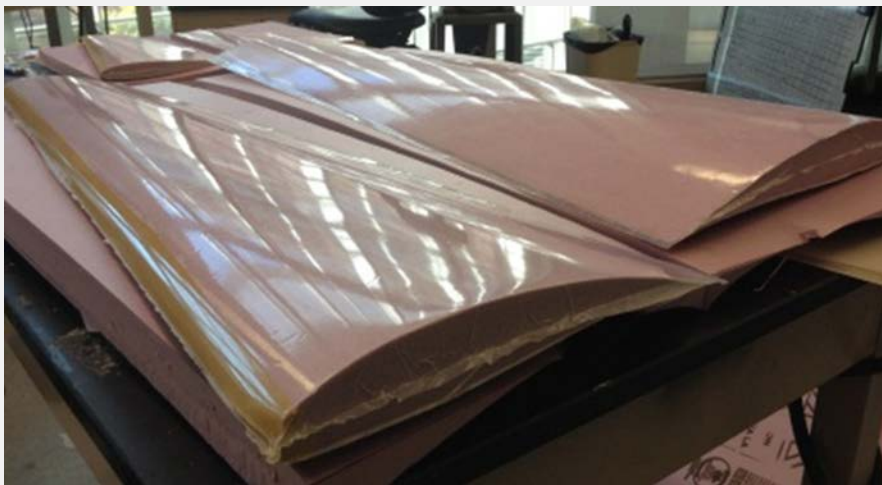


Vacuum Bagging Wings Instruction Manual Purdue University

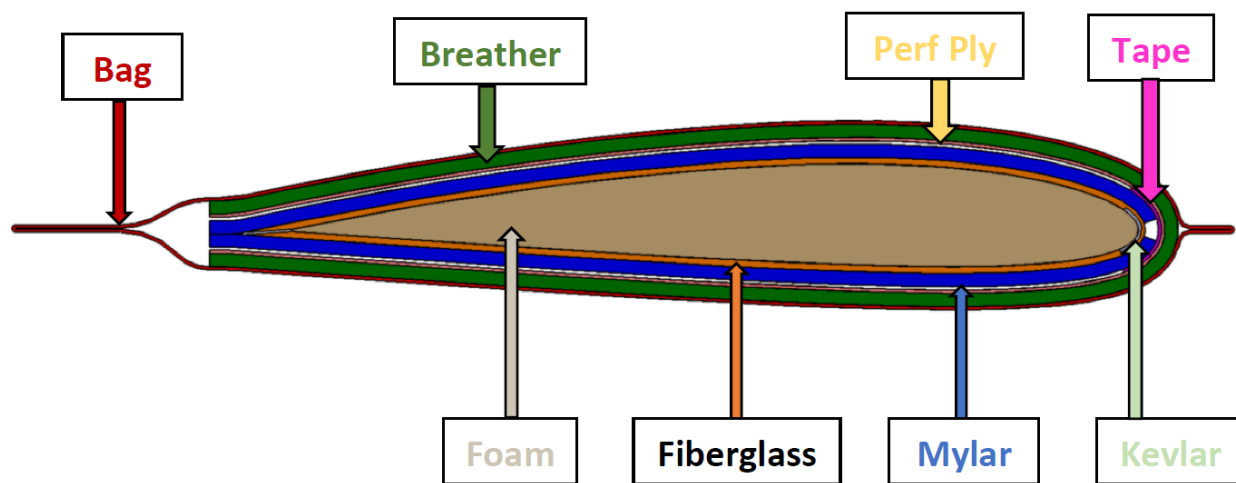


**Note:
Do not leave the vacuum pump
running unattended!**

Vacuum bagged wings are quick to build, light weight, and have excellent aerodynamic and structural performance. The method described, sometimes called the “glass slipper”, produces wings with a smooth surface requiring only a slight cleanup of the leading and trailing edge.

