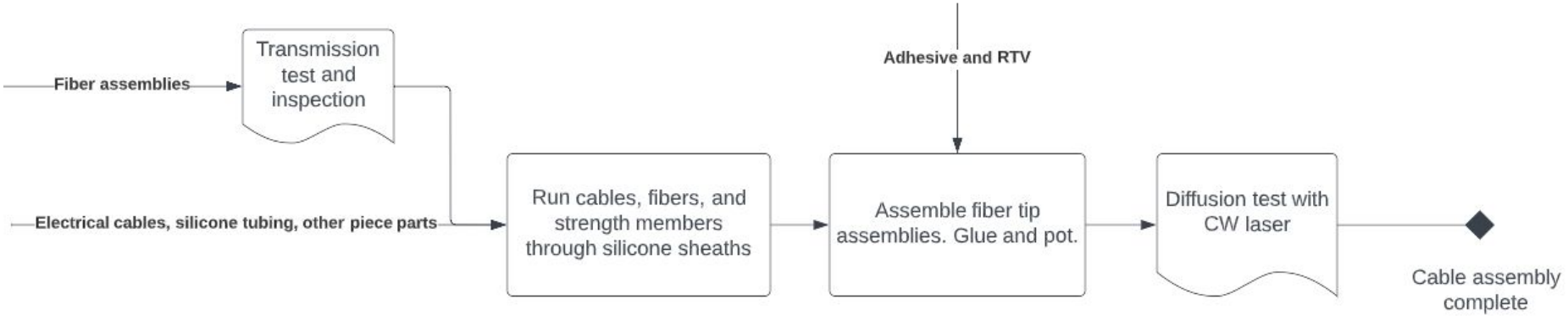
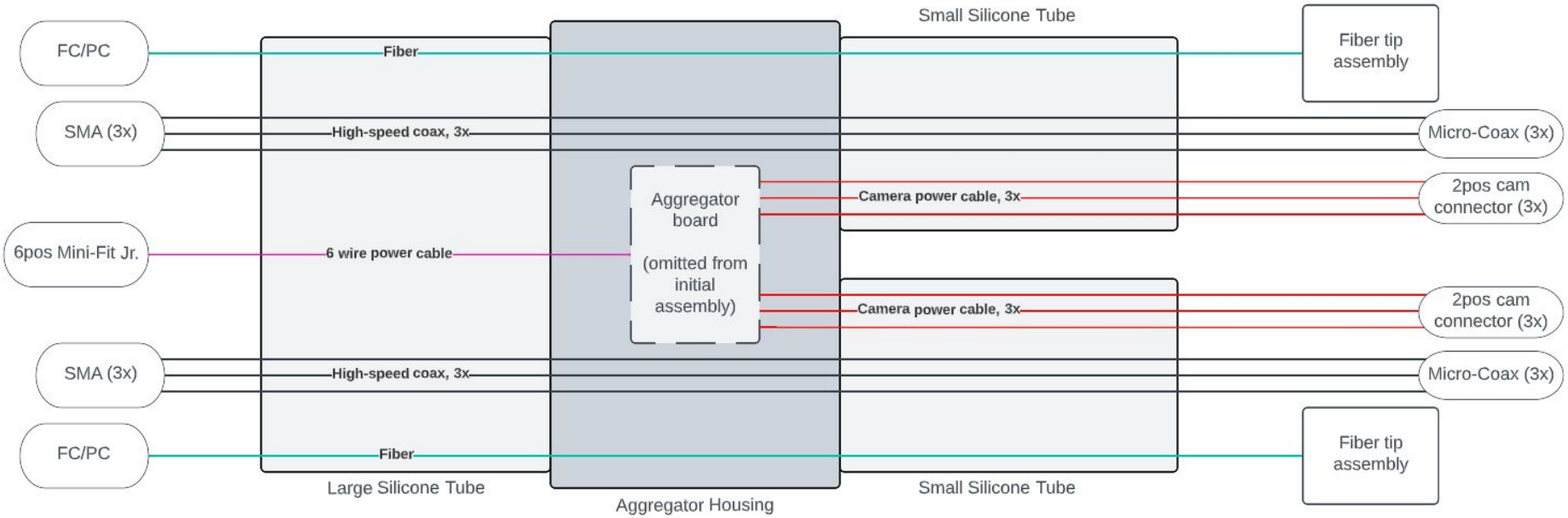
Openwater Blood Flow Hybrid Cable Design and assembly overview

