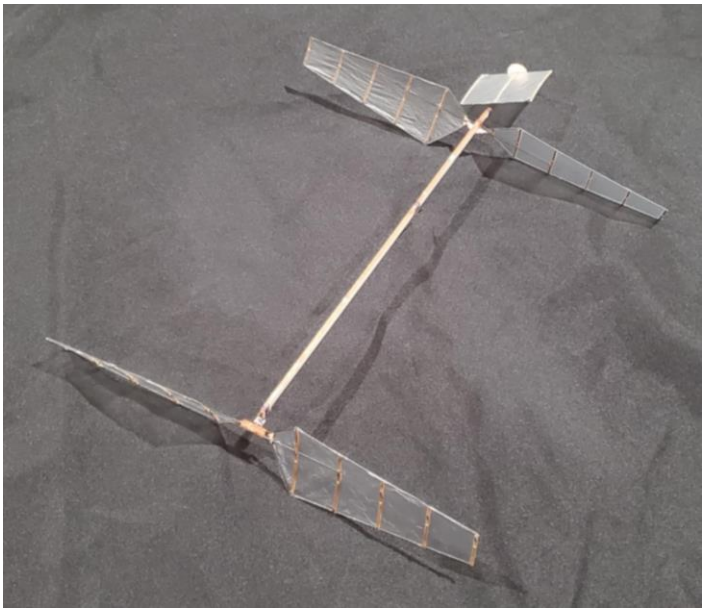
Tornado 2025
Division B/C Helicopter
Build Manual V2B

By *J&H Aerospace*

www.jhaerospace.com



A high performance helicopter legal Science Olympiad Helicopter 2025 competition

Includes materials for two complete helicopters

Tools/materials required: *rubber lubricant (son of a gun works great), winder, needle nose pliers/wire cutters, CA glue (or Duco/Ambroid/Sigment), razor blades, sandpaper, ruler, scissors. Optional: Torque meter, turns counter (volareproducts.com).*

Tornado Helicopter

J&H Aerospace

Building Instructions

Congratulations on your purchase of the Tornado helicopter! You are about to build a reliable rubber powered helicopter capable of over 1 minute flights in small gymnasiums.

1. Parts list

Before beginning construction, please verify that your kit contains all of the necessary parts listed below. Please be aware that some of the laser cut parts may have separated from their carrier sheet, so you should ensure that all of those parts are present and undamaged.

1. 0.020" piano wire, 6" long
2. 0.020"x19" carbon rods (4x)
3. 0.040"x13" carbon rods (5x)
4. Parts Sheet #1: Rotor jigs, 1/8" balsa
5. Parts Sheet #3: Motorsticks, 1/8" balsa
6. Parts Sheet #4: Ribs and caps, 1/16" balsa
7. Parts Sheet #5: Rotor hubs, 1/8" basswood
8. ¼" sq x 5" sticks (2x)
9. ¼" sq x 10" sticks (2x)
10. Veggie bag
11. 1/8"x16' rubber
12. O-rings (8x)
13. Thread binding
14. Ballast (modeling clay)
15. 0.050" heat shrink tubing. 2" long
16. Vane stopper tubing, 2" long red plastic tube, 0.045" ID
17. ~~*0.020" prop shafts (2x)*~~
18. ~~*Rotor washers (2x)*~~
19. ~~*Nose bearings (2x)*~~
20. ~~*Nose rings (2x)*~~
21. ***Red Plastic propeller units (2x)***
22. ***Teflon washer set (white plastic)***

Items 17-20 have been replaced in this kit with items 21-22 due to supply issues; the instructions reflect these changes

Flight Data Log

Entry Number	Date	CG Location	Incidence Settings	Airframe Weight	Initial Rubber Length	Turns	Torque	Backoff Turns	Climb Height	Flight Time	Turns Remaining	Comments/Adjustments
1												
2												
3												
4												
5												
6												
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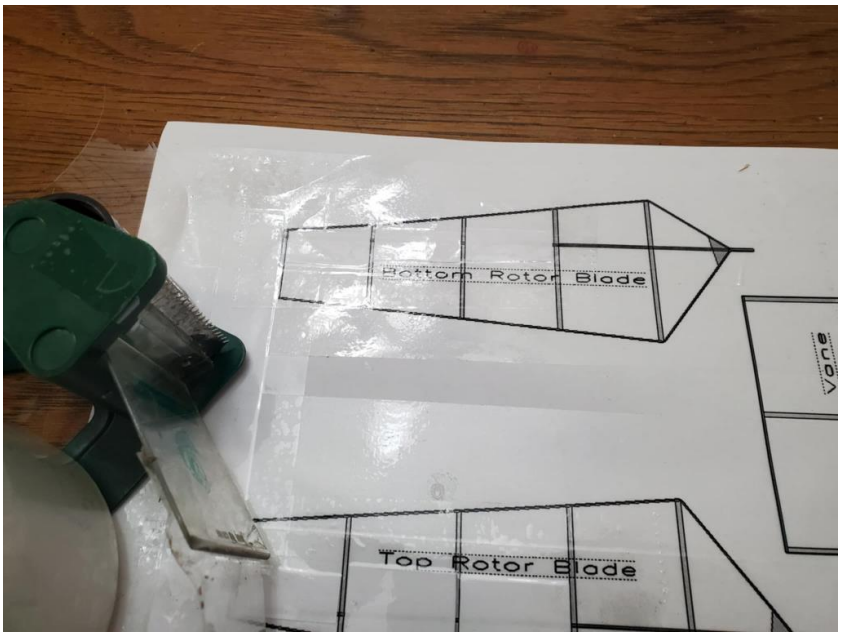
Before beginning construction, be sure to verify that you have all of the recommended tools for building your Tornado. Also be sure to verify that all parts are present in the kit. If anything has been damaged in shipping, please contact us IMMEDIATELY to get those issues resolved. Occasionally a component will be missing or different from what's shown in the instructions. Please contact us for that as well. Sometimes minor changes are made during the production life of a model, so most confusion is simply related to these changes.

DO NOT separate all the parts out of your parts sheets. Only separate parts out as you actually need them so that they don't get damaged or lost.

The kit documentation sheets include patterns for the rotor blades and stabilizer vane. These are used to correctly align and assemble the helicopter components

Lay down packing tape over the leading and trailing edges on the plans to make a non-stick surface. If you are working on a table, you can actually overlap the tape over the edges of the plan to secure it to the table, which will make construction much easier.

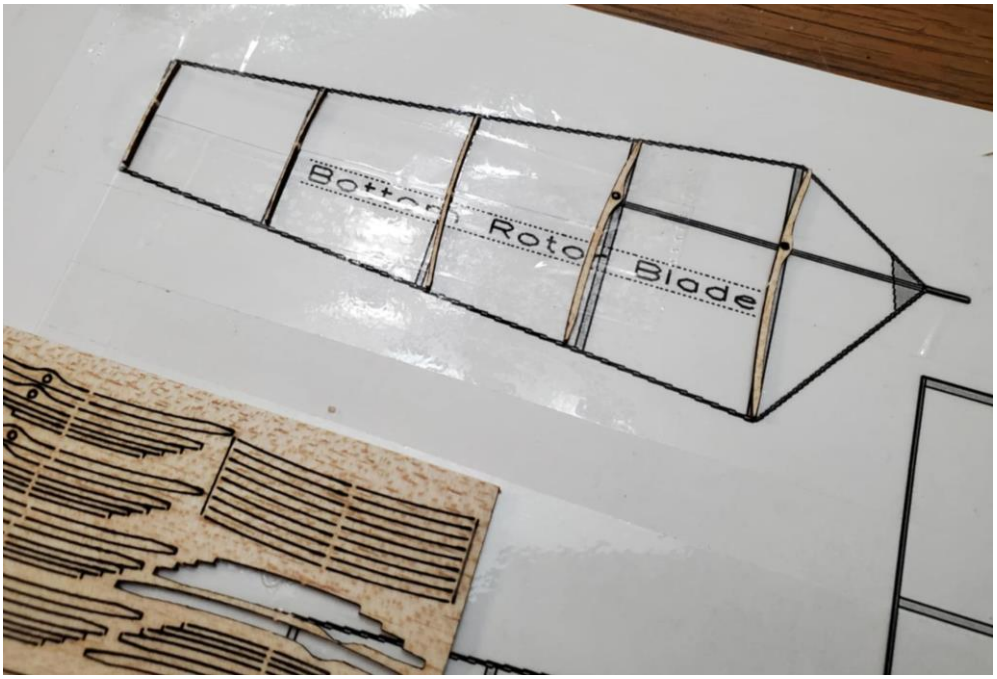


Warning: the patterns are labeled Top and Bottom for the rotor blades. You will need to build two (2) top blades and two (2) bottom blades. If you fail to follow this process, your helicopter WILL NOT FLY. Such mistakes will require you to purchase additional parts to produce a flyable helicopter.

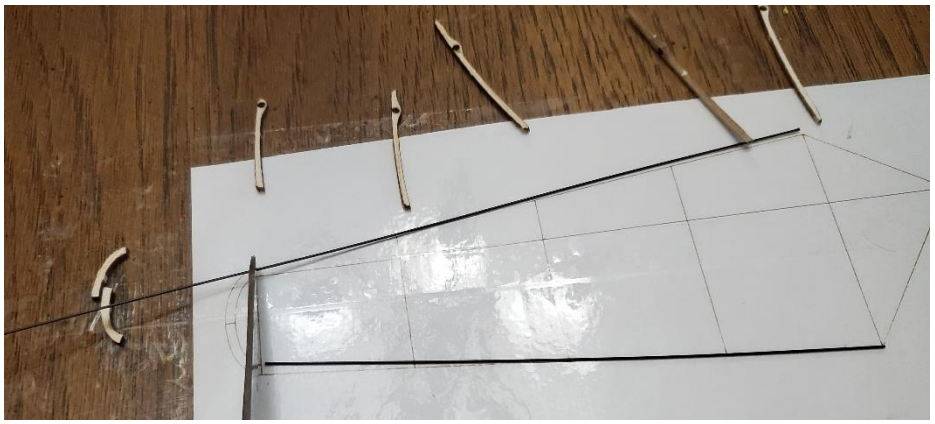
The photos below document the assembly of a BOTTOM rotor blade.

Use a razor blade to carefully separate a set of wing ribs (the larger and more curved ribs) from the 1/16" parts sheet. Be careful because the ribs are quite fragile.

