putty gooshed everywhere. They set the boat back down in the cradle, and peeled the hull back off the keel.

This picture is really important.

I now have a keel that is perfectly mated to the stub. You can see how the lead is uneven on the top, with 1/4" variance across the surface. Before, I had as much as 1/4" of bedding compound taking up the slack between lead and stub. Heck, it worked for nearly 30 years. I probably would never have had a problem if the mast step hadn't cracked.

Anyway... Now, when the boat is heeled over hard, or I get stuck in mud or sand, or (heaven forbid) I hit a rock or a reef, the stress will be evenly distributed along the entire structure. The boat was hung in the slings overnight. Actually, it was over a weekend. I was really worried about alignment, and spent a bunch of time measuring from finite points on the hull to finite points on the keel. It's right on.

Hanging the boat while the epoxy cures actually works, as the 6500 pound keel levels the boat in the slings, and the keel hangs level on the bolts. Of course, if the bolts are off center, or the holes are off center, that could screw things up. But, I measured everything, and it's fine. Once everything was cleaned up again, the keel was bedded in 3M 5200.

This is one of the few applications where I think 5200 is okay, since I honestly believe this keel is never coming off again. Note that the bolts are thoroughly coated in 5200 as well. This will ensure that no moisture in the original keel stub wood filler will contact the bolts. I like that air powered caulk gun. I personally smeared 5200 up the entire length of the long bolts. They were blasted clean, and I am confident that no salt water will ever touch them again. The hull was then set down on the keel, and the bolts tightened down again.

The entire boat was then hung in the slings again, to ensure that everything was straight and true. I like to see the 5200 gooshing everywhere, and being forced up the bolts and inside the boat. These guys worked really fast. That's good, since I'm counting three guys, at \$100 per hour. The other two guys work the travelift, and I'm paying for that, too, but not by the hour. Sven's yard plays fair.

The lead wasn't quite as wide as the fiberglass stub, so I laid a couple of one inch strips of X Cloth with Mat along the lead. To get a good bond, I dry sanded the lead, wet it out with epoxy, and then sanded the epoxy into the lead with 60 grit paper. This made sure that the epoxy was well bonded with new lead that had never been exposed to air. That's important, since lead oxidizes really quickly, and nothing sticks to it once it oxidizes. I sanded until the epoxy was dark gray mud.