The steps in the process are:

1. Cut the foam core out with CNC hot wire or CNC mill
2. Cut out the Mylar, fiberglass, Kevlar strips, breather and vacuum bag tube
3. Tape the Mylar together with ~1/2 inch gap at the leading edge and release wax the Mylar
4. Glue Kevlar strips to the leading edge and aileron hinges with light coat of 3M 77 spray adhesive
5. Lay the fiberglass on the Mylar. Pour resin on near the middle and squeegee out the resin
6. Wrap the Mylar/fiberglass around the foam core. Tape trailing edge and tips to keep the foam core in place.
7. Add the release film, breather and insert in bagging tube. Attach the vacuum connector and the end clips
8. Turn on the vacuum pump and smooth the bag over the wing as the pressure drops. Check for and seal any vacuum leaks.
9. Allow resin to set. Remove wing, sand leading edge and trim trailing edge.



Cross Section of layup materials

1. BASIC VACUUM BAGGING SYSTEM SETUP

Vacuum bagging composite parts is a simple process that is used to compress composite layups while they cure. Here we will describe the basic assembly of our vacuum bagging system. One common use for vacuum bagging is foam core wing and tail surfaces for models. In this instruction manual we will cover how to set up the bag and use the system to vacuum bag a foam core wing with fiberglass. Here are the materials that should be prepared.

Vacuum bagging materials:

- Fiberglass/carbon fiber (just enough to cover wing area)
- Kevlar strip
- Epoxy resin and hardener
- Nylon bagging tube (at least half a size wider than the chord of your wing)
- Mylar sheet
- Release wax
- Release film
- Packing tape
- Bag clips
- Breather strip
- Vacuum pump

Other materials:

- Gloves
- Clean plastic mixing cups
- Clean mixing sticks
- Clean plastic squeegee

Preparations:

1. The first step to setting a vacuum bagging process is to have a clean, spacious work area that is enough to lay the foam wing and place the rest of the materials needed. The work area/table should also be close to a power outlet to be connected to the vacuum pump.



2. Vacuum bag can be reused many times. Cut the vacuum bag tube at least a foot longer than the longest part of the wing that is to be bagged. Bag clips are used to seal the ends of the bag at desired lengths. Throughout this entire process, the Nylon bag should be handled careful to prevent having holes on it.
3. Mylar film should be cut to two pieces that covers almost the exact area of top and bottom of the wing, about $\frac{1}{2}$ in from the leading edge. Try not to scratch or put any gauges on the Mylar because any of the defects will be transferred to the wing later on. Tape the trailing edges of the Mylar together to make a folding layer. Clean the inside surface of the Mylar and with paper towels, apply release wax all over the surface. Rub some of the wax along the outer edge of the other surface as well. This prevents the excess resin from sticking and allows the Mylar to be reused.
4. Cut breather strip about a foot longer than the foam core wing that you are using.
5. Cut the release film to almost the size of the wing area, top and bottom.
6. Cut the fiberglass cloth to match the surface of the taped Mylar combined.

All the materials prepared above should be at least a foot shorter than the Nylon bag.

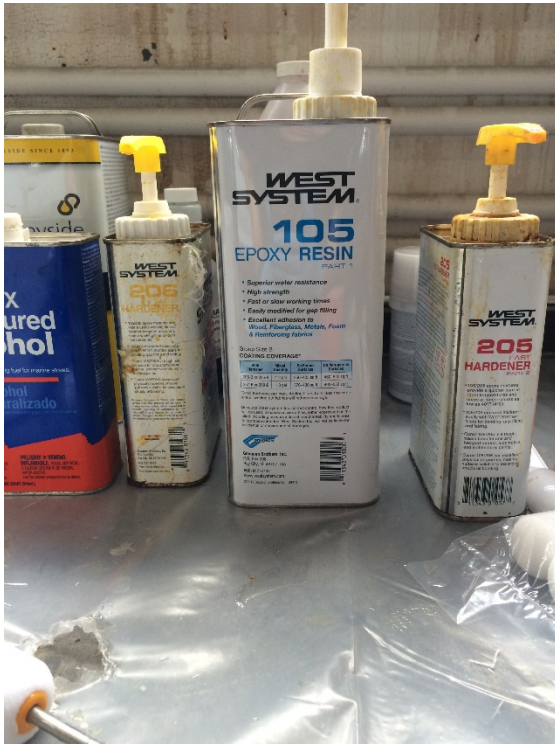
7. Epoxy and resin hardener mix (usually West System 105 Epoxy Resin and 205 Hardener) should be prepared the last due to its curing time that allows limited working time. The fast hardener should allow a working time of about 30 minutes in room temperature. Higher ambient temperature makes the epoxy cure faster. Further reading and understandings of epoxy cure time can be done on <http://www.westsystem.com/ss/epoxy-chemistry>.

