

WALT DISNEY WORLD®

PROJECT RED

ARIEL'S TAIL

OPERATIONS AND REPAIR MANUAL



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Revision History

Date	Version	Description	Author
07/06/24	1.0	First Iteration	Bridget Reilly Beauchamp, Brieaunna Avery
09/18/24	1.1	Addition of Comprehensive Materials	Bridget Reilly Beauchamp, Brieaunna Avery
10/22/24	2.2	Final Iteration before installation	Bridget Reilly Beauchamp, Betsy Falk

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1 Introduction and Preface

1.1 General Project Information

1.1.1 Notes from Monkey Boys Productions

This character is designed for use in collaboration with Walt Disney World/Disney's Hollywood Studios for use in the Voyage of the Little Mermaid Theater. All information contained herein was prepared for Monkey Boys Productions, LLC and is property of the Disney Corporation and not to be used in any way without their consent.

1.1.2 From the Disney Scope of Work, section 1.2-1.4:

General Resort Overview

Movie magic comes to life at Disney's Hollywood Studios. This park features 8 sections: Hollywood Boulevard, Echo Lake, Grand Avenue, Sunset Boulevard, Commissary Lane, Star Wars: Galaxy's edge, Toy Story Land and Animation Courtyard.

General Venue Overview

Project Red will take place in the Voyage of the Little Mermaid (VOLM) Theater located within the One Man's Dream building next to Animation Courtyard in Disney's Hollywood Studios. The VOLM Theatre is a 400-seat theatre with a small, elevated stage with access between the house and backstage on Stage Left. All elements must fit through a double door at most due to limited load in infrastructure.

General Show Overview

A reimagined retelling of the classic film seen through the unique perspective of Ariel, a 16-year-old girl. Through cutting edge technology, mixed media, puppetry, and live actors, we follow Ariel's journey as she boldly pursues her dream to be part of the human world above, even if it means leaving her under the sea home.

1.2 Item Description

1.2.1 Summarized from the Disney Scope of Work, Section 4.17.1:

N/A

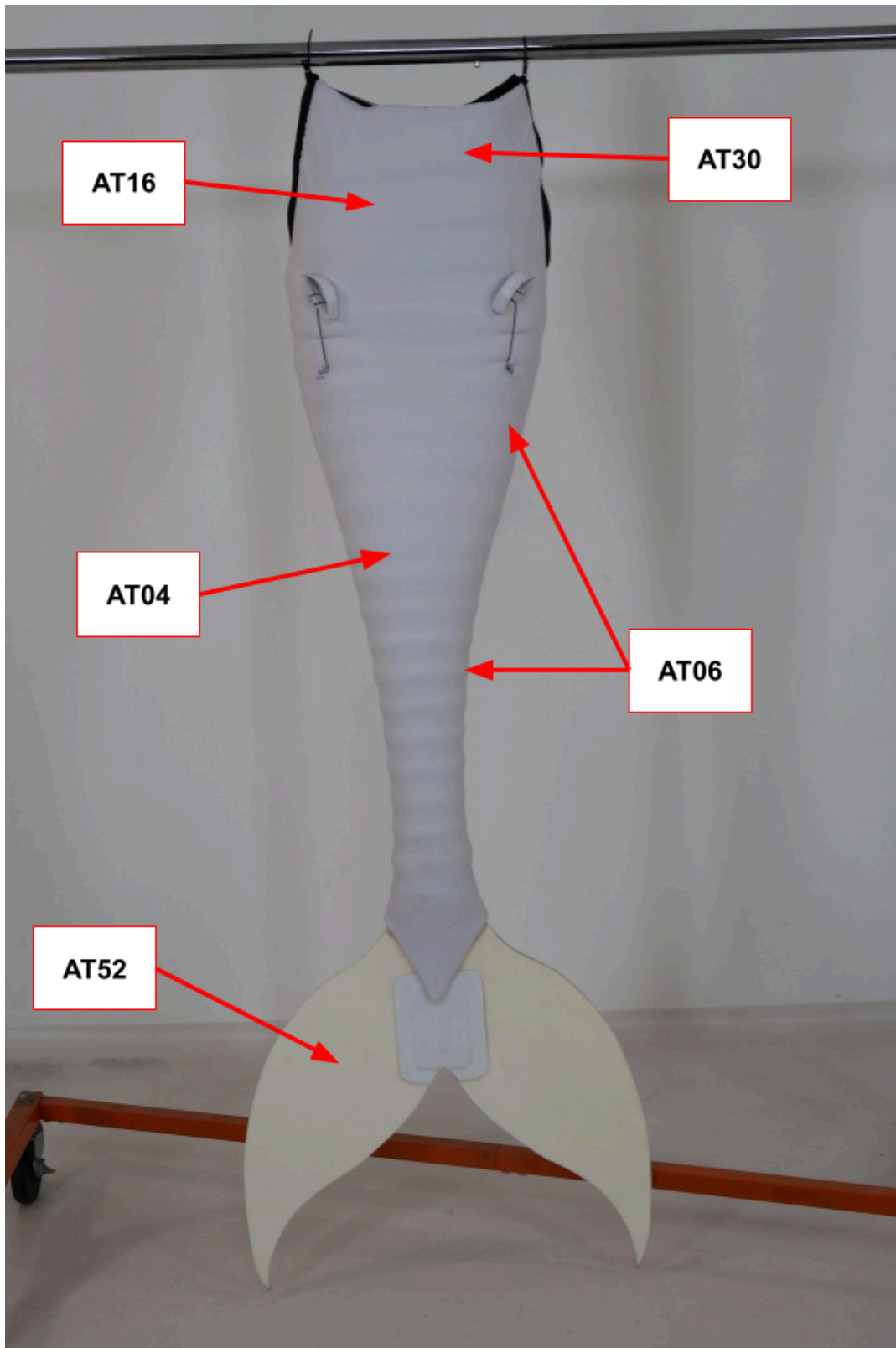
1.2.2 Basis of Engineering

Ariel's tail is constructed of slices of rigid, lightweight foam with a soft foam portion that comes into contact with the Performer. The segments are held together and given their range of movement with a set of bungees that run the length of the tail, secured with a custom 3D printed bushing system. The tail is covered with a layer of soft foam and 4-way stretch spandex. The fluke is carved L200 foam, and the carbon fiber control rod connects to a custom 3D printed receiver. The tail is equipped with retractable handles to allow the Performer to assist with lifting it over set pieces.

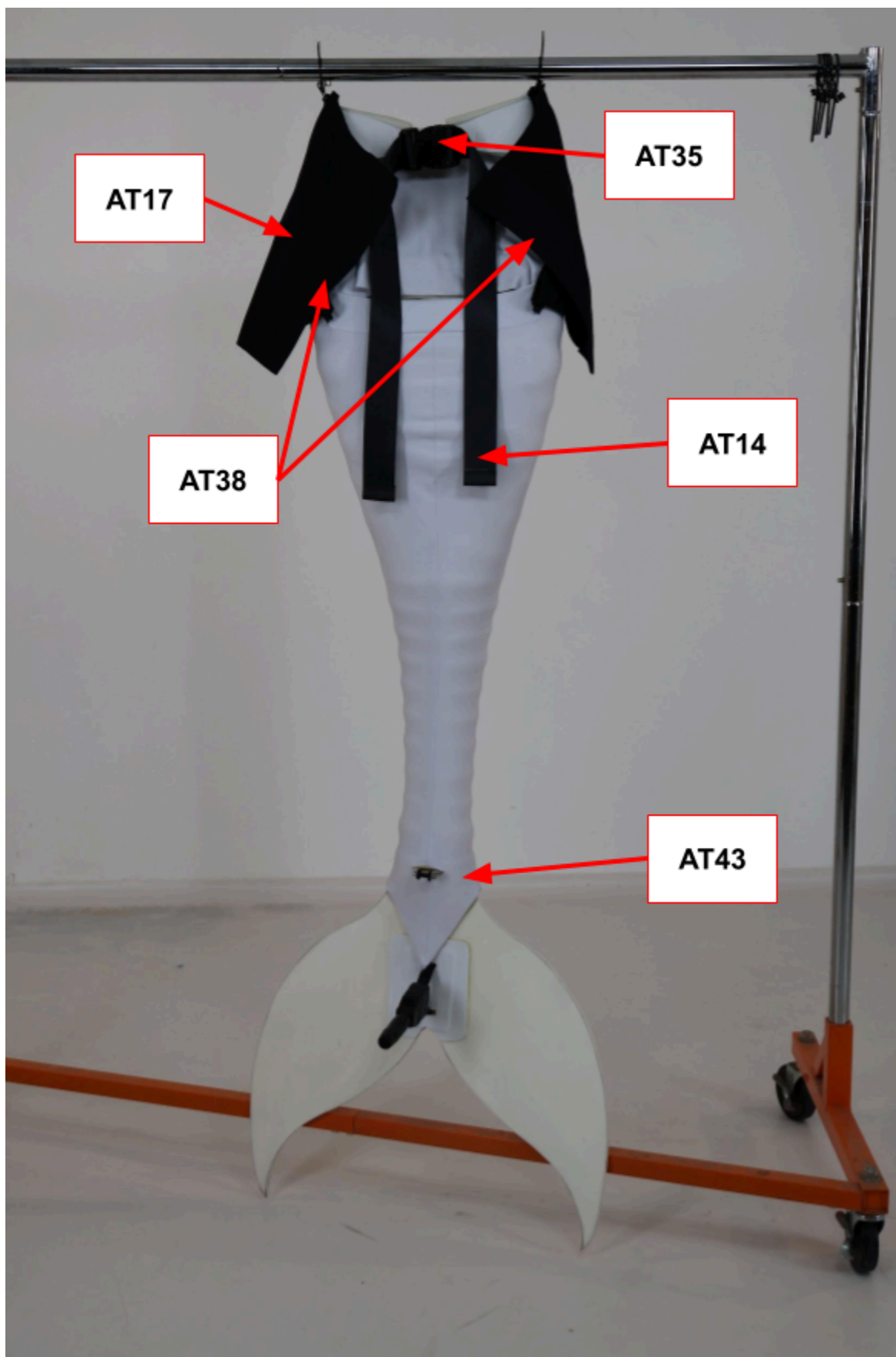
2 Construction and Assembly

*****All views are of the Tail BEFORE covering with final layer by Costuming*****

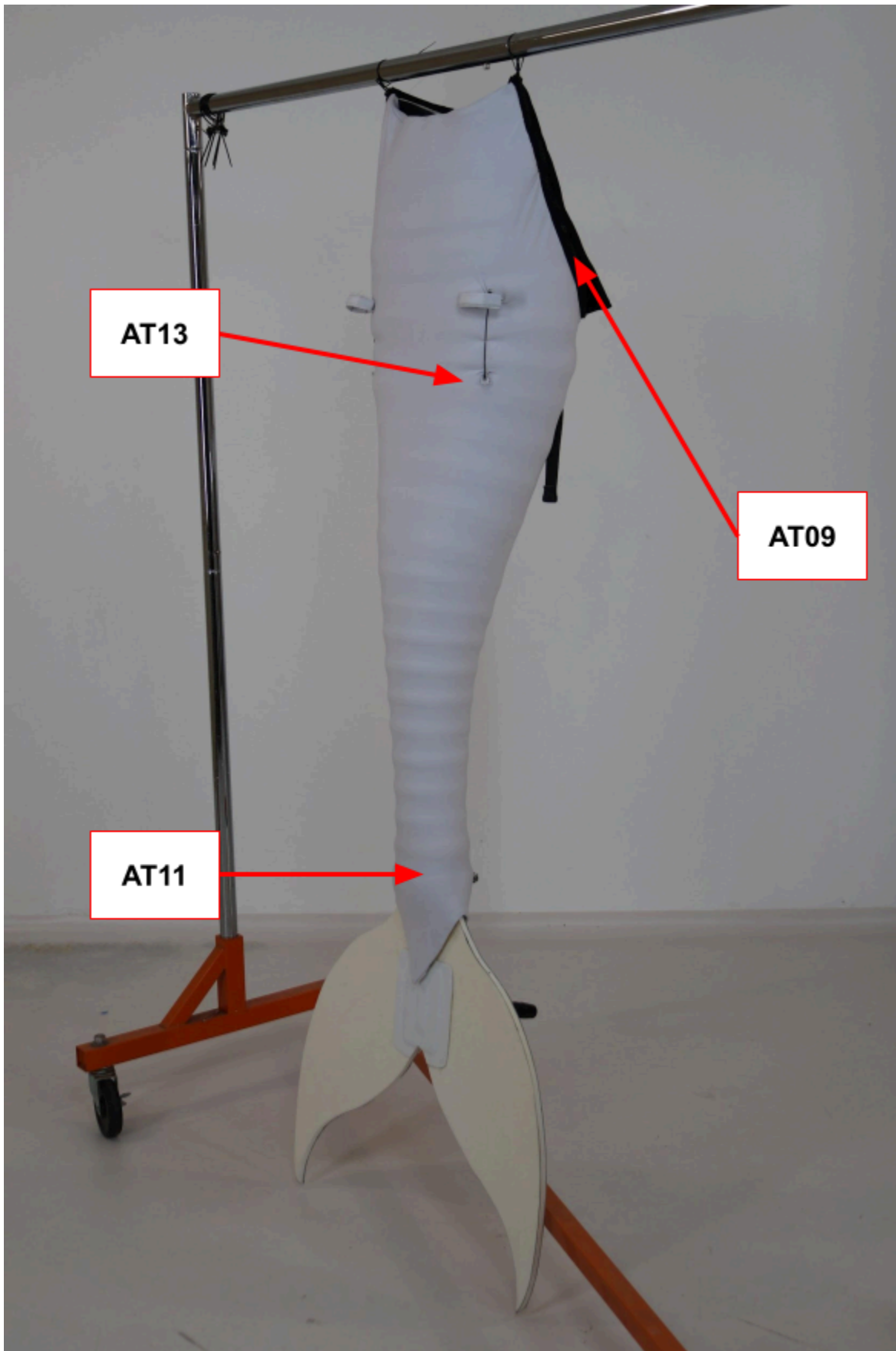
2.1 Front View