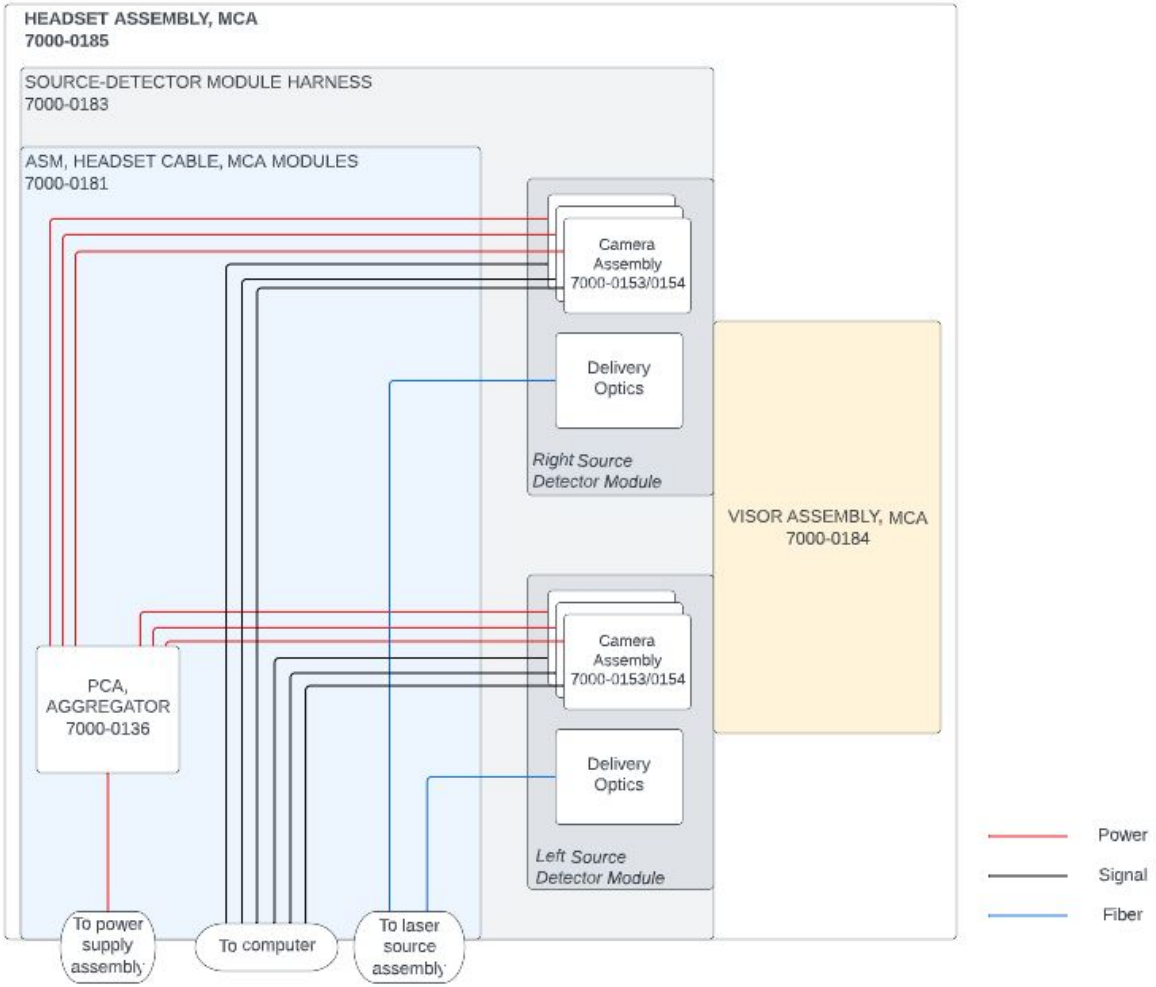
High-level process flow



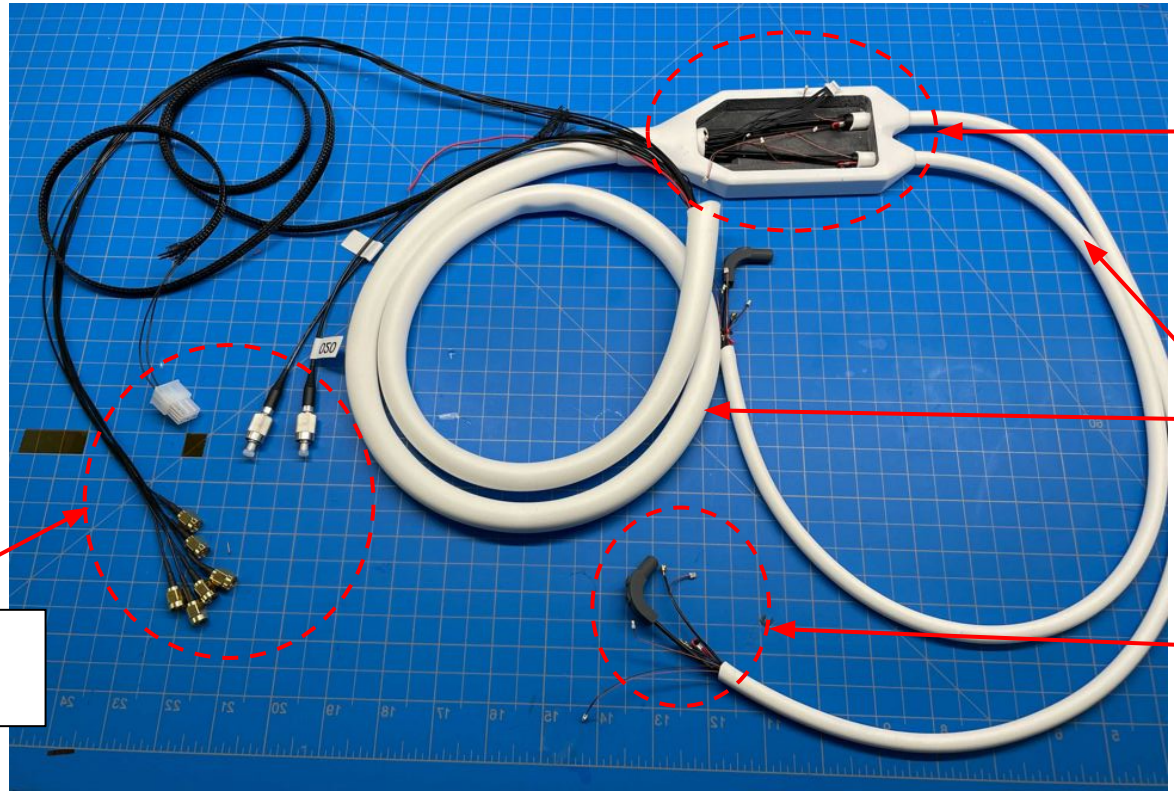
Block diagram
Hybrid cable



Block diagram
Complete 6-cam headset assembly
7000-0185
For reference



Design overview
Complete cable



Aggregator assembly

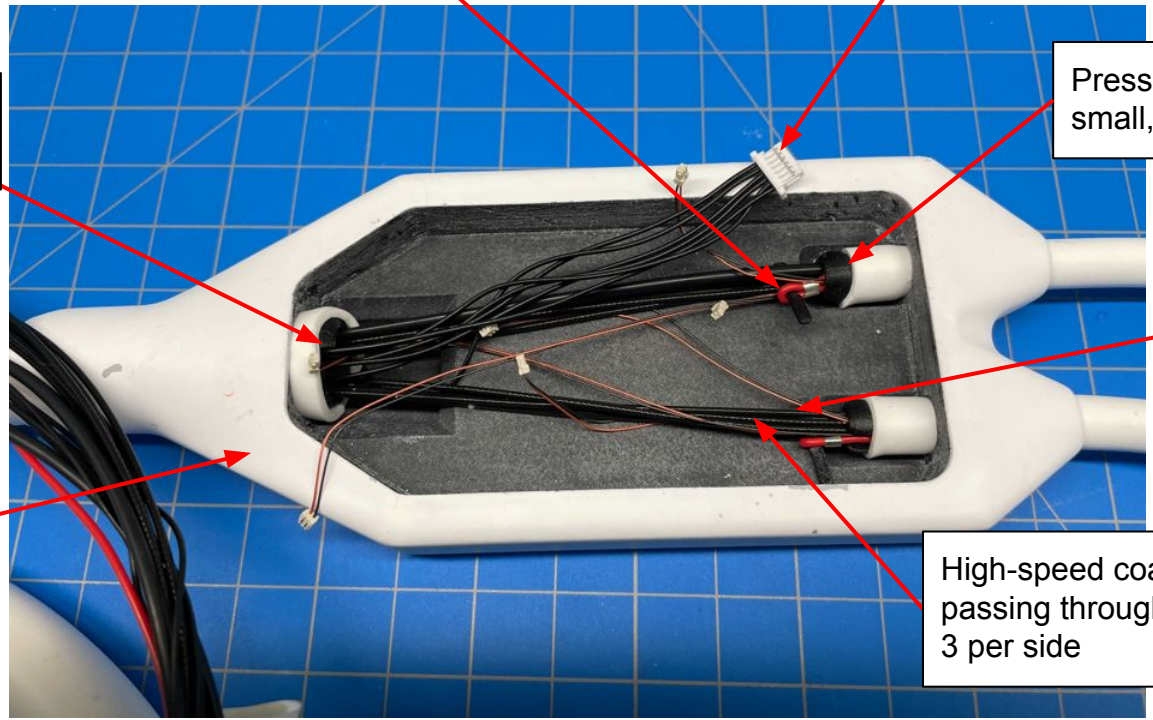
Silicone tubing, all parylene coated

Module components, 2 places

Delivery optics and connections to cameras

Connections to system console

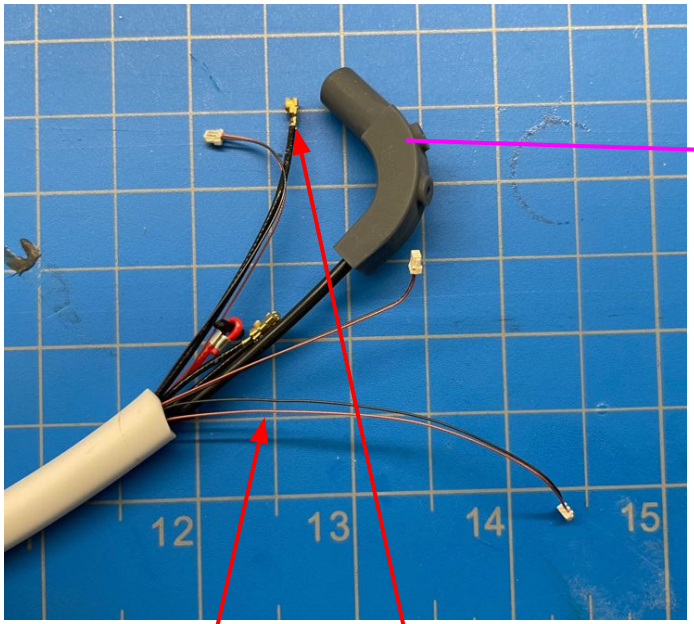
Design overview
Aggregator assembly



Note that the aggregator board is not populated at this level of assembly. Access to the 32ga wires is required during installation of the cameras later on. Aggregator board installed and housing closed out after those steps are complete.

Design overview
Module connections and delivery optics

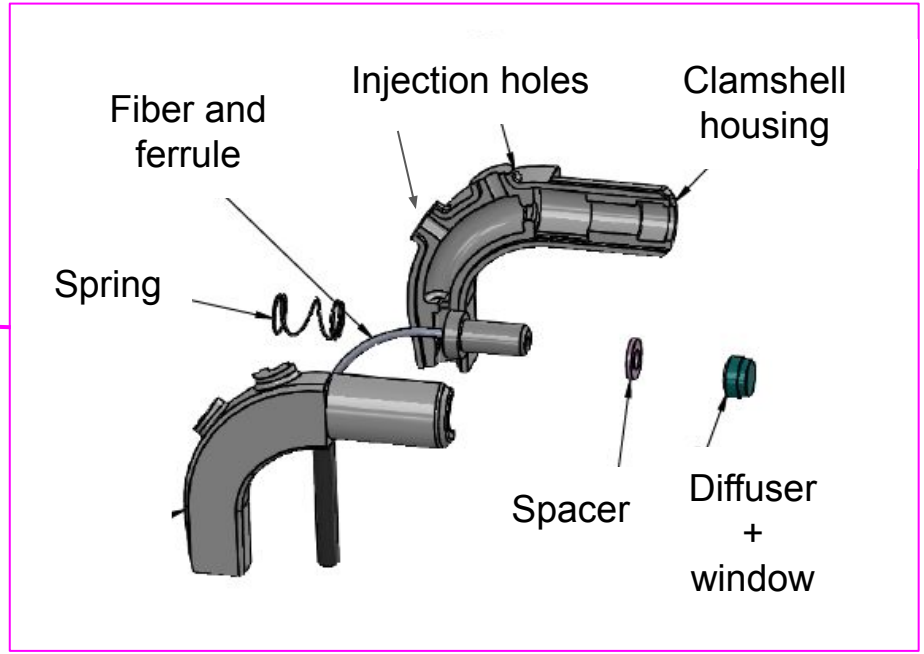
Module components, 2 places



32ga camera power cable, 3x

High-speed coax, 3x

Micro SMA

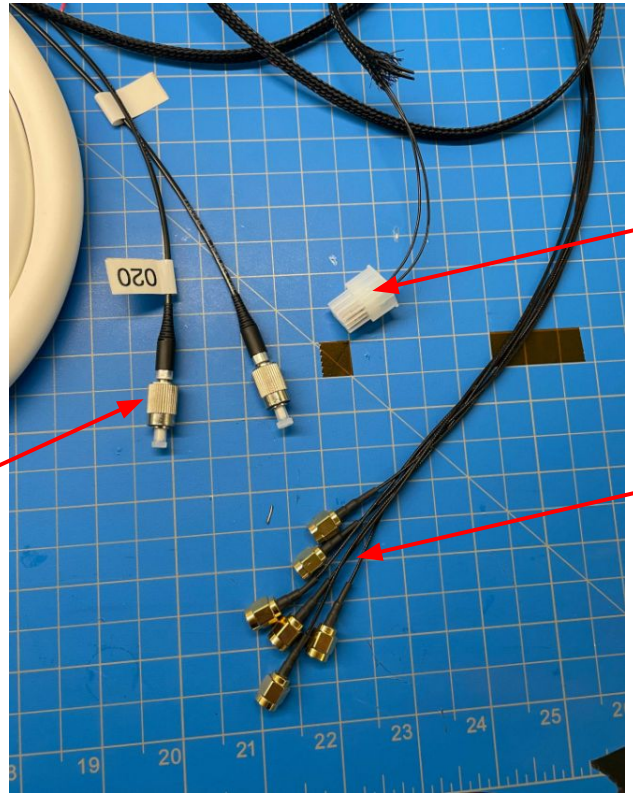


Laser tip assembly

The fiber is tacked in place during assembly with UV cure adhesive

The laser tip assembly is potted with RTV after assembly

Design overview
Connections to system console



Connector to power distribution board

6 position Mini-Fit Jr.

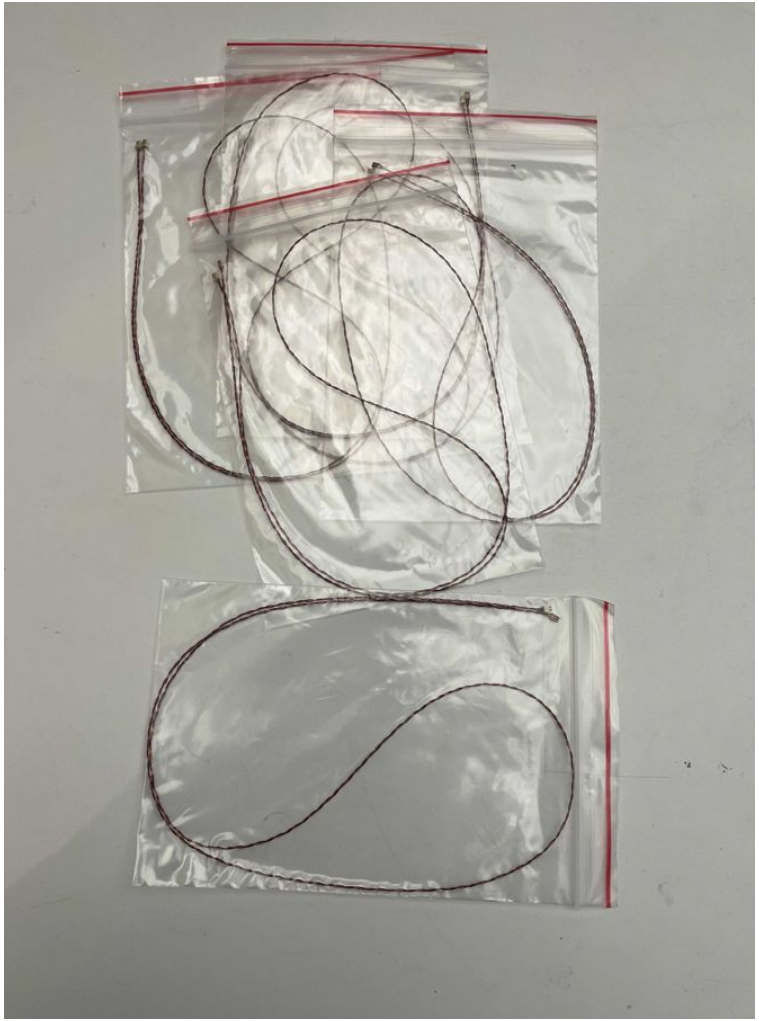
High-speed coax camera connections to computer, 6x

