Mini-HowTo - Make Your own Booms by Dave Hill

http://www.rcgroups.com/forums/showthread.php?t=1000547&highlight=Wrap+your+own+booms

OK, here we go.....

I think its best that we start with the main item. To effectively make a good boom you need a constant rate of turn to the mandrel for winding. When I started out teaching myself it was by hand turning the mandrel myself " NO GOOD", It has to be done by a motor. What happens when its hand turned is you are applying uneven pressure and you end up with a lumpy boom.

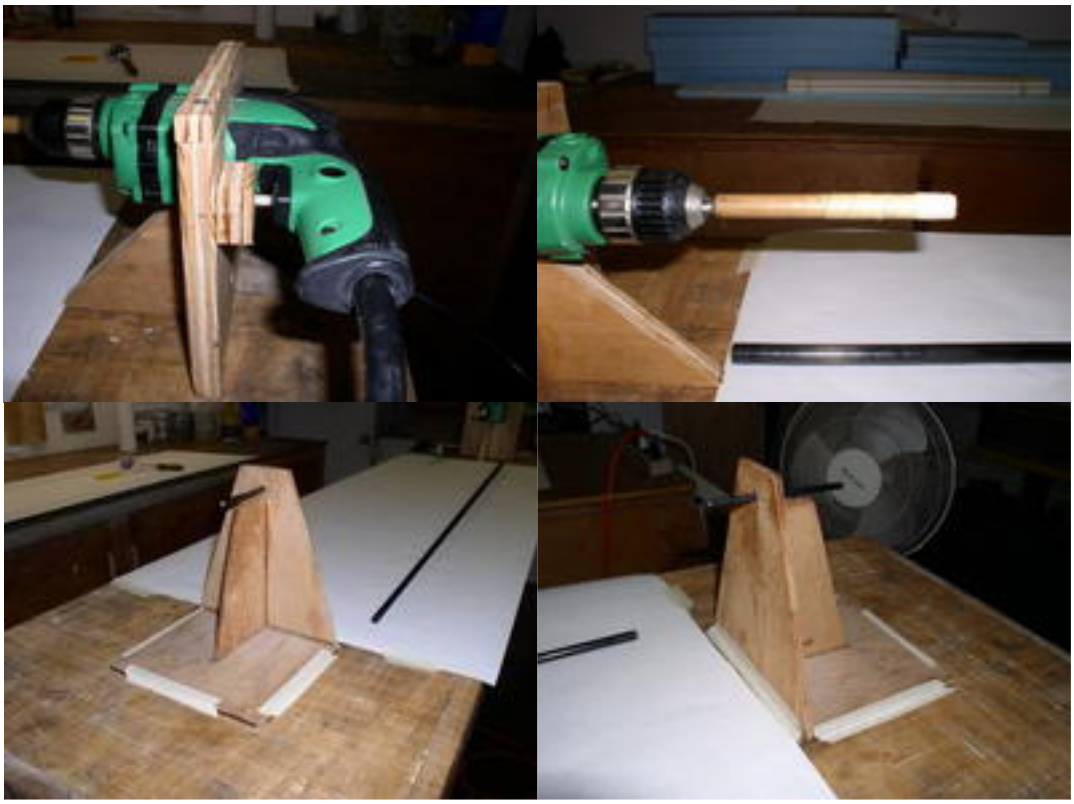
So after a bit of head scratching, what would be the quickest and easiest way to make a motor drive the boom. How about a variable speed hand drill, Bingo Baby!

A trip down to the Hardware Store and I found a nice Hitachi drill for a good price. Plus I liked the color.

So for the holder I started jigging it up in place and made several sketches then cobbled the holder up. Kind of built it as I went along. However, it has worked perfectly for the last 3 years. You can see everything you need from the photos. I attach it to my bench with 3 screws driven up from underneath. The insert chucked in the bit is a piece of hardwood dowel that has a metal rod epoxied in the center.

EDIT: Forgot to mention to add an on off switch in an easy to reach location. I just snipped the power cord and added a toggle switch which you can see in the photo.

The rear holder is just 1/4" ply put together with 5 min epoxy. The bearing tube that is inserted in the mandrel is 1/4" carbon tube that I had laying around. It is just taped in position. What's really great is that it all comes off my portable bench and stowed away in my cabinets. Only takes 2 minutes to set up and its ready to go.

TOOLS

These are the only tools you will need:

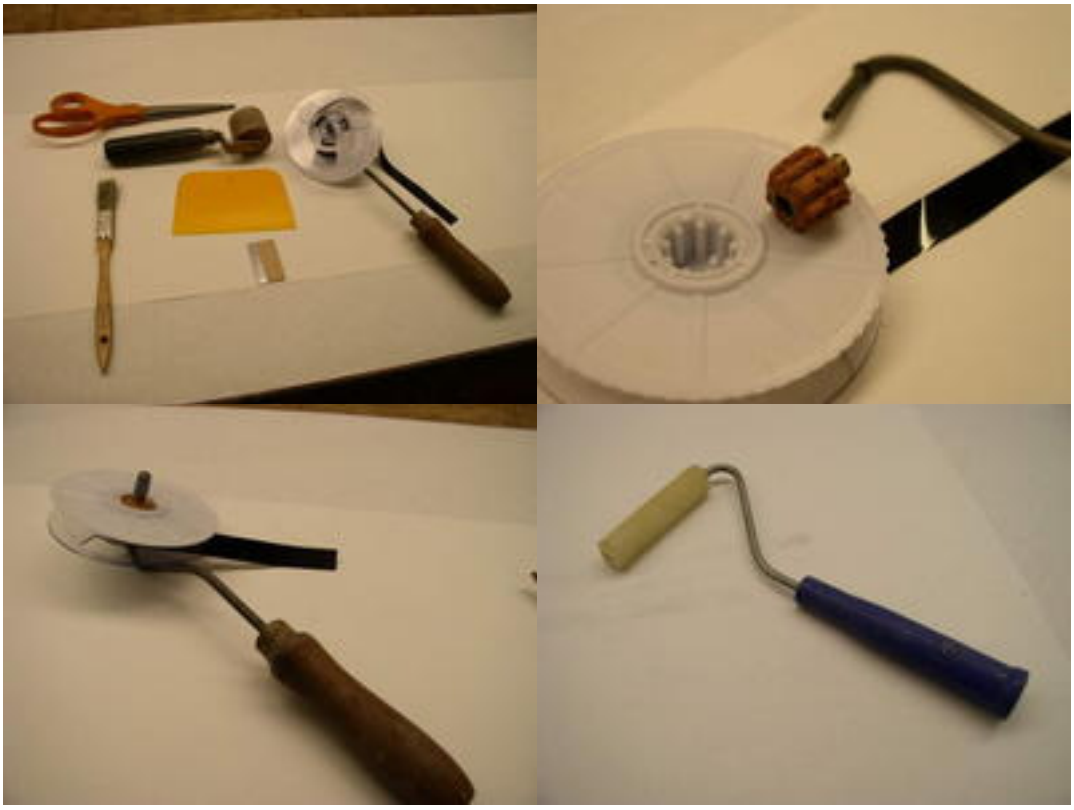
1. 1/2" Brush
2. 4" Squeegee
3. Video Tape & Holder
4. Razor Blade
5. Scissors
6. Hard Roller (optional)
7. Petroleum Jelly (shown later)