Lay out the ribs, in order, for the rotor blade, as well as the optional curved tip (the curved tips are included for experimentation and are not necessary for a flyable helicopter)

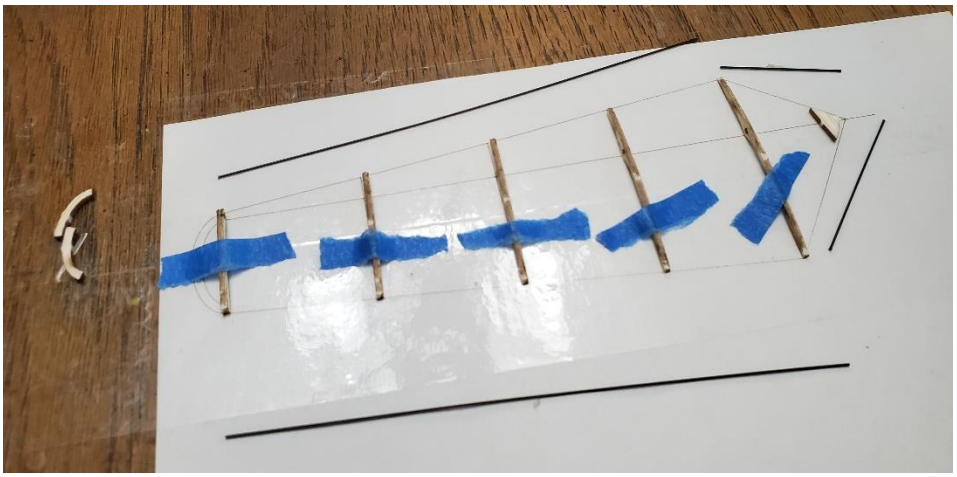


Lay in place one of the 0.020” carbon rods (these are the thin rods). Use scissors or wire cutters to trim the other end of the carbon rod. DO NOT throw away the excess carbon—you will need it later!

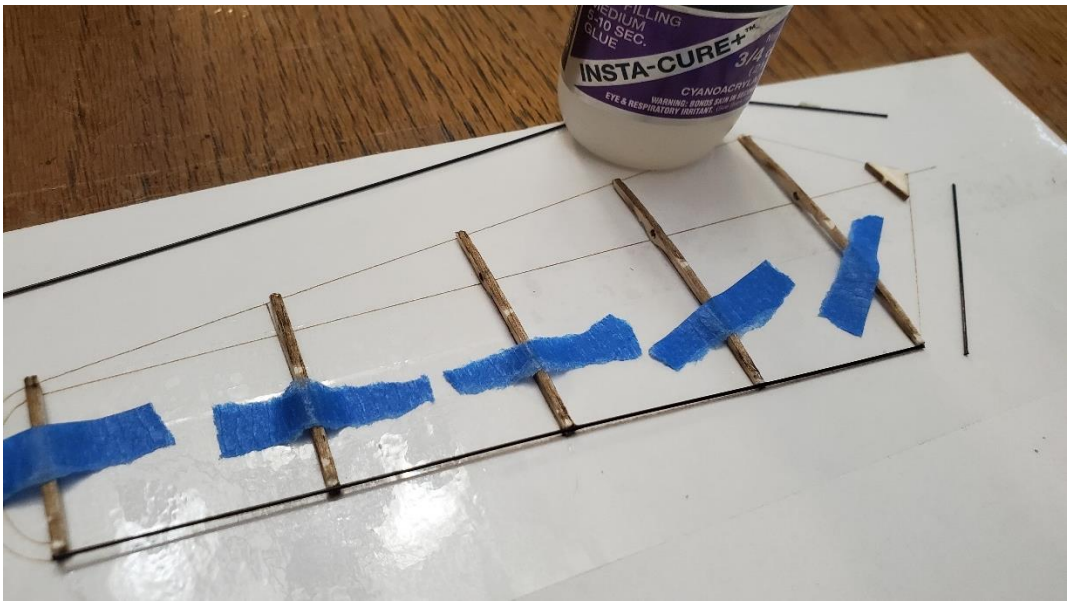


Continue cutting carbon rods to size until you have all four (4) of the outline parts as shown.

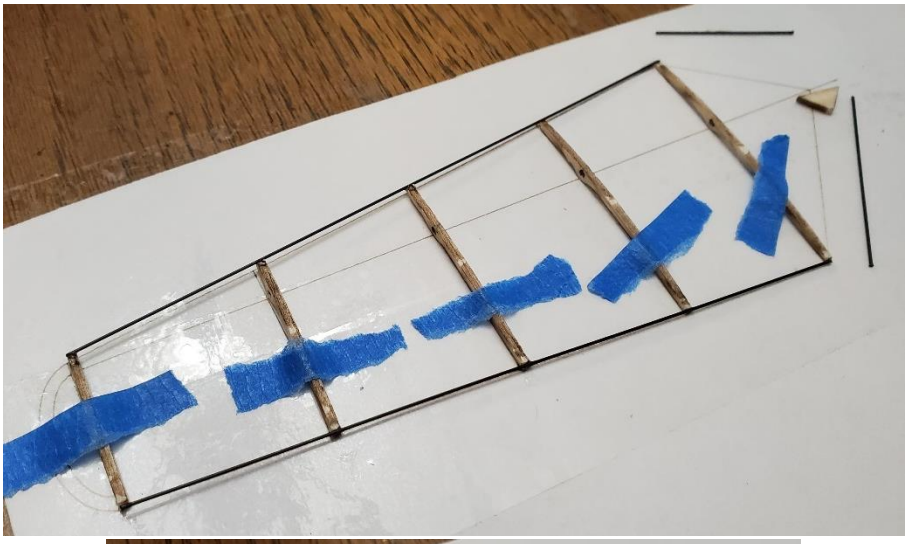
Gently tape the ribs in place over the template using masking tape or scotch tape, being careful not to crush or break the ribs (the tip ribs are particularly fragile!).

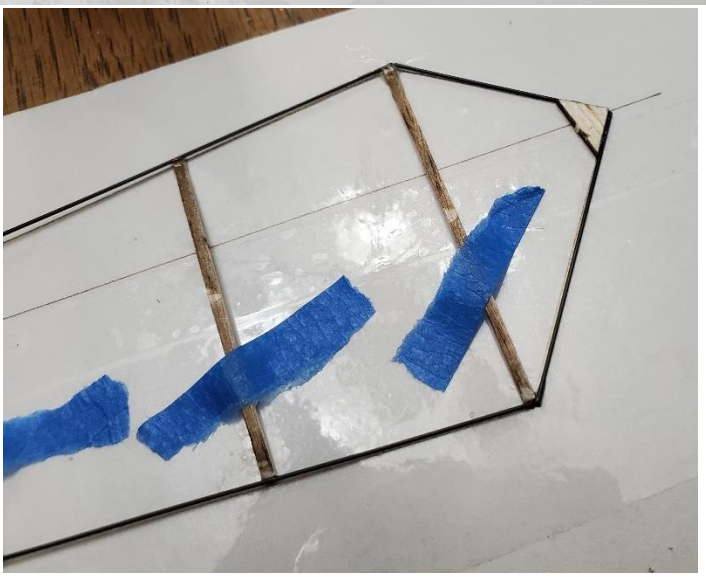


Glue the ribs to the carbon outline. Take your time to try to get them aligned as closely as possible over the rib marks on the template.



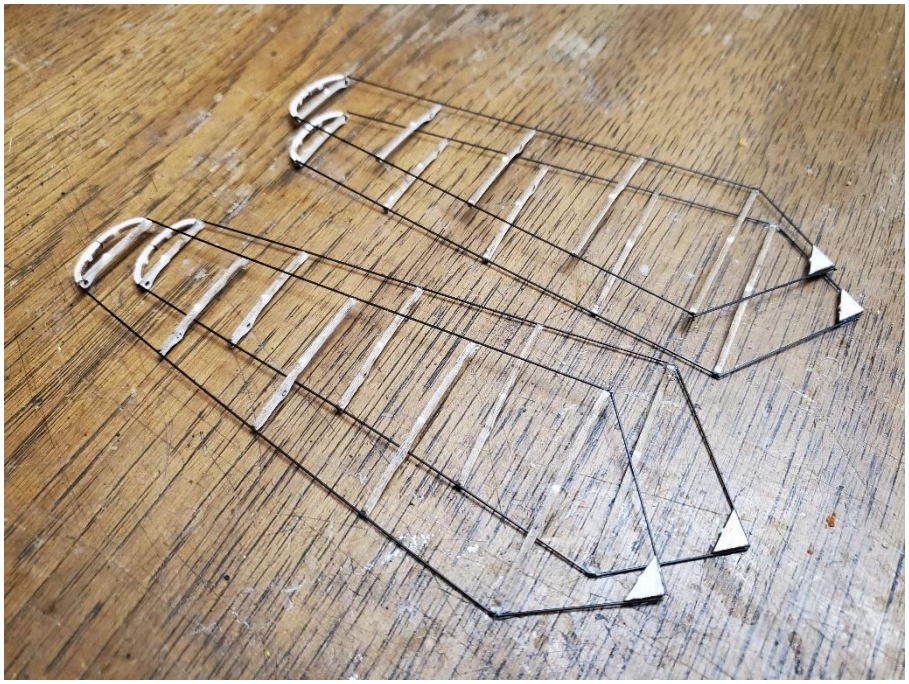
Continue attaching the carbon outlines as shown. Note that the triangular gusset at the root end of the blade is used to reinforce that joint.



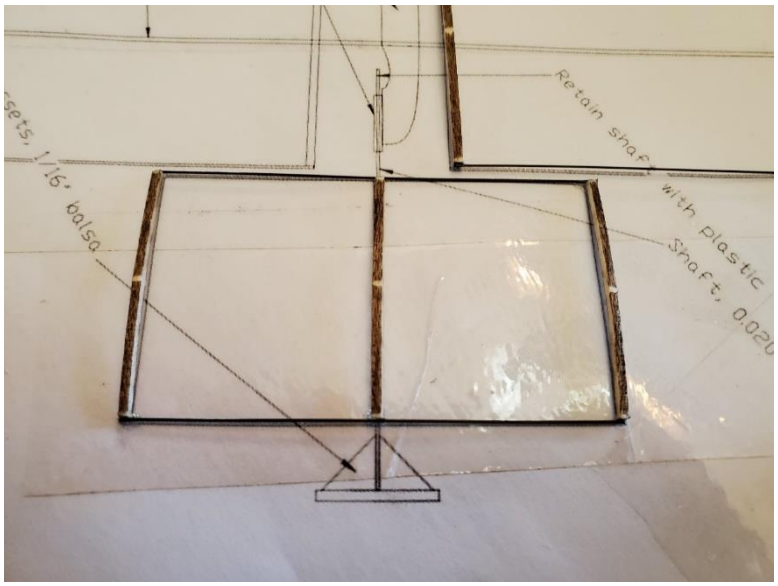


You can now remove the tape strips and carefully remove the blade from the plans.