SMA

Fiber connectors, 2x

FC/PC

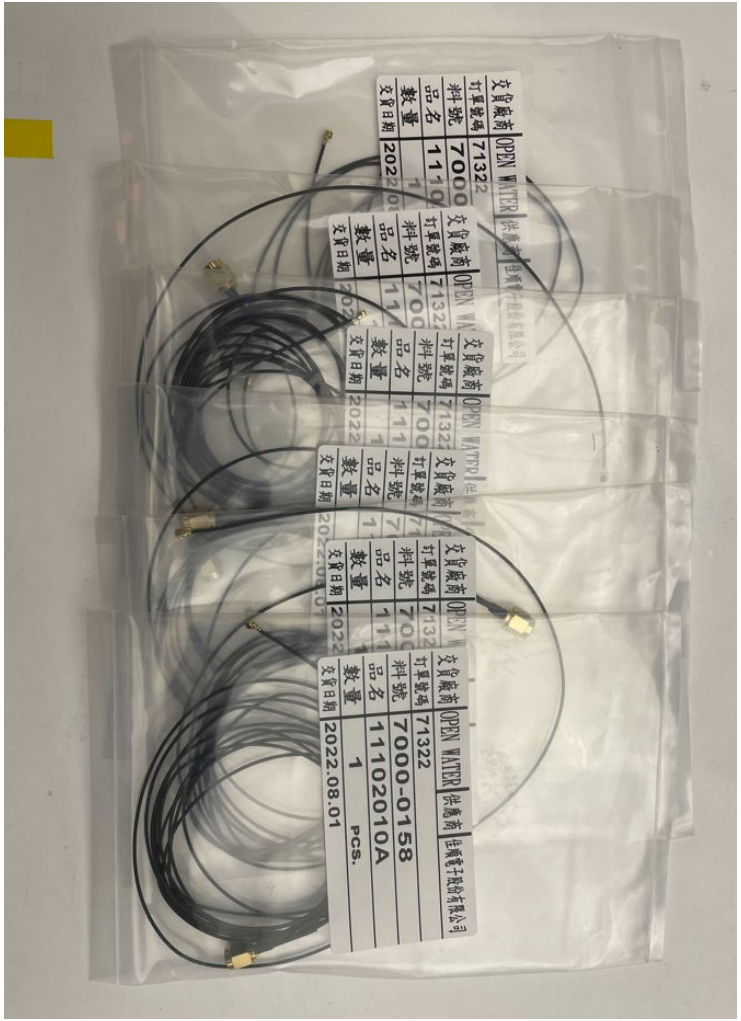
Assembly process



Obtain materials

32ga camera power cables
7000-xxxx
QTY 6

Note that these cables are twisted pairs, with dot of adhesive at rear of connector to act as strain relief



Obtain materials

High-speed coax camera cables
7000-0158
QTY 6

Obtain materials

6-wire power cable
7000-xxxx
QTY 1

Note that this part number will be updated with pre-installed Mini-Fit Jr. version

Make subassembly

Fiber assembly
7000-0141
QTY 2

Ensure that fibers are tagged with serial numbers near the fc/pc connectors, serial numbers are recorded, and fiber assembly transmission is tested

*Confirm adhesive curing process with pull test data recorded.

Obtain materials

Aggregator housing

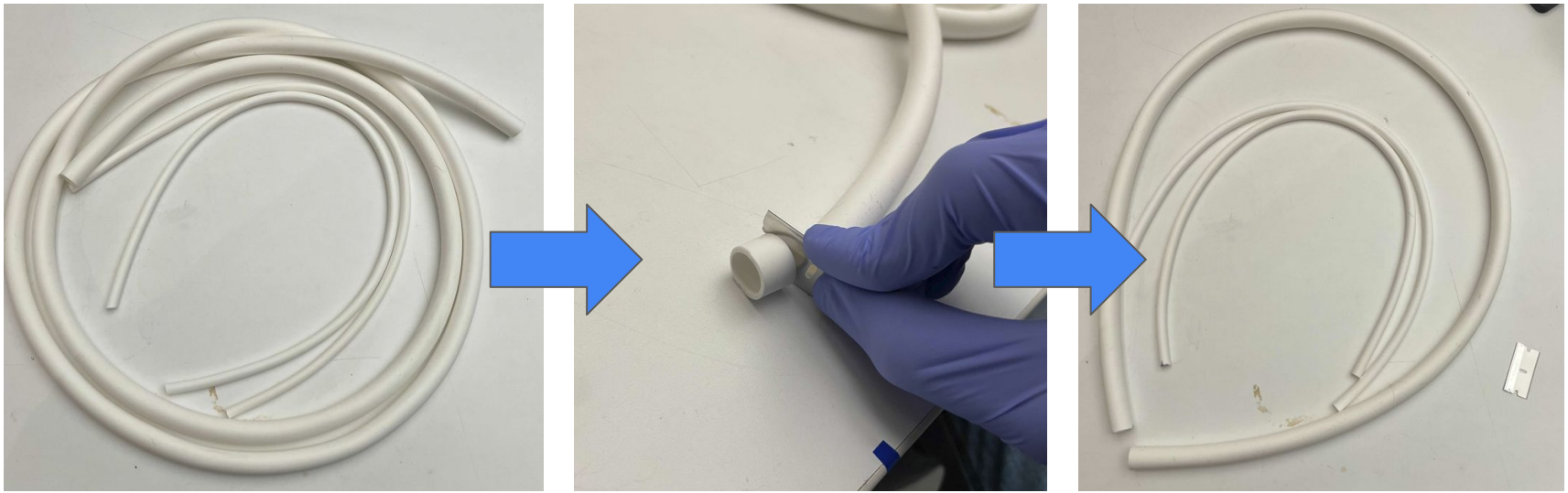
1x Body
3000-xxxx

1x Lid
3000-xxxx

Prepare silicone tubing
Obtain parylene coated silicone tubing, large and small.

Cut to length with a razor blade. Ensure that both ends have been cut square.

2x (small tube, PN)
1x (large tube, PN)



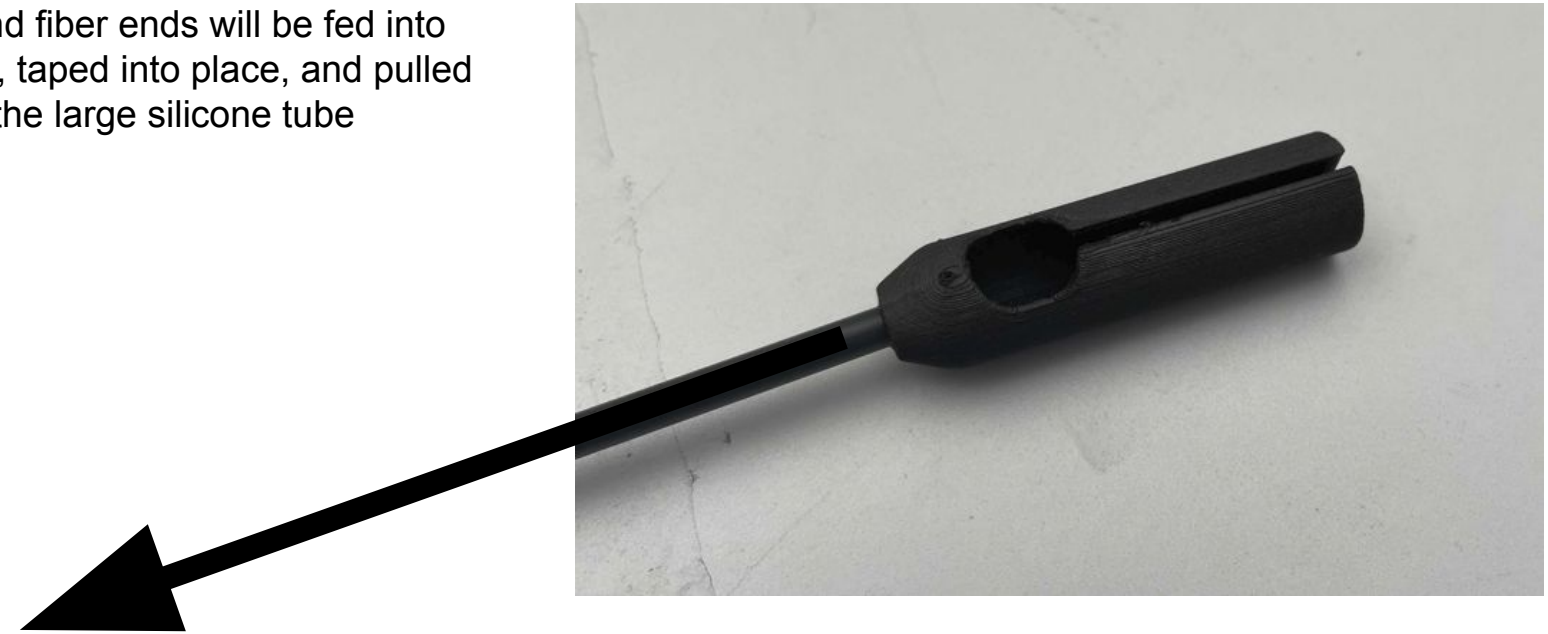
Obtain materials

Sheath stop, large
3000-xxxx
QTY 1

Sheath stop, small
3000-xxxx
QTY 2

large pull tool
3000-xxxx

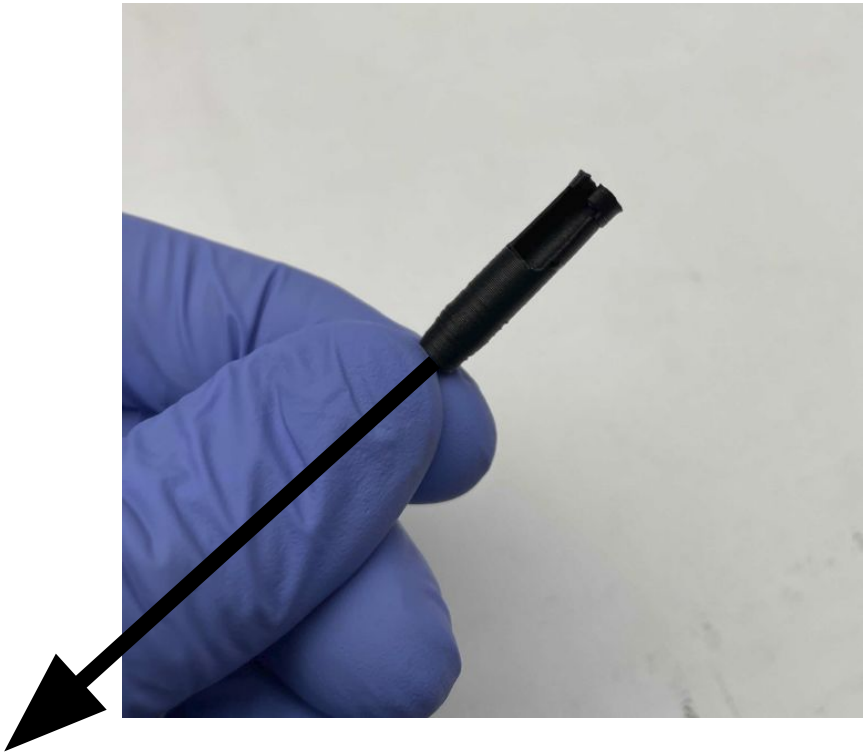
Cable and fiber ends will be fed into this tube, taped into place, and pulled through the large silicone tube



