Competition Building

The Rotacrock 20

13MM HELICOPTER DURATION MODEL

by Bob Kaplow (NAR 18L)

This rocket is an obvious modification of George Gassaway's popular Rotaroc helicopter design. I flew some of his early designs, but found several things I didn't like, the major one being the draggy nose assembly. I eliminated the elongated proboscis by replacing the rubber bands with torque rods. Second was cutting and regluing the blades to shape the airfoil. Instead, I soak them in water and warp them using a PVC tube as a mold.

I've been using this design and its 18mm big brother in competition since 1986, and have collected seven places at NARAM, plus a handful of places at local meets, and set two US records.

Before we discuss construction, here is an important note regarding how I build competition models:

Rule #1: Build light!
Rule #2: Build light!
Rule #3: Build light!
Rule #4: Add strength where necessary using composite reinforcing materials.

If you aren't into high tech, you can build this model without the Kevlar reinforcing, but you may need to increase the balsa thickness to avoid shredding with some motors. I did build a Rotacrock 20 with no reinforcing, and flat unairfoiled rotors to beta test the Apogee rotor hub, but never flew it with A motors.

Building

Cut the three rotor blades from a sheet of A-grain balsa. Airfoil them as you would a glider wing. Then soak them in hot water until they soften. Wrap the PVC pipe with several layers of newspaper. Lay the 3 blades along the pipe, with the leading edge of the airfoil on the left side. Then rotate the bottom end of the blades about 50% of the blade span towards the leading edge. Tape the blades in place, wrap with several more layers of newspaper, and then wrap the whole thing with some 1-inch elastic shock cord, or an ACE bandage. Allow the assembly to sit until dry.

I designed this rocket before the Apogee molded rotor hub was available. You can certainly use one of those if you have one. I actually prototyped one of these for Apogee when the hub was in beta test. If you don't have a molded rotor hub,

Rotacrock 20

13mm Helicopter Duration model

Designed by Bob Kaplow (NAR 18L)