Repeat the above steps to finish **a second bottom rotor** blade. The use the **top rotor template** to build **two top rotor blades**.



Use the same procedures to build the **Rotor Vane** using the rotor vane ribs, 0.020” carbon rods, and rotor vane template.



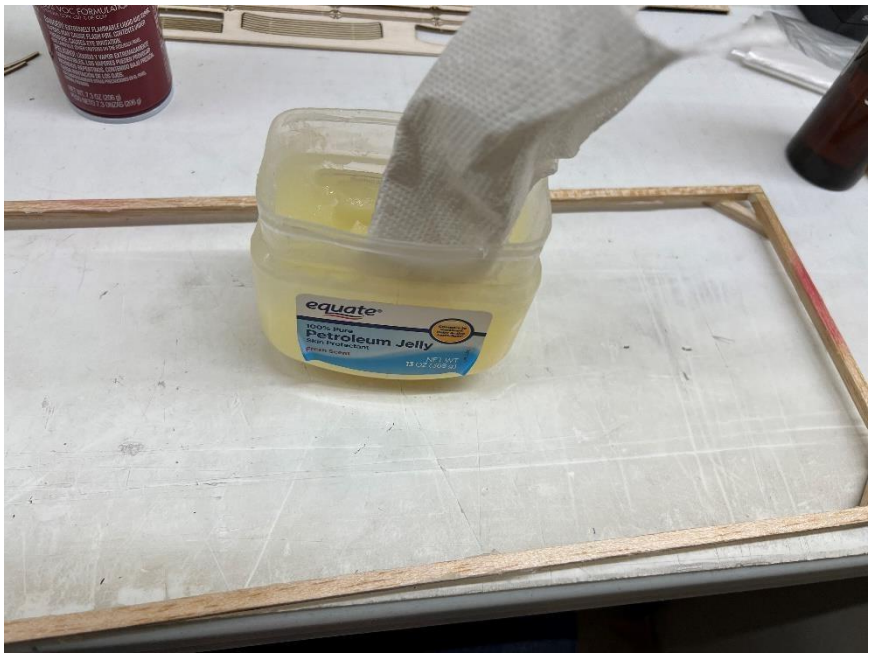
You now have complete structures for the rotor blades and vane.

The large ¼” square sticks are used to make your covering frame. Glue them firmly together to form a rectangular frame as shown.

You will need 3M-77 spray adhesive to cover your wing and tail. Get it out and have it handy. Plan ahead—you do not want to use this product indoors because it will make everything around you extremely sticky!

You need petroleum jelly/vaseline to make the covering frame stick to the veggie bag plastic. This method allows you to reposition the covering so that it can be applied neatly to the flying surfaces.

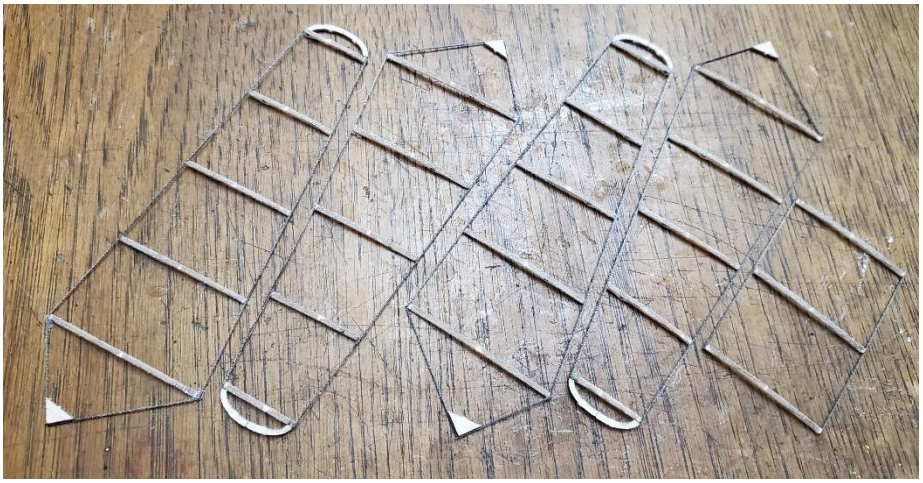
We recommend using a paper towel to smear the Vaseline onto the frame so you can limit the travel of this material. DO NOT get Vaseline/petroleum jelly near any of the rubber bands or strip in your airplane because it will destroy those materials. Also it is best to do this over an alternate workspace that you won't be using for the rest of the build.



Cut out a piece of veggie bag a bit larger than your covering frame. Make sure it is going to be large enough to have about 2 inches of excess on all sides before cutting it out and wasting covering material. You have plenty of extra covering material, so if you don't get it right the first time, try again. Take the piece of covering and wad it up tightly into a ball. Flatten the covering out BY HAND on a clean, flat surface. Now wad it up again. This time, flatten it out fully and completely, again by hand only, and get it as smooth as your hands can get it. Do not try attempt to iron it flat or use any other method than simply smoothing it out with your hands. Take your time to get it right. Once the film is smoothed out (it will now have a crinkled appearance and texture), lower your covering frame, Vaseline side down, onto the covering, and press it down all around to get it to attach to the covering. Now lift the frame-covering assembly off, flip it over, and tension out any wrinkles or excess slack to get the covering as smooth as possible (again, the crinkled texture is good, don't try to get rid of it, and never attempt to heat shrink the film).

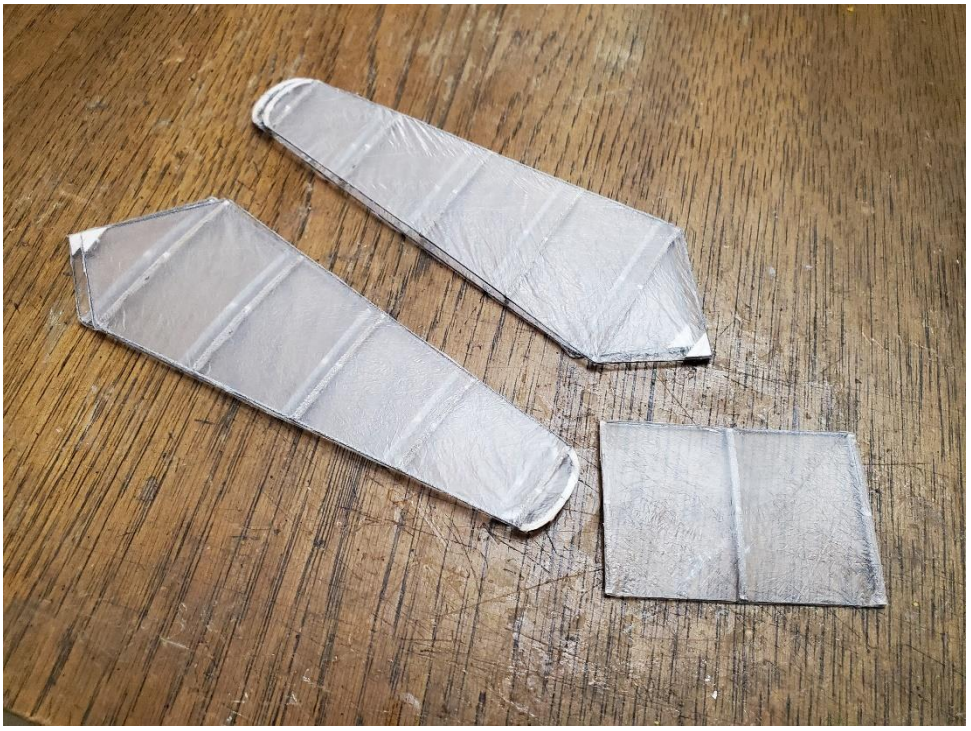
Take your rotor blades and vane outside, or into a spray booth, and spray the convex curved rib side of each with 3M Super 77. This will make them extremely sticky—be careful! It is very easy to damage the parts once they have been sprayed because they will stick to your hands and get damaged if you don't carefully disengage your hands from them. Arrange the parts so they will fit within the bounds of the covering frame.

The rounded blade tips shown below are no longer used.



Lay the parts, adhesive side up, onto a smooth, flat surface. Carefully lower the covering frame, covering side down, onto the flying surfaces. Then gently run your finger around the outlines of the wing and tail to press the film into contact with the parts. Be careful to press very, very gently so that you do not damage the fragile ribs!

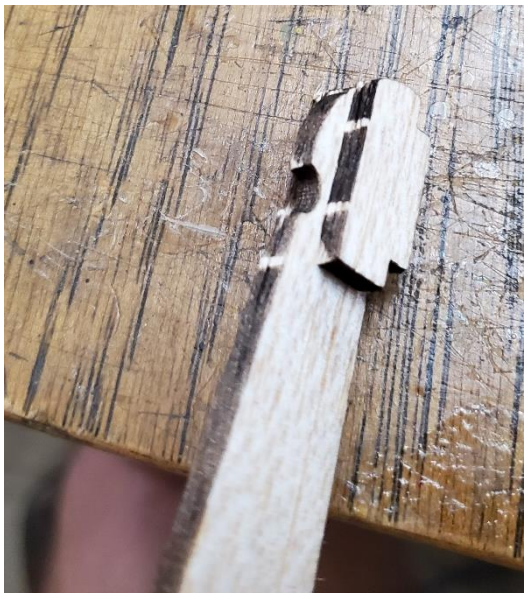
Use an electric cautery (available from indoorffsupply.com) or brand new razor blade to cut the film around the outside of the flying surfaces. Do not leave any excess. Try to get as smooth of a trimming job as possible. Excess film waving in the air will make your model fly poorly.



It is time to assemble you rotor jigs. The orientation of these components is absolutely critical. **Failure to EXACTLY follow the orientations shown below will render your helicopter unflyable and will require purchase of a new kit!!!** Please follow the instructions so that you are not delayed by needing to get a new kit and spend unnecessary money on your flying program!