No, you do not need mylar, bleeder cloth, heat shrink tubing, strapping tape, clamps or any other item you have read about.

I made the handle for the Video tape from a roller that is used for rolling glass mat typically in mold making or whenever mat is used. They can be found at all Resin & Fiberglass supply shops. You can be creative with this and Im sure there are many ways to do it.

That ugly brown blob is the insert for the tape. Find the right size brass tube that fits the roller shaft. Drill a hole through the cassette. Paint in some mold release and add epoxy and filler to make the plug. This one isn't pretty but it works.

The roller originally looks like the one in the last photo. They come in lots of sizes so pick a small one. They have a screw in the end so its easy to replace the tape when you run out.



Mandrel

The Mandrels I use are Carbon Golf shafts. Specifically a Wood or Driver shaft. I found a link to an early "How to thread" on the Net and they mentioned "Golfsmith" at http://www.golfsmith.com This place is huge and they always have a sale going on for shafts. I purchased the Attack Lite Wood Shaft and spent $11.00 apiece for 5 a few years ago. Im sure its a lot more now. Go to the Club Making menu and shop around. Look for one that is stiff and for high speed swing. a .605" OD is perfect for 1.5 meter DLG's the Iron may be good for smaller gliders.

The shape of the shaft is straight for 6" at the big end then has a slightly tapering mid section then is straight again for about 5" for the Club Head to attach. This is good for us, the straight parts give you the ability to position the soon to be boom with different choices.

I always make the booms at 34" long to take advantage of the straight section for ballast under the wing if needed. Or you can cut it further back to have less size in the tail if needed.

Making the pattern

You need to have a template or pattern for cutting the carbon. This is very simple. You need to know how long and how wide.

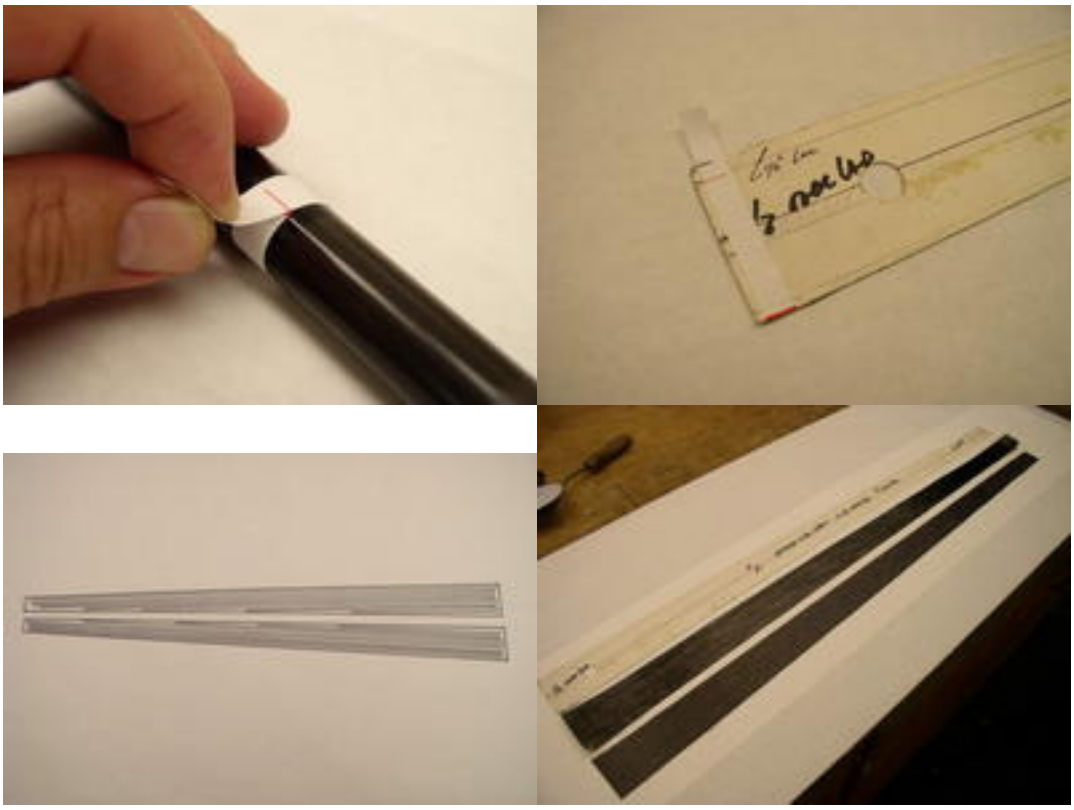
I like 34" as a standard length. This gives me extra length to play with as I mentioned and if you screw up the ends there's plenty to cut off.

I drew mine on poster board and its getting pretty beat up. To find the width for each end you can do the math or do it the simple way. A strip of paper attached to the boom, wrap it around and mark where they meet. Then add how much over lap you want. Through trial and error I have settled on just under 1/4" or 6 mm.