Glued to ~2m long flexible rod

small pull tool
3000-xxxx

Cable and fiber ends will be fed into this tube, taped into place, and pulled through the large silicone tube



Glued to ~1m long heavy gauge flexible wire

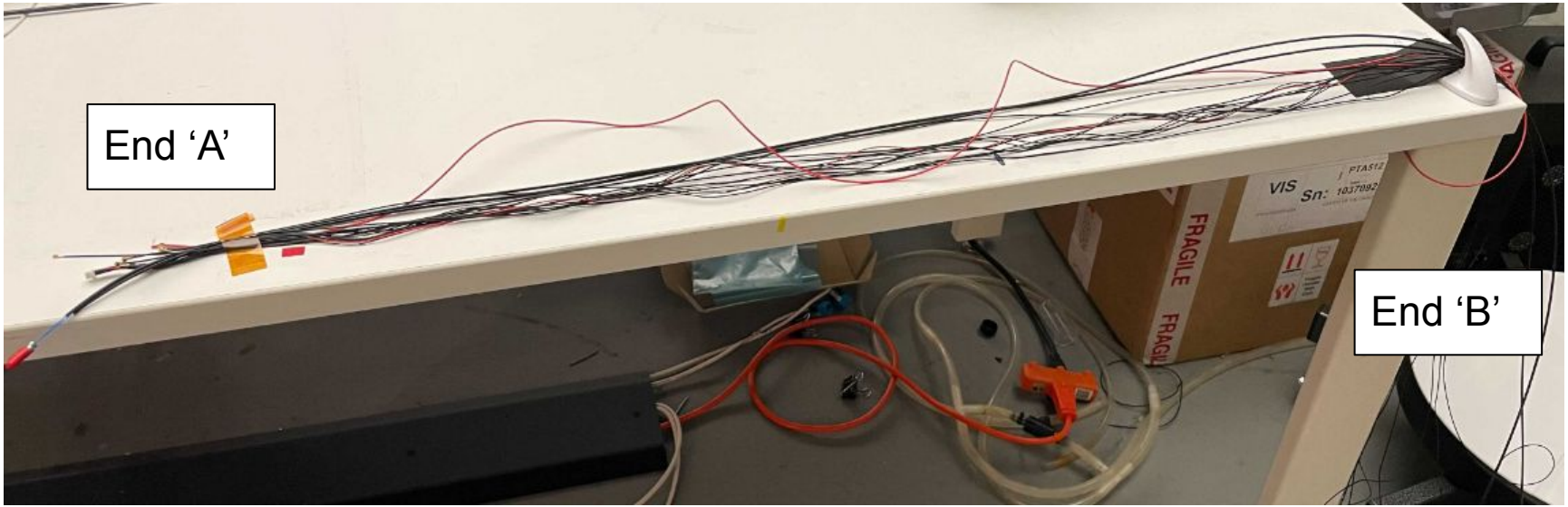
Prepare large tube strength member wire

Obtain strength member wire (24 ga stranded) and verify that it fits through the receiving hole in the large sheath stop

Cut a length of wire approximately 12 inches longer than the large silicone tube (~56 inches total)

Crimp a jewelry crimp at one end of the wire with rounded-tip needle nose pliers

Arrange cables to be pulled through silicone tube

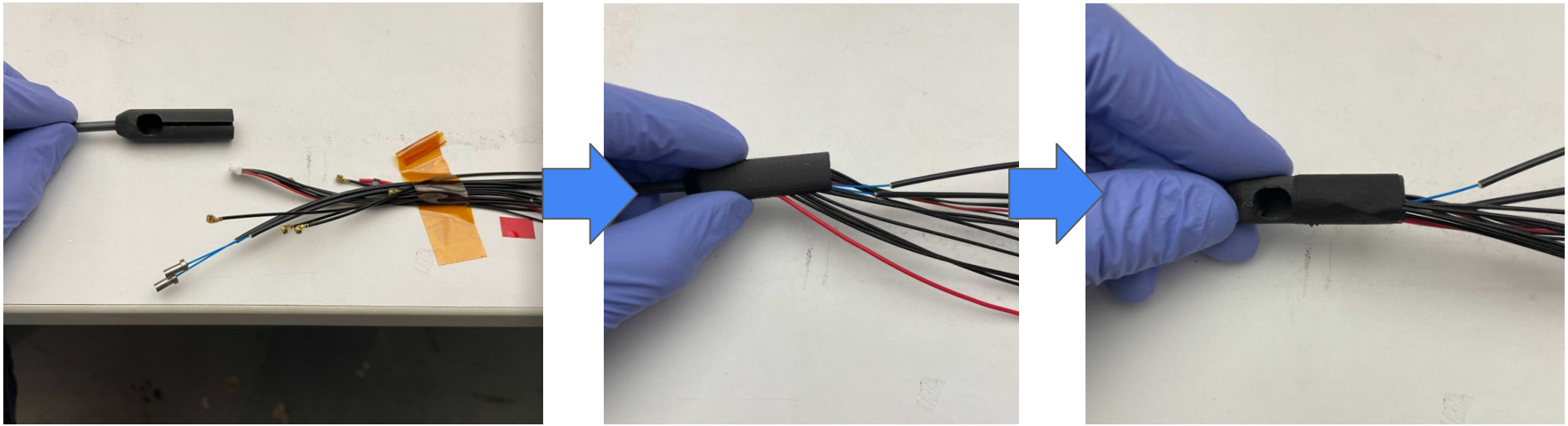


Gather the component cables on the bench to be pulled through the large silicone tube

- 1x 6-wire power cable
- 6x high-speed coax able, micro SMA connectors at end ‘A’
- 2x fibers, ferrules at end ‘A’
- Strength member wire, crimped end at end ‘A’

It has been helpful for us to route them through a hook at the end of the table, and hold the bundle in place with a piece of Kapton tape

Load components into large pull tool



Load component cable/fiber ends into tool in this order:

1. 6-wire power cable
2. Fiber ferrules (with protective covers temporarily removed)
3. Micro-SMA coax cables
4. Strength member wire (crimped end)

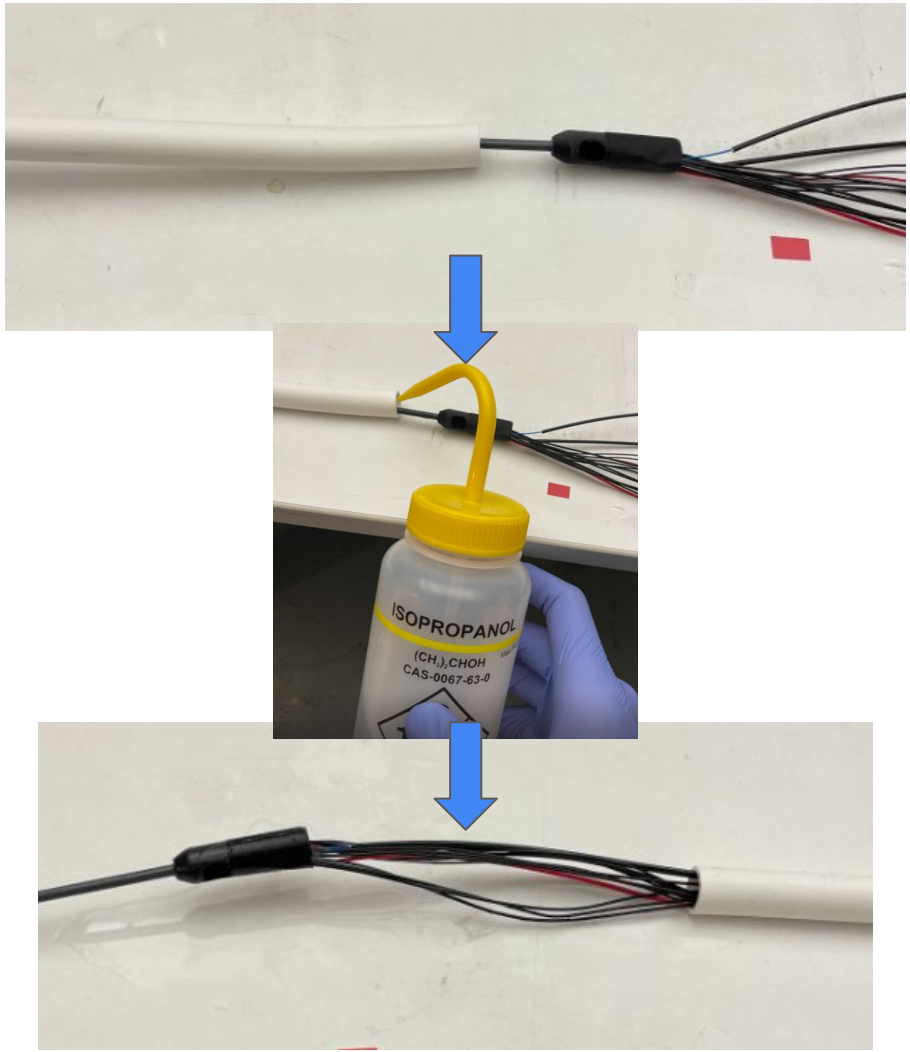
Gather the wires to minimize the cross-section, and secure in place by wrapping a piece of tape around the tool (1-inch 3M Black ShurTape)

Pull components through large silicone tube

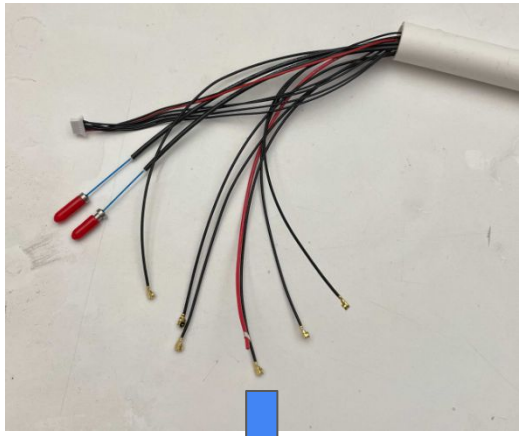
Slip the large silicone tube over the pull tool shaft, until it is close to the bundled cables as shown

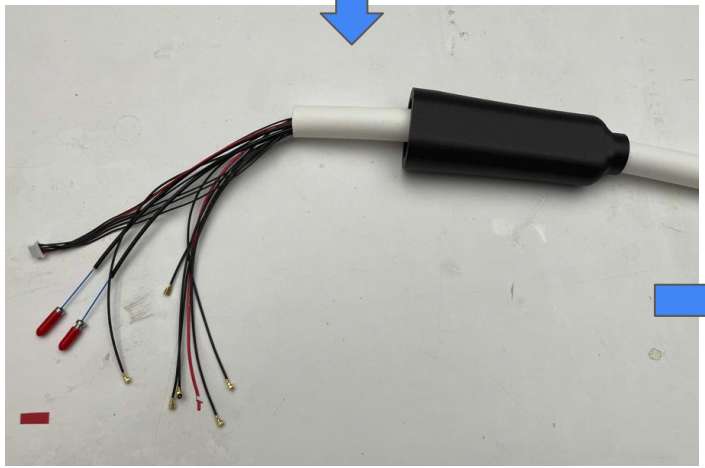
Lubricate the tube by squirting in a small amount of IPA