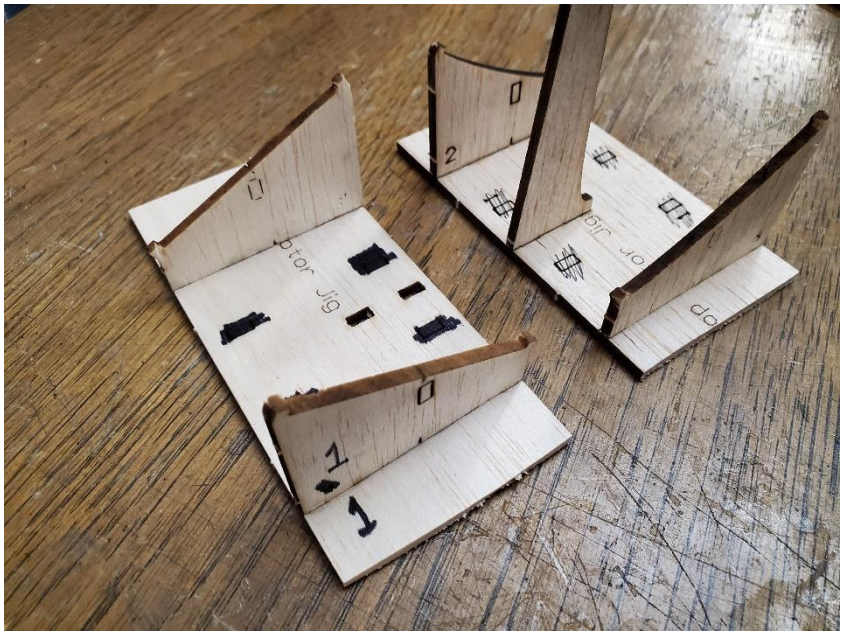
There are two trapezoidal parts with “2” labels on them. Break these out of the parts sheet and attach them to the TOP ROTOR JIG on the ENGRAVED SIDE as shown. Pay attention to the orientation show, assisted by the “2” labels lining up as shown.

Remove the **top rotor** motorstick post from the jig sheet and attach the side plates to it as shown.



Attach the **top rotor** motorstick post to the jig exactly as shown below. **This orientation is absolutely crucial!**

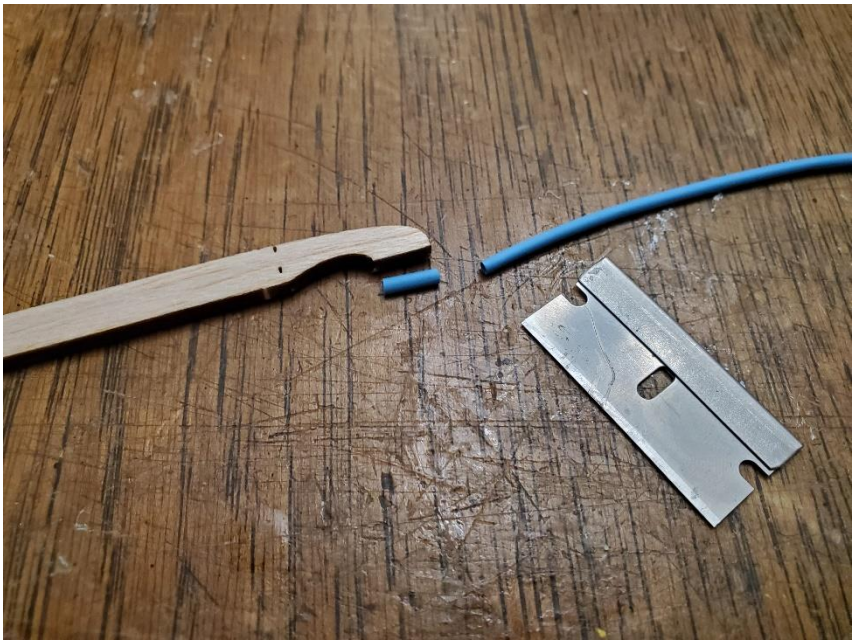
Assemble the bottom rotor jig as shown, matching up the numbers to achieve the mirror image of the top rotor jig as shown.



Assemble the **bottom rotor** motorstick post with its side plates as shown.

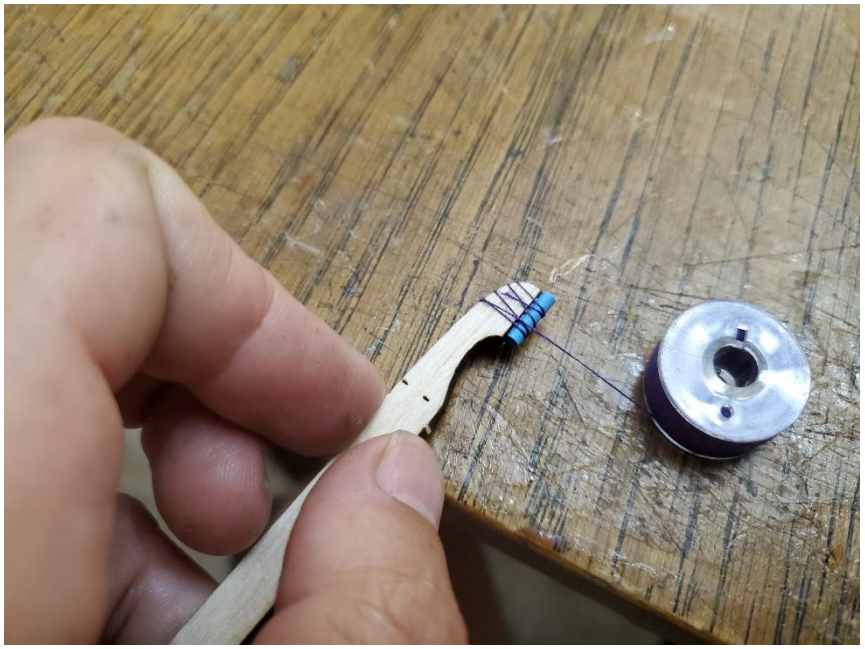
Install the **bottom motorstick post** in the **bottom rotor jig** exactly as shown below.

Remove a motorstick from its carrier sheet and cut a piece of heat shrink tubing to the length of the flat spot on the end of the motorstick as shown.



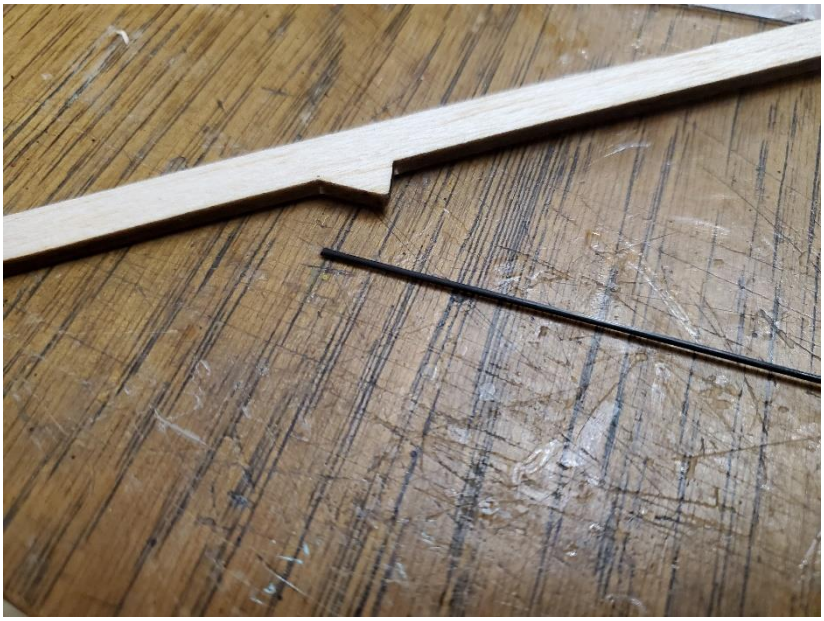
Glue the tubing in place on the flat of the motorstick (top end).

Bind the tubing in place with thread and harden the thread with glue, being careful to avoid getting any glue in side the tube.

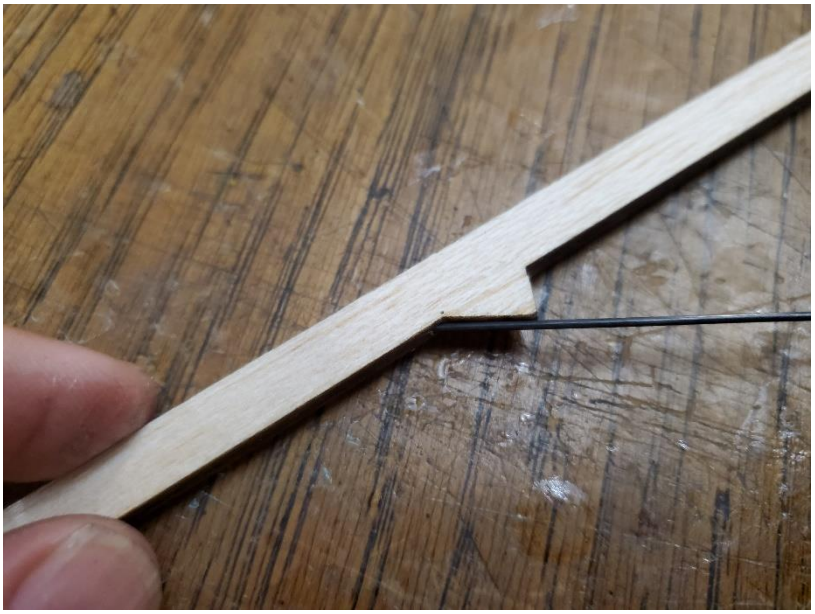


Trim off the excess thread.

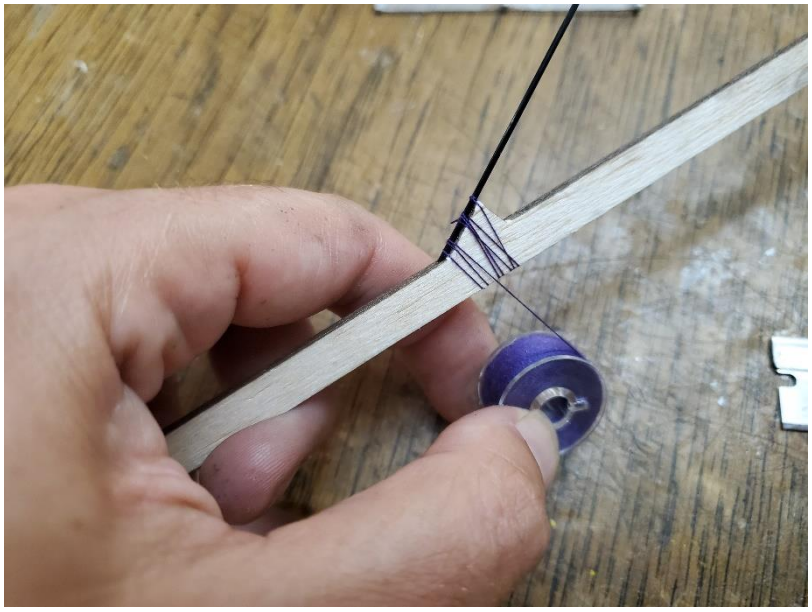
Find a piece of 0.040” carbon rod, and line it up with the triangular protrusion (called a gusset) on the motorstick.