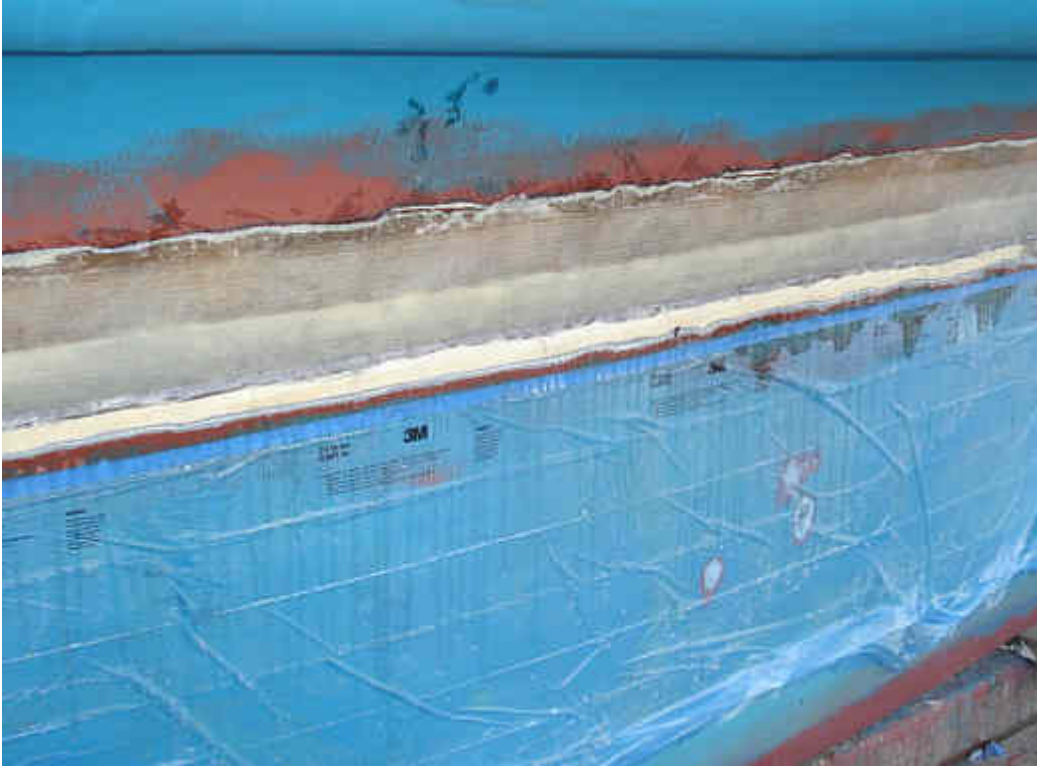


While the boat was hanging, I got out the hose and my right angle die grinder, and cleaned the joint back three inches on either side.













It's starting to get really cold, as we're having a series of weather fronts move through. I tented off the entire bottom of the boat, and the yard lent me a couple of 1500 Watt heaters. That was kind, since I was doing the work myself and not paying them for tools or time. I think the guys started to respect my effort, since I was willing to do the dirty, time consuming work.

Inside the plastic, it was about 75F degrees. The entire joint was covered with a bit of thick epoxy putty of West Systems and colloidal silica. Then I laid down a four inch strip of X cloth with Mat, and a six inch strip on top of that.

X Cloth has two layers of unidirectional fiberglass, set at right angles to each other, and a layer of mat, all sewn together. So this was better than laying up six layers of fiberglass over the joint. This thing is never coming off, or leaking again.

The next day, I sanded the new fiberglass smooth and removed the amine blush, and covered the area with a thick layer of System Three Quikfair compound. That works like Bondo, but it's epoxy based, less brittle, and stronger.

The following day I sanded it fair. There are a few imperfections, and I could have gone back with another layer.

But it's getting really cold, and I want to get out of here before Christmas. I'll fill the imperfections with barrier coat. I don't race. The fairing compound was covered with four layers of barrier coat, so that water won't penetrate. Two intermediate layers were made by Pro-Line, which cures below 40F. Unfortunately, I didn't take a picture of the can, and can't find the web site. Here's the inside, showing how those blocks of G10 keep the nuts up off the bottom of the bilge. They're stainless steel nuts, but I still like the idea of keeping them dry.

I need to cut off the excess caulk, clean everything and paint.



There. I think this is done, forever and for good. I'm going with red bottom paint this time, since it has more copper content, and I plan to head into warmer waters. The weather has not been cooperative, and has kept me in the yard an extra couple of weeks. Here's my "drizzle mitigation" solution, so that water running down the topsides wouldn't touch the paint.

I didn't paint in the rain, but there was light drizzle forecast during the eight hours while the paint was green, and I wanted to keep everything dry. Since I had the rig out, I scuffed it up, added two more coats of paint, and two red stripes at the top. I've never seen another boat with two stripes at the top, so folks will know it's me. Maybe people will think I'm Canadian and won't shoot at me. (smile) This also means I can never do anything stupid, since my boat will be easily remembered.

I added steps at the very top of the mast, and a series that go up to the first spreaders. I would have liked to add them all the way up, but these things cost \$20 each, and I'm not working. Note that they're bare aluminum. I've seen other boats where they were just bolted on, and in a couple of years they're white, corroded, and ugly.

I'd like to hard coat anodize them, but that would cost hundreds of dollars for all these pieces. So I'm painting them. First, I etched them with **Alumiprep**(phosphoric acid.) You can see how previously clean looking aluminum suddenly turned white as the acid worked on invisible oxidation. Then, I painted them with **Alodyne**, which is a chromic acid solution. Then they were all primed with this Petit two part metal primer. It's really nasty toxic stuff, but I like it.



