iRobot DEXTER Hand

How to Change from Dumb Fingers to Smart Fingers

7/22/13

Rev 1.0

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Sourcing the tendon material:

Additional tendons can be sent to you by iRobot if necessary. Please contact **ARMH_Support@irobot.com**. If you plan on stringing your own tendons the material can be found below. See the repair manual for detailed instructions on how to create your own tendons.

DRC Version: PN: MAG802500GN from www.baspro.com

The current tendon material specified by iRobot is a small Spectra braid. While extremely strong in tension, the braid is susceptible to abrasion. This is the most common cause of failure.

Required Tools

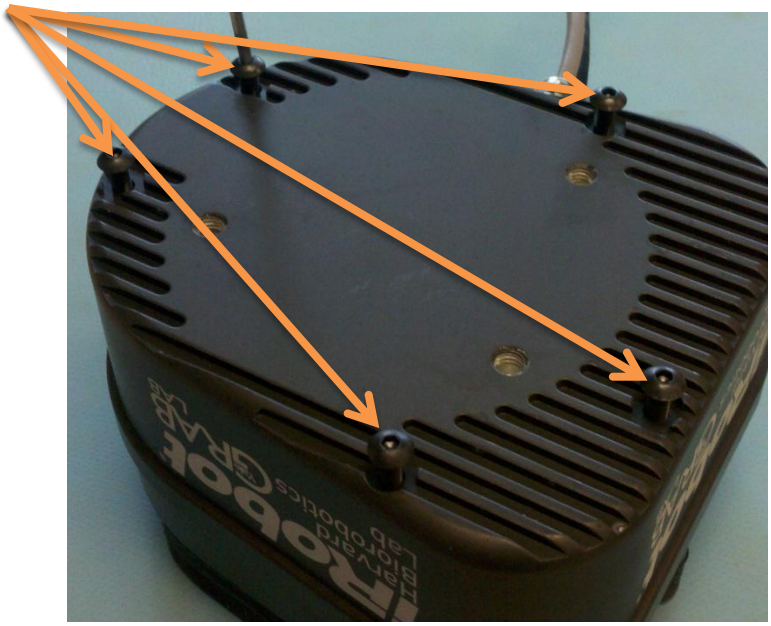
- Small Tweezers
- 1.3mm Hex Key or Torx T5
- 2mm Hex Key
- 2.5mm Hex Key
- Needle nose pliers
- Sharp X-acto knife or razor blade

Removing the Back Housing

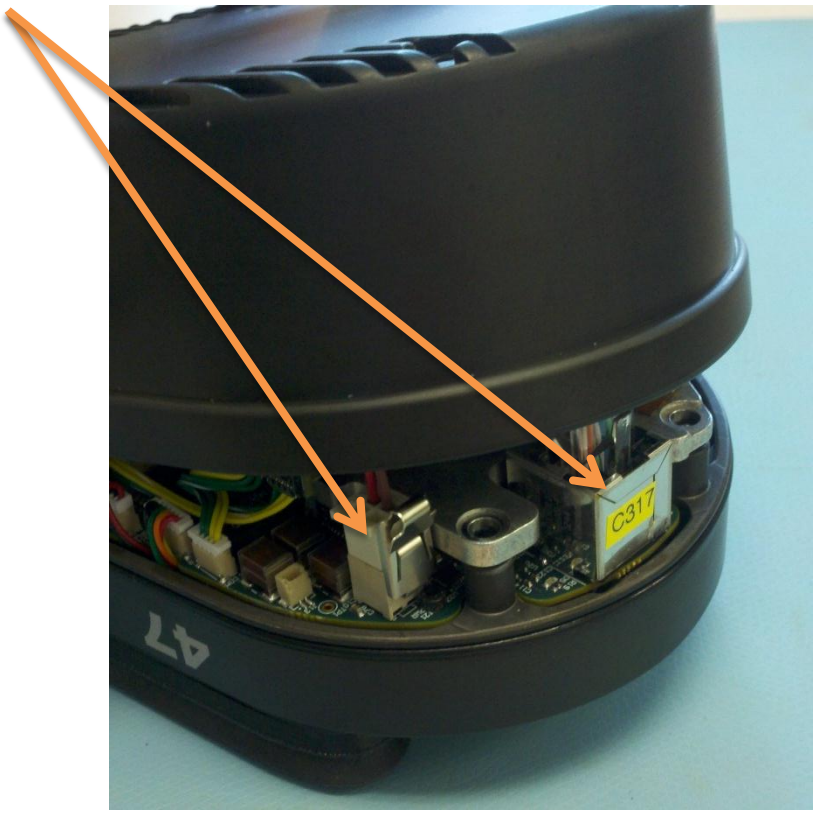
Perform this work only in an ESD safe environment!

Disconnect both the power and Ethernet cables.

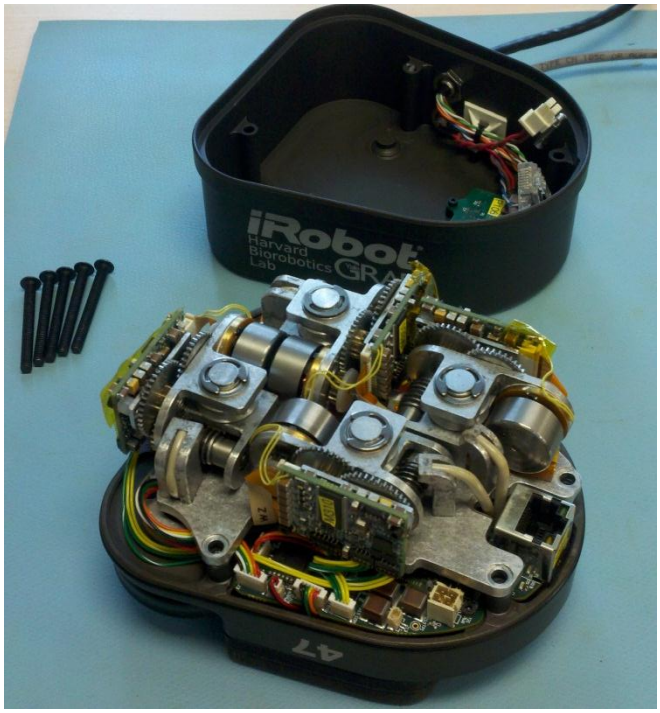
Remove the five (5) long M3 screws holding the back housing on



In an **ESD SAFE** environment, carefully lift off the housing unit you can see the power and Ethernet plugs. It may require a little finesse as the cables are rather short.

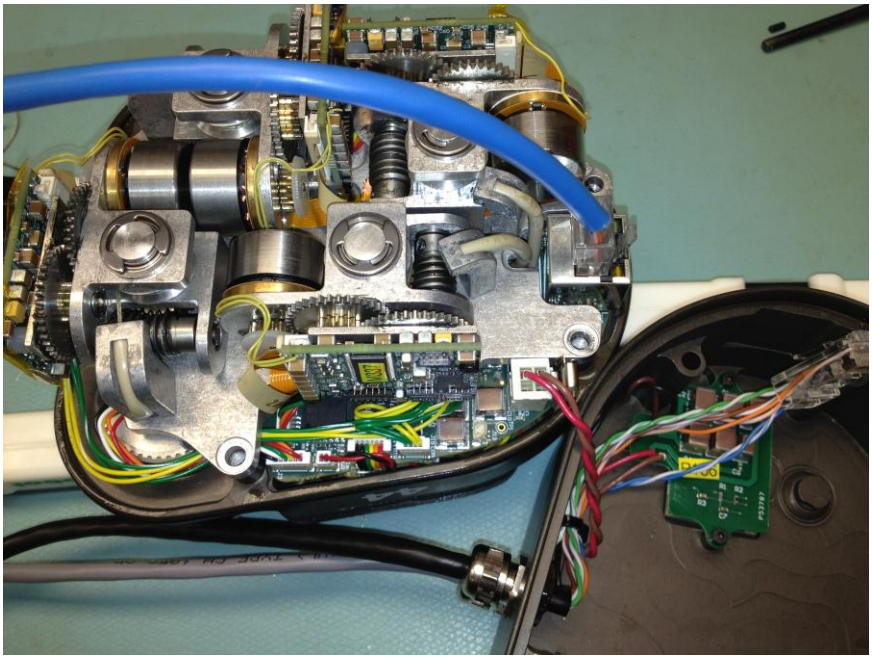


Uplug the ethernet and power connectors, lift off the back housing, and set aside.