Line the 040” carbon rod with the gusset and press it into the motorstick parallel to the face of the gusset. The rod should point upward to toward the shrink tubing end of the motorstick. Glue it firmly in place.



Bind the rod in place and harden with glue. Trim off the excess thread.

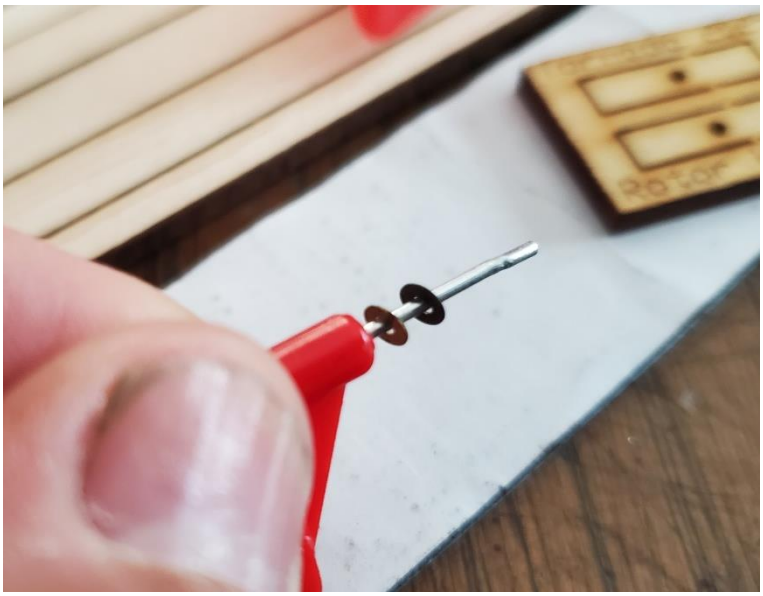


Cut off the excess carbon so that the rod sticks out about ½ inch from the gusset.

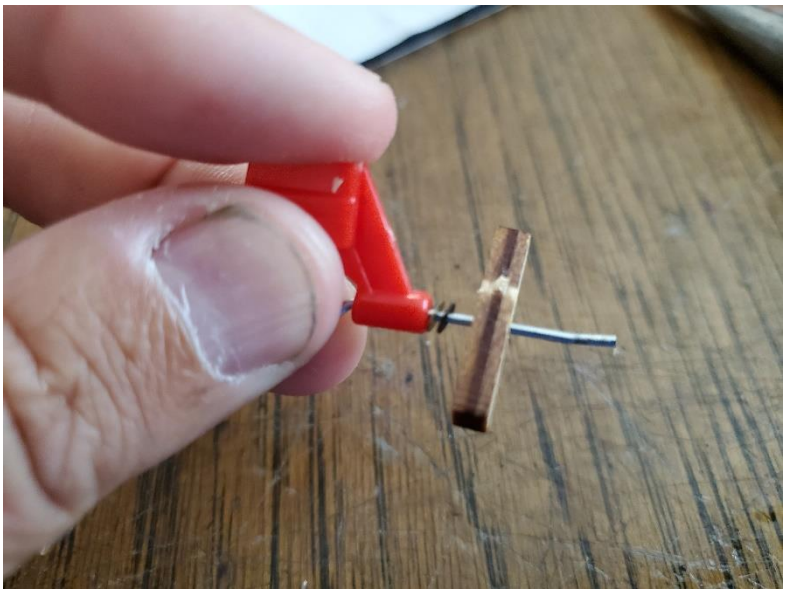
Use pliers to straighten the 90 degree retaining bend on one of the plastic propeller assemblies. If that portion of the wire breaks off, do not worry, the shaft will still be long enough.

Remove the propeller and set it aside. It cannot be used for Science Olympiad competition per the rules requiring student-built rotors.

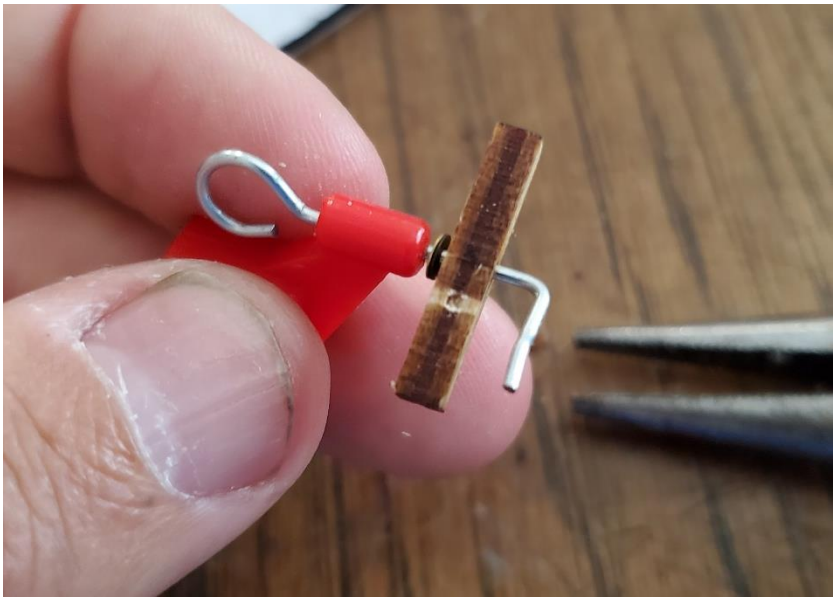
Remove three (3) of the laser cut white Teflon washers from the washer sheet and slide them onto the propeller shaft (brass washers are shown in the photos).



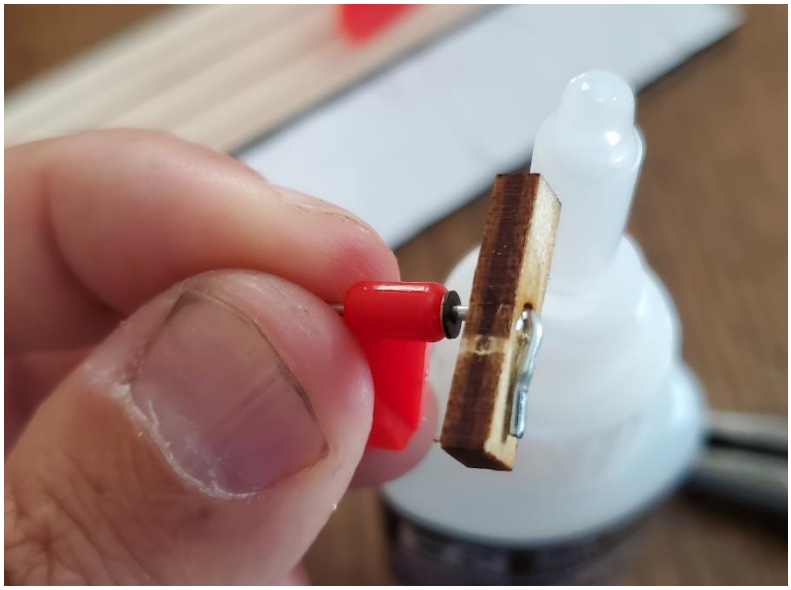
Slide a wooden rotor hub onto the propeller shaft.



Bend the end of the shaft over at a SHARP 90 degree angle as shown. If your fingers do not hurt when you are bending the wire over, you're not pressing hard enough, and you will end up with a curved propeller shaft which doesn't turn true. Bend it sharp and neat!

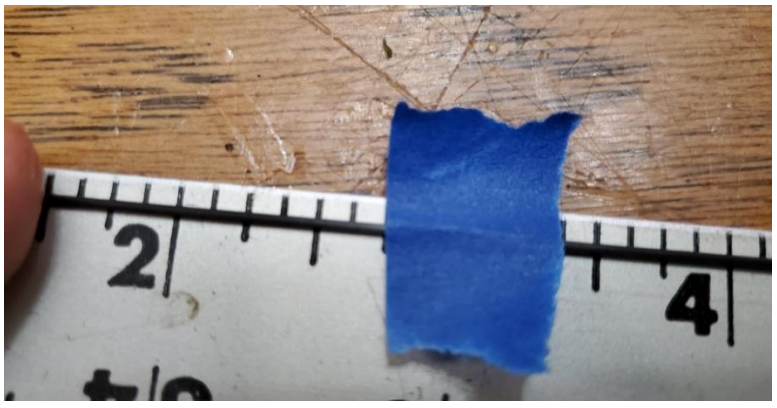


Slide the rotor hub up against the bend and glue the bend over part of the shaft to the hub.

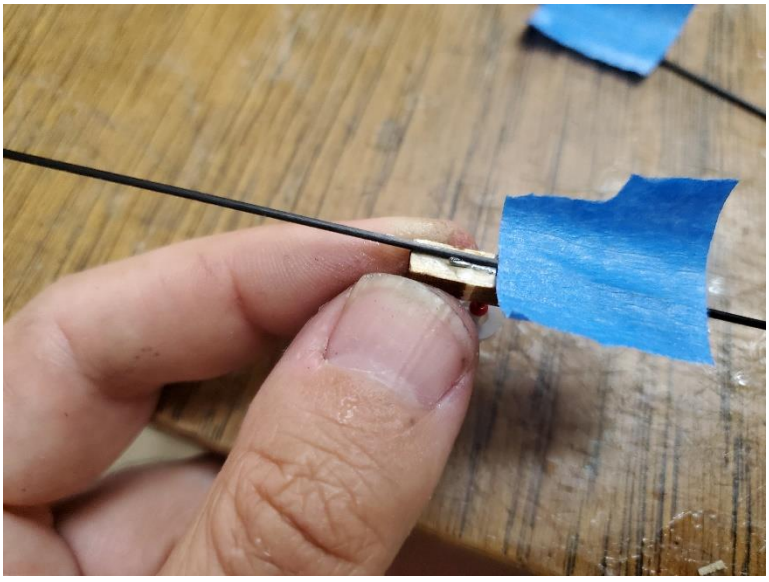


Cut two of the .040” carbon rods to exactly 5 1/2” length.

Place a piece of masking tape on each rod at the 2 3/4” point as shown to mark their center lines.