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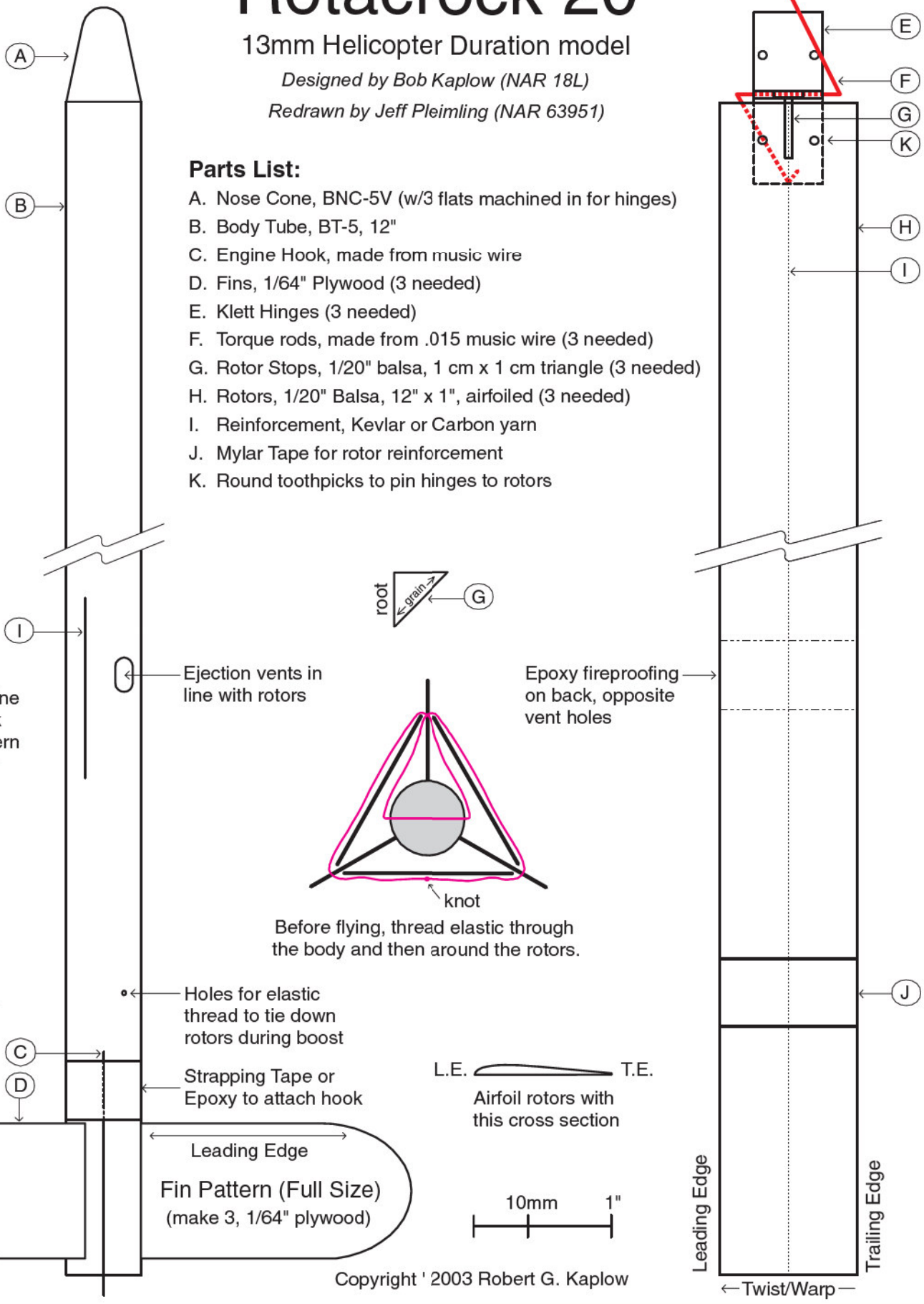
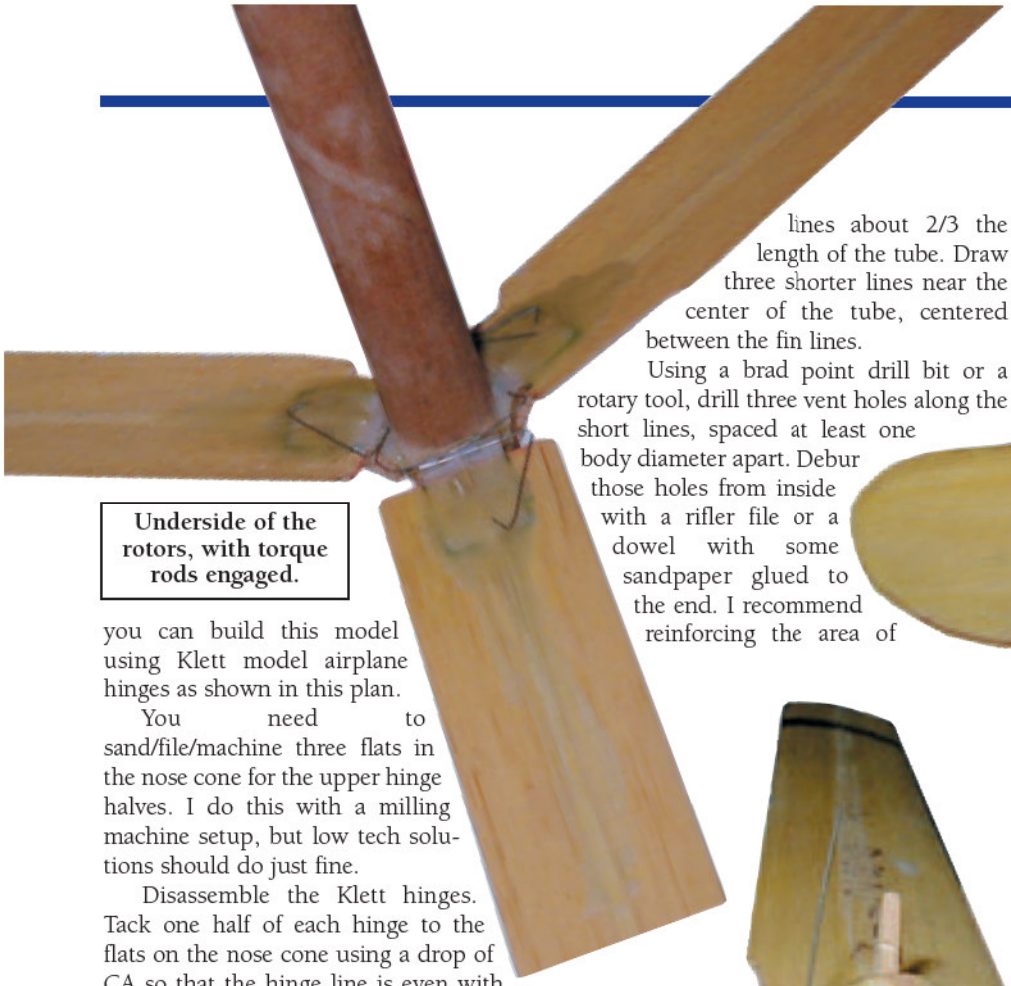
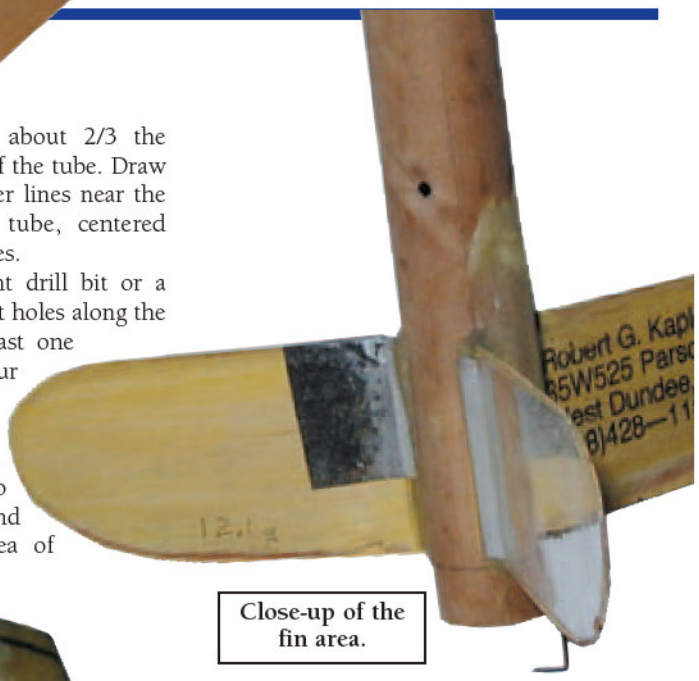
Parts List:

A. Nose Cone, BNC-5V (w/3 flats machined in for hinges)
B. Body Tube, BT-5, 12"
C. Engine Hook, made from music wire
D. Fins, 1/64" Plywood (3 needed)
E. Klett Hinges (3 needed)
F. Torque rods, made from .015 music wire (3 needed)
G. Rotor Stops, 1/20" balsa, 1 cm x 1 cm triangle (3 needed)
H. Rotors, 1/20" Balsa, 12" x 1", airfoiled (3 needed)
I. Reinforcement, Kevlar or Carbon yarn
J. Mylar Tape for rotor reinforcement
K. Round toothpicks to pin hinges to rotors





Underside of the rotors, with torque rods engaged.



Close-up of the fin area.

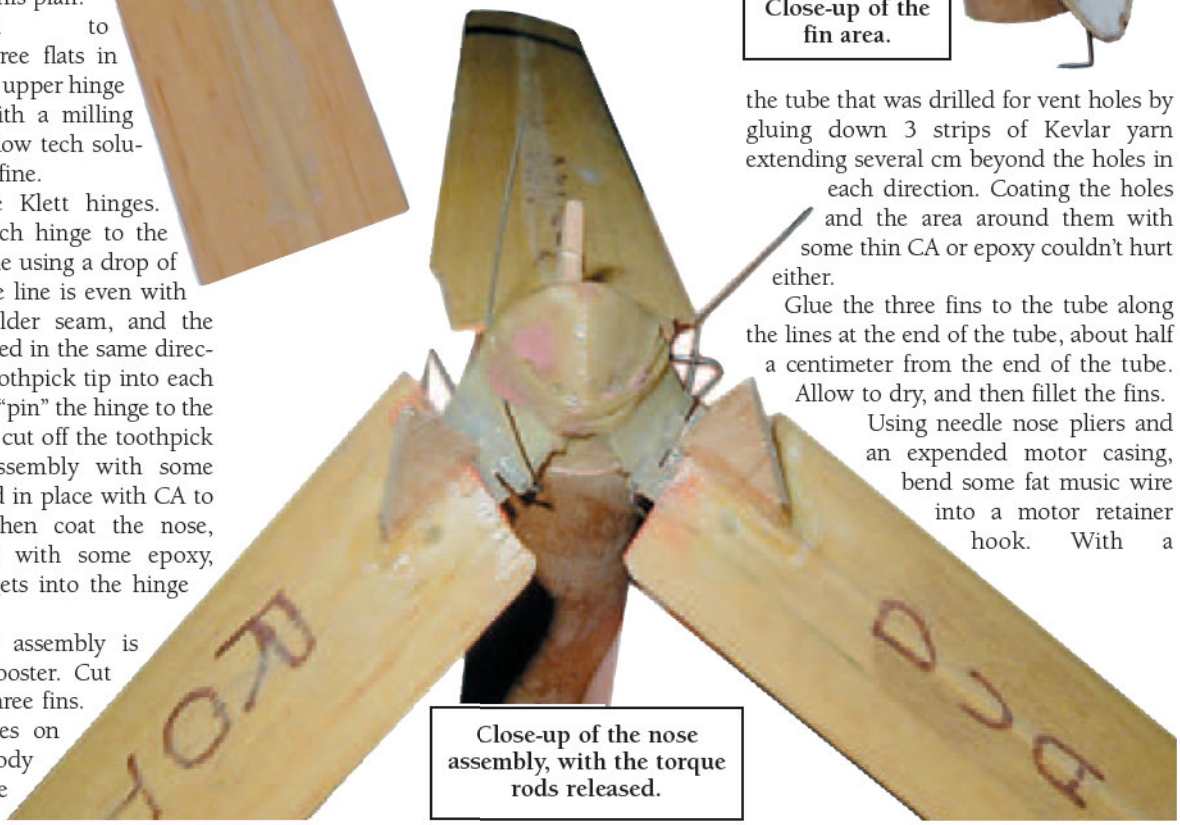
you can build this model using Klett model airplane hinges as shown in this plan.