In the beginning I was using just 1 diameter for the inside wrap with no overlap. This was hit and miss. If you mess up the roll and the lap does not meet perfectly you have a weak spot. So now that I have it mastered I use the same overlap for both inside and outside layers. I still get the projected weight I want and it ensures I have no gaps.

The size of your over lap also dictates how much flex you want or don't want. The 6 mm lap I use has very good compression strength and should be used on the side opposite your rudder control horn. This can be seen on your bench by bending your boom with the lap on one side then the other. With your home made boom you can see the lap by taking it into some good light and it will show up. The commercial boom's, not so much.

Now you have your pattern and its time to see how you want the fibers to run. There is a straight side and a tapered side. We want the straight side on the outside of the wrap and the short fibers on the inside when its rolled.
The drawing tells it very plainly.



Carbon & Glass

The Carbon I have settled on is a unidirectional with a web like binder on it. This stuff is affordable and available. I like it because the binder is soft and it will conform nicely with out distorting the finish like a thread binder. I use this on the outside.

It is carried by all supply houses as far as I know. There is a conflict of information on both CST and ACP so Im not sure what to recommend for you. My carbon measures .006" thick x 12 " wide. I don't remember what the weight is listed at.
Aerospace Composites list it at 3.7 oz at .006 http://www.acpsales.com
CST list it at 4.7 oz at .006 http://www.cstsales.com
So your on your own. I think that the .006 is the main issue here.

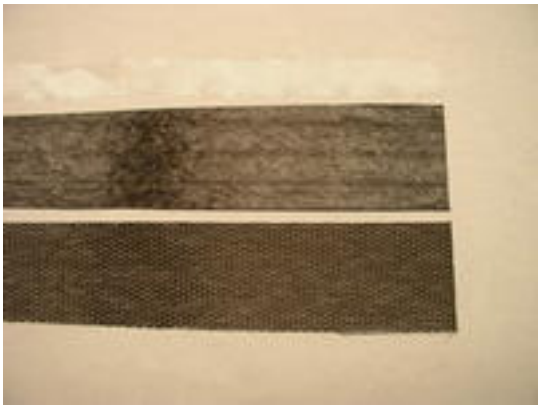
The inside layer is what is known in the model industry as 8020. This is what Phil Barnes has been using for many years in his wings.

I purchased some yardage of the "8020" style from Aerospace Composites a few years ago. I just went to their site to get the info for you guys and it is not listed any more. This is a bummer because the stock they had was really good. I believe it was listed as 4 oz but I think it was heavier than that. The roll of 4.1 oz 8020 from Carbcom I have in stock is not as thick so this leads me to believe it was closer to 5 oz in actual weight and the carbon was more tightly spaced. I believe that I remember hearing that Phil may have some heavier 8020 which would work very well for booms. I may also have a roll here in Hawaii I heard about left over from the sailboard days. I'll check on that. If I find it I will

offer yardage for sale.

So the big deal on this cloth is that the fill on it is S Glass. This gives really good Hoop strength or Squeeze strength to the boom. Also if the boom cracks it will not spread like it was just Uni on the inside.

To hold the two Carbons together I use a 3/4" wide strip of .75 oz E Glass. Any old type will do. This does not add any strength. Its only to make sure the carbon does not split apart when rolling. You do not want this as an outside layer because it will show up and be real ugly for the finish. And you will only be adding more weight. I cut it on a 0-90 deg usually so it does not distort while handling. But the strands can go all over. On a 45 deg there's no strands but it can distort in a flash while you brush it on the carbon. Either way is fine. Theres no strength benefit so up to you.



The 8020 carbon has to be cut with the straight side up as in the photo. The reason is that it is upside down for the next step. It needs to be attached to a paper carrier sheet to keep it under control. With out it you don't stand a chance. I lay out enough 8020 (716) to do at least 10 booms. Get the fibers straight then mist with Spray 77 and lay the paper right on it and smooth out. Then cut your pieces out as you need them. The Webbed carbon can be cut in any orientation because it can be flipped over. No need for a carrier sheet.

I have to admit that the sequence of how the carbon is prepared prior to rolling is a bit odd. This has been a while in development to get it down so Im going to go step by step and it is in sequence so bear with me.

On the bench I have 1 sheet of butcher paper down. It comes on a large roll and you can find it at Costco. Really great for resin work. Anyway, then I take a second piece and fold it in half with a mist of Spray 77 so it doesn't ripple up as you squeegee the carbon. The webbed carbon is on top and the 8020 below. I like to mark the paper so I know how far to brush the resin.

Now the mandrel is pushed on the drill insert. Masking tape is used for a friction fit. Just twist and push, if its to hard remove some tape until you get a good fit. you will have to drill out the end of the shaft for the rear pin to fit. Don't make the hole to tight or too big so it flops around on you or is binding.

Taping the mandrel

With the mandrel in the fixtures its time to apply the "Vaseline, Petroleum Jelly" what ever. I waxed my mandrels at first and it doesn't hurt to do it and in fact its a good idea until you get the process down. The "Stuff" does not prevent the epoxy from sticking to the mandrel as wax does. It acts as a barrier, but if you do not have enough to actually squeeze into all the gaps in the tape you can have problems. Thats why you will see how much I use. I have stuck a lot of booms and had a very hard time getting some off and did have to cut some off because of not using enough.

I just eye ball where to put the stuff. Leave ample room at the ends so your masking tape can stick.

Reach in and grab a blob, turn the motor on and run your fingers up and down the mandrel making sure there's plenty of coverage. In the photos you can get an estimate of how much. Get the stuff even all the way down and turn off the motor. Then take a paper towel and lightly smooth all the spirals down. Not really taking much off, just a light pass turning the mandrel as you need it by hand. The last photo shows it finished. Nice and even all the way down. This takes practice and you will know if there's too much.

Take your tape holder and hold it so you are using the INSIDE SURFACE UP This is the release side. If you cannot remove the tape from the outside or inside its because you did not use the correct side.

Its easier to just look at the roll before you start. I have to really focus when Im doing a

batch of 5. Don't worry about what side is dull or shiny. Just think about the " **INSIDE SURFACE**".