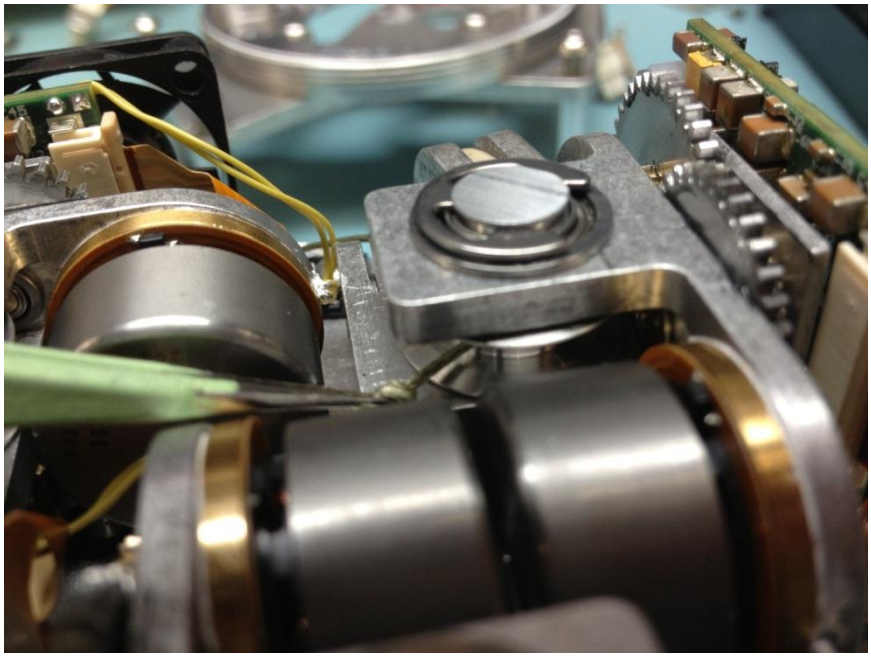


Un-winding the Tendons

The power cable in the housing should be plugged into the board. The housing should rest next to the palm. The Ethernet cable can be plugged directly into the board.



To unwind the tendons, reverse the actuator until all the tendon is spooled off the drum. Using tweezers, pull the on the knotted piece of tendon until there is enough free to cut the knot off. The tendon can then be pulled free. Do this for all four (4) tendons.

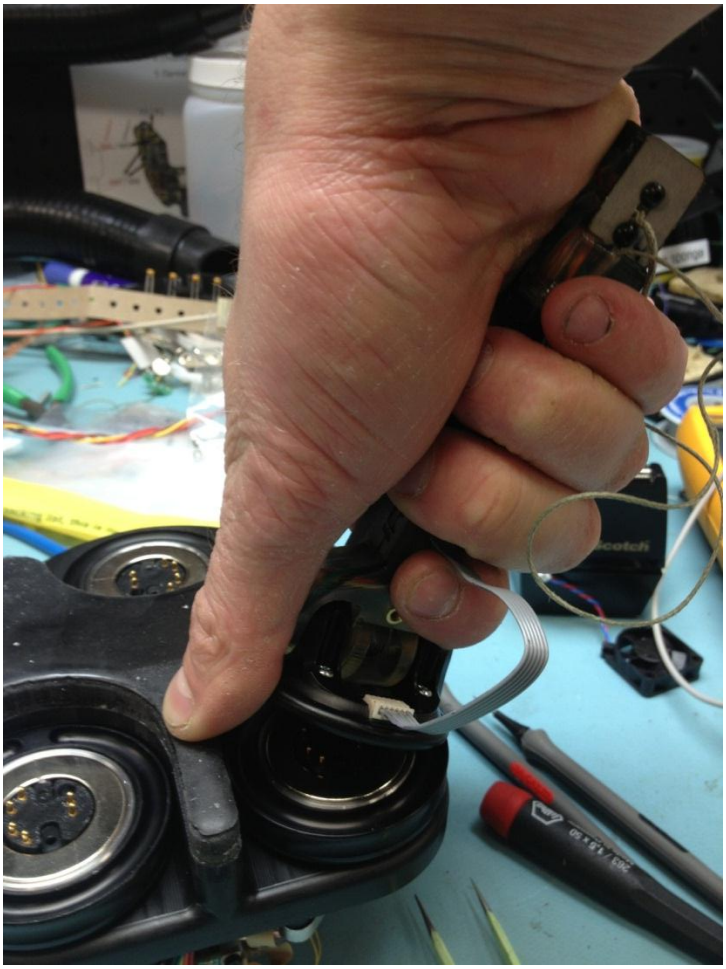


Removing the Dumb Fingers from the Palm

Once the tendons have been removed from their drums pull them through to the outside of the hand.

To remove the fingers from the hand you must overcome the magnetic breakaway base. Stand the finger straight up, get a firm grip on the proximal link of the finger, and push against the palm with your thumb to pry up the breakaway mechanism in a peeling motion. DO NOT apply force exclusively to the distal link as this will deform the flexure joint and potentially damage the finger if you apply enough force to overcome the breakaway base.

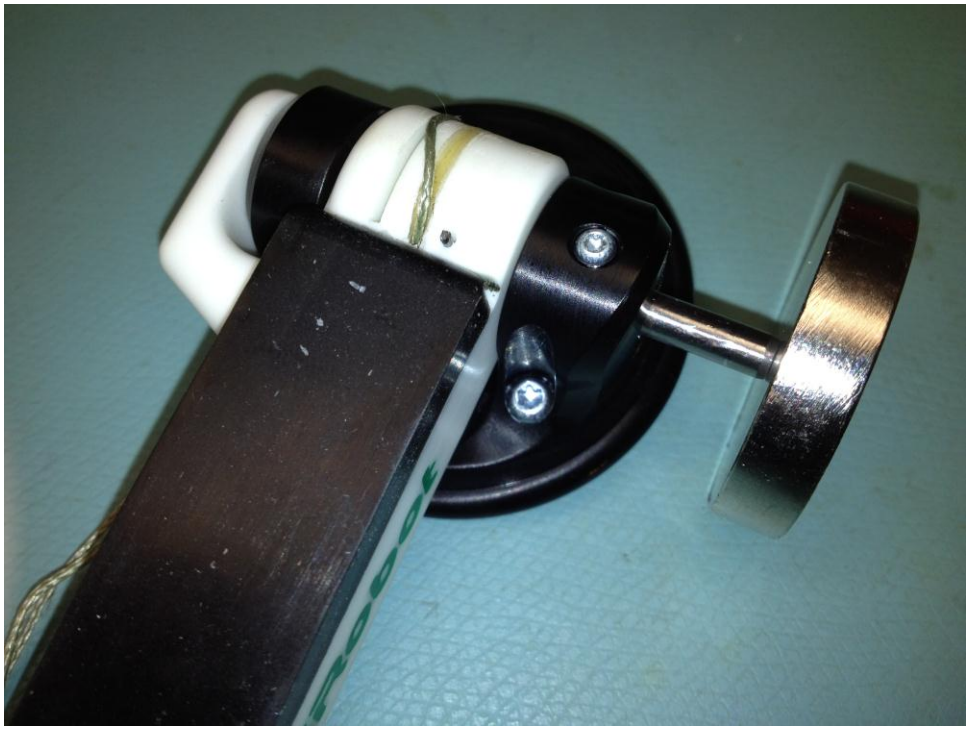
Do not twist off the finger, as damage to the pogo pins may result.