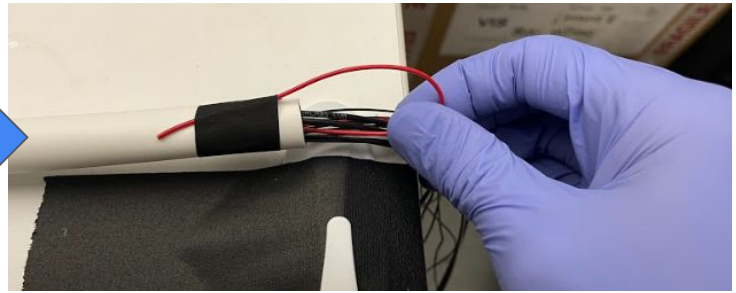
Hold the end of the silicone tubing in place, and pull the tool through until the wires emerge from the other end



Feed large tube and cables through aggregator housing body







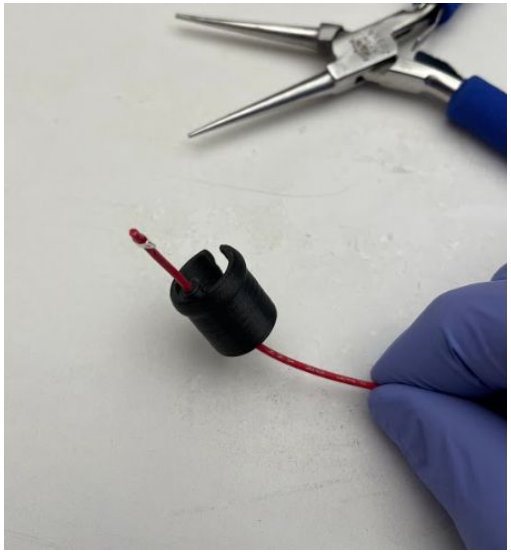
Wipe away excess alcohol, and replace the protective fiber ferrule caps

Feed the silicone tube and cables through the body of the aggregator housing as shown

Be careful not to pull the strength member or any cables completely into the tube

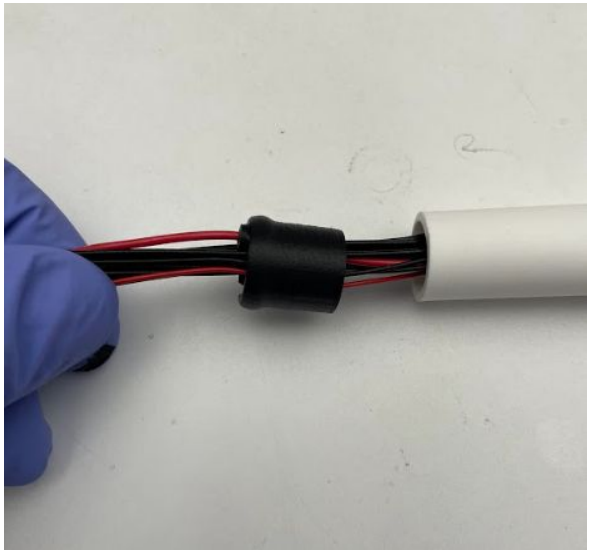
Tape End ‘B’ of the strength member end can be taped to the tube to prevent losing it

Install large sheath stop

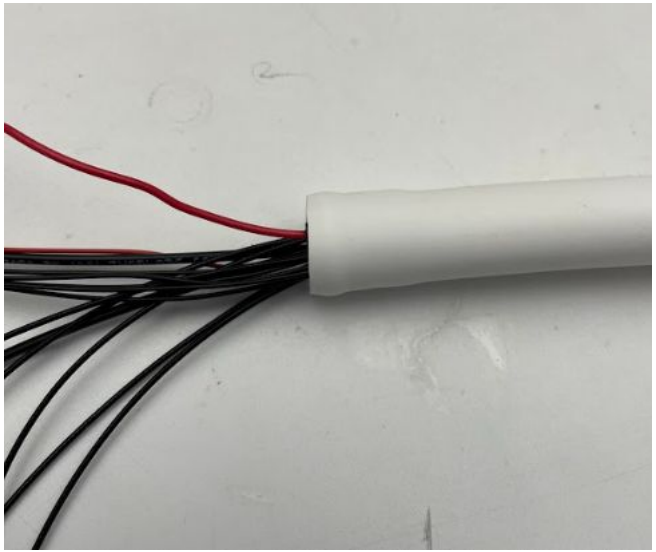


Cut the crimp off of the strength member, and thread on the large sheath stop as shown.

Add another crimp to the wire end



Capture the wire bundle in the sheath stop



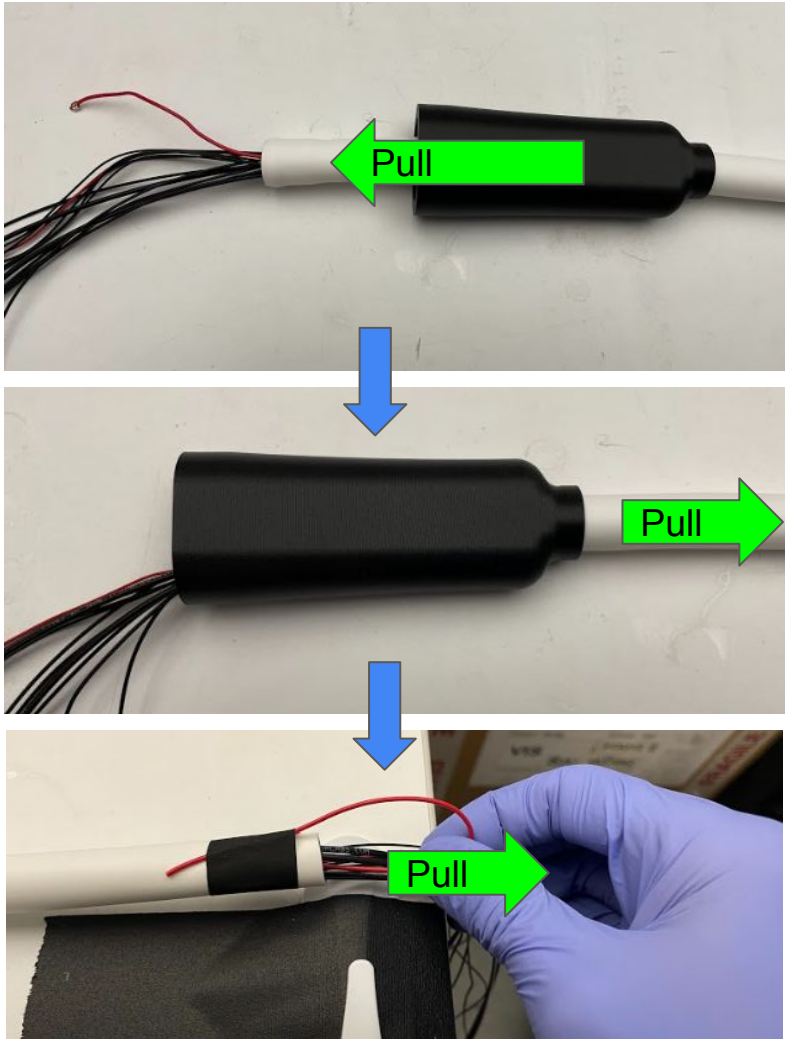
Push the sheath stop into the silicone tube, and work the tube over it so that it is completely captured

Secure large tube and sheath stop in aggregator housing body

Slide the aggregator housing body over the sheath stop and wire bundle

Pull on the silicone tube to fully seat the sheath stop at the bottom of the housing interior

Pull any slack out of the strength member at end ‘B’. This will seat the crimp against the sheath stop.



Wrap excess length of 6-wire power cable with ¼” braided sleeve material

Replace B end power connector with Mini-Fit Jr.

Note that this step will not be needed when we move to purpose-built Mini-Fit cables (we are currently reworking 6-wire cables we had on hand)

Prepare small tube strength members

Cut two lengths of 24 AWG stranded wire, ~30 inches long

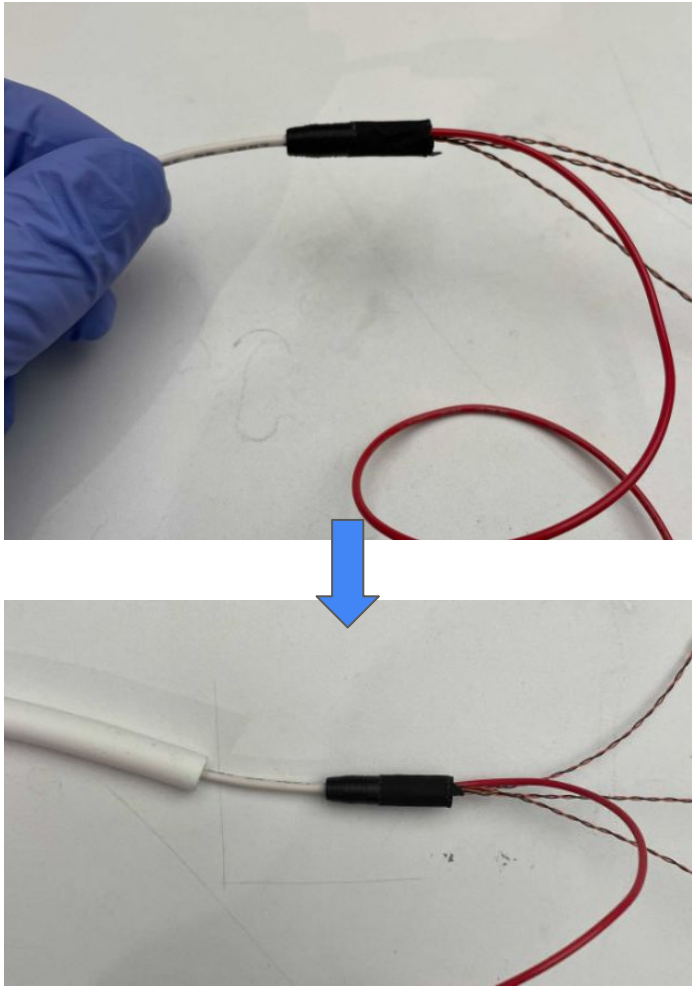
Crimp a jewelry crimp at one end of each wire

Pull components through small tubes

Load one end of the 3 camera power cables into the small tube pull tool, followed by the crimped end of the small tube strength member wire

Capture the components in the tool with a piece of black 3M shurtape wrapped around the tool.

