

Layups: Epoxy resin

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Teams that do this

Baja, FSAE, CUAir, CUSail, CRT, CEV, CU Solar Boat, Hyperloop

Chemicals involved & MSDS for each (should also be included in confluence SDS)

Chemical	MSDS
Epoxy 2000 (CU Sail)	https://s3.amazonaws.com/cdn.fibreglast.com/downloads/PDCT-SDS-00130.pdf
Hardener, Fibre glast 2060 (CU Sail)	https://s3.amazonaws.com/cdn.fibreglast.com/downloads/PDCT-SDS-00130.pdf
Partall Paste Wax (Baja, others)	https://s3.amazonaws.com/cdn.fibreglast.com/downloads/PDCT-SDS-00101.pdf
635 Thin Epoxy Resin + 3:1 Hardener System (Baja, others)	Chemical SDS and MDS

Safety Gear

- Nitrile gloves, thick preferable
- Gray masks/respirator (vapor protective)
- Skin protection long sleeves/jumpsuits/tyvek pants

Step by step

[CU Sail - Epoxy 2000 + Fibreglast 2060 Hardener]

1. Use snorkels and curtains
2. Measure out and mix epoxy according to ratio given by manufacturer
 - a. Use epoxy cups, solo cups can/will melt
3. Lay out fabrics on table, use bag film as a protective tablecloth or lay directly on table
4. Wet out epoxy on table - spread/paint the epoxy on to the carbon fiber fabric
5. Place fabric in mold
6. Bag for cure - seal the bag and turn on the vacuum pump.

[Baja - 635 Thin Epoxy Resin + 3:1 Hardener System]

PREPPING FOR LAYUP:

1. Cut all materials
Cutting materials can take a long time, so it's important to start this process well before the layup process happens. To make cutting easier /more accurate, lay masking tape over the line you want to cut. Be sure to oversize your parts for the layup because the edges of the layup may have misaligned fibers that need to be cut off. You want your part to have completely solid edges.
2. Lay mastic down around the mold
Mastic is a sticky gum that comes in long strips. Press a perimeter of mastic roughly 1" beyond the edge of where the layed-up part will sit. Ensure there are no air gaps between the mastic and mold.
3. Wax & buff the molds
It is critical to wax and buff the molds so that the finished layup can be popped off the mold without damaging it (sticking to it). Wax and buff the mold seven times with Partall Paste Parting Wax 1016, using T-shirts as rags.

4. Debristle brushes & measure chemicals

It is important to debristle the brushes so that bristles don't fall off the brush and into the layup. If the bristles fall before the first layer of carbon is laid down, the final part will have bristle hairs visible on the outside (smooth side of the layup).

Mix 3 parts by mass of Thin Epoxy Resin to 1 part Epoxy Hardener (e.g. 120g resin and 40g hardener is a good amount for 2 layers of 2 ft. x 2 ft. carbon). We use 635 Thin Epoxy System, with 3:1 Ratio Medium Epoxy Hardener. Once the resin and hardener are mixed, there are roughly 20-30 minutes before they start to cure (heat up and harden), so be sure to work quickly. Make sure to wear vapor-protective masks when working with epoxy.

MAKING THE LAYUP:

1. Apply initial layer of epoxy

Use brushes to apply a thin layer of epoxy on to the waxed mold. Check to make sure no bristles have fallen into the epoxy. If so, carefully pick them out using the brush.

2. Lay down carbon fiber, kevlar, etc.

Starting with one edge of the carbon fiber, gently lay down the fabric. Make sure the weave stays aligned in a straight line and that there are no large gaps or bubbles.

3. Impregnate the carbon fiber/kevlar with epoxy

It is important that all the fibers get completely soaked with epoxy, without getting misaligned. To achieve this, dab the epoxy-filled brushes firmly into the carbon fiber (sweeping brush strokes will ruin the fiber alignment). It is best to start at the center of your part, or wherever there may be bends, and move towards the edges. This ensures any air bubbles gently get guided from the middle to the edges.

4. Add perf, peel ply, breather and turtle

Once all layers of carbon, kevlar or core have been added, add a sheet of perf on top, cut to size. Perf is a perforated film that allows for the epoxy to be drawn up through all layers of the layup. Then add a layer of peel ply, and finally breather, a white felt-like material. Peel ply prevents breather from being stuck to the layup at the location of the holes in the perf. Fold up a few layers of breather into a small square and place the "turtle" (a small device for attaching to the vacuum pump) on top of it. It's necessary to have extra layers of breather underneath the turtle to ensure the turtle doesn't leave an exaggerated indent in the layup.

5. Seal inside vacuum bag

Cut a small slit in the vacuum bag and sandwich the turtle around it. This allows air to flow from the layup into the vacuum. Peel back the paper layer on the mastic and stick the vacuum bag to the mastic. Ensure there are no large wrinkles in the vacuum bag and no air gaps between the vacuum bag and mastic. One solution to ensuring there aren't large wrinkles is to do "micropleating." By massaging small wrinkles into the mastic as you go, this can make sure you don't end up with a huge wrinkle at the end.

6. Turn on vacuum pump

The goal for vacuum pump pressure is roughly 25-30 psi. If it is lower, check your layup for holes in the vacuum bag and seal them with more mastic.

7. Wait 12 hours

To be nice to other project teams, leave a note on the layup indicating when you'll come back to pop it and a contact name/phone number in case of issues.

8. Pop the layup

Rip off the mastic, vacuum bag, breather, peel ply and perf. To 'pop' the layup, lift the edges with a razor or with your fingertips, then slide in the edge of a wedge and keep pushing it in until the layup is completely removed from the mold.