Build Your Own
Helical Anistropic Reinforced Polymer (HARP) Actuator

Materials & Tools

- Silicone Tube (durometer 50, 5/32x3/32")
- Nylon Fishing Line (.038" ("The Core")
- Nylon Fishing Line (.017") ("The fiber")
- Duct Tape
- Copper Wire (26 AWG)
- Mandrel (4x300mm aluminum rod)
- Leur Lock Barbed Connector (1/8")
- Barbed plug
- Syringe (10ml)

Instructions

1. Cut Material to Length:
   A. Cut silicone tube to 30 cm
   B. Cut 0.038" nylon fishing line (the **core**) to 40 cm
   C. Cut 2 lengths of nylon fishing line (.017") to 50 cm
   D. Cut 4 lengths of copper wire to 20 cm each

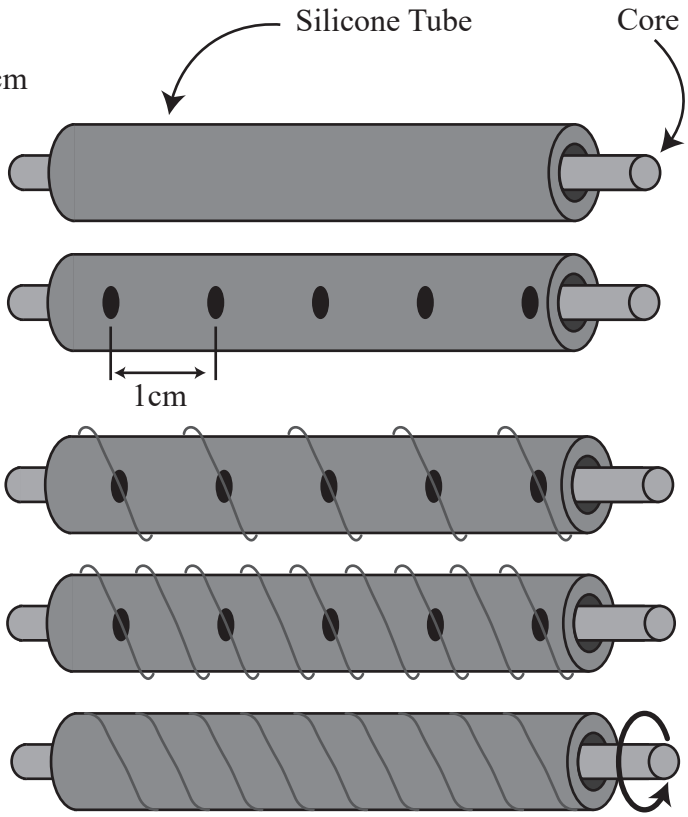
2. Insert core into the tube. Spinning the tube while inserting the core can make this easier.

3. Mark the tube every 1 cm with a sharpie

4. Use duct tape to attach the 0.017" nylon fishing line (the fiber) to attach the fiber to the tube. Then, wrap the line helically around the tube, using the marks from the previous step as a guide.

5. Add a second fiber in the gap between the first fiber

6. Twist the tube to tighten down fiber



7. Clamp the tube to the mandrel and coil the muscle around it to make a spring like shape.
   TIP: When coiling, have a friend hold the free end of the tube while you hold the mandrel. Spinning the mandrel will coil the tube. While you coil, the fiber should become ***tighter*** on the muscle. If not, you are coiling in the wrong direction!

   To clamp to the mandrel, use duct tape to attach the tube, and then ***tightly*** wrap with copper wire to prevent slipping.

8. Anneal the muscle by placing the muscle in an oven a 150C for 10 minutes. Allow the muscle to ***completely*** cool before removing the mandrel.

9. Remove muscle from the mandrel. Add the luer lock barbed fitting to one end and plug the other. Wrap the copper wire over the tube to prevent the tube from coming off the barbed fittings.

10. Attach the luer fitting to the syringe. Sqeezing the plunger should cause the muscle to contract.