You need to sand/file/machine three flats in the nose cone for the upper hinge halves. I do this with a milling machine setup, but low tech solutions should do just fine.

Disassemble the Klett hinges. Tack one half of each hinge to the flats on the nose cone using a drop of CA so that the hinge line is even with the nose cone/shoulder seam, and the hinge pins are oriented in the same direction. Now drive a toothpick tip into each of the hinge holes to "pin" the hinge to the nose cone, and then cut off the toothpick flush. Wrap the assembly with some Kevlar thread, tacked in place with CA to prevent slipping. Then coat the nose, hinges, and thread with some epoxy, making sure none gets into the hinge joint holes.

While the nose assembly is drying, build the booster. Cut out and airfoil the three fins. Draw three fine lines on one end of the body tube. Extend those lines about 2/3 the length of the tube. Draw three shorter lines near the center of the tube, centered between the fin lines.

Using a brad point drill bit or a rotary tool, drill three vent holes along the short lines, spaced at least one body diameter apart. Debur those holes from inside with a rifler file or a dowel with some sandpaper glued to the end. I recommend reinforcing the area of the tube that was drilled for vent holes by gluing down 3 strips of Kevlar yarn extending several cm beyond the holes in each direction. Coating the holes and the area around them with some thin CA or epoxy couldn't hurt either.

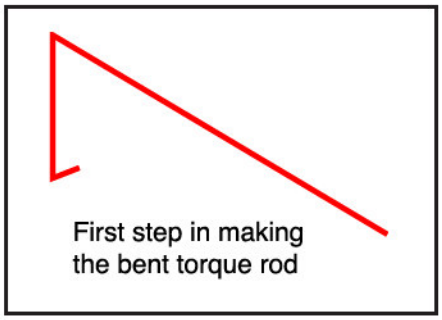


Close-up of the nose assembly, with the torque rods released.

Glue the three fins to the tube along the lines at the end of the tube, about half a centimeter from the end of the tube. Allow to dry, and then fillet the fins.

Using needle nose pliers and an expended motor casing, bend some fat music wire into a motor retainer hook. With a needle, punch a hole 4.0 cm from the end of the tube, centered between two of the fins. Stick one end of the motor hook through the hole. Align the hook and tack it in place with a small piece of masking tape. Wrap a piece of adhesive Mylar (or strapping tape) around the full tube diameter, covering the motor hook from the hole to the fin leading edge.

About one body diameter ahead of the motor hook, make a needle hole through both sides of the tube. The sewing elastic thread that folds the rotors closed during boost will be threaded through these



First step in making the bent torque rod

holes.

Now tack the remaining three hinge halves to the bottom surface of each rotor. Make sure you've got the right end of the rotor, and that all three hinges are aligned to nest with the hinge halves on the nose cone. Carefully drill through the hinge holes, and pin the hinges to the rotors with toothpicks, then cut and sand the toothpicks flush on both sides. Then glue the balsa rotor stop to the top surface of the rotor, over the centerline of the hinge.

