



OpenHand

Model F3

Version 1.0



Assembly Instructions

Last updated: December 15, 2024



Bill of Materials

Part Name	Quantity	Description	Vendor
Power Pro Spectra	1	Tendon	Amazon [link]
PMC-780 Urethane	1	Finger Joint Urethane	Smooth-On [link]
Dragon Skin 10 Silicone	1	Finger Pad Urethane	Smooth-On [link]
Ø1/4", L1-1/2", 8-32 zinc-plated female standoff	4	Support	McMaster [93330A482]
Ø3mm, L32mm dowel pin	8	Joint pin	McMaster [91595A138]
Shielded stainless steel ball bearing, 3mm shaft diameter	8	Joint ball bearings for reducing friction	McMaster [7804K126]
8-32, L3/4" countersunk bolt	8	Support bolt	McMaster [92210A197]
M2.5, L8mm bolt	2	Center bolt for Dynamixel (included w/ Dynamixel)	McMaster [91292A012]
M2, L5mm bolt	4	Mounting bolts for Dynamixel	McMaster [91290A012]
4-40, L0.135" heat-set insert	4	Insert for bolt anchors	McMaster [93365A120]
4-40, L1/4" countersunk screw	4	Tendon/spring anchors	McMaster [91253A106]
Dynamixel XM430	2	Actuator	Various [Link]
Logitech C920x HD Pro Webcam	1	RGB Camera	Amazon [link]

* **Note** * There are certainly other combinations of fasteners that may work with these designs. We do not even claim that the parts list provided here is optimal for these designs. They are merely the components that we have used in past builds.



Printed Parts List

Part Name	Quantity	Description	STL File Name
F3 finger (thin wall mold)	2	Fingers	F3_finger_mold.STL
a1 part 1	1	Finger base with camera mount	a1_part1.STL
a1 part 2	1	Extended camera mount	a1_part2.STL
a2	1	Motor fixture top	a2.STL
a3	1	Motor fixture bottom	a3.STL
a4	1	Mount to robot arm	a4.STL
b1	2	Tendon routing for motors	b1_xm_f3.STL
d1	2	Case	d1.STL
Bearing sleeve	8	Sleeve for ball bearings to prevent tendon from slipping	bearing_sleeve.STL



Finger Sub-Assembly

Flexure-Flexure

Parts

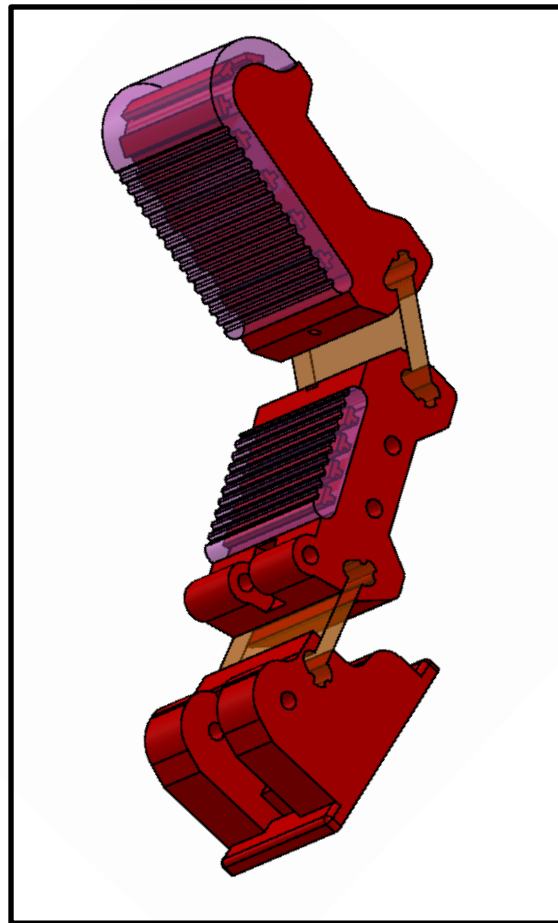
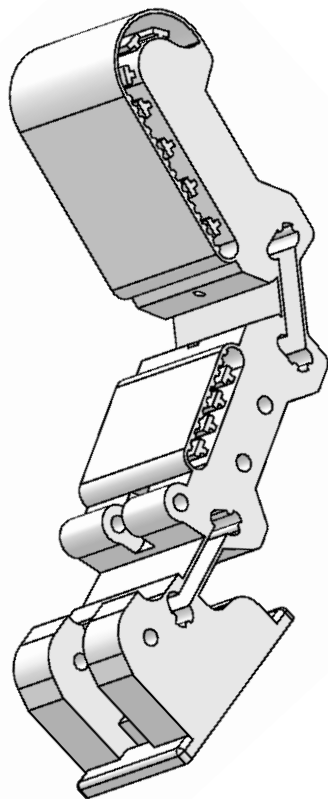
F3_finger_mold.STL