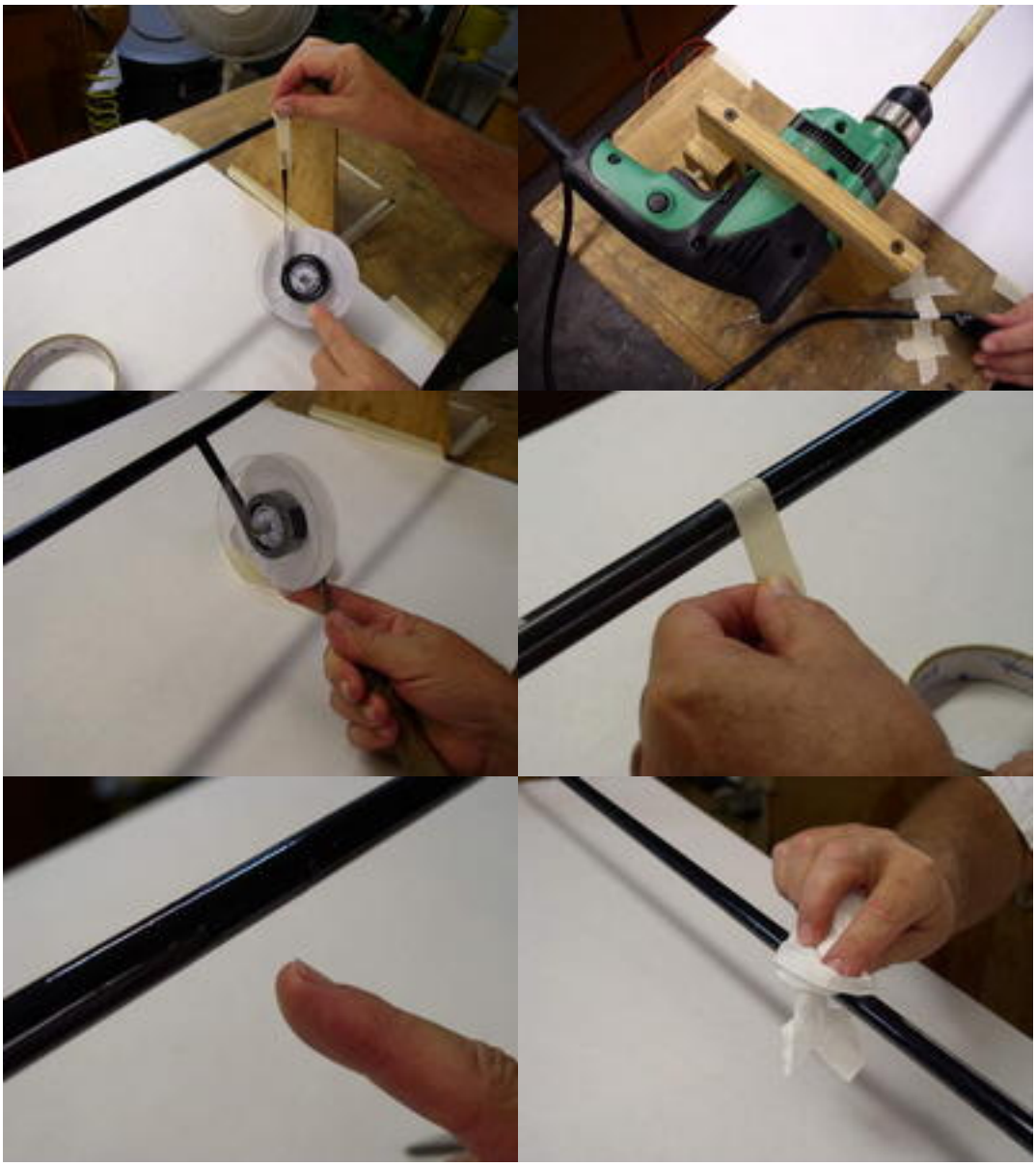
Turn the motor on to check that it is turning the right speed. Now this is hard to tell you what the speed should be. Too slow and the motor will bog down under tension and take too long. Also you will not be using very much tension for this wrap of tape. You do not want to squeeze all the Vaseline out. Too fast and it can get away from you.

Add a piece of masking tape to the end of the video tape and wrap it a full turn. Remember no Vaseline where you need to stick tape.

Reach over and start the motor. As you start, try and move smoothly as you go down the boom applying a little pressure to the wheel with your finger, this sets your tension. Try to overlap each turn by 1/2 the width of the video tape. Like all things this takes practice. You should have a piece of masking tape cut and ready at the end with a pair of scissors to cut the video tape.

Stop the motor and keep the tension on the tape and apply the masking tape and wrap it around the mandrel.

You should see a slight squeeze out of Vaseline and I mean hardly any. Photo of my finger pointing. If there's a lot you either pulled too hard or you have to much Stuff on the mandrel. Wipe it down with a paper towel.



Remove the mandrel and set it on the rolling area between the fixtures. I have found that it is best to roll the tape on just before your ready to do your carbon. The video tape will loosen if left for any more than 30 minutes. So don't think you will get ahead of the game by doing all the mandrels at once. Take your Video tape handle and use the **INSIDE SURFACE** down this time and add the masking tape piece to the end and stick it on the end fixture somewhere with the handle ready to use. You really don't want to try and do this with gloves on. You'll see what I mean when you try.