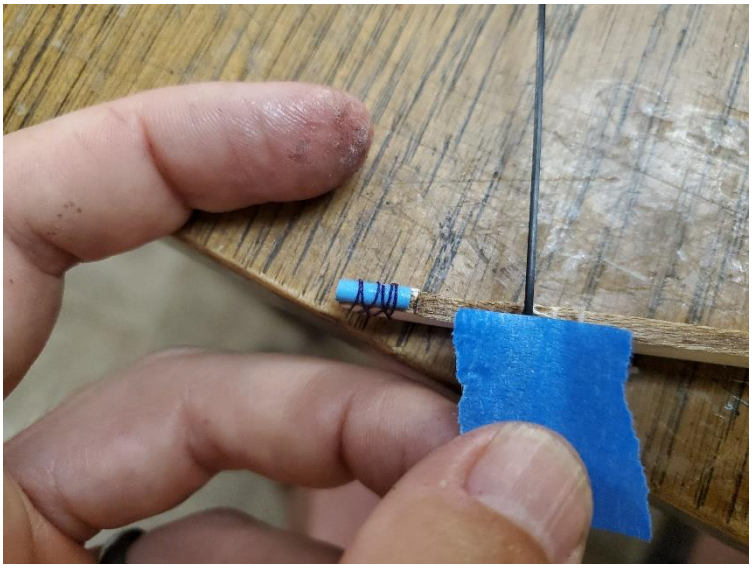


Glue one of the 0.040” rods, on its centerline, to the bottom of the rotor hub. Remove the tape once the glue has hardened. If a little tape remains, do not worry.

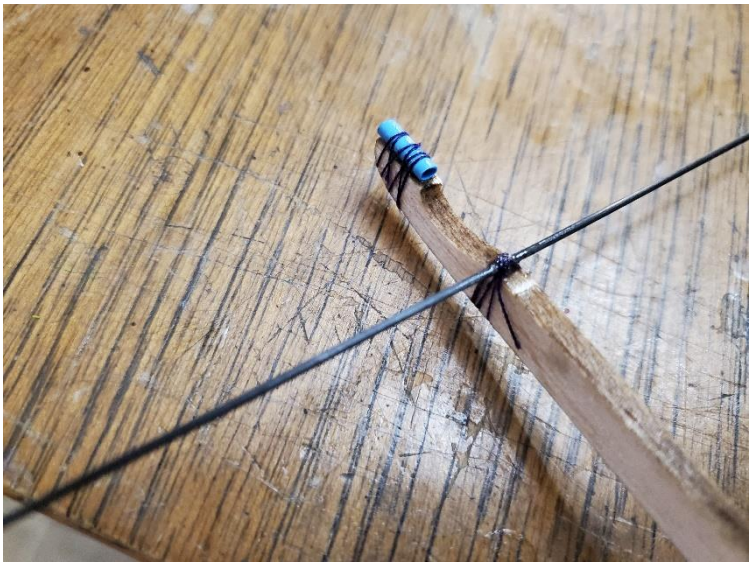


Wrap the hub/carbon rod joint with thread and harden with glue (Ikara grey bearing shown in photo).

Attach the other 0.040” carbon rod on its centerline at the top of the motorstick where the engraved lines are located below the shrink tube.

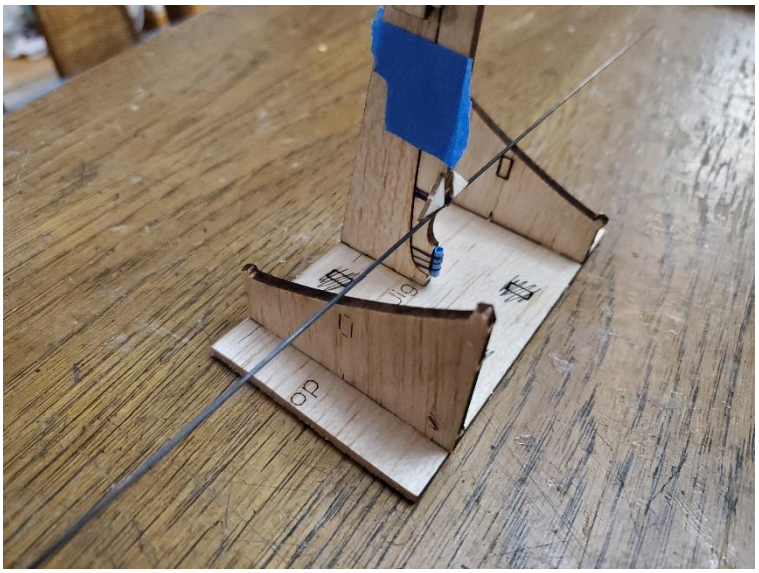


Remove the tape and bind the rod firmly in place with thread and harden with glue.

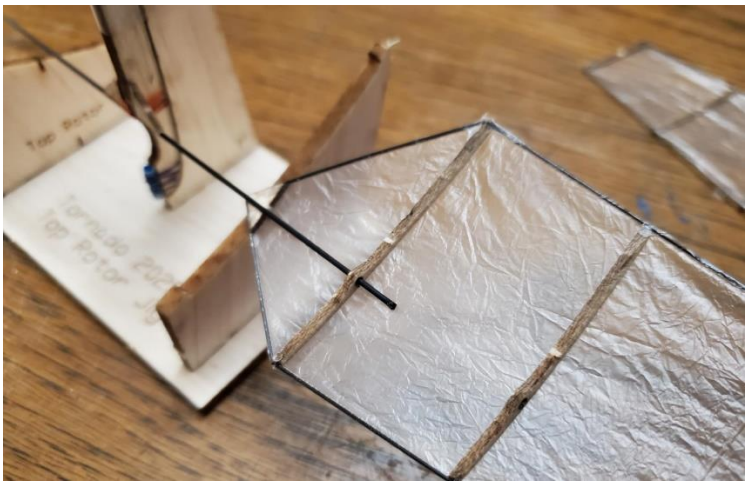


Attach a pair of gussets on either side of the motorstick as shown to reinforce the rod attachment.

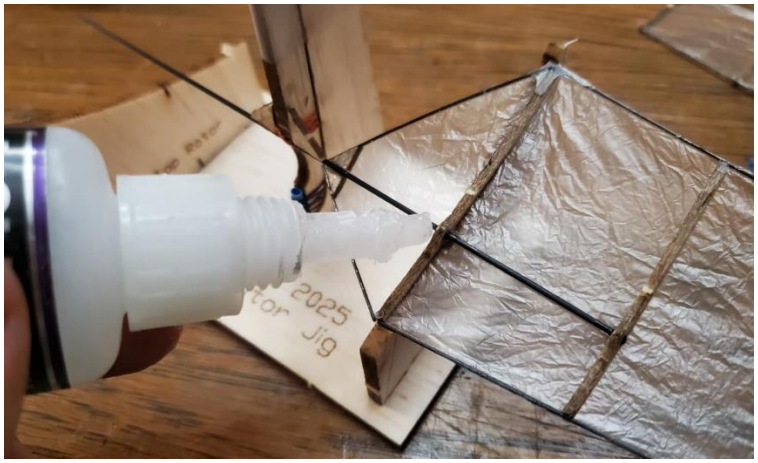
Insert the top end of the motorstick into the top rotor jig as shown, using the side plate in the motorstick mast to hold the motorstick in place. Tape the motorstick in place for additional retention. DO NOT GLUE THE MOTORSTICK TO THE MAST OR THE REST OF THE JIG!!!



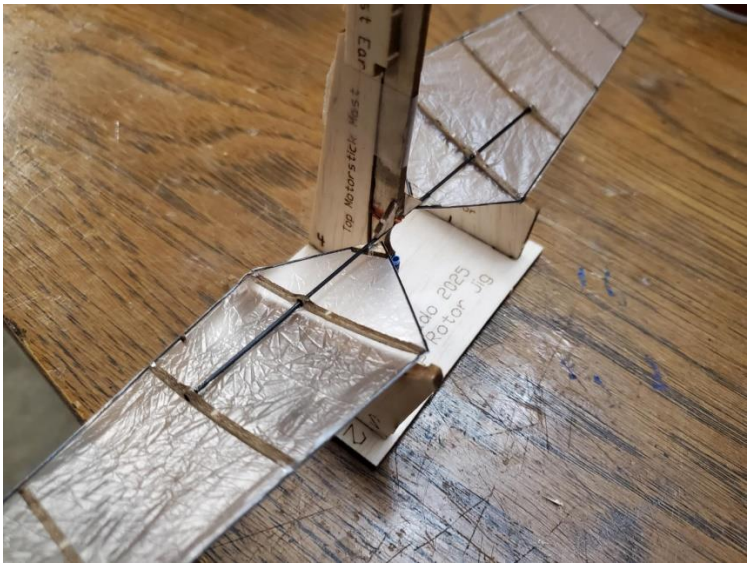
Slide a **top rotor blade** onto the 0.040” carbon rod as shown (covered side down) until the rod is flush with the outside edge of the second rib (only two ribs have holes for the spar). You may need to sand the ends of the carbon rod to get it to slide into the ribs reliably. Take your time on this step as it is easy to break the ribs in the process!



Glue each rib to the carbon rod with a small drop of glue. Don’t forget to glue the gusset to the carbon rod as well.

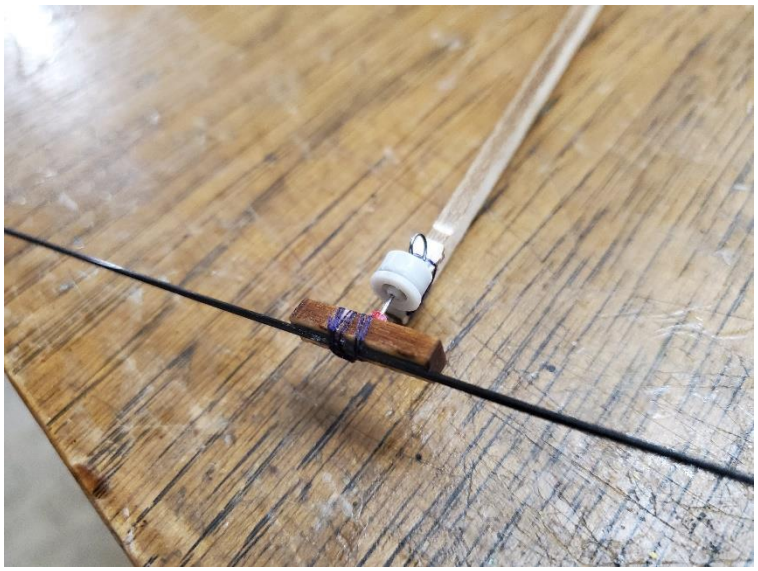


Without removing the assembly from the jig, install the **second top rotor blade** by repeating the above steps and verifying with the photo below.