Removing a Finger from the Breakaway Base

Loosen the set screw that holds the pin shaft in the breakaway base. This will require a Torx T5 wrench or a 1.3mm hex key.

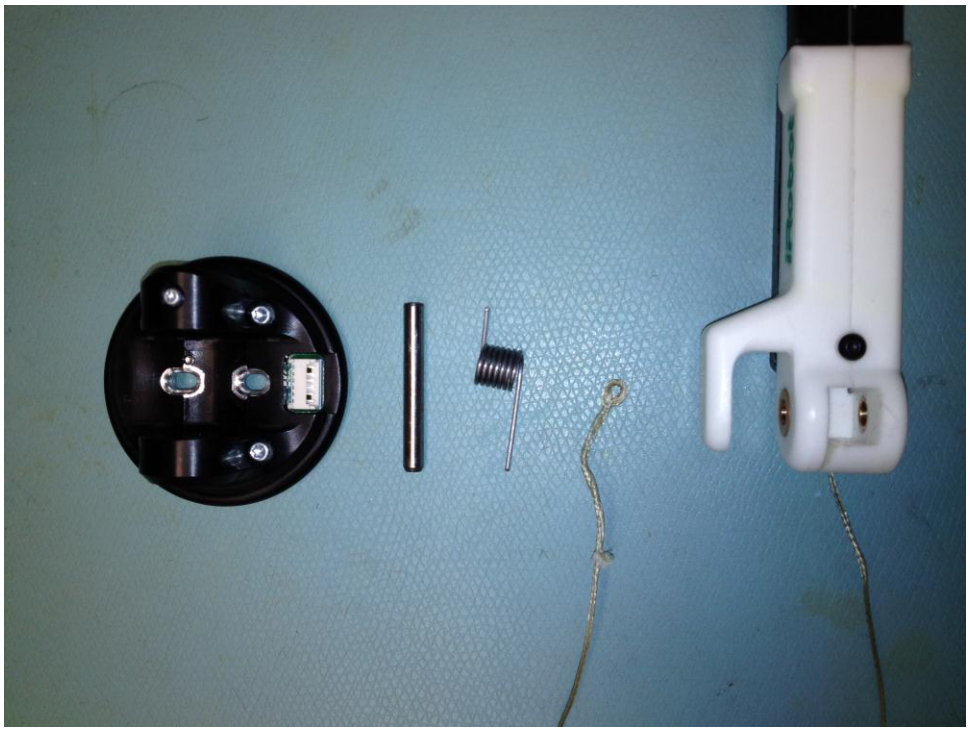
To remove the pin shaft from the breakaway base, use a magnet to pull the pin shaft out.



If the pin shaft does not come out easily when using the magnet, the breakaway base can be banged against the working surface until the pin starts to work its way out. Be sure to hold on to the finger and

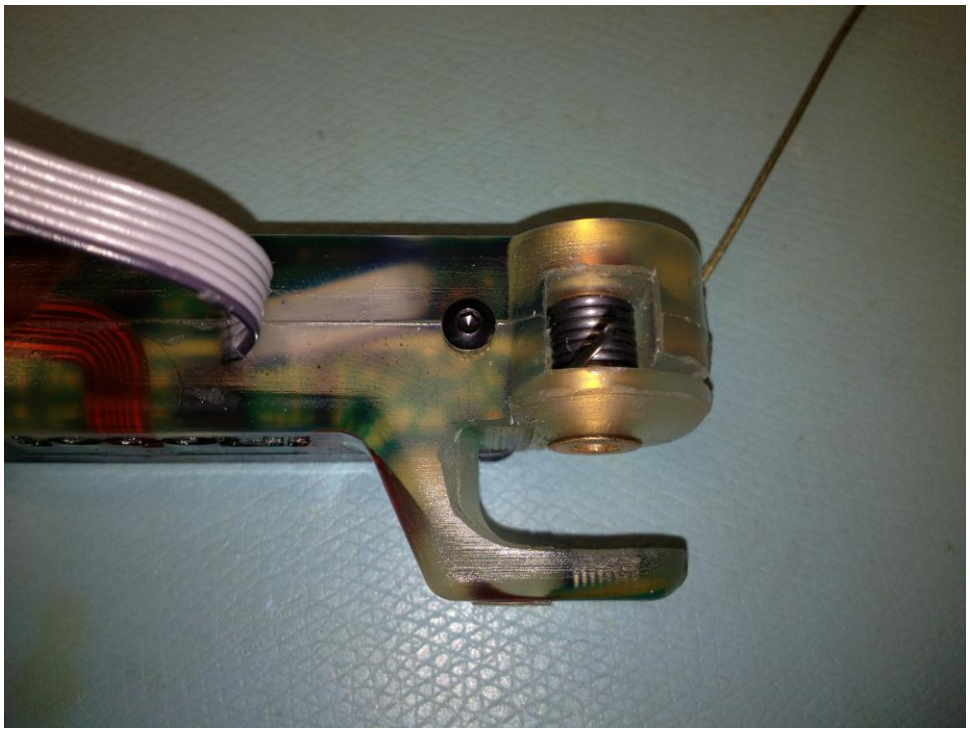
the breakaway base at the same time while banging to prevent the finger from getting damaged. It may help to relieve the pressure on the pin shaft caused by the spring rubbing against it by rotating the breakaway base 90° and holding that position while banging it against the working surface. When there is about a ¼" of the the pin shaft protruding from the breakaway base, it can be pulled out with a pair of pliers.

When the pin shaft is removed, the finger should separate from the breakaway base. Remove the spring from the cavity of the finger and set aside. For finger 3, remove the antagonistic tendon by loosening the M2.5 screw with a 1.5mm hex key. Set the tendon aside and reinstall the M2.5 screw back into the finger.