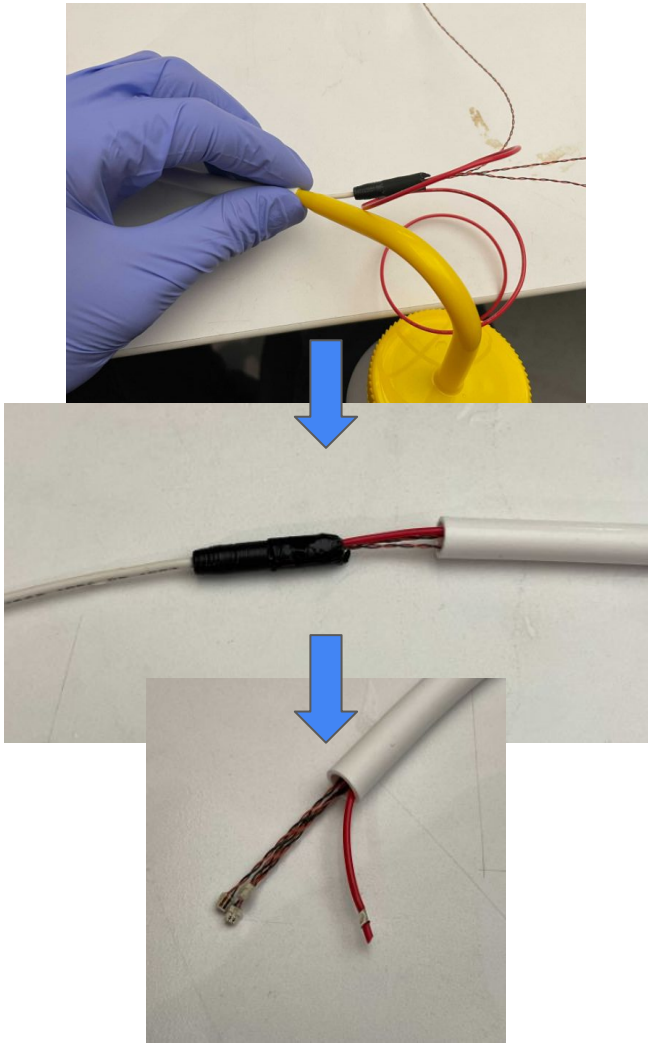
Slip the pull wire through the small silicone tube, using a small amount of IPA for lubrication if needed



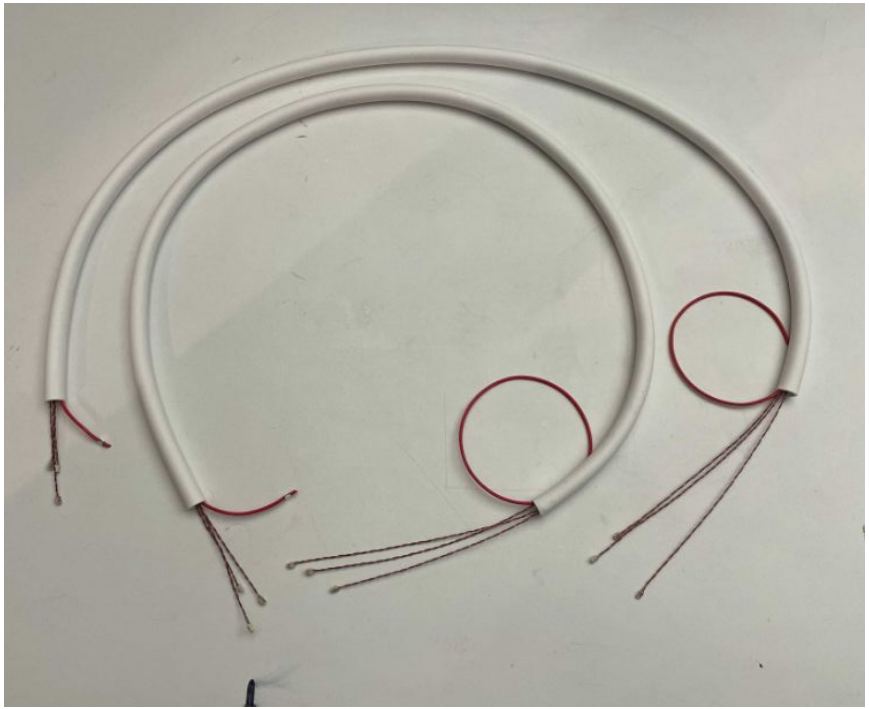
Pull components through small tubes

Squirt a small amount of IPA into the tube, and carefully pull the assembly through the tube

Release the components from the tool and dry



Repeat for second small tube assembly

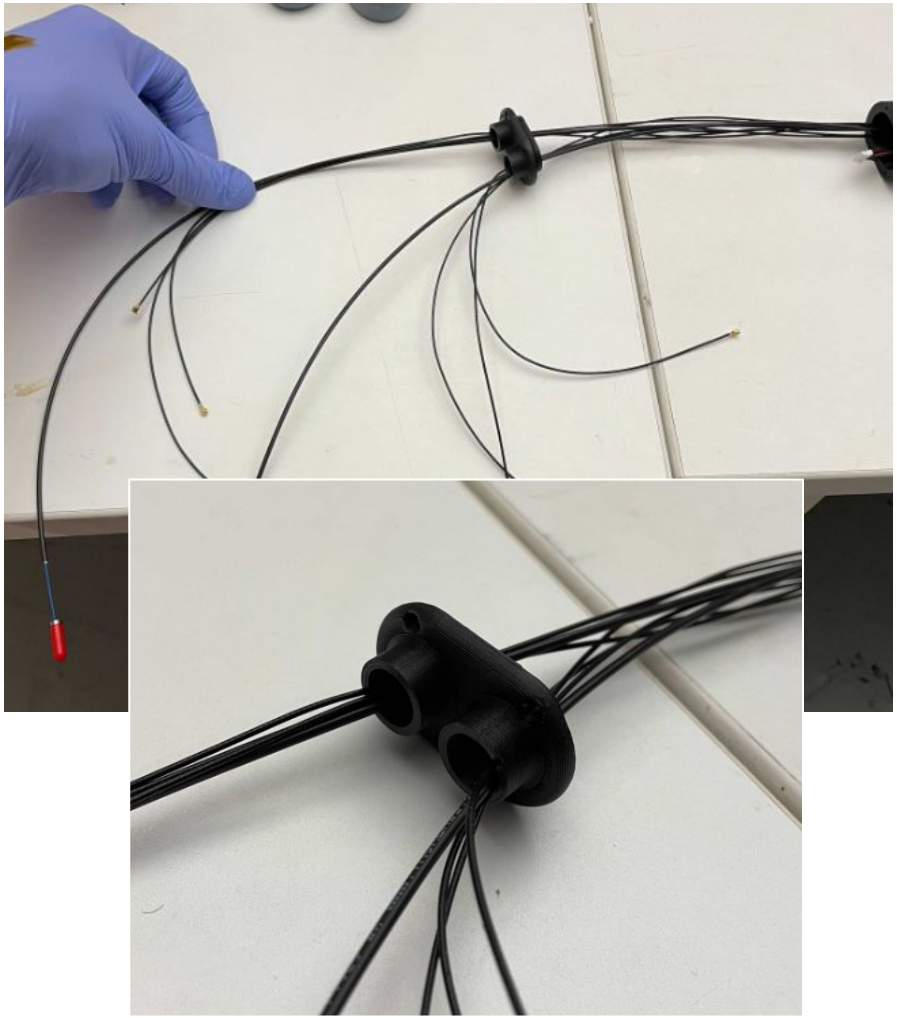


Guide wires through aggregator housing lid

Route the wires through the aggregator housing lid

Make sure that o-ring is installed on the lid, and that it is facing in the direction shown (o-ring side towards the aggregator housing body)

Route 3 micro-coax and one fiber through each port in the lid as shown

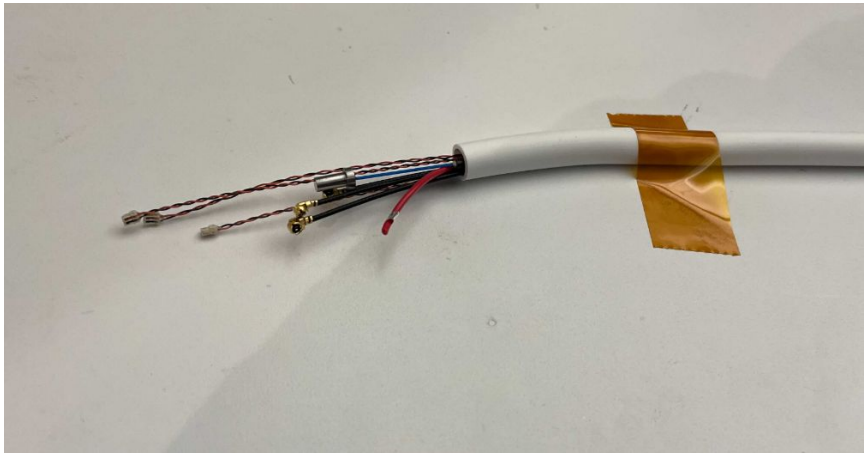


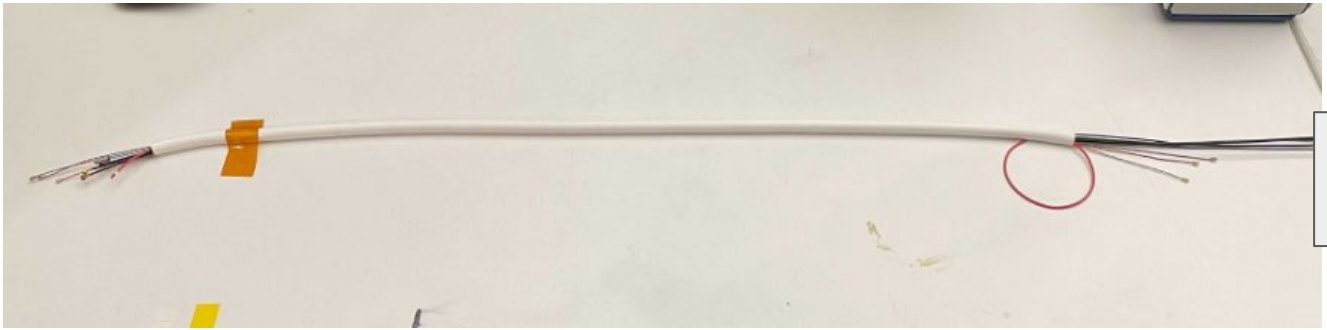
Push fibers and coax through small tubes

Position the small tube assembly on the bench in a straight line, secured with tape if needed, to help with passing wires.

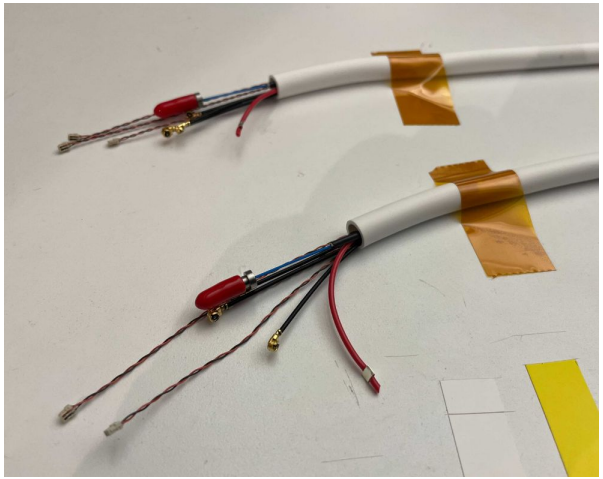
Push through the fiber ferrule first (with safety cap removed), followed by the 3 micro coax cables.

Use a small amount of IPA for lubrication if needed.