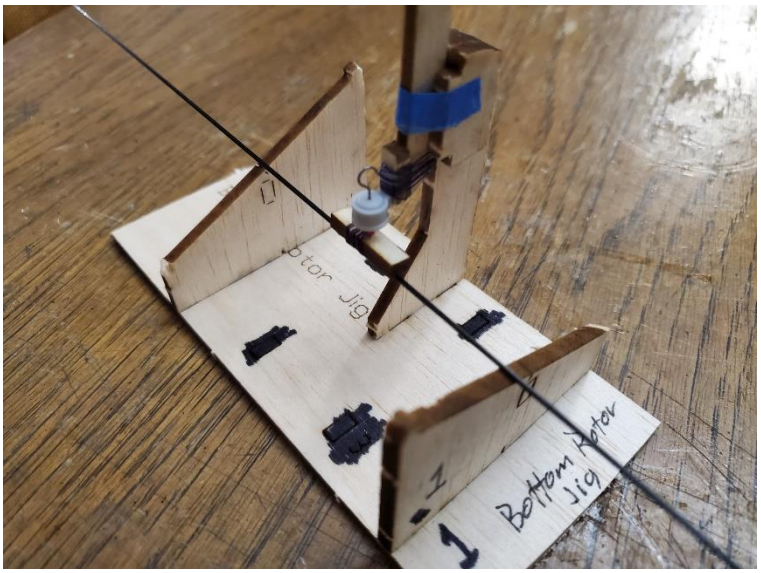


Remove the completed motorstick/top rotor assembly from the top rotor jig.

Install the bottom rotor bearing into its mount. If you use a small amount of tape as a shim, you will not need to glue the bearing in place, allowing you to remove the rotor for maintenance and storage (Ikara grey bearing shown in photo).

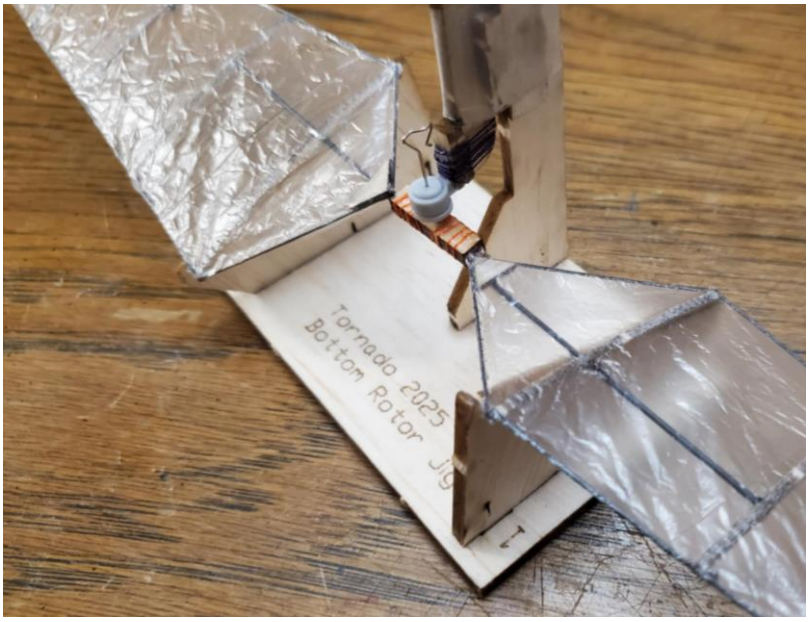


Slide the bottom rotor/motorstick assembly into the bottom rotor jig as shown, sliding the motorstick downward until the 0.040” carbon rod spar contacts the jig at the laser cut slots. Use a piece of tape to secure the motorstick in place on the bottom motorstick mast. Do not glue the motorstick in place!



Side a bottom rotor blade in place, covering side up, as shown on the 0.040” carbon rod bottom rotor spar, up to the second rib as you did on the top rotor.

Glue each rib, and the gusset, to the carbon rod. It is not a problem if the gusset has to ride up on the rotor hub in order for the blade to slide fully in place.



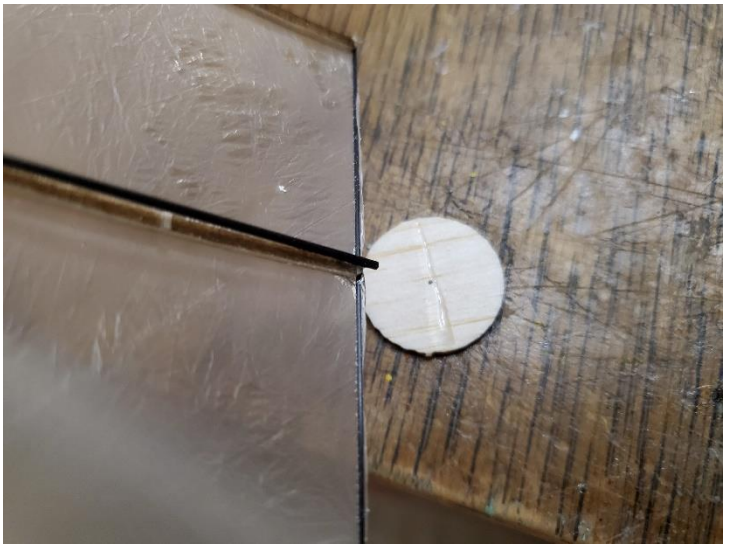
Slide the second bottom rotor blade in place onto the 0.040” carbon rod spar and glue it in place as well.

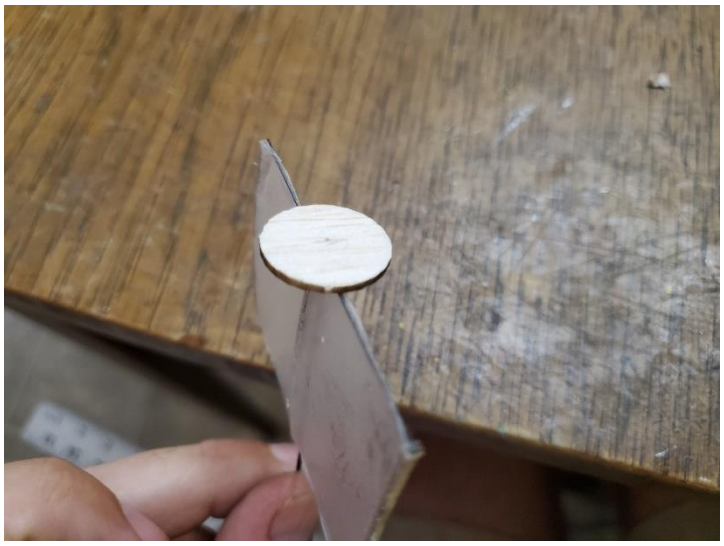
Remove the motorstick/bottom rotor assembly from the bottom rotor jig.

Cut a piece of 0.040” carbon rod to a length of 2 ¾ inches. Sand both ends of the rod to a point.

Glue the rotor vane to one end of the carbon rod as shown, leaving a tiny bit (1/32” to 1/16”) sticking out.

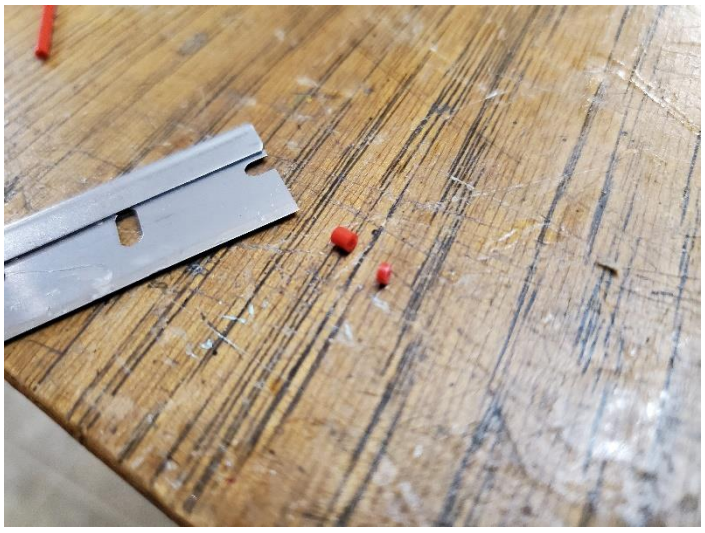
Glue one of the balsa top disks to the top of the vane, sticking the tiny amount of excess carbon rod into the small hole in the disk.



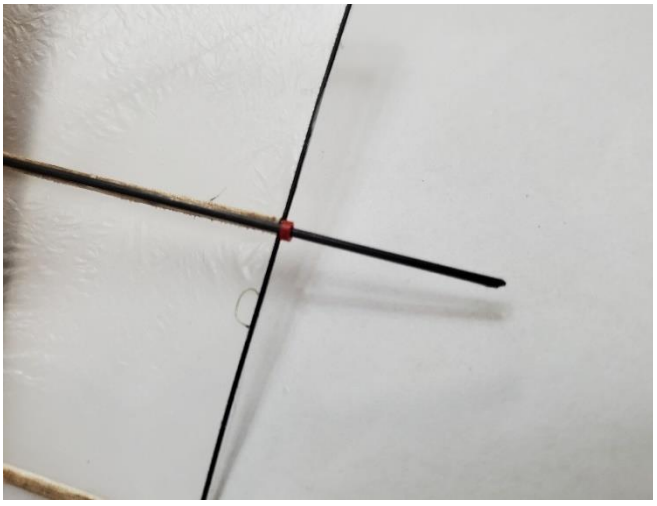


Attach a gusset between the disk and the carbon rod.

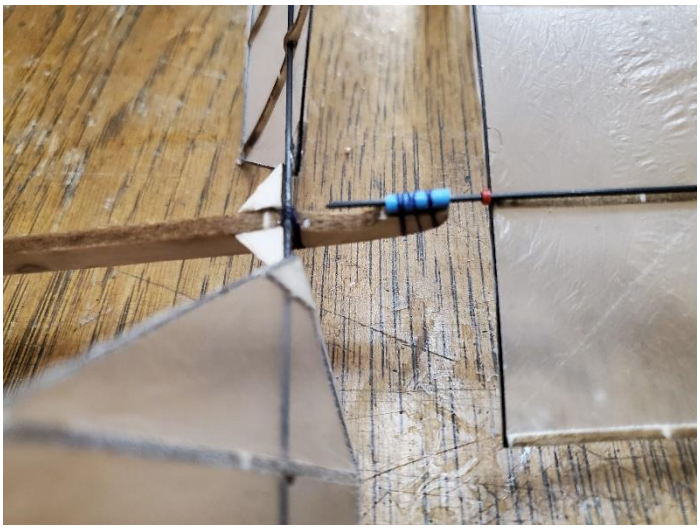
Cut off two very small lengths of the red plastic tubing, cutting the ends as square as possible.