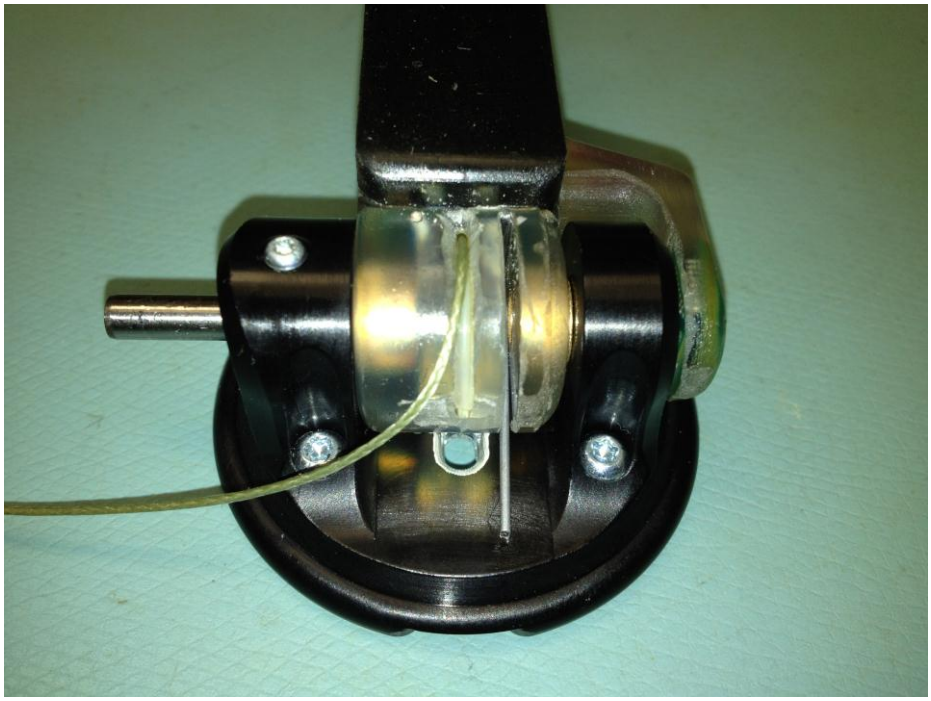


Installing a Smart Finger onto the Breakaway Base

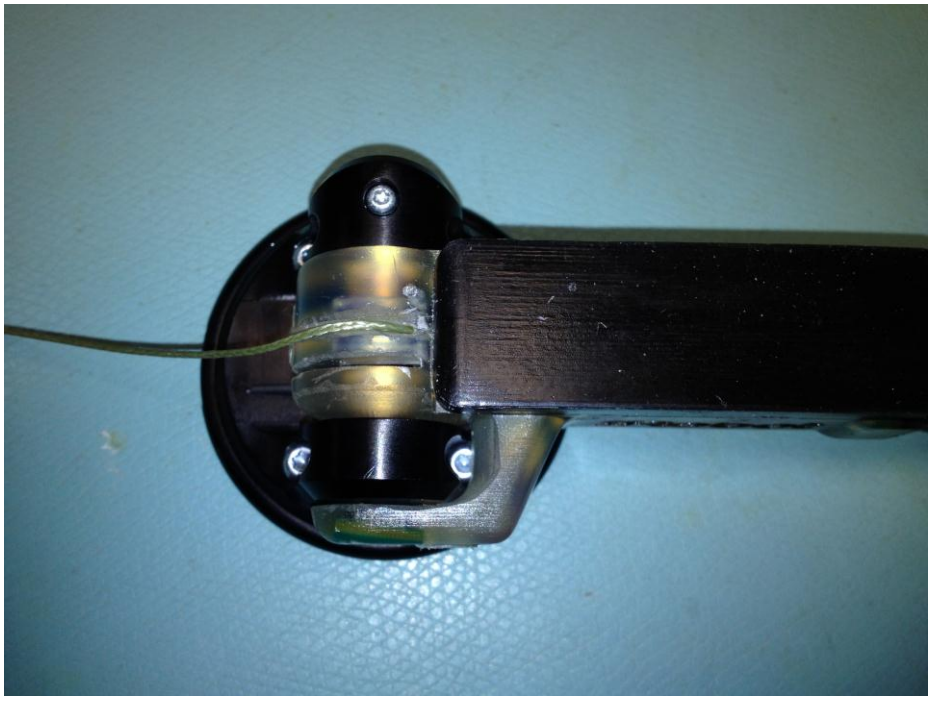
Fit the torsion spring inside of the cavity of the smart finger. There is a hole at the bottom of the cavity that the short end of the spring will fit in to.



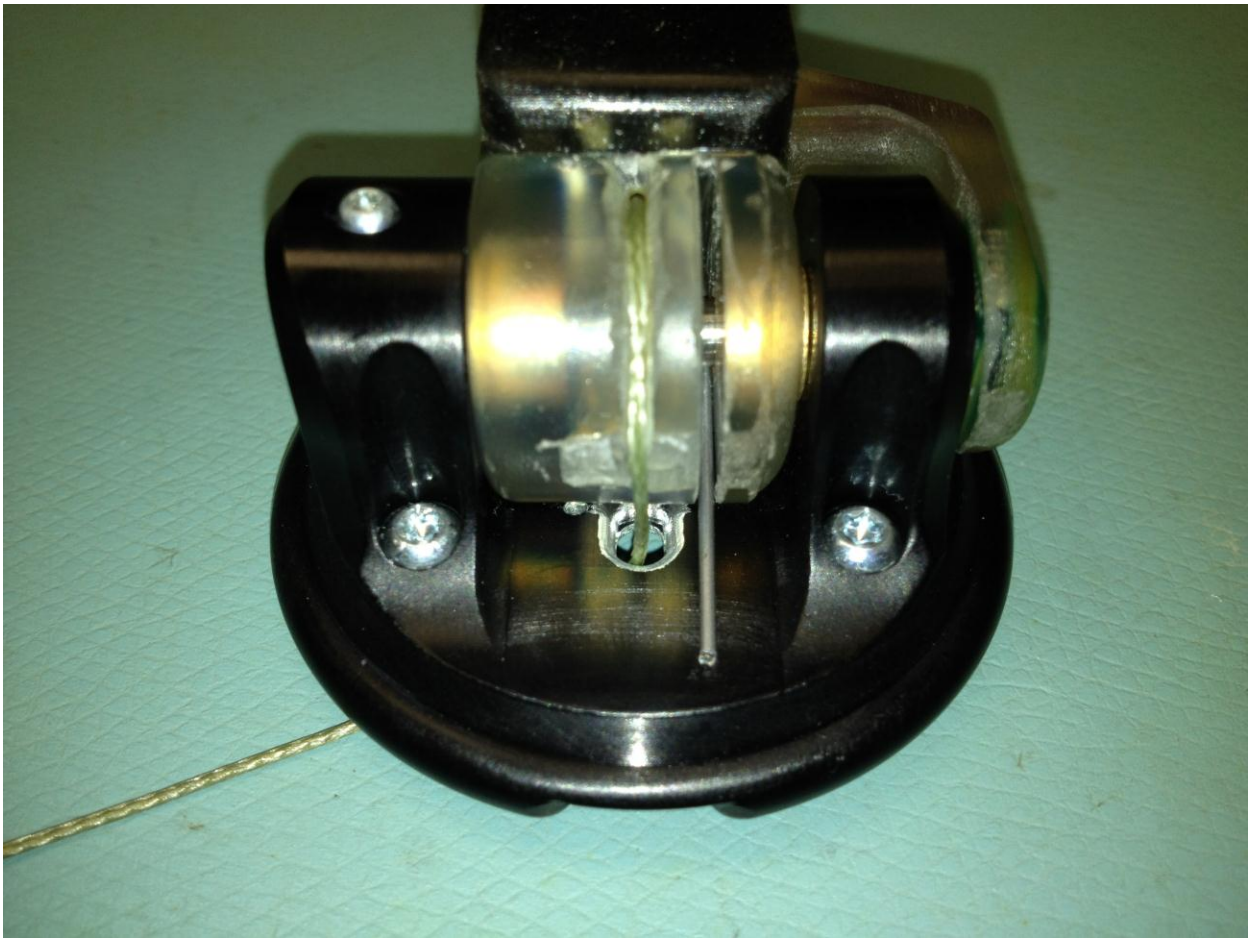
Pull back on the long end of the torsion spring 90° and place the finger in the breakaway base. The long end of the torsion spring should be resting on the bottom face of the base and the magnetic encoder chip in the ear of the smart finger should line up with the magnet in the base. While holding the finger in position, slide the pin shaft through the breakaway base and the finger until the end of the pin shaft is flush with breakaway base.