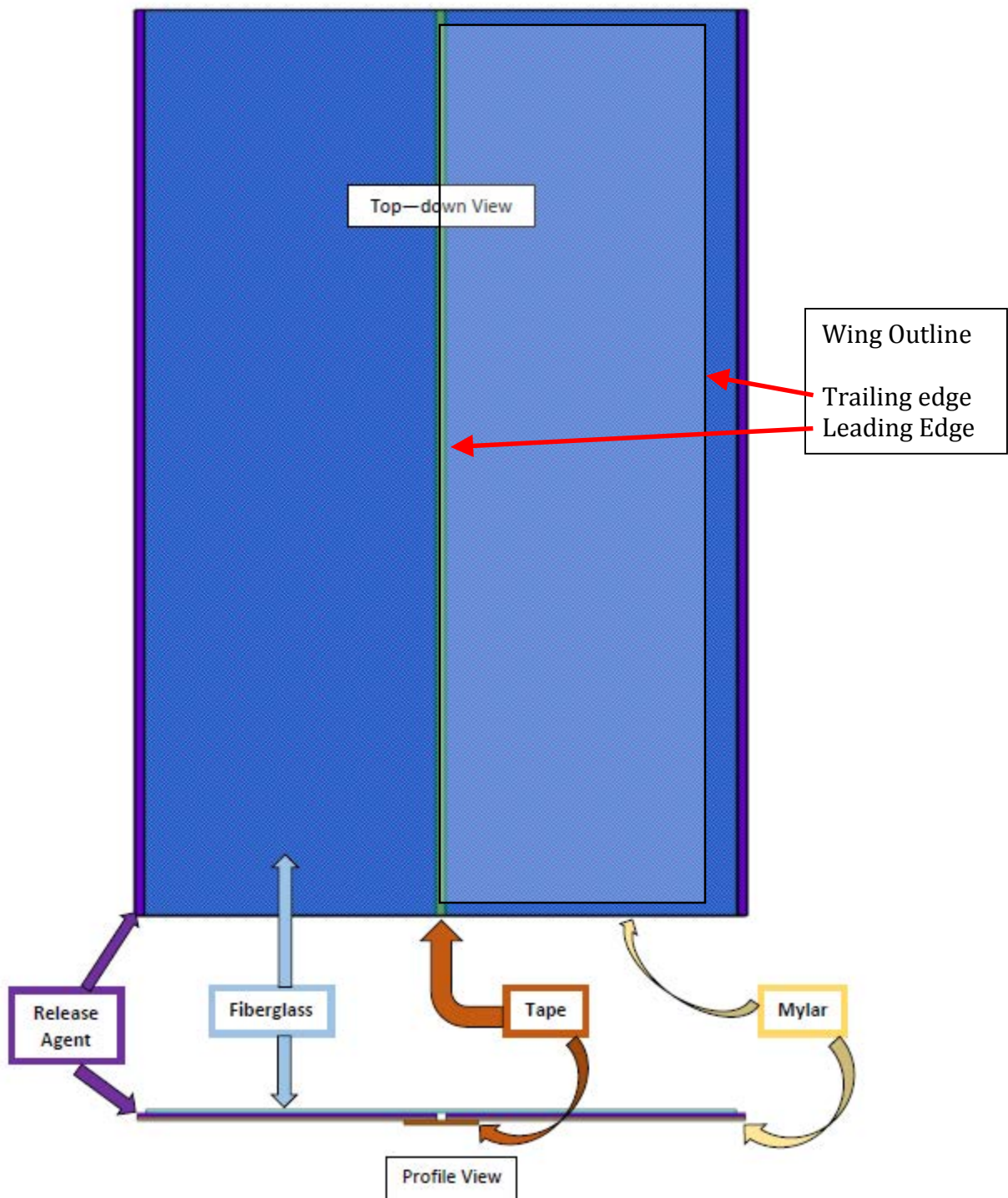
Dispense the proper proportions of resin and hardener into mixing cup. One squirt of resin for one squirt of hardener.