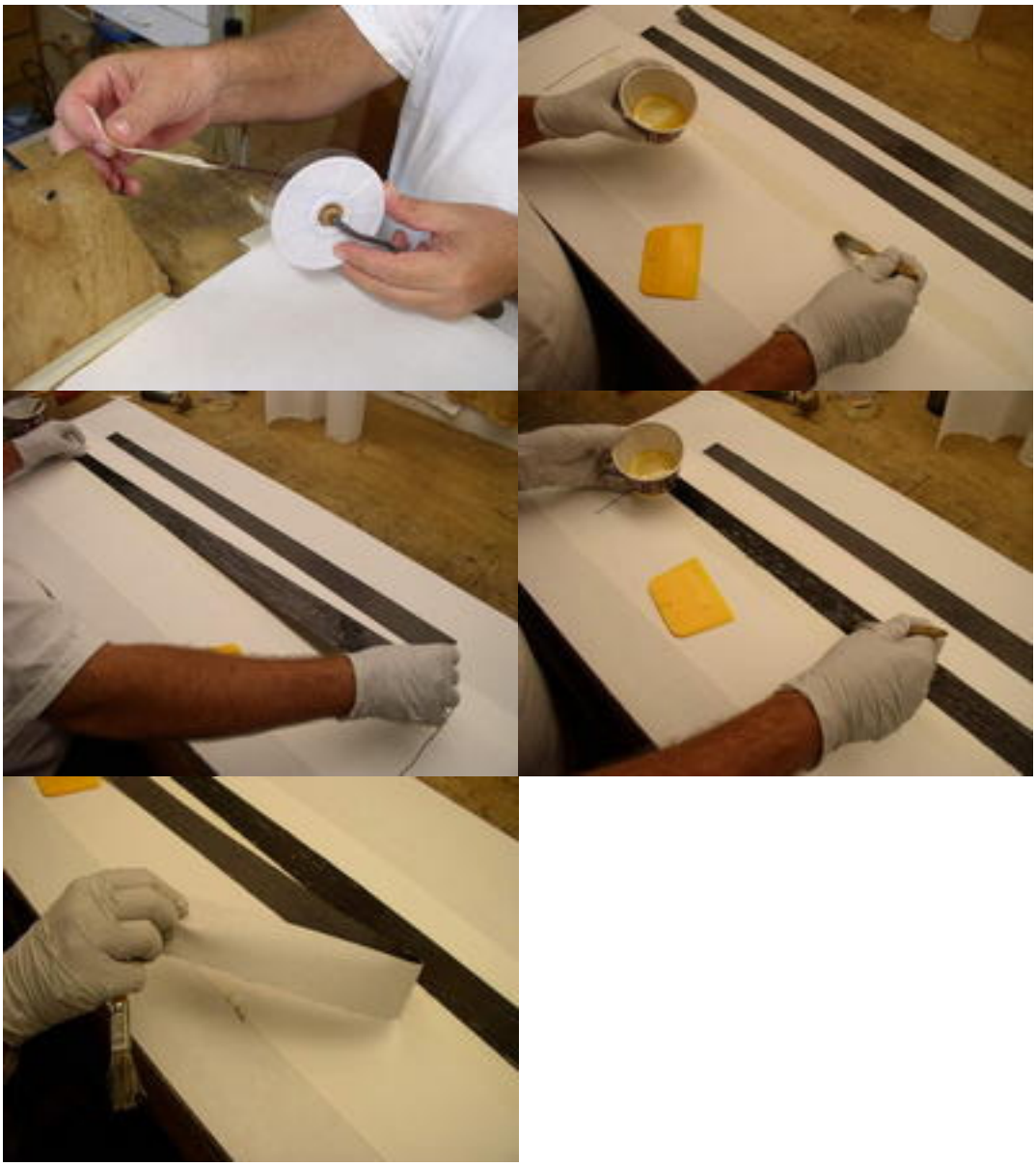
Now I need to talk about resin and the squeegee. Most of you guys think the foam roller is the way to apply resin like on bagged wings. This time its best to not use one. Just use a brush to saturate the carbon. The good old squeegee is the tool for helping saturate the carbon after the brush.

Now Pay Attention: You do not remove all the resin. For any composite structure to achieve maximum strength you have to have the right amount of resin to fiber content. Drying all the resin out makes a week boom. True it is light, but week. Using the squeegee in ever increasing passes moves the resin from one end to the other and makes sure you have good saturation and on the final passes you have removed all the resin you need to.

Please use a Squeegee. You can get them at any Auto Parts shop or resin supply house. Napa sells a packet of different sizes and they are a brownish color. Do Not Use a Credit Card. You need the tapered edge and the flex of the plastic to be effective. I use the yellow ones on all my glass work even on my wings after I use the foam roller. Nothing has as good of resin control as the squeegee.

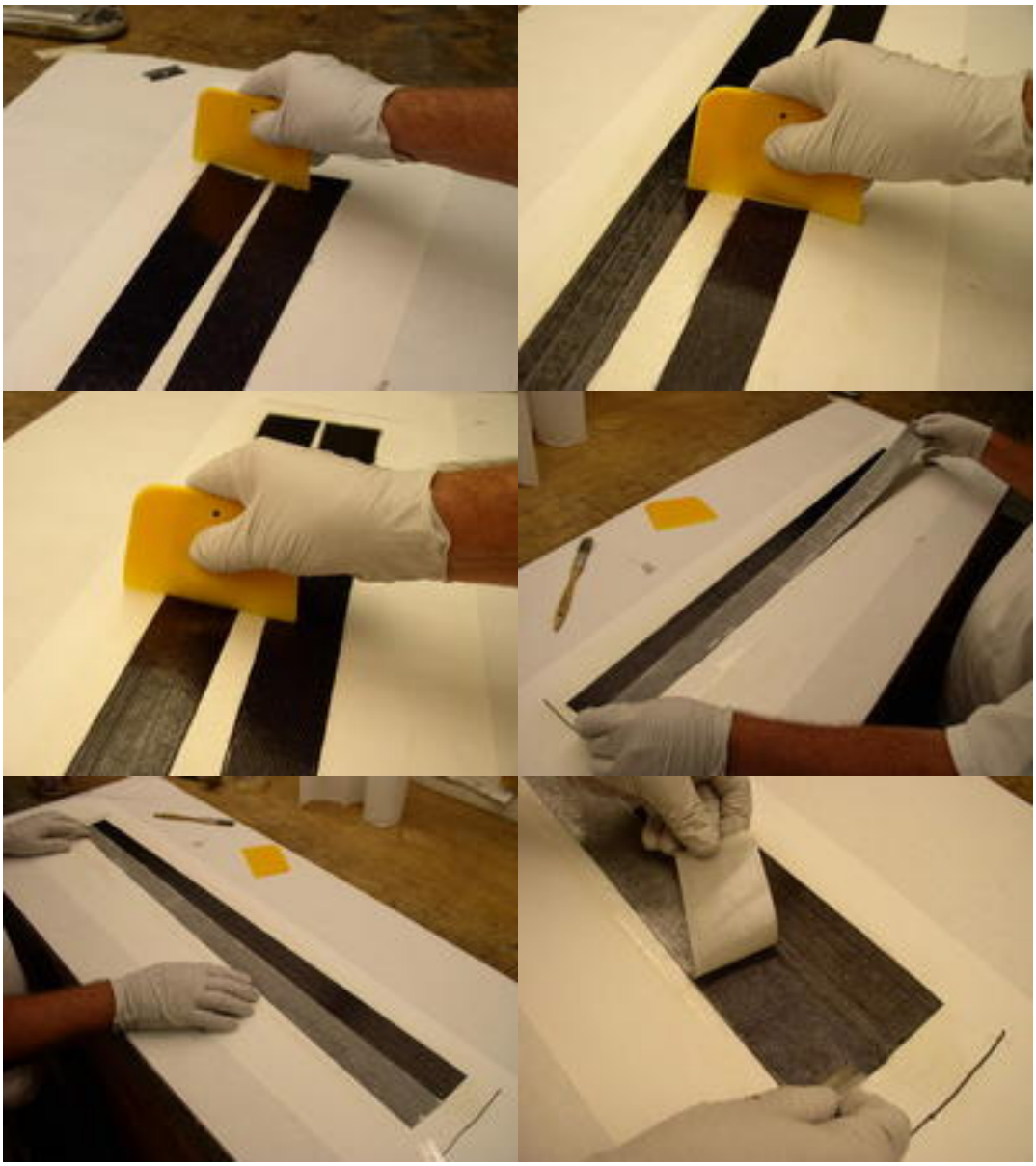
OK, back to the show.