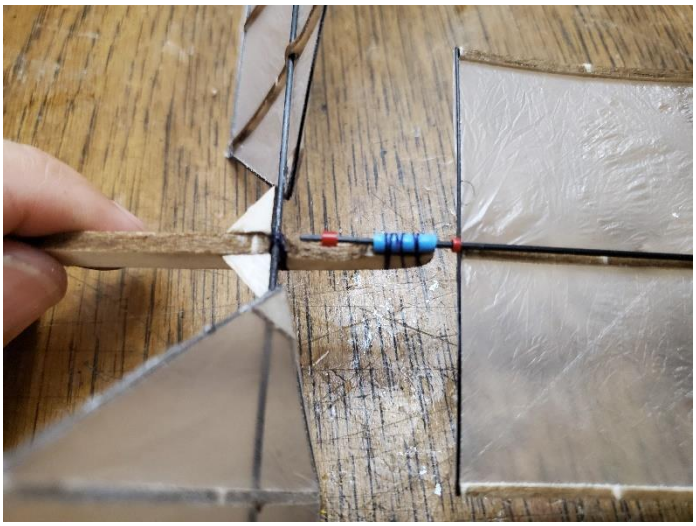
Slide one of the red plastic tubing pieces onto the rotor vane mast as shown. It does not need to be glued in place.



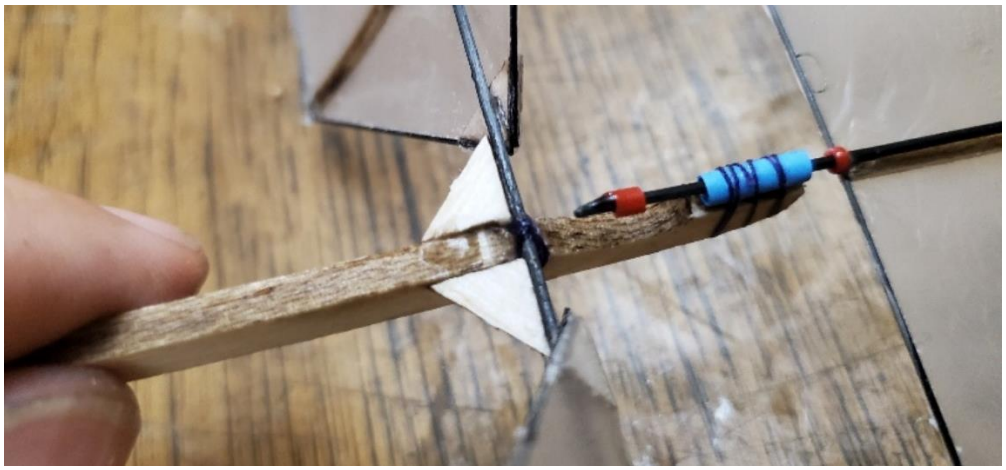
Slide the end of the carbon rod into the heat shrink tubing on the top of the motorstick.



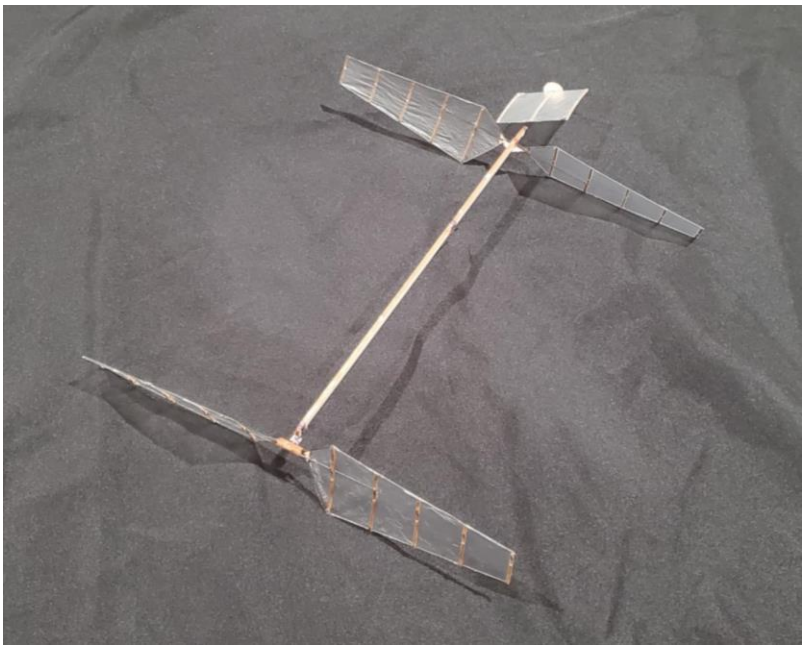
Very carefully slide the second small piece of red tubing onto the bottom of the carbon rod to retain it in the heat shrink tubing.



Use a **tiny drop** of glue on the **bottom** of the red tubing to secure it to the carbon rod.



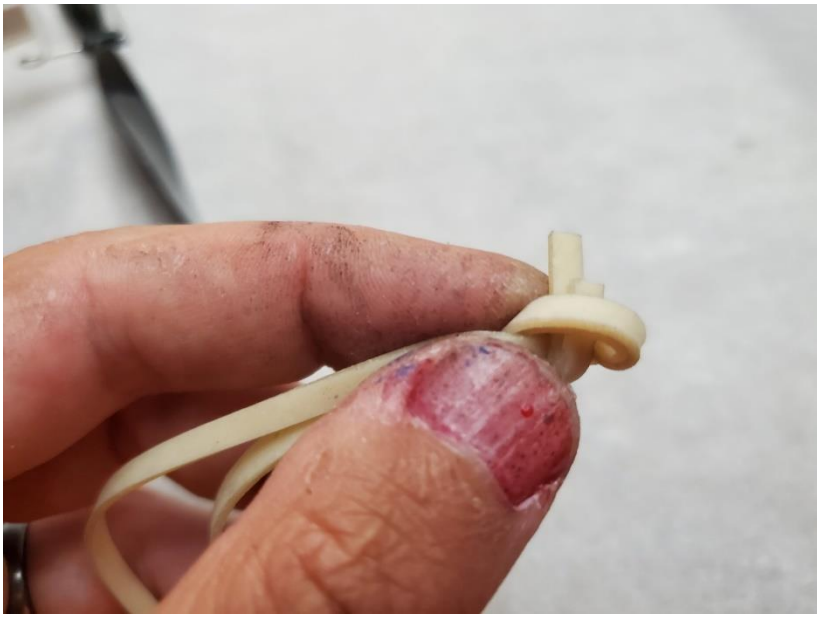
Congratulations!!! Your Tornado 2024 is now complete! Weigh your model to verify that it meets the minimum weight of 4.00g. If not, glue clay to the bottom of the motorstick, out of the way of the propeller shaft and rotor, to bring it up to the minimum weight.

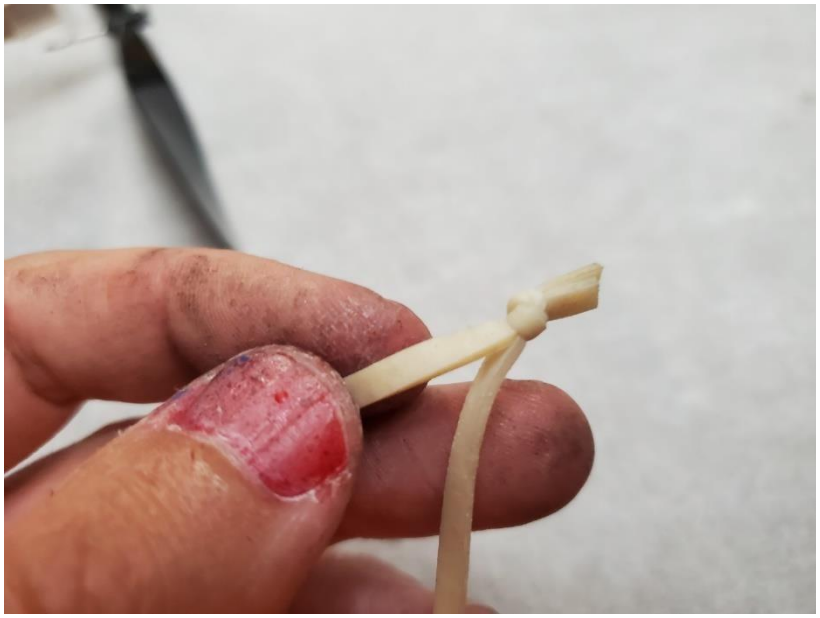


Now you will need to make some rubber motors for it.

Cut a piece of rubber about 20 inches long (this is a good size to start with—you may find that longer loops are more optimal, but start with 20 inches). Slide two of the white plastic o-rings onto the rubber. Now you will need to tie a knot to join the ends of the rubber.

Bring the ends of the strip together and tie a granny knot as shown.





Tie a second granny knot and sinch it up to the first one for added security. Add a tiny dab of glue to the knot on the outside (free ends) of the rubber loop. Trim off any excess.

Now lubricate the rubber as shown by rubbing silicone oil into it. As mentioned before, do not use petroleum products to lubricate your rubber motor because they dissolve the rubber, making it unusable.

You can now load the rubber onto the rear hook and the prop shaft. Typically the rubber will be very slack, hanging loose under the model. It's ok for the rubber to hang loose, as this will actually reduce tension on the prop bearing and allow the rubber to be wound more tightly.

Wind the rubber motor, off the model in a clockwise direction using a hand crank winder. In the absence of a torque meter, the other end of the rubber motor can be secured using a bent paperclip around a chair leg. Start with 200-300 turns (not winder cranks—calculate this based on the gear ratio of your winder) Be careful when installing the rubber onto the model that the o rings does not slip off the bottom rotor shaft. This will take some experimenting to get it right.

If your model is correctly assembled, it should hover slightly or maybe gain a little altitude. Gradually increase the number of turns in the rubber motor until the helicopter rises to the ceiling, keeping record of you turns, torque, any turns you back off to remain clear of snags in the ceiling, and the model's overall performance.

Do not expect perfect flights from your model at first. If it does not perform correctly, veryify that it is properly assembled and that you are winding in the correct direction.. All model airplanes require subtle adjustments to get them flying their best. If your model crashes, never simply try to fly it again without taking time to figure out what made it crash and what can be done to correct it. Crashes can be caused by a poor launch (throwing too hard or too softly) or by the model being out of trim.

Please contact us using the contact form at jhaerospace.com or at joshuawfinn@gmail.com if you have any questions regarding your Tornado.

Want to become a pro at indoor flying? Try our Indoor Flight University curriculum. It contains extensive information on building, designing, and flying your airplanes to get the most out of them. Along the way you will learn a strong foundation of aerodynamic principles which will reveal the secrets of flight.

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