Do not try to adjust the mix ratio.

Do not use glass or foam containers because of potential danger from exothermic heat build-up.

Stir the two ingredients together thoroughly-at least 1 minute-longer in cooler temperatures. To assure thorough mixing, scrape the sides and bottom of the pot as you mix. Use the flat end of the mixing stick to reach the inside corner of the pot.





FOAM CORE FIBERGLASS SLIPPER LAYERING

1. The foam wing should be sanded down to a clean smooth surface before beginning the layering process. Make sure that there are no stray foam fibers on other materials or the workspace.
2. Place the fiberglass cloth on the inner surface of the waxed Mylar film. Wet out the cloth on the Mylar with mixed epoxy resin and spread the resin all over with plastic squeegee, making sure there are no dry spots (cloth should be transparent). Now the surface should look nearly dry. If there are any wet areas repeat the roller and towel process on those areas.



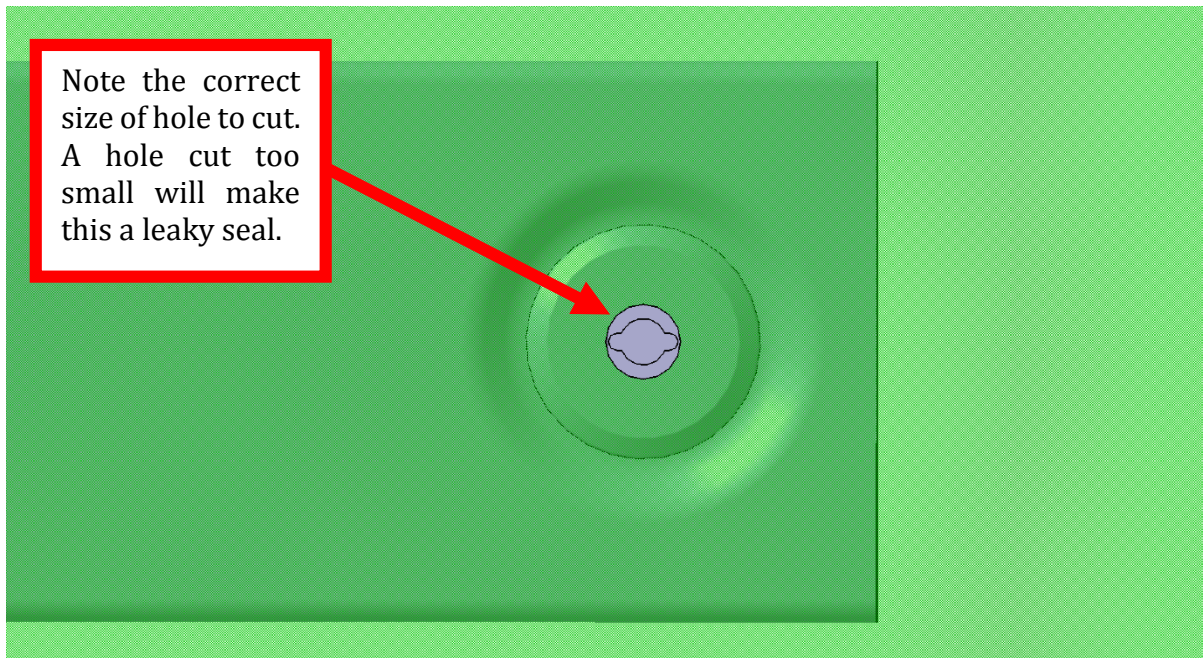
3. Place the foam core on one side of the Mylar and fold over, making sure that the foam is lined and wrapped up properly with the outer Mylar layer.
4. Now we are ready for layering the bag contents. The first layer outside the part is a film of peel ply. Epoxy does not stick to the film. It is very thin and flexible. It easily conforms to the part. The next layer on each side is a breather layer. It assures the vacuum will be uniformly distributed over the entire surface of the part.