Paint a strip of epoxy the length and width of the Webbed Carbon on the paper. This is to help it saturate from the bottom up. This stuff is double layered and it takes some time to saturate. Brush an ample amount of epoxy on the top and let sit as you start the 8020 with the paper backing.
Brush epoxy straight on to the top and use a lot working it into the weave. It will saturate much faster. Remember to have the straight fibers on the top of the webbed carbon and the 8020 fibers are straight on top as well at this point. (its upside down remember).



Now that the carbons are floating in resin start dragging the squeegee from the big end to the small end. You will have a large bead of resin in front of the squeegee. Pick the resin up at the end of your pass and drop it back down at the big end again. Do this 2 or 3 times for both carbons. Then on each pass wipe the resin back into the cup. Keep adding a little more pressure until there is hardly any resin in front of the squeegee. You can remove too much if your not careful. But you really have to try.

Flip the 8020 over and position it butting up to the top carbon and remove the paper. The carbon is now in the correct position with the straight fibers on the outside and tapered sides in the middle.



You can check to see how your squeegee job is by hard rolling with a paper towel. If its still too wet it will soak into the towel. If its too dry you will get none at all. You can just see a tiny bit in the towel which is perfect.

Now add a small amount of resin down the center to stick the .75 oz to. Once its down, stipple it (dabbing the brush) don't brush it. Just enough so it gets filled. No extra resin. If its too wet the joint may split apart when rolling or the same can happen if its too dry.

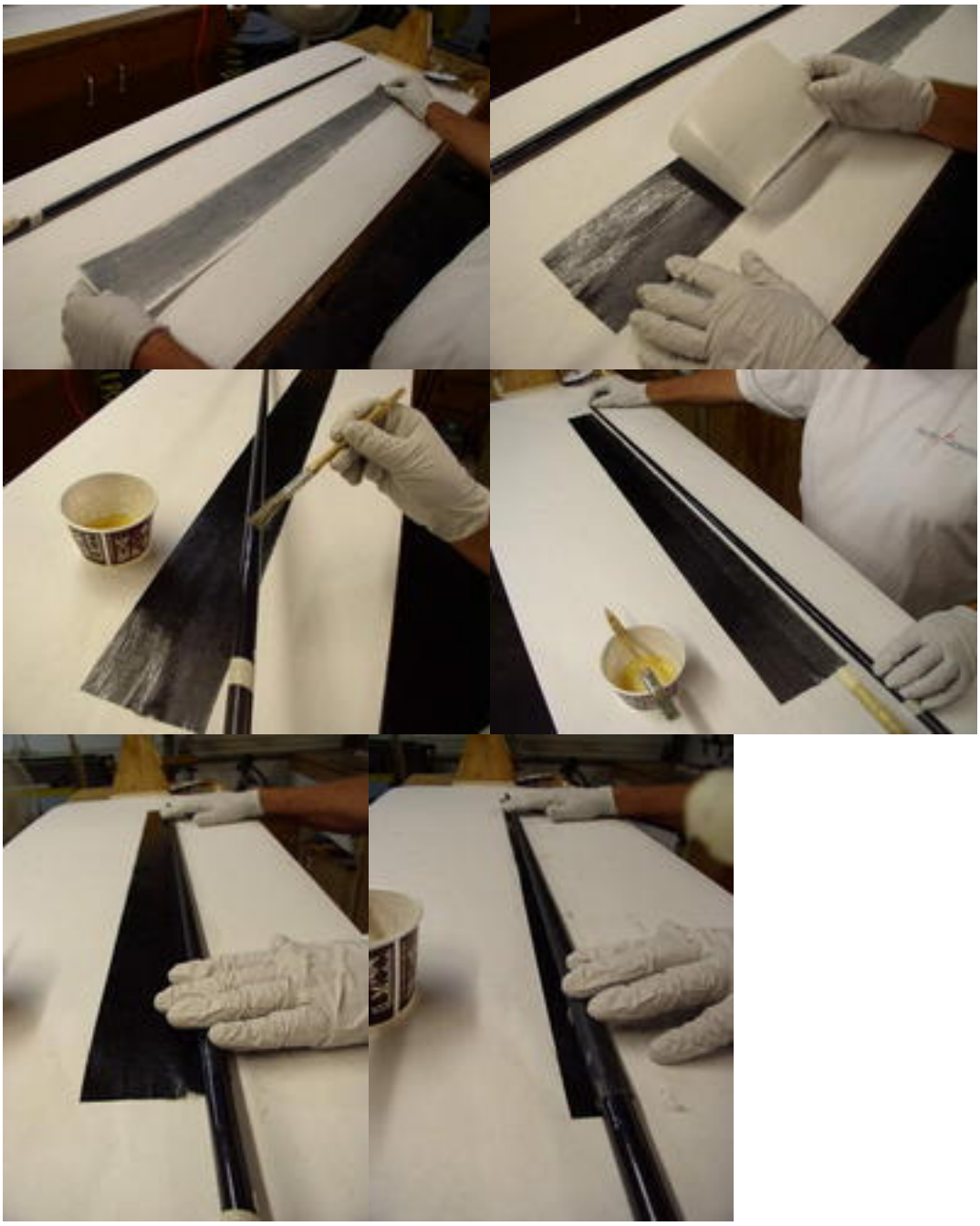
Cut around the out side with the razor blade and lift it free from the other paper. This is the outside of the carbon when rolling.

