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PEAK OF FLIGHT

NEWSLETTER

In This Issue

How To Get A Quick And Strong Composite To Composite Epoxy Joint

Cover Photo: Apogee Components' Gyro Chaser rocket. Get one at: www.ApogeeRockets.com/Rocket_Kits/Skill_Level_4_Kits/Gyro_Chaser

Apogee Components, Inc. — Your Source For Rocket Supplies That Will Take You To The "Peak-of-Flight"
3355 Fillmore Ridge Heights
Colorado Springs, Colorado 80907-9024 USA
www.ApogeeRockets.com e-mail: orders@apogeerockets.com
Phone: 719-535-9335 Fax: 719-534-9050

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How To Get A Quick And Strong Composite to Composite Epoxy Joint

By Matt Fletcher

If you join 2 fiberglass parts (say a fin to a body tube), then you have a few options:

- Use a quick setting epoxy.
- Use a slow setting epoxy.
- Use CA (cyanoacrylate).

Using a quick setting epoxy sets the fin in quickly, but then you don't have the strength that you would have with a slower epoxy.

On the other hand, using a slow epoxy (I use US composites 635 Medium, which at 80 degrees has a set time of 3-4 hours), has a stronger bond, but it takes MUCH longer to cure. So, you have to find or build a jig, then let the rocket sit there in the jig for 3-4 hours. You could put it in front of a heater, but then you have to sit there and watch it, and also it weakens the epoxy bond (at least for the epoxy I use. Check with your epoxy instructions to check if a post cure is required).

Finally, CA by itself is brittle, but it does set quickly.

Now, to the bonding itself. Before you even mix the epoxy, you have some prep work to do. DO NOT start by sanding, because this will simply rub wax and mold release into the fibers, which will weaken your joint.

Photo 1: My epoxy workstation. Make sure you have everything out and ready before beginning to work.

Instead, start by giving all of the parts a HOT water bath, with a little bit of Dawn soap. This will start to remove the fiberglass dust, and also helps start to take a little bit of the mold release off. Scrub them with soap (this is comparable to getting grease off a frying pan). Next, take them out of the bath, and dry them off.

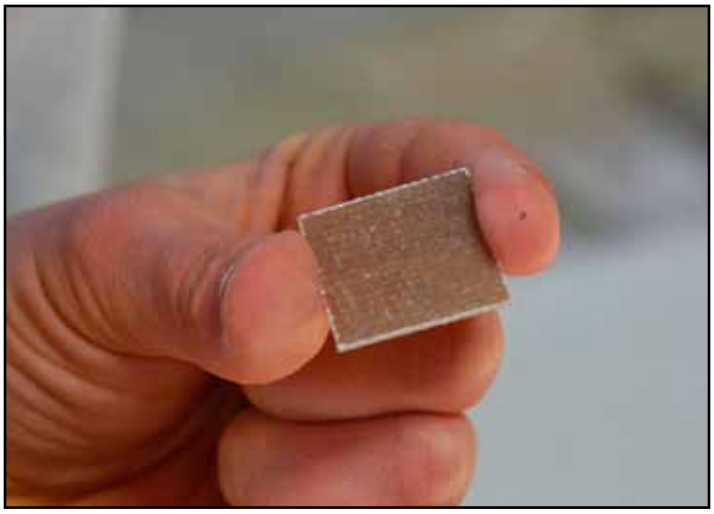

Photo 2: The unsanded, unwashed piece of fiberglass.

Now, take a little bit of denatured alcohol, and put it on a lint-free cloth (you can find these at any home improvement store). Wipe ALL surfaces that will be exposed to epoxy. You are trying to remove any of the following:

- Mold release
- Dust
- Wax
- Any other extraneous substances on there that could weaken the bond.

The way you can tell if you have done enough wiping is if the cloth comes off clean (no dust), and it succeeds in passing a *"water break"* test. A water break test is where you pour a little bit of water on the surface of the object. If the water beads up, then you have not washed it well enough. On the other hand, if the water lays flat on the surface, then you are good.