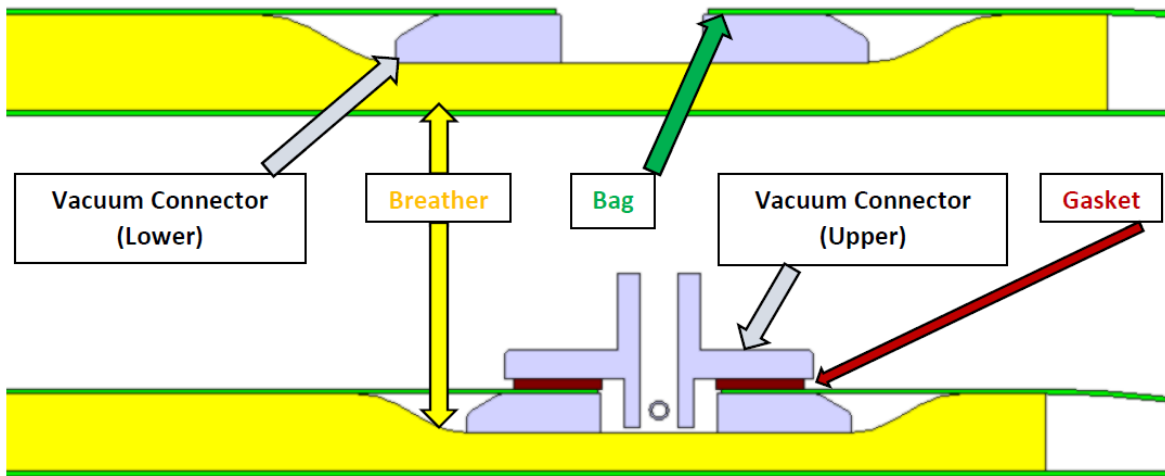
VACUUM BAGGING

1. Getting all the layers into the vacuum bag can be a little difficult the first time. One of the easiest ways to slide all layers in the bag is to stack them up the table. Then put an arm through the bag tube and pull the layers into the bag while flattening out the bag over the stack with the other hand.



2. After all the layers are in position in the bag tube, place the female vacuum connector on the excess breather cloth on one of the sides of the layers.





3. Make a cut on the nylon bag where the female connector sits. Insert the male connector. Connect the pump hose.

MAKE SURE TO CUT A HOLE IN YOUR BAG LARGER THAN THE “CROSS PEG” OF THE MALE CONNECTOR. THIS CONNECTION IS PRONE TO A POOR SEAL IF THE BAG GETS WRINKLED WHEN CONNECTING THE MALE AND FEMALE CONNECTORS.

4. Close both ends of the bag tube with clips. This is done by folding the bag tube over the white rod then pressing the blue channel over the outside of the rod. Make sure that the breather cloth does not obstruct the clips and there are no wrinkles in the bag film under the channel. This is another area prone to leaks, but easy to fix.



5. Turn on the vacuum pump. The bag will pull down quickly over the part. Check the reading on the vacuum gauge. It should read between 18 and 24 inches of Hg depending on your altitude. Use a squeegee over the outside of the bag to smooth out the bag surface and help the bag pull tight around the edges of the part. The squeegee will also smooth out any edges in the layup under the Mylar and move any excess epoxy off to the edges.
6. Keep the wing under vacuum for at least 24 hours.

REMOVING WING FROM VACUUM BAG

1. Unclip bag
2. Slowly and gently, separate Mylar surface from Nylon bag and pull wing out from one end.
3. Gently peel off Mylar (to be reused) from wing.
4. Discard any one-time-use materials (perf ply, breather).
5. Keep bag for reuse.
6. Clean off vacuum bagging table for the next user.
7. Clean up rest of work area.

NOTE:

Reference #1 below describes how to paint the Mylar sheets and have the paint transferred to the wing. This gives a smooth shiny painted wing

Reference #2 describes using a light colored cloth as the first layer and thus producing a colored wing

References:

http://www.cstsales.com/vac_wing.html

<https://www.youtube.com/watch?v=x9OWFZ9ZPhM&feature=youtu.be>

<http://www.westsystem.com/>

http://www.fibreglast.com/category/Vacuum_Bagging

<http://www.cstsales.com/tutorials.html>