Prop Guard: On Machining Carbon Fiber and Using Epoxy

This document is more about the general ideas of machining carbon fiber and using epoxy. For specific instruction on making the prop guard, see *Prop guard assy.pdf* made by AeroVironment

If possible, try to avoid machining carbon fiber. The damage carbon fiber dust will do to human body, especially lungs, is irreversible. There are vendors like DragonPlate that sells precut carbon fiber materials.

If possible, also try to avoid using epoxy and use other kinds of glue. Human bodies build up allergy to epoxy. If our bodies are constantly exposed to epoxy, it will get to a certain points when our bodies will be terribly allergic to epoxy

Machining Carbon Fiber

1. Protection

Safety glasses: As always.

Gloves: Carbon fiber chips can easily get into your skin, and you will feel super itchy.

Respirators: The normal disposable respirators are not enough. Use these 3M ones.

2. Select Tools

   Carbon fiber wears out tools quickly. Try to get tools that are made of diamond. They will produce a cleaner cut and have longer life.

3. Set up

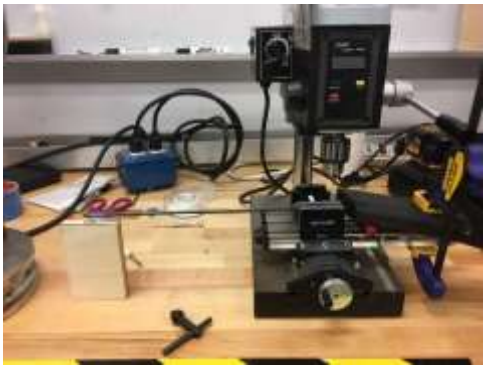
One thing I like to do is to have a vacuum pointed right at the tool, so it will suck the dust instantly during machining.

Do not center punch carbon fiber. Use a center drill.

4. While Machining.
   For drilling, carbon fiber requires higher speed than metal.
   It is really likely that you will see split-ups on the edge.

5. After Machining
   Most of the deburring tools might not work on carbon fiber, sadly. If you want to sand carbon fiber parts, make sure you wear protection and have a vacuum set up.

6. On Protruded Rods



   Protruded carbon fiber rods are tensile, which means that they are rigid along themselves but really vulnerable in the perpendicular direction.
   While clamping the carbon fiber rods, do go too hard. They will snap pretty easily.

Using Epoxy

In the composite space of the lab, we have West System epoxy. That is only epoxy students are allowed to use, because it is the least harmful kind.

1. Protection

   Safety glasses: As always.
   Respirator: You won't like the smell of epoxy.
   Gloves: Skin contact with epoxy is really damaging to human body. If epoxy gets on your skin or your clothes, washing them off immediately.
   Ear plugs: The composite space in the lab is really close to the Shopbot. If the Shopbot is on operation, make sure you have ear plugs.

2. Mixing Epoxy

To make epoxy, simply mix the resin and the hardener in 1:1 pump ratio. The pumps are precisely calibrated. We have hardeners of different speeds, including fast, slow and extra slow.

HARDENER	USES Resin/Hardener	HARDENER TEMPERATURE RANGE (°F) Room Temp. 40° 50° 60° 70° 80° 90° 100°	CURE SPEEDS at room temp.* POT LIFE 100g cupful	WORKING TIME thin film	CURE TO SOLID thin film
205	General bonding, fabric application and barrier coating		9–12 minutes	60–70 minutes	6–8 hours
206	General bonding, fabric application and barrier coating		20–25 minutes	90–110 minutes	10–15 hours
207	Clear fabric application and clear coating for a natural wood finish		22–27 minutes	110–130 minutes	12–18 hours
209	General bonding, fabric application and barrier coating		40–50 minutes	3–4 hours	20–24 hours

*Epoxy cures faster in warmer temperatures and in thicker applications—Epoxy cures slower in cooler temperatures and in thinner applications.

For reference, 205 is the fast hardener, 209 is the extra slow hardener. Past pot life, the epoxy mixture will not be liquid enough for you to apply it.

3. Increase viscosity
   In some of the situations, you may want the epoxy mixture to be thick. That's when you add adhesive filler to the mixture. The filler powder is like flour. The more you add, the thicker the mixture will be.

4. Dry your parts
   While drying your parts, it's highly likely that the epoxy will drip. You can use the hooks above the work space to hang your parts, and make sure the epoxy won't drip on where you don't want epoxy.

5. On removing epoxy
   In general, don't do it.
   When you want to glue something with epoxy, think of it as a permanent joint and plan it really carefully.
   If you have to, first try using pliers or razor knives to cut the epoxy off, or sanding it off with filers or sand papers. Epoxy will shatter pretty easily.
   If that doesn't work, heat up the epoxy with a heat gun in the fume hood in the mini-shop. Make sure you wear the same protection as you did while using the epoxy.

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