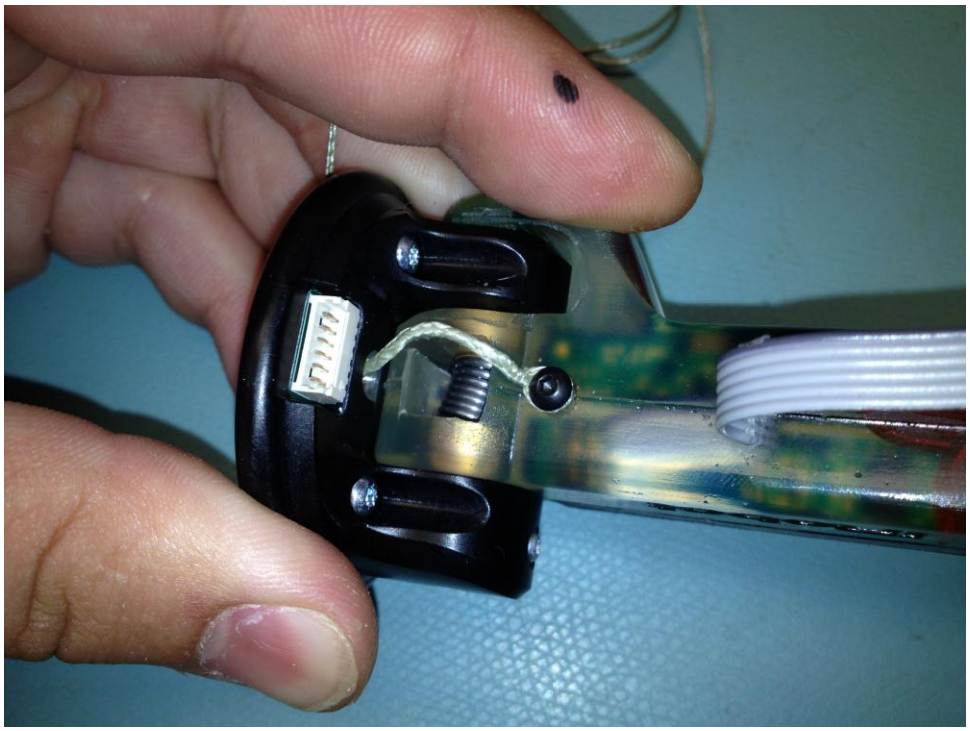
Tighten the set screw with a Torx T5 wrench or a 1.3mm hex key.



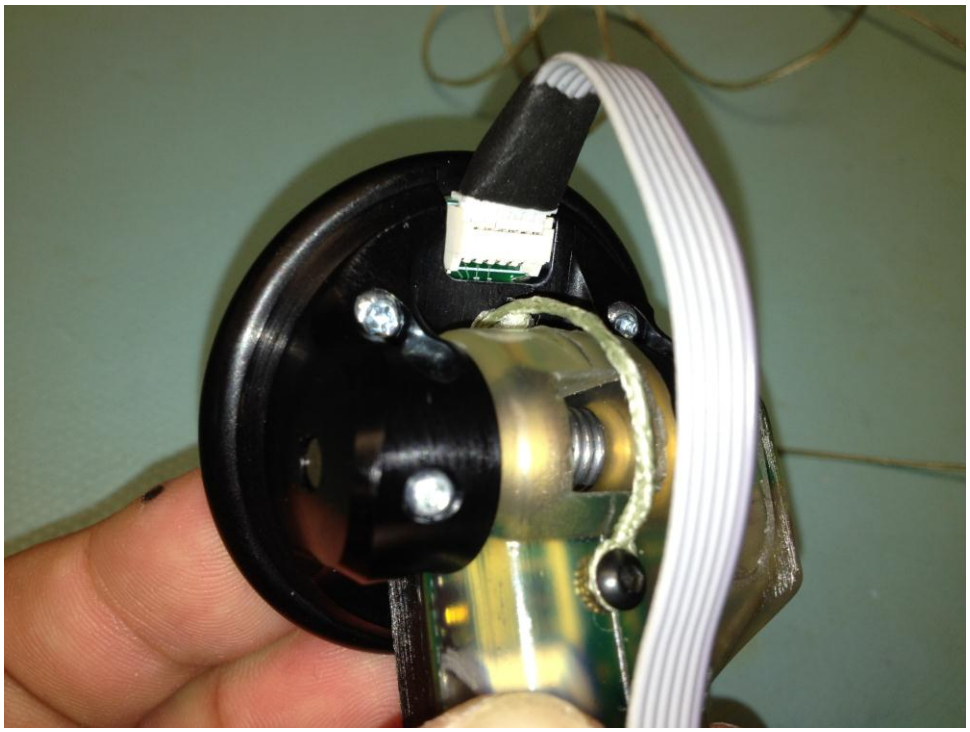
Feed the tendon through the hole in the breakaway base.



If replacing finger 3, install the antagonistic tendon by loosening the M2.5 screw with a 1.5mm hex key. Put the M2.5 screw through the loop at the end of the tendon and reinstall the M2.5 screw back into the finger. Feed the tendon through the hole in the breakaway base.



Plug the ribbon cable on the finger into the housing on the breakaway base.



Installing a New Finger

First, check the magnet and alignment groove for debris. The magnet will pick up small screws and pieces of wire that can interfere with the function of the connector.

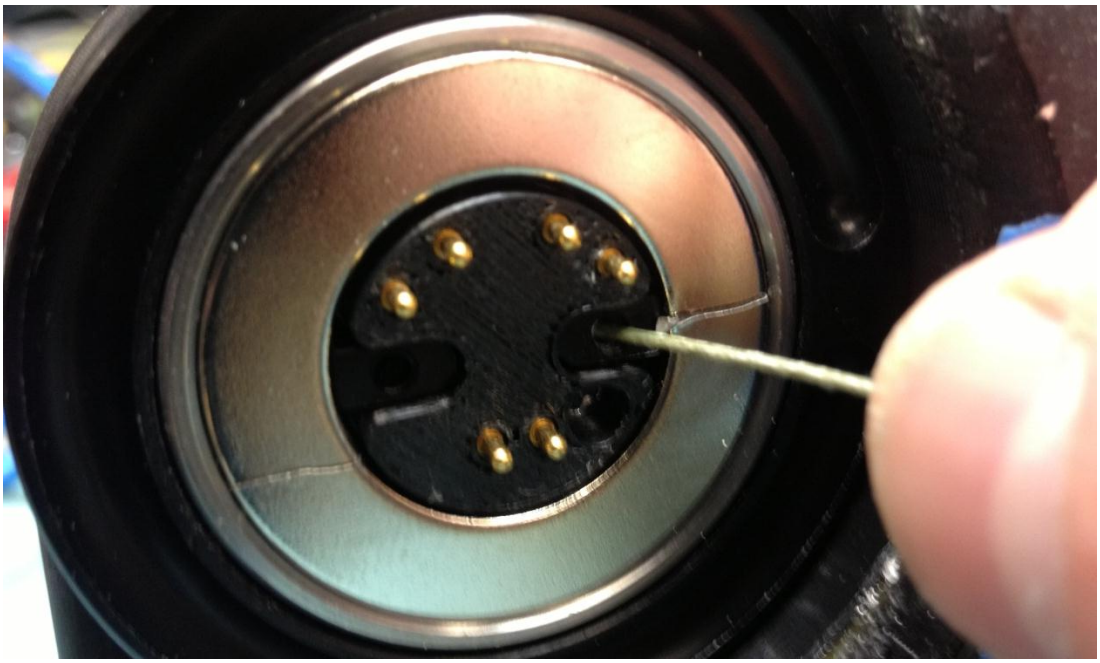
Check the function of the POGO pins, ensuring each one retracts and extends smoothly without binding. Also check to see the plastic POGO protector is fully seated.