Now that you have cleaned the fiberglass of any extra-

Continued on page 3

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Newsletter Staff

Writer: Tim Van Milligan
Layout / Cover Artist: Tim Van Milligan
Proofreader: Michelle Mason

Continued from page 2

Composite to Composite Epoxy Joints

neous substances, do NOT touch the fiberglass with your bare skin ANY more. This will just put oils on the fiberglass (which will defeat the purpose of everything we just did). Instead, put on nitrile gloves, and then handle the fiberglass ONLY with the gloved hands. If you touch your nose (oily), rub your hair (oily), pick up the dog (oily), or come into contact with any skin on any part of your body (also oily), put on new gloves.

You may have heard the best way to attach composites to anything is roughing the heck out of the fiberglass, because the bond is purely mechanical. This is not true. In fact, the epoxy reacts molecularly with the fiberglass strands to create a solid bond. This means that attacking your fins with 5 grit sandpaper and a chainsaw will just weaken your bond, because you cut all of the fibers that the epoxy is supposed to bond with.

SO...take some 150-220 grit sandpaper and lightly sand the tube and fins. Limit your sanding, though. The main rule of sanding fiberglass for bonding is THOU SHALT

Photo 3: Sanding with 220 Grit sandpaper.

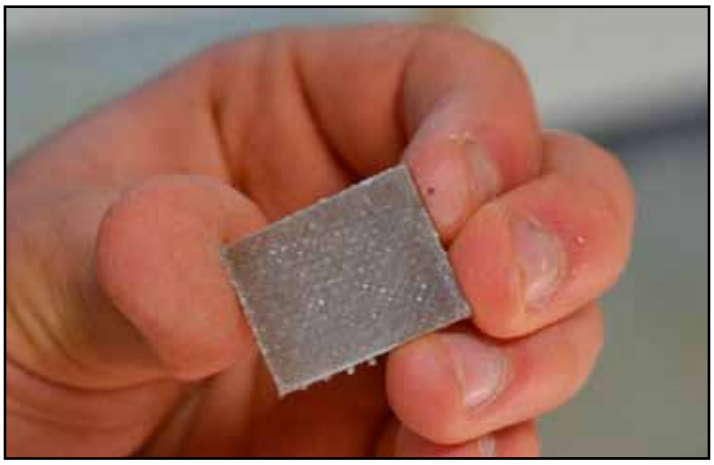


Photo 4: The sanded piece of fiberglass. Notice all of the dust still on there.

NOT CUT into the fibers in the fiberglass. This will simply weaken your glue joint. You want to simply sand down to the fibers without cutting them.

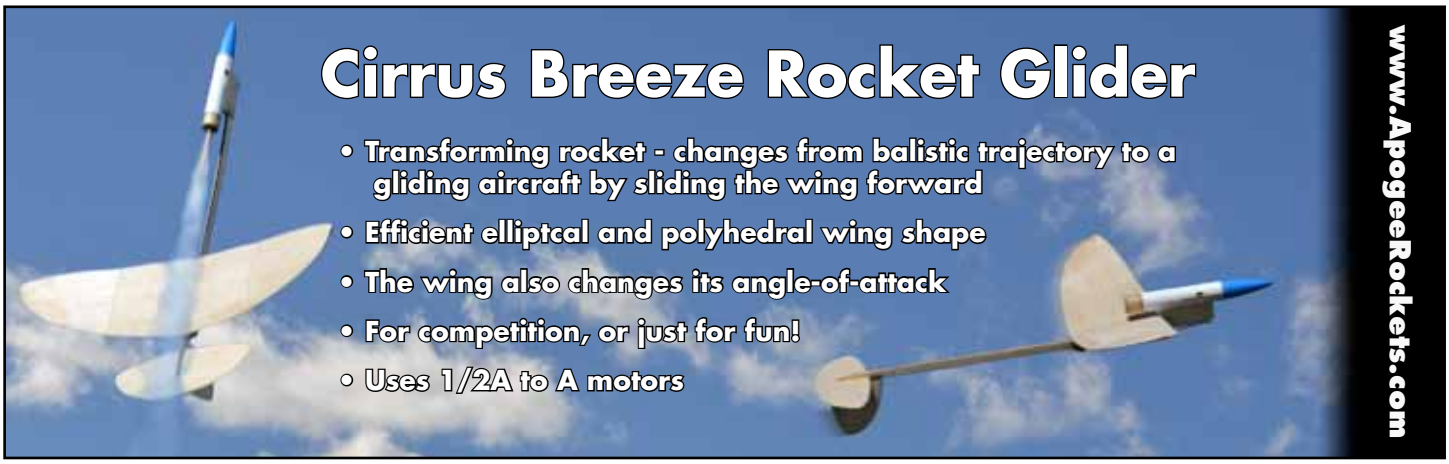
Now that you have sanded, you want to get rid of the sanding dust. Pull out that Denatured Alcohol and lint-free cloth (you grabbed a clean one, didn't you?), and start wiping again. This gets rid of all of the sanding dust you created that weakens the bond. Check with another water break test.