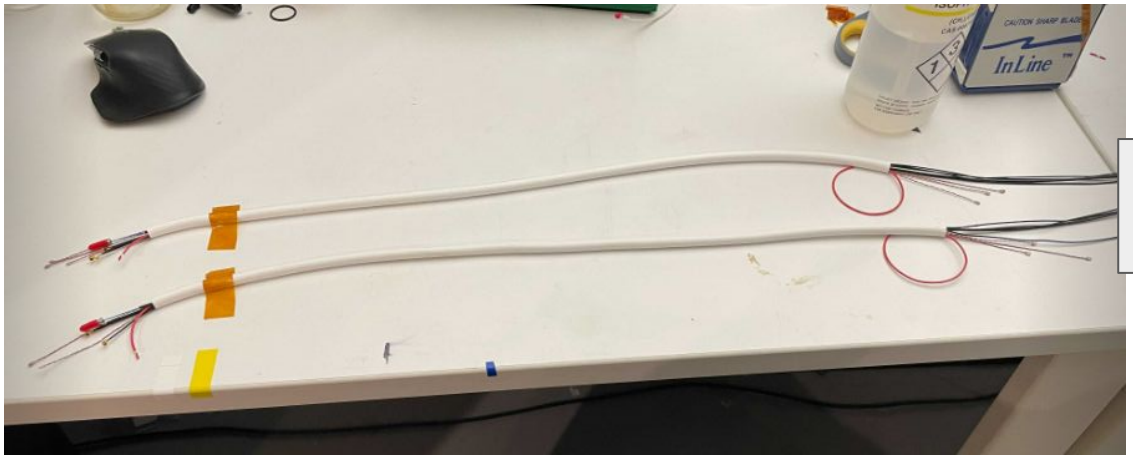


Push fibers and coax through small tubes

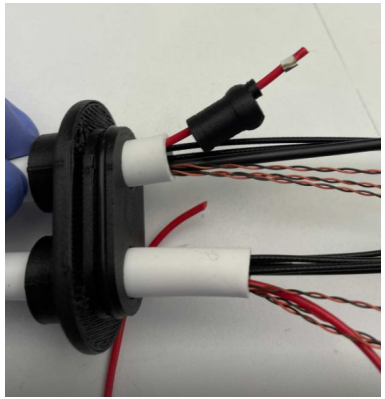


Repeat for second tube assembly

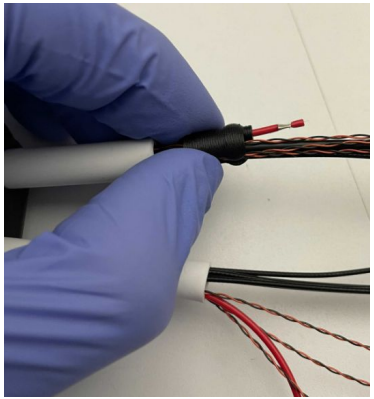
Replace the safety caps on the fiber ferrules



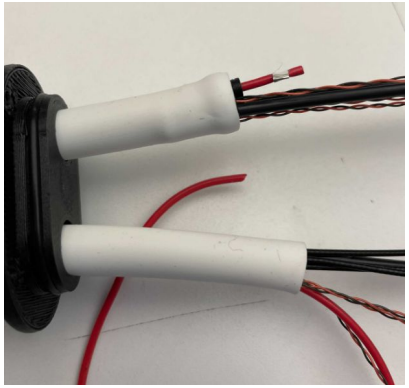
Install small tube stops



Thread strength member through small sheath stop as shown, and crimp end.



Capture all of the wires and fiber within the sheath stop



Push into the silicone tube, and work the tube completely over the sheath stop

Install the second stop and repeat for second bundle of wires

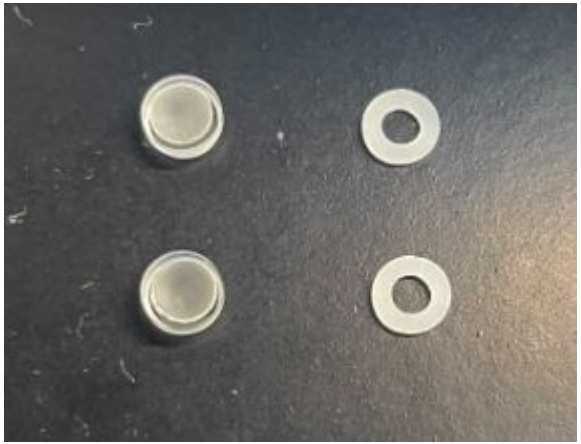
Push both tube ends into the openings in the lid until they are seated securely

Close up aggregator housing

Pull slack out of internal wires to bring the aggregator housing body and lid together.

Be careful to leave exposed length of the camera power wires and 6-wire cable so that they don’t get pulled into the tubes

Secure the lid to the body with 2 screws only (M2 x 10 mm). (this will be opened again later in system assembly)



Obtain materials

Diffuser optic assemblies (previously assembled)
7000-0148
QTY 2

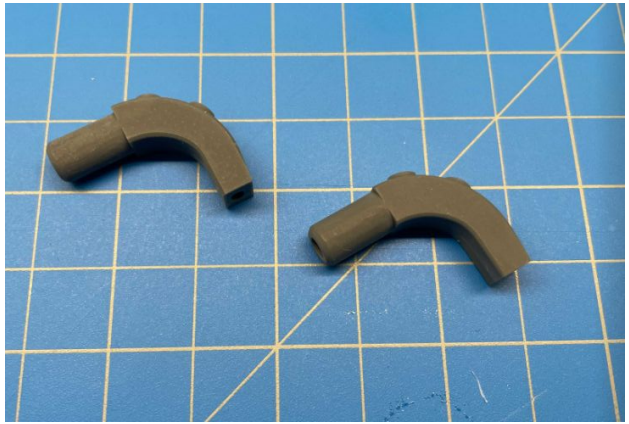
See 7400-0148 for assembly detail

Obtain materials

Fiber housing halves
3000-0480
3000-0481
2x each

Verify that housing halves snap together, then separate with tweezers

Spring
1000-xxxx
2x

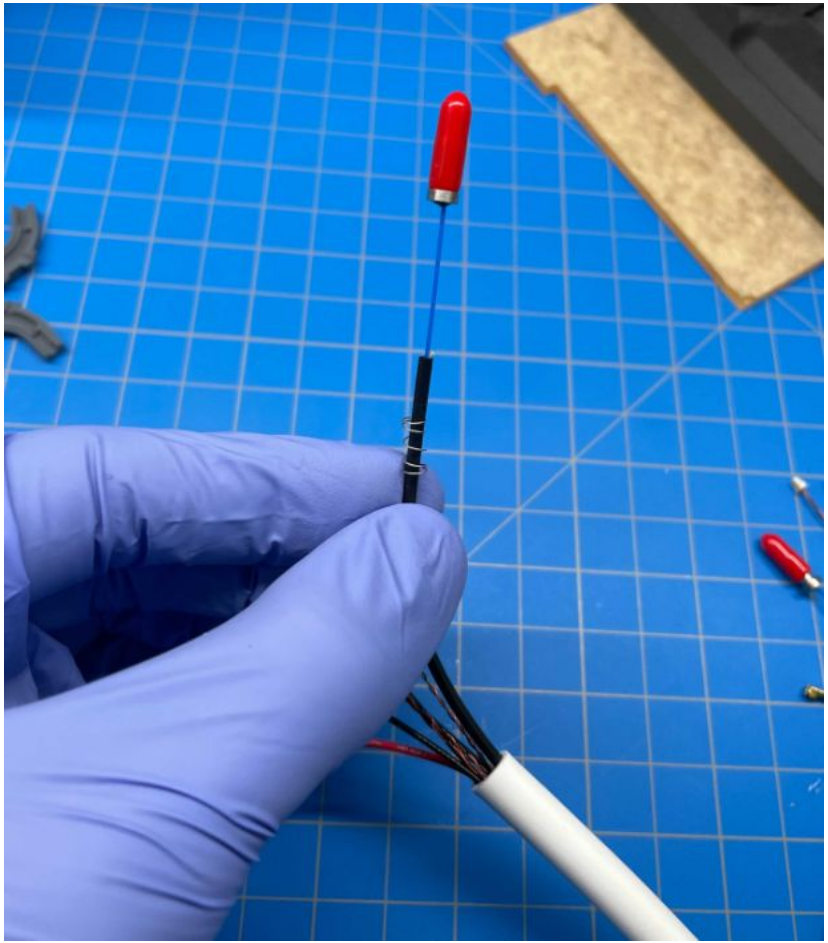


Install ferrule backing spring

Wind spring around black outer fiber sheath

Avoid blue tefzel section

Repeat for second fiber



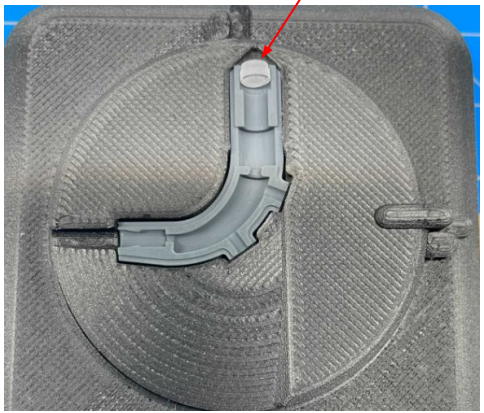
Fiber assembly tool

Obtain fiber assembly tool
7000-xxxx

Wipe clean prior to use

Install diffuser optic, spacer, and fiber ferrule into housing

Install first half of fiber tip housing into tool as shown. Make sure that it is rotated to the correct position.



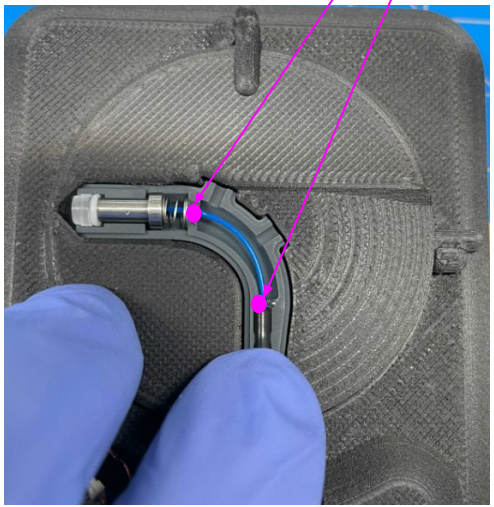
Install diffuser optic into position shown. Note that diffuser surface faces DOWN in this image

Place spacer after diffuser optic

Push in ferrule, and capture the backing spring. Push the parts down so that they do not pop out.