When installing the new finger, align it as best as possible before snapping it to the base. If it is not aligned, gently rotate the finger using the proximal joint until the breakaway mechanism locks into place.

Feeding the tendon through the base

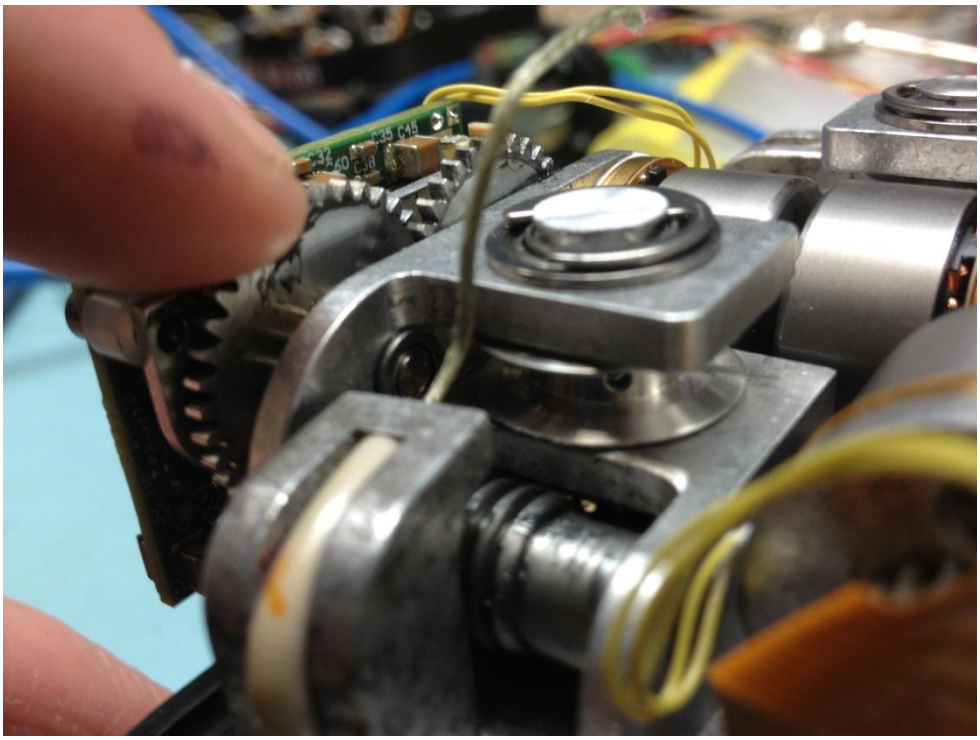
With a clean cut on the end of the tendon, begin feeding it through the hole in the base of the finger at a slight angle towards the pivot.

The tendon should emerge at the correct actuator inside the palm. If you cannot feed it through, or it doesn't appear at the actuator, you will need to try again and may wish to remove the finger to do so.

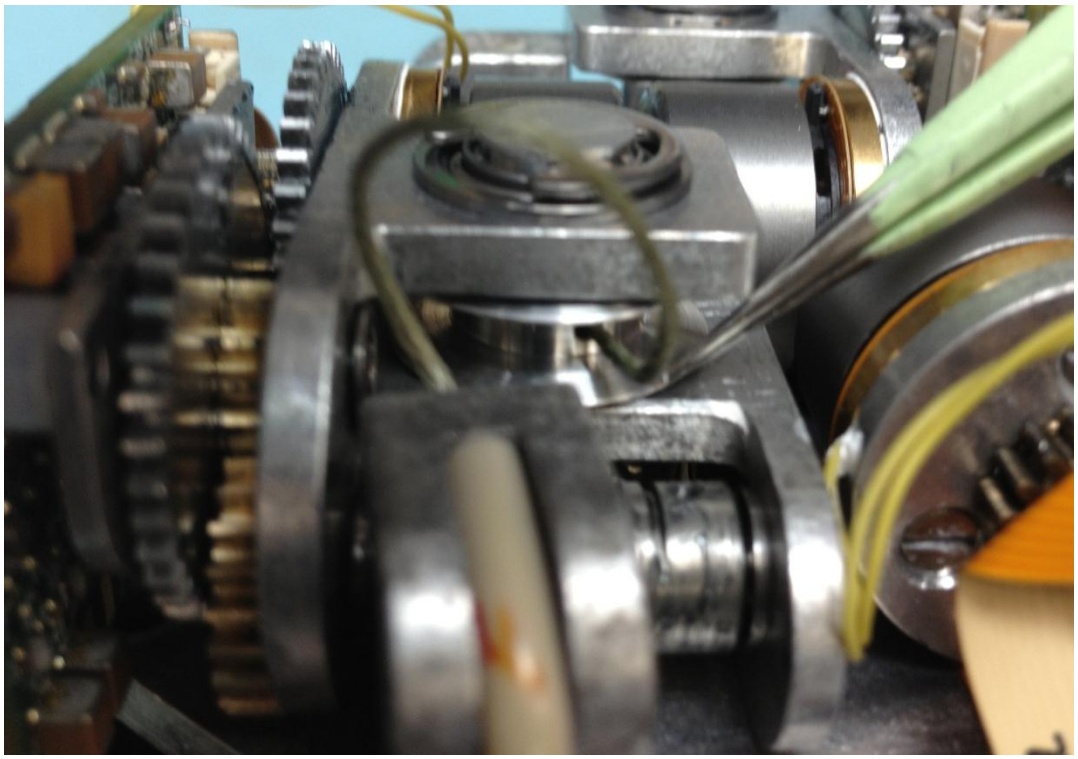


Feeding the tendon through the actuator and tying a knot

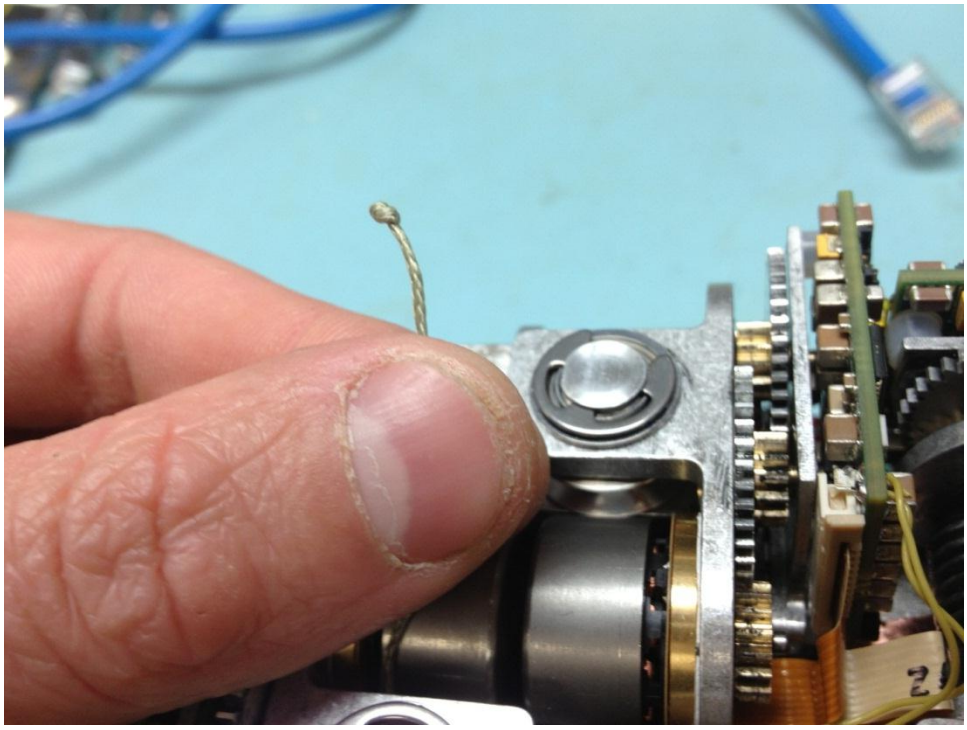
Rotate the actuator by spinning the large spur gear to make the hole in the drum easily accessible.