A Fast, But Strong Bond

So, what you can do is combine CA and a

Photo 5: Pull out the correct volume of resin with a syringe.

Continued on page 4



Continued from page 3

Composite to Composite Epoxy Joints

Photo 6: The stuff I use has a ratio of 3ml Resin to 1ml Hardener.

Photo 6: Chopped carbon fibers

slow epoxy. Mix up your epoxy. (Tip: when mixing epoxy with a ratio that is not 1:1, pour the epoxy into a small cup, and use a syringe to pull out the correct amount, as shown in the following photos). Mix this epoxy up thoroughly, before adding any form of additive. This way, you have a much lower chance of getting an unmixed bit of epoxy resin.

Then add a little bit of chopped carbon fiber or chopped Kevlar®. Make sure that you mix the epoxy for a while, as you need to break up all of the carbon strands.

Now, when that is all mixed, add enough Fumed Silica to make the epoxy have a peanut butter consistency. I added 4 times the amount

Photo 7: The epoxy mixed with chopped carbon fibers.

shown. Stir some more, and repeat. It is almost impossible to overmix epoxy.

You can also add some fumed silica to thicken up the

Photo 8: Adding the fumed silica to thicken the mix.

Continued on page 5

Continued from page 4

Composite to Composite Epoxy Joints

Photo 9: Final result of epoxy.

mixture.

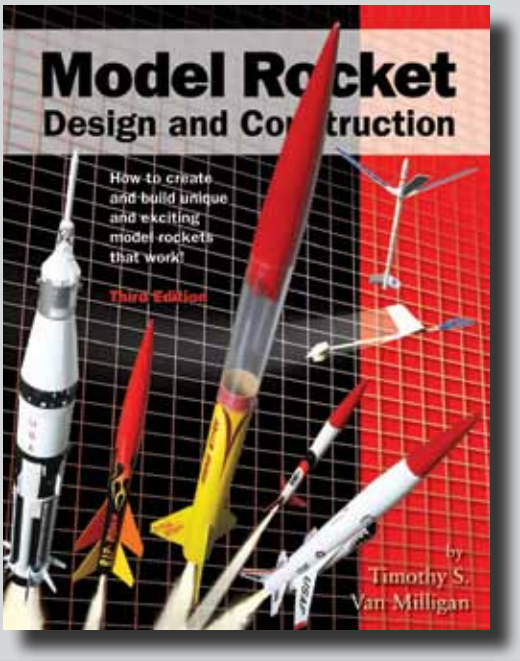
Notice how thick the epoxy is as shown in Photo 9. It has the consistency of peanut butter. Ignore how it looks like a hairball. That is good, because the fibers add strength to the bond.

Now, start to put it on the root edge of your fin. HOWEVER, you must leave a few spots on the edge epoxy free. I left the very ends of the edge free of epoxy, in this case. The reason for this is that you need a few spots to put a drop of CA on to hold the fin in place while the epoxy sets. The CA sets up quickly (much quicker than the epoxy), and allows the fin to hold itself while you prepare the next fin.

Press... And you are done!

Photo 10: Dripping the CA on.

Photo 11 & 12: Press the pieces together and you get an instant bond thanks to the CA.



Model Rocket Design and Construction

By Timothy S. Van Milligan

The Expanded 3rd Edition

This massive, 328 page guidebook for serious rocket designers contains the most up-to-date information on creating unique and exciting models that really work. With 566 illustrations and 175 photos, it is the ultimate resource if you want to make rockets that will push the edge of the performance envelope. Because of the number of pictures, it is also a great gift to give to beginners to start them on their rocketry future.

For more information, and to order this hefty book, visit the Apogee web site at: www.ApogeeRockets.com

Apogee Components
3355 Fillmore Ridge Heights
Colorado Springs, Colorado 80907

telephone: 719-535-9335
website: www.ApogeeRockets.com

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