Rolling the Carbon

Move the sheet with the carbon on it to the rolling area. Flip it over and remove the paper. The carbon is now quite dry and will not stick to the new paper. This is a good thing because it will be much easier to roll.

The 8020 or your inside wrap is now in position at the bottom. Take some resin on your brush and dab a line down the top of the boom. Keep it straight.
Position the mandrel just off the carbon with the resin ready to meet the carbon when you start the roll. Be very straight on your line up. Roll the carbon up half way and make sure it is laying flat on the mandrel. Just dab it with your fingers. When its good, continue to just before the seam line, then in one smooth roll go all the way. Roll it back and forth a few times to make sure its all attached.

At this point it will not come undone and it should be stable. You may have some wrinkles but don't worry about them unless their really bad. I don't recommend unwinding it past the seam line, it will probably split apart.



Mount the mandrel in place. Turn the motor on to check the speed. You will need a little more for this step than the first. Your videotape is ready with the masking tape on it and the **INSIDE SURFACE IS DOWN**. Tape it on and hit the power switch. You can pull harder on this wrap. But not hard enough to stretch the tape. Just a firm tension on the

wheel with your finger. Keep the tension steady and move smoothly over lapping 1/3 - 1/2 the width of the tape. Your only using one hand so get ready to turn off the motor as you pass the end of the carbon. Go a couple of inches past is good. Scissors should be right there to cut the tape and a piece of masking tape ready and your done.

Just after you finish winding you will see beads of resin coming through the tape. I always find this amazing due to such a small amount left in the layup to begin with.

This is what you want to see. The beads will grow to a point then I wipe them off with

alcohol on a paper towel. It will continue to bead until the resin thickens up.

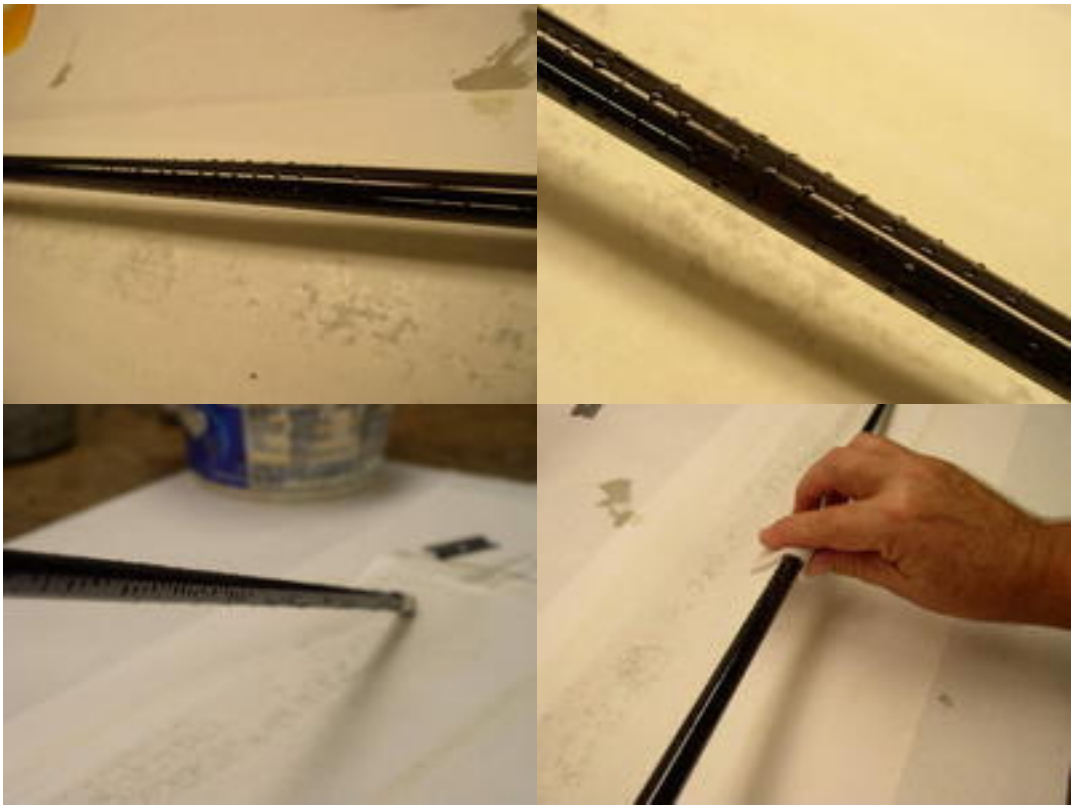
From what I have learned, the 30 min hardener has the best working time to gel time. I would be afraid that a slower hardener would allow to much resin to escape and lead to a dry lamination.

My attempts to pull real hard yielded a heavier boom due to the resin not being able to escape.