Feed the tendon through the drum and pull from the other side until a few inches has emerged.



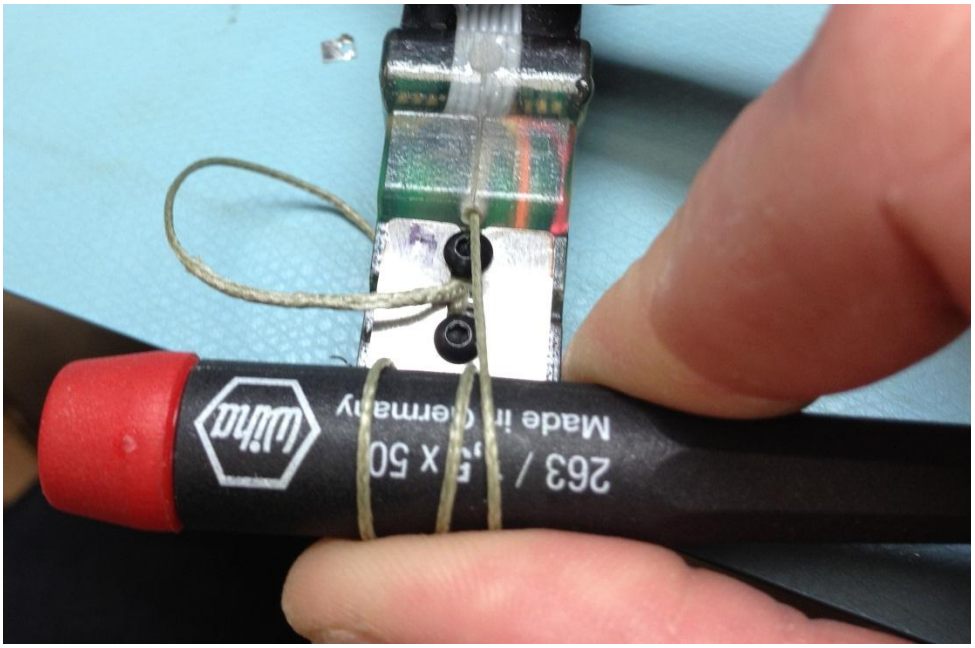
Tie a simple overhand knot and remove the excess with a sharp knife.



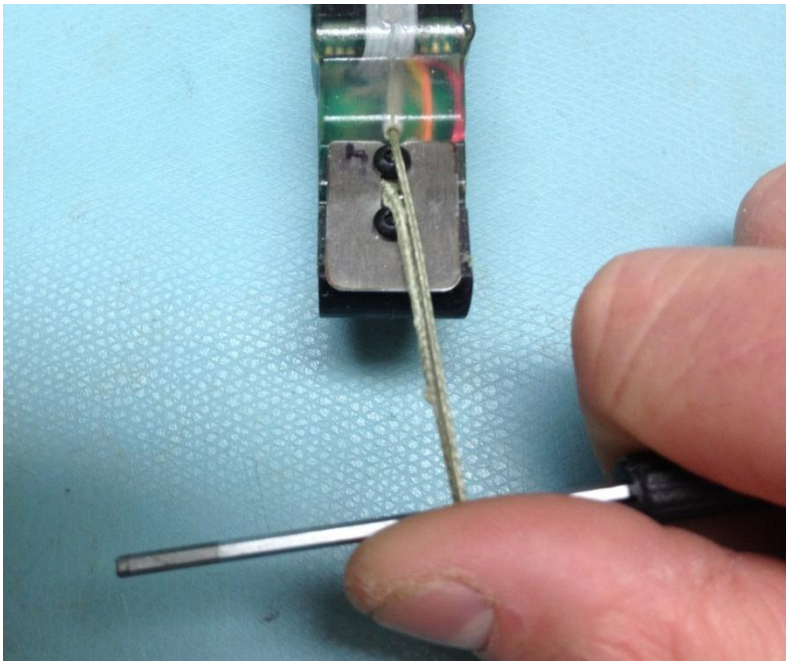
Remove all slack from the line by pulling gently at the line where it exits the fingertip. Pull until the knot is seated in the hole – but do not pull too hard as the knot will come undone.

Spooling in the Tendon

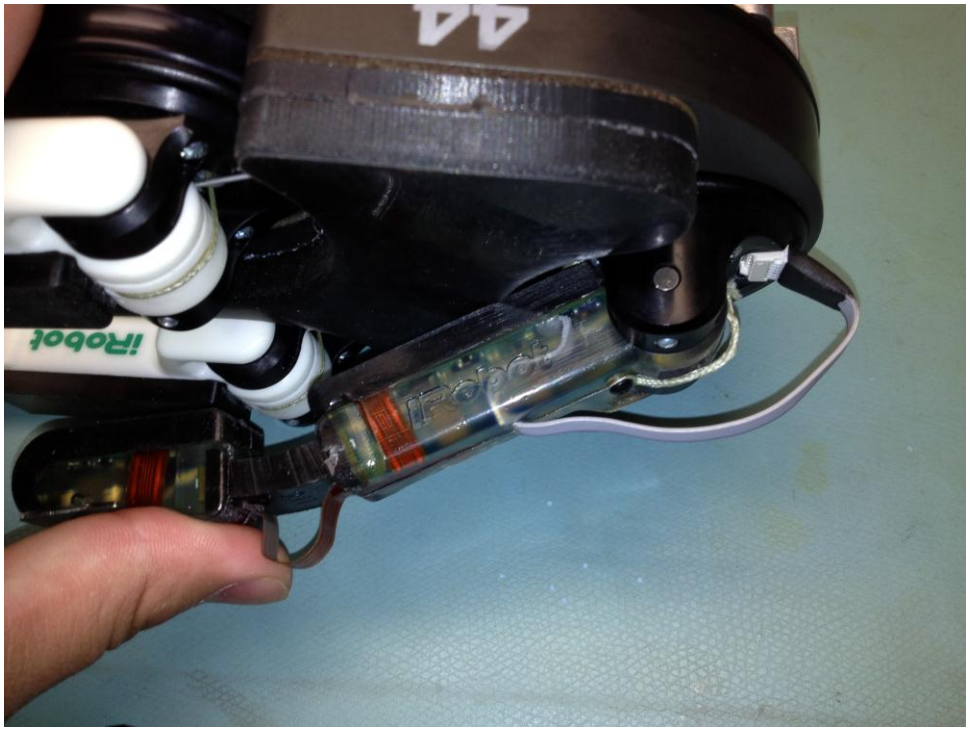
Much like fishing line, the tendon must be spooled on under some load to prevent bunching. I like to wrap the tendon around a screwdriver handle a few times and put pressure on it as I wind it in. Spool on one or two complete wraps under light resistance, then spool on the rest under heavy resistance.



BE CAREFUL NOT TO WRAP THE TENDON AROUND YOUR FINGER!! The actuator is very powerful, and the tendon can easily slice into your finger if proper care is not taken. After most of the slack has been taken up, wrap the tendon once around the shaft of the screwdriver and continue.