Here's what they look like after priming.





My mast has curved sides, and these steps don't match up perfectly. However, I like them because they fold up and don't catch halyards. So, to keep them from working back and forth, I injected an epoxy shim on each side. Of course, if I ever try to take the steps off, this will probably rip the paint off the mast. However, if I ever take them off, it will be to paint the mast, so what the heck.







The epoxy shim was well coated with 3M 4000UV. That's a UV resistant white caulk. In addition to making them look pretty, it will protect the epoxy from UV degradation. Another little thing done on this haul out. I pulled the anchor rode, and painted the chain and primary anchor white. My old "code" for tracking rode length wasn't orking for me, so I just put white stripes on the chain every 20 feet.

One stripe at 20, two at 40, etc. Keeping it simple. I added additional drains to the anchor locker, so it'll drain faster. This isn't the prettiest thing, but I needed to allow water to get out of the locker faster, since I have an open hatch on the deck. I used mushrooms because they were smaller. Flush fittings would have been two inches, and really would have looked odd. Then I painted the heck out of them with Interlux Brightsides. Actually, I put too much paint on, and they don't fit together very well. I think over time the extra paint will get scraped off.

In May 2007, I was waxing my topsides on a weekend when the phone rang. It was an important work call, and I had to take it. I sat there for two hours being polite, while a newbie manufacturer's rep gave me a lecture about my own business. And I watched the wax bake onto my topsides.



It left a horrible buildup, that I'd tried to remove for the last two years. A wonderful woman on the next dock over suggested that I use Zep Floor Wax stripper, following the directions and using really hot water. It worked incredibly well, and also chemically removed all the gelcoat oxidation. It took two iterations of stripper, scrubbing with a soft abrasive and a white 3M scrub pad. But it worked really well, and my topsides look great gain.

Also on this haul, I added a [little teak shelf](#) on the transom, under the monitor. This can also be used as a step, or a seat when installing the emergency rudder. Mainly, though, it's a place to keep a plastic gas can, and a place to toss things when I pull up in the dinghy.

Finally. We spent most of a day getting the rig back in and tuning it up, and then it was time to go home. Those two red stripes on the mast really stand out. I've had longer hauls, but only because I had a job and had to let the boat sit untouched during the week. This time, I've been working in the yard almost every day since mid-November.

By the way, all the time spent seven years ago, prepping and priming the mast, worked well. Seven years later, here is not one speck of corrosion on the spar.

I added another hole in the hull. It's a raw water feed for the water maker, shared with a wash down pump. The hole was cut, the core reamed back, packed with epoxy, and four layers of X cloth set around the edge of the hole. Then the hole was re-drilled. No pictures of that work, since it's exactly like the [2003](#) and [2006](#) through hull work.

Caulk is cheap, leaks are a bitch. Note: The plywood fill serves no structural value, and I surmise that the builders put it there to make it easier to add the interior hull layup, which is tied into the outer hull.

I replaced the fitting on one of the cockpit drain sea cocks, so that it's a single bronze fitting.



When originally installed, I'd planned to put two drains into each sea cock, since I was adding cockpit drains during the whole [sole recore](#) project. However, there wasn't room above the [new engine exhaust](#) elbow, so I didn't add a drain there. The starboard sea cock fittings have a red brass nipple joining the bronze sea cock to the bronze hose fittings. I just can't find cast bronze Male/Male fittings anywhere. But I've always hated the thought of that red brass under the waterline. Now, at least, I can close that sea cock when I leave the boat, and leave the totally bronze one open, and not worry about a red brass failure. Note, though, the condition of the replaced nipple. It's just fine, after three years in a "hot" marina. That makes me feel a bit better. Having been in the yard for nearly two months, my entire life is in disarray. I can't find anything.