(x2)

PMC-780 urethane (2:1)

Dragon Skin 10 Silicone (1:1)

Refer to the *OpenHand Finger Guide* for more detail on casting these pads and flexures. No pins or additional elastic elements are needed for the joints in the Flexure-Flexure finger design.



*** Note *** We printed the finger in red so that it stands out from the background. Theoretically any finger color that doesn't blend in with the background should work fine for force estimation.



Finger Sub-Assembly

Flexure-Flexure

Parts

Flexure-flexure finger from page 3 (x2)

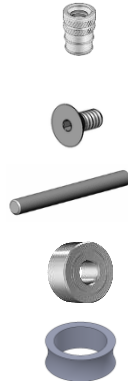
4-40, L0.135" heat-set insert (x2)

4-40, L1/4" countersunk screw (x2)

Ø3mm, L32mm dowel pin (x8)

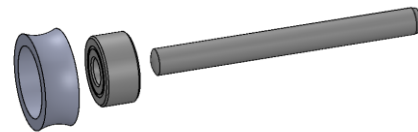
stainless steel ball bearing (x8)

bearing sleeves (x8)

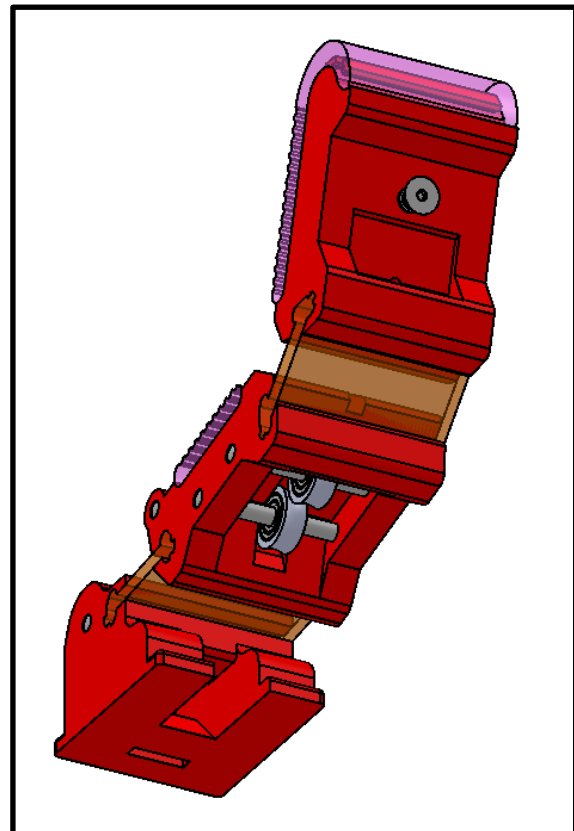
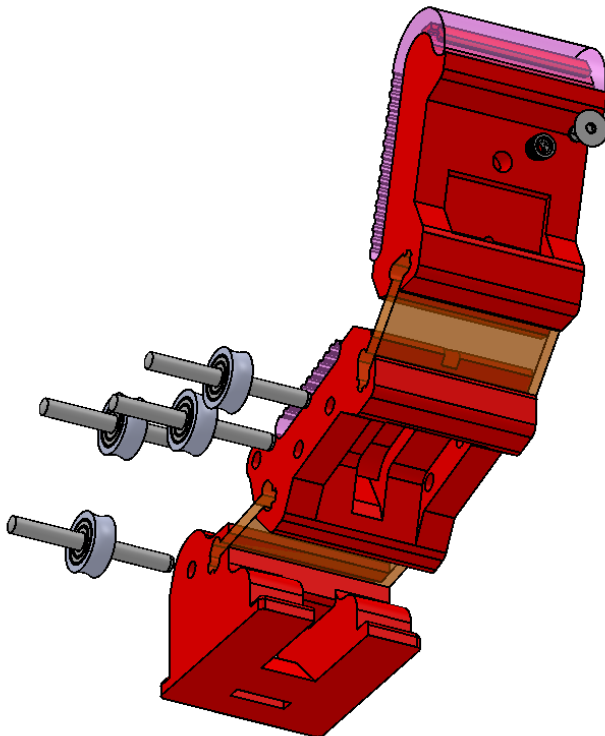