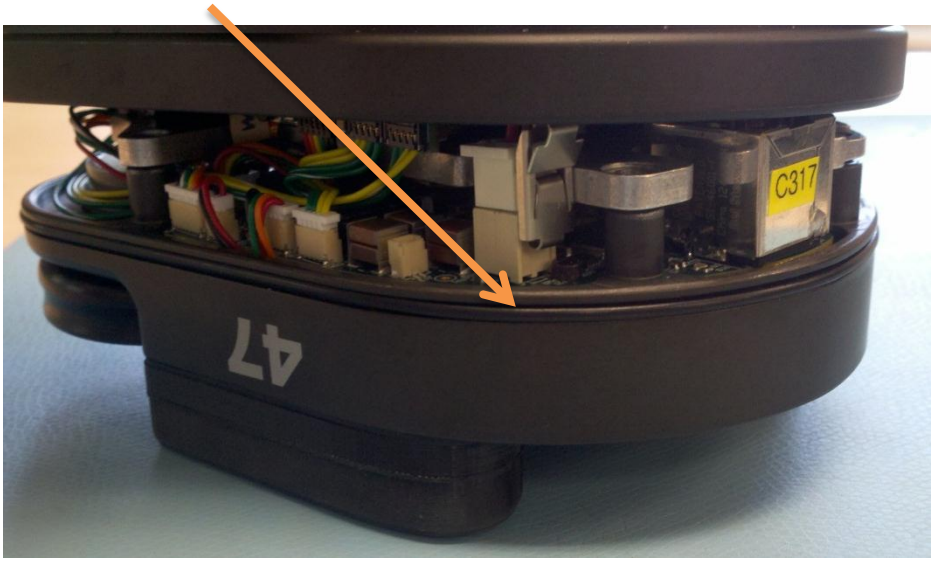
When spooling the antagonistic tendon, it is important to have the finger bent against the palm to provide enough slack for the full range of motion when actuated.



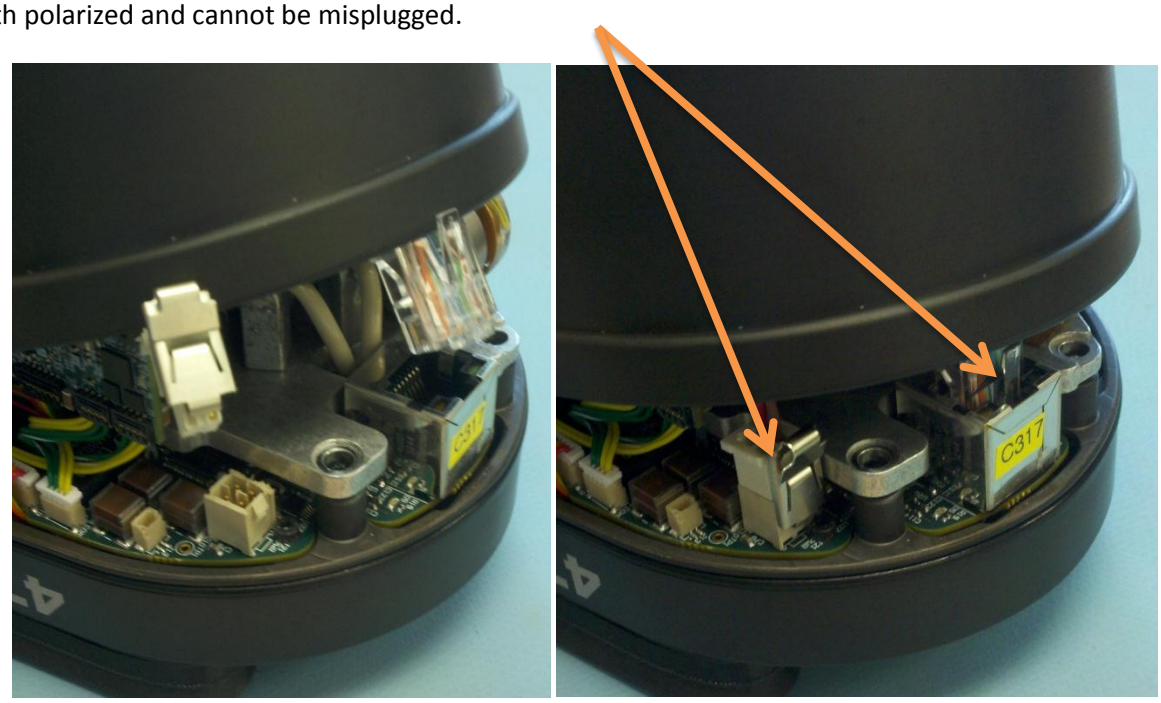
Reinstall the Back Housing

First, tuck in all loose wires and inspect all cable connections to ensure they are securely in place.

Inspect and ensure that the o-ring is intact and seated in the groove around the edge of the top housing.

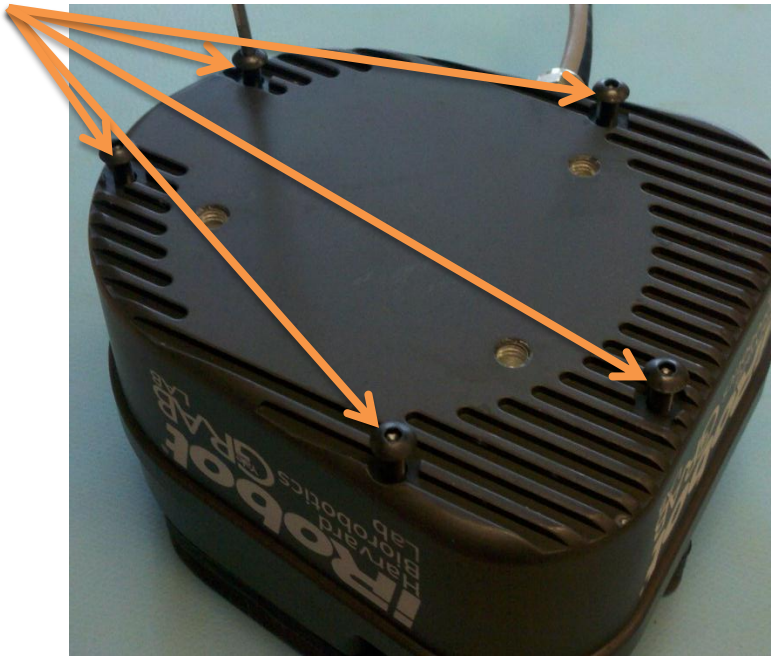


Lower the back housing onto the top housing and plug in the Ethernet and power connectors. They are both polarized and cannot be misplugged.



Slowly lower the back housing until it is fully seated on the top housing and covers the o-ring completely. You may need to gently twist the back housing back and forth to get the alignment just right as this is a very tight fit around the various plugs.

Install the five (5) M3 screws and you're done!



Software Changes

After swapping the finger, there are some minor software changes to make:

1. Loginto the hand
2. `makerw`
3. edit the `/etc/init.d/handle_control.sh` file:

To go from dumb to smart fingers:

4. Remove the `--dumb` or `-d` flag.
5. Save and exit the file
6. `makero`
7. power cycle hand
    a. if power cycling the hand is not possible:
    b. `./killhandle.sh`
    c. `./stopall`
    d. Run the last line in `/etc/init.d/handle_control.sh`. Be sure to run it in the background by using an "&".
    e. Logout

To go from smart to dumb fingers:

4. Add the `--dumb` or `-d` flag.
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    e. Logout