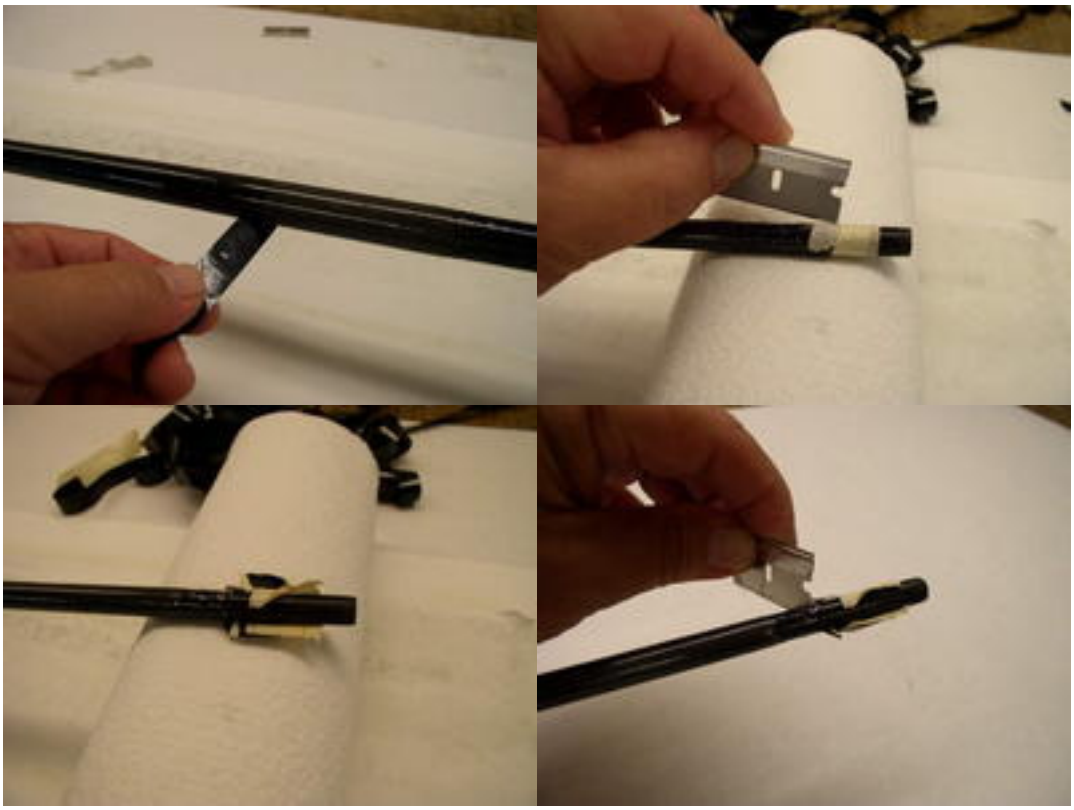
Armed with all this information Im sure you can come up with your own techniques.

For me its a proven process and has a very repeatable result. I always mix the same amount of resin in the exact same ratio. For the 34" boom I mix only 17 grms. of resin total. This is the perfect amount for me and just enough to complete the job.

When trimmed to 32" for a standard length they weigh 16 - 16.8 grms. time after time. So you should be looking at 16 - 17 grms as a good durable boom. Under 16 grm and I would not put them in a kit but possibly use them for a personal model.

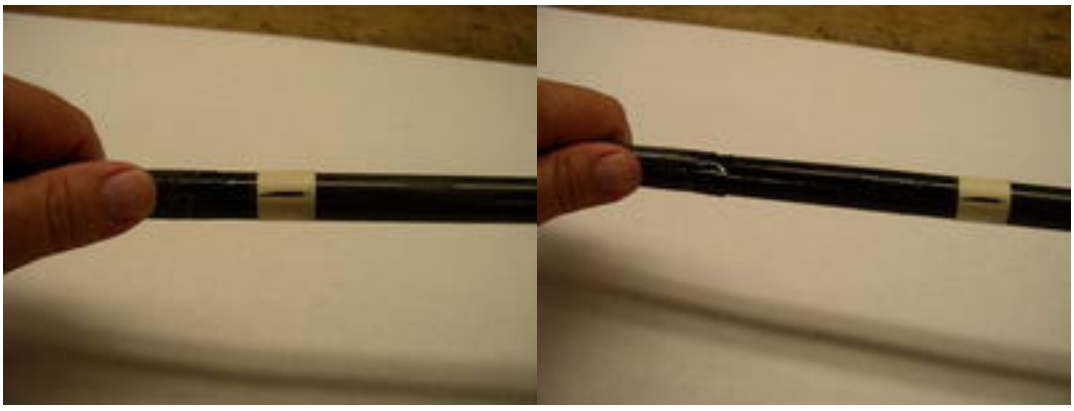


After letting sit overnight you can remove the tape. Be careful as you get to the resin because the tape can tear very easily. Once its started it just falls off the carbon. If you have some large drops of resin cured on it, it will tear. Just restart it with an Exacto blade. When you get to the end use a blade and cut through both layers of tape. Leave 1/4 " behind the carbon so you have something to grab on to to start pulling the inside tape out.



I wasn't really able to show how I twisted the mandrel. Camera in one hand and all. All it needed was a easy twist and it was loose. I placed the masking tape on the mandrel to show it moving out. Black on Black photography is not to easy. Just move it back and forth to slide it out. Make sure the tape at the small end does not get pulled inside.

Now grab that 1/4" piece sticking out the back and gently pull it out. You have to go easy so it wont break. If it does you still have the front piece to pull on.



OK, thats it. What only takes me 33 min. to do the real thing including setting up the drill and rear fixture has gone into major time telling how its done.

Its been fun and I hope you guys get some ideas out of this. My selection of carbon was through a real trial and error process. The booms are very stiff. Id say probably up to 15 % more than any commercial boom I have seen. The availability of the 8020 or 716 as its really called is in question at this time. My guess is its probably better to go with an available woven carbon of about 5 oz weight and give it a try. The Aircraft Spruce 716 that Phil Barnes mentioned may be the one were looking for. I recently went to my local supplier and tried to find the roll I was offered a while ago, Gone. The replacement 716 listed as 4.7 ounce was with E-glass instead of S. So Im not sure what will happen. If I find it again I will post it here.

The photo shows the weight of the boom in the thread.

Thanks for watching. I will still answer any questions you have.

Dave