Tack glue fiber and close housing

Carefully rotate the tool and guide the black fiber sheath into the housing groove as shown

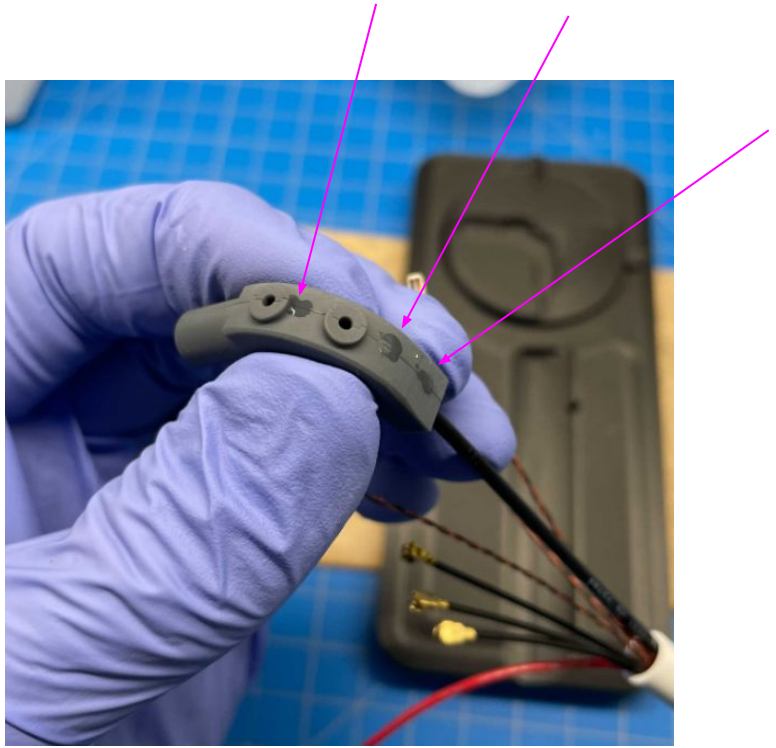


Use tweezers to adjust the blue tefzel section as shown (roughly centered within the housing). Tack glue with UV adhesive in positions shown.

Install the second half of the fiber tip housing and push down until the parts click together.

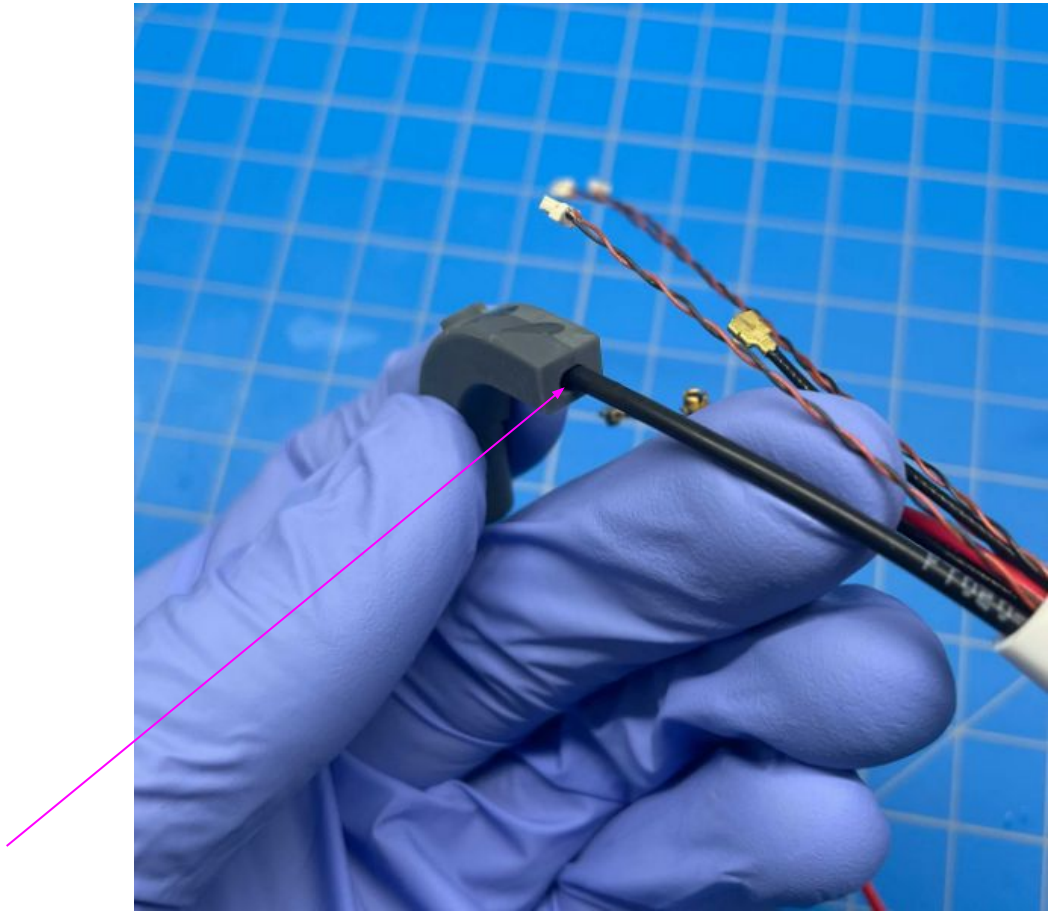
Glue and pot fiber tip assembly

Carefully remove the fiber tip assembly from the tool, and tack glue with UV adhesive in positions shown

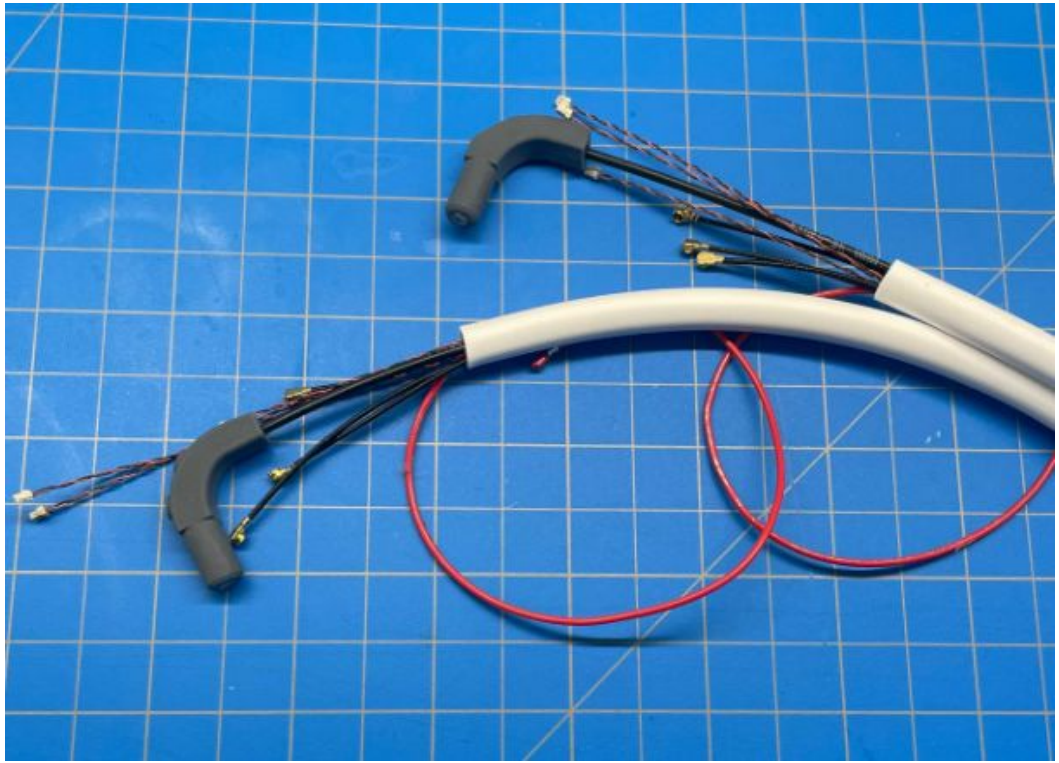


Glue and pot fiber tip assembly

Apply a generous amount of UV cure adhesive to the pocket where the black fiber sheath exits the tip assembly, and cure



Repeat assembly and UV glueing steps for the second laser tip assembly.



Glue and pot fiber tip assembly

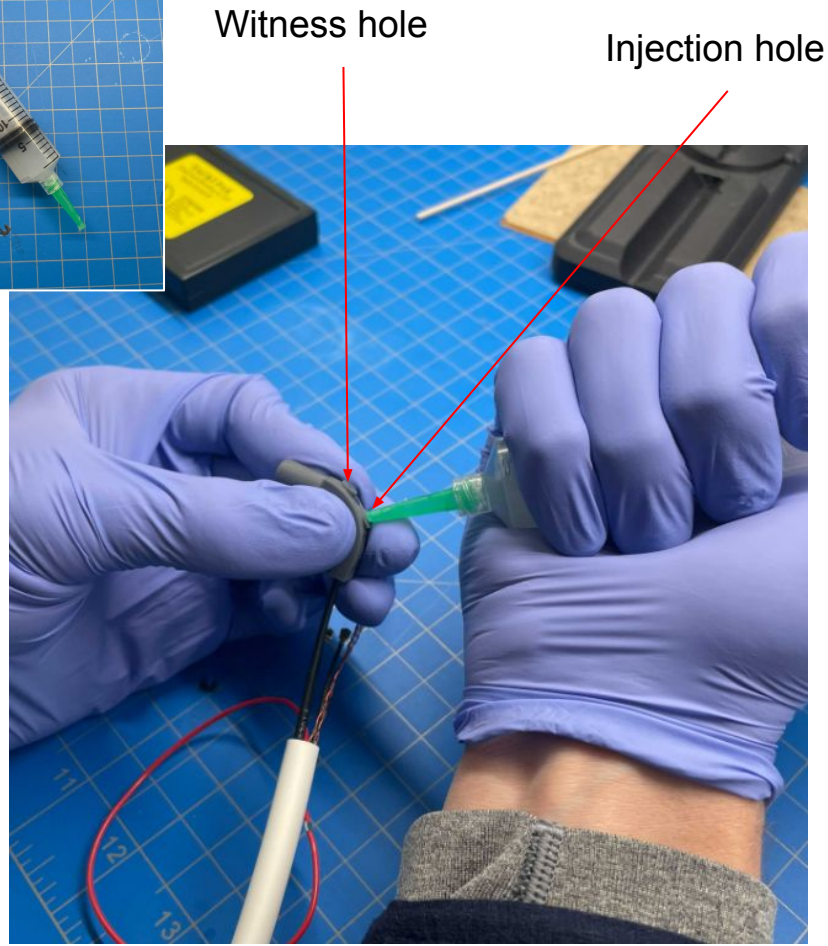
Load a 30 mL syringe with MED-1037 RTV material

Install Luer-Lok tapered #x needle

While holding the fiber tip assembly in place, push the needle face against the housing, and carefully inject material into the injection hole as shown. Be sure to inject into the hole which is farther from the diffusing optic.

Continue to inject until material is about to emerge from the witness hole.

Repeat for second tip assembly



Seal aggregator housing tube exit points

Replace the syringe tip with a #TBD

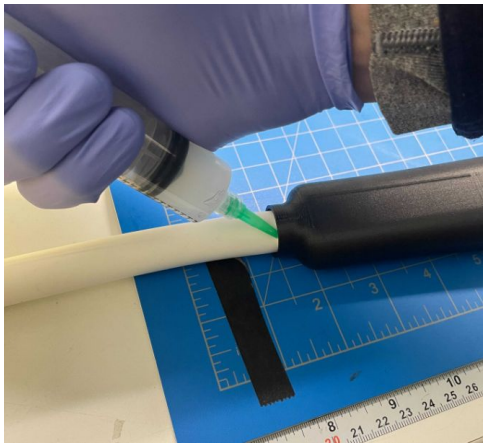
Carefully inject the RTV in the groove at the exit of each tube from the aggregator housing

Ensure that the grooves are filled to their full depth, and that there is sealing all around.

Wipe away any excess material.

Repeat process for each tube.

Note that full ambient temperature cure time for MED-1037 is approximately 72 hours.



Cable complete