Using a laminating epoxy or Ambroid, reinforce both sides of the rotors with Kevlar yarn from the end of the hinge to the tip, and from the end of the rotor stop to the tip. Using a finger and glove, or a plastic scraper, squeeze down to make the yarn/glue as smooth and flat as possible, and to remove any excess glue. Coat both sides of the hinge rotor assembly with some epoxy to secure the hinge and fillet the rotor stop.

Finished Rotacrock 20.

The three torque rods are bent from 0.015" music wire using needle nose pliers. Bend the half of the "Z" pattern as shown in the diagram above. Align the rotor hinge with the nose hinge, thread the rod through the hinge holes from leading edge to trailing edge, with the bent part under the rotor. Adjust the bend so the corner is even with the leading edge of the rotor, and the end tab is over the hinge tab. Use masking tape to temporarily hold the end of the torque rod to the hinge. Once all three torque rods are installed, use the needle nose pliers to complete the "Z" bend. Note that the "Z" is not flat, but at a right angle to the first bend (see photo). See the flying instructions for the final step of the torque rod preparation (do not do this step now!).

Finally slip the nose cone/rotor assembly onto the top of the body tube. Align the rotors so they fit between the fins. This means that the top of the rotors will not match up with the fin gaps. Mark the nose and tube for alignment, then glue the nose cone in place.

Put a strip of adhesive Mylar over the top surface of each rotor centered on the two needle holes for the burn string, to prevent the string from cutting into the rotor blades. Coat the backside of each blade where the ejection vent holes are located with a thin layer of epoxy or more adhesive Mylar to prevent rotor charring.

I finish my Rotacrock wood surfaces with a single coat of thinned dope to reduce warping. I'll typically use two colors to aid in spotting the model both in the air and on the ground. A bit of reflective Mylar on one fin surface makes a nice flashing beacon during recovery.

Flying

I store my Rotacrock with the torque rods released from the adjacent hinge. To fly, I use my fingers or a needle nose pliers or hemostat to hook the end of the torque rod under the hinge of the next rotor. This holds the rotors open. Bend the torque rod if necessary to increase the opening torque. It is not necessary for the torque rods to hold the rotors fully deployed, as long as it holds them roughly horizontal. (Reverse the process when done flying. You won't forget because it's hard to store the model with the rotors forced open!)

Next thread a 15cm piece of sewing elastic thread through the needle holes. Now carefully close the three rotors down towards the body of the model. It's easier to have a helper do this for you. Cross the elastic as shown on the plans and wrap it around the three rotor blades, and pull as snug as possible. Then tie a double knot and trim off any extra elastic. Be sure the elastic is over the Mylar strips so it won't cut into the balsa of the rotors.

After safety check insert the motor using the wire engine hook to hold it in place, and, if desired, a wrap of tape. Install the igniter. The model needs no launch lug, since the torque rods at the top and the fin/blade cavities form built-in launch lugs.

The Rotacrock 20 flies well on 1/2A3-2T and A3-4T motors. I used to use A3-2T and even 1/4A3-2T when they were available. I've yet to try a 1/4A3-3T.

Parts List for Several Rotacrock Sizes

Note: The Rotacrock 23 & 24 are 18mm versions of this same rocket. The only difference between the two is that the Rotacrock 23 uses 1/16" balsa for the rotors, and the Rotacrock 24 uses 3/32" balsa rotors. 3/32" is necessary for C6-3s but 1/16" holds up fine for B4-2s.

PARTS:	ROTACROCK 20	ROTACROCK 23 & 24
Body tube	30 cm BT-5	45 cm BT-20
Nose cone with milled flats	BNC-5V	BNC-20A
Plywood fins (3)	2.5 x 5 cm, 1/64" thick	3 x 6 cm, 1/32" thick
A-grain balsa rotors (3)	2.5 x 30 cm, 1/20" thick	4 x 45 cm, 3/32" thick
A-grain balsa triangles (3)	1 cm, 1/20" thick	1.5 cm, 3/32" thick
Klett hinge or equivalent (3)	small size	small size
Music wire torque rods (3)	6 cm of 0.015" wire	8 cm of 0.020" wire
Music wire engine hook	6 cm of 0.020" wire	8 cm of 0.032" wire
Kevlar (or graphite) yarn	2.5 meters	4 meters
PVC pipe (rotor forms)	1.5" diameter	2" diameter

Also required: Kevlar thread, Round toothpicks (6), Adhesive Mylar tape, Sewing elastic thread, Laminating epoxy or Ambroid, Titebond or other glue