Press fit the 3mm dowel pins for tendon-rerouting into the finger links. If the pins do not press-fit easily, use a larger reamer to clean out the pin clearances or a vice. Use a soldering iron to install the heat-set insert into the distal link. The heat-set insert can be skipped in favor of using a nut for tendon termination.

The tolerance of the bearing sleeve may come out differently from different printers. Test print and change the size of the inner sleeve to find out what would achieve a press or loose fit. Fix sleeve relative to outer bearing using super glue if necessary.



Bearing sub assembly



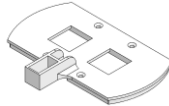
Finger Sub-Assembly

Flexure-Flexure

Parts

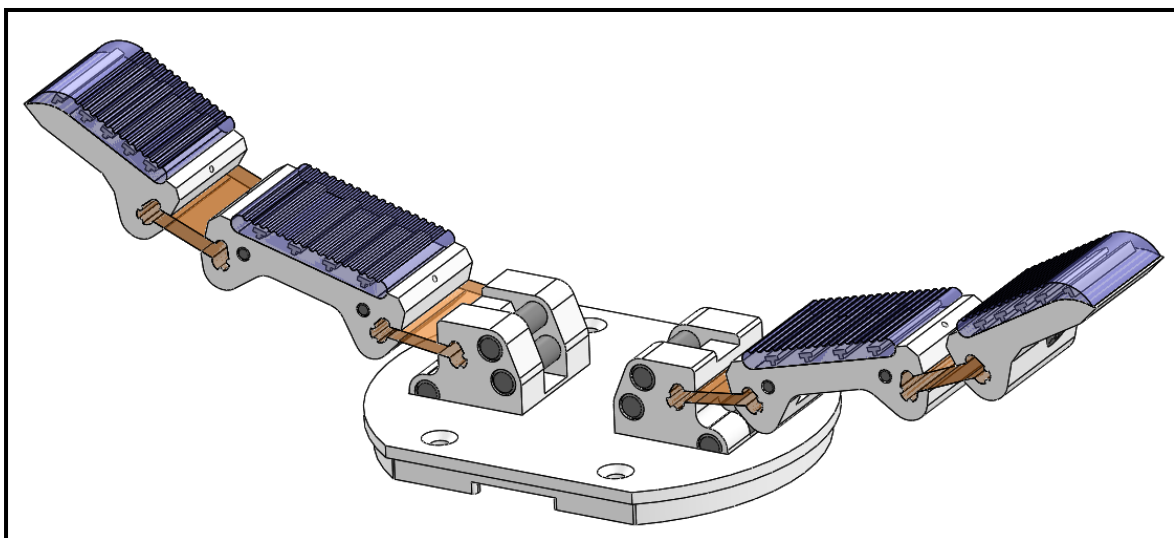
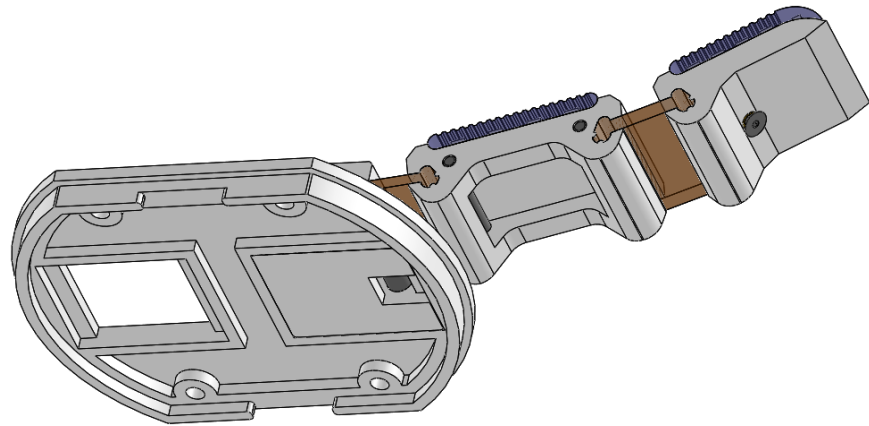
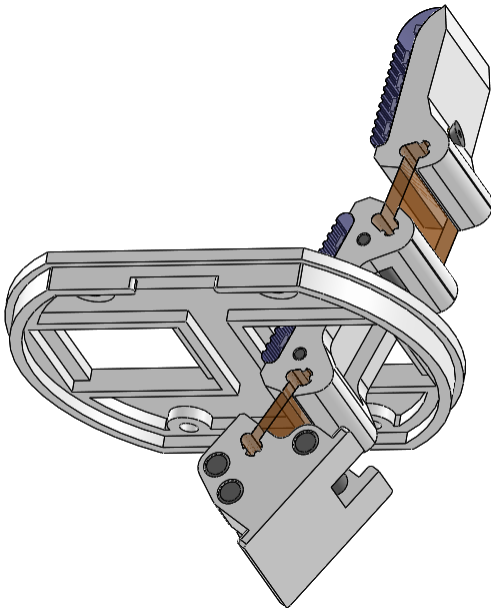
Flexure-flexure finger sub-assembly
from page 4 (x2)

a1_part1.stl



The Flexure-Flexure fingers are simply inserted up through the top plate *a1_part1.stl* and press-fit into place.

The following visuals are adapted from the T42 finger assembly guide. The a1 part used for F3 is wider but should follow the same assembly. Part 1 and part 2 of a1 can be glued or clamped together.





Actuator Sub-Assembly

Dynamixel

Parts

Dynamixel XM430 (x2)

b1_xm_f3.stl (x2)

Spectra tendon line

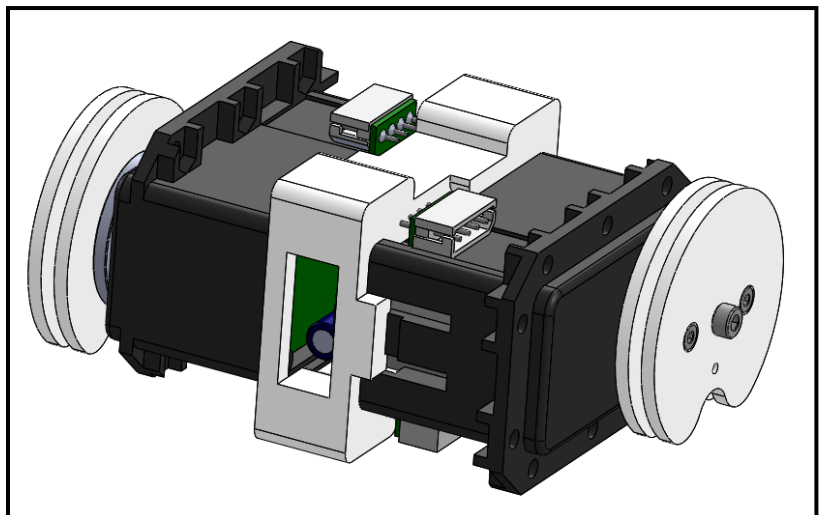
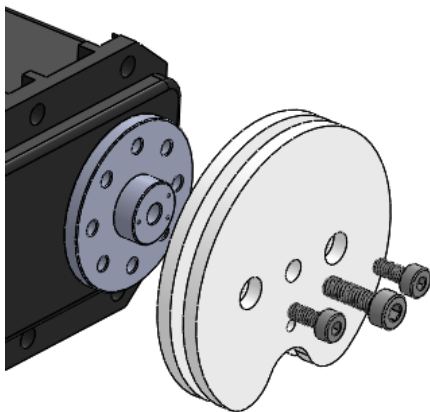
M2.5, L8mm bolt (x2)

M2, L5mm bolt (x4)



Tie about a foot (~30cm) of tendon line to the servo pulley *b1_dynamixel_t42.stl* through the non-bolt hole. It's a good idea to wire the two Dynamixels together in a daisy-chain setup in this step.

The following final assembly is adapted from the T42 assembly guide. The middle-printed part is no longer needed and the Dynamixels should fit directly between parts a3 and a4.





Actuator Sub-Assembly

Dynamixel

Parts

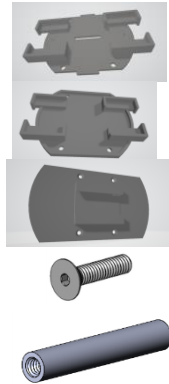
Dynamixel sub-assembly from page 12

a2.stl

a3.stl

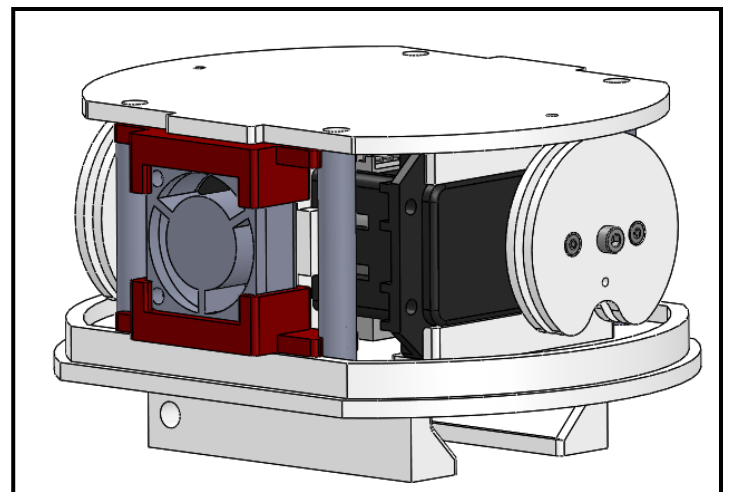
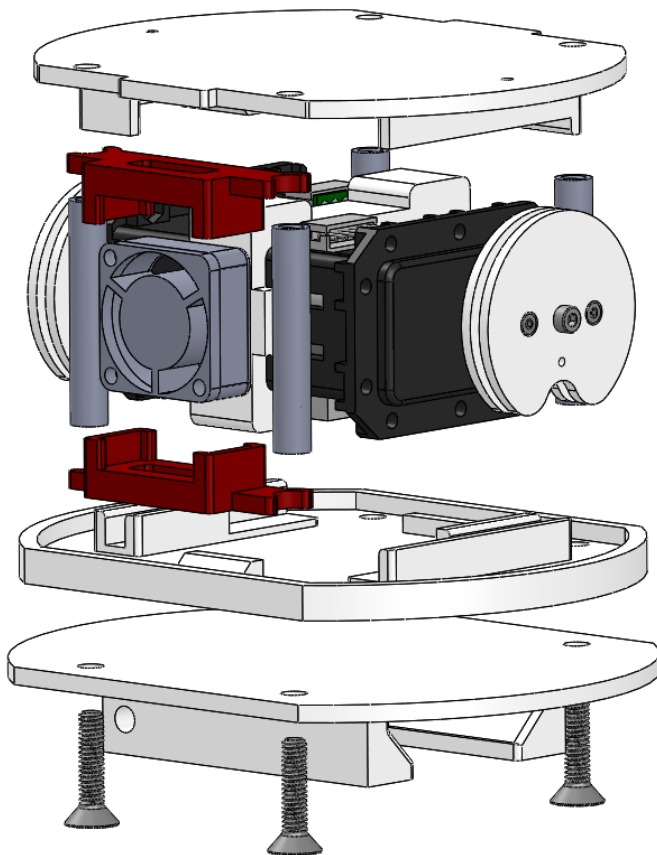
a4.stl

8-32, L3/4" countersunk bolt (x4)

 $\varnothing 1/4"$, L1-1/2", 8-32 zinc-plated
female standoff (x4)

The final actuator sub-assembly is sandwiched together as shown. The Dynamixel sub-assembly should be oriented such that negative rotation (counterclockwise) of the servos will pull the tendon downwards.

The following visuals are adapted from the T42 assembly guide. The cooling fans are not needed and the a2, a3, a4 parts are wider than they were to avoid additional finger tendon routing. The overall structure should be similar to T42.





Final Assembly

Hand Frame

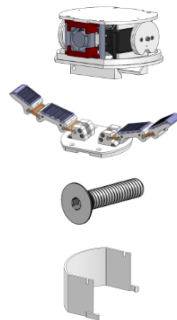
Parts

Actuator sub-assembly (Dynamixel)
from page 7

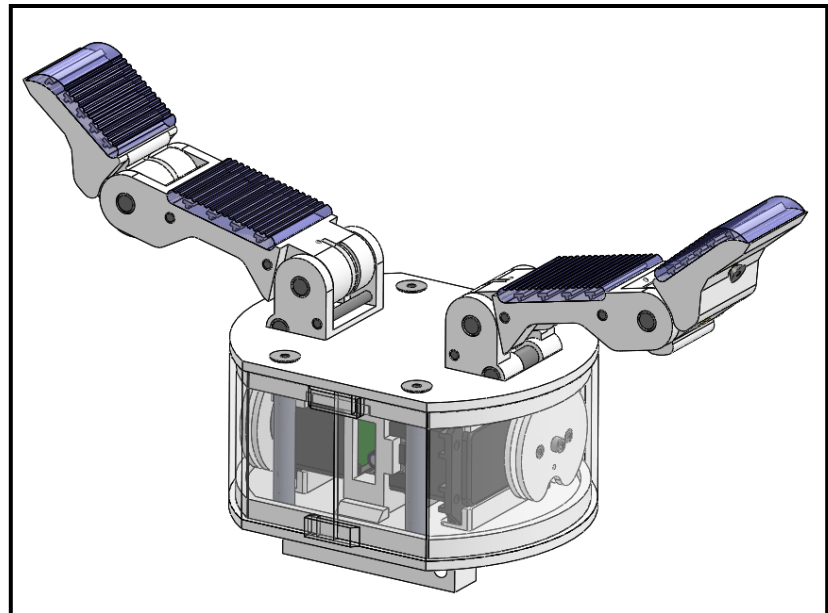
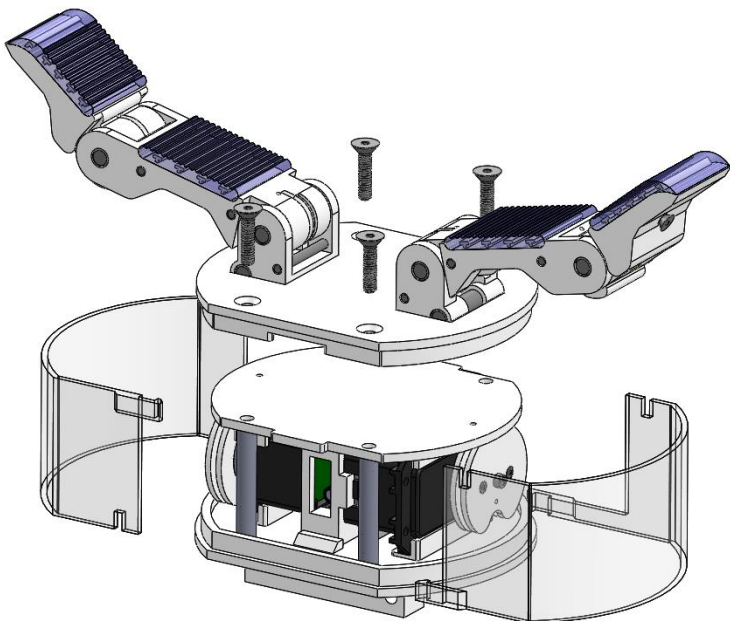
Top flexure-base sub-assembly from
page 5

8-32, L3/4" countersunk bolt (x4)

d1.stl (x2, optional)



The top sub-assembly with topmost plate and the fingers are assembled onto the actuator sub-assembly in the same way, no matter which fingers are used. Use the 4 countersunk 8-32 bolts to sandwich and secure all the parts together.





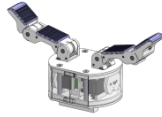
Final Assembly

Tendon Routing

Parts

Hand assembly

Spectra tendon line



The tendon is routed from the servo pulley through the tendon clearance. The tendon is routed for each finger as shown below. The tendons will run over the ball bearings on the dowel pins.

The tendon can be terminated on the bolt at the back of the distal finger link or with a nut right after the tendon exits the back of the finger.

To zero the tendon line:

1. Anchor the tendon
2. Hook up the actuator and command it to its zero position
3. Unscrew the pulley until it can spin freely
4. Rotate the pulley until the tendon line is taut
5. Re-secure the drive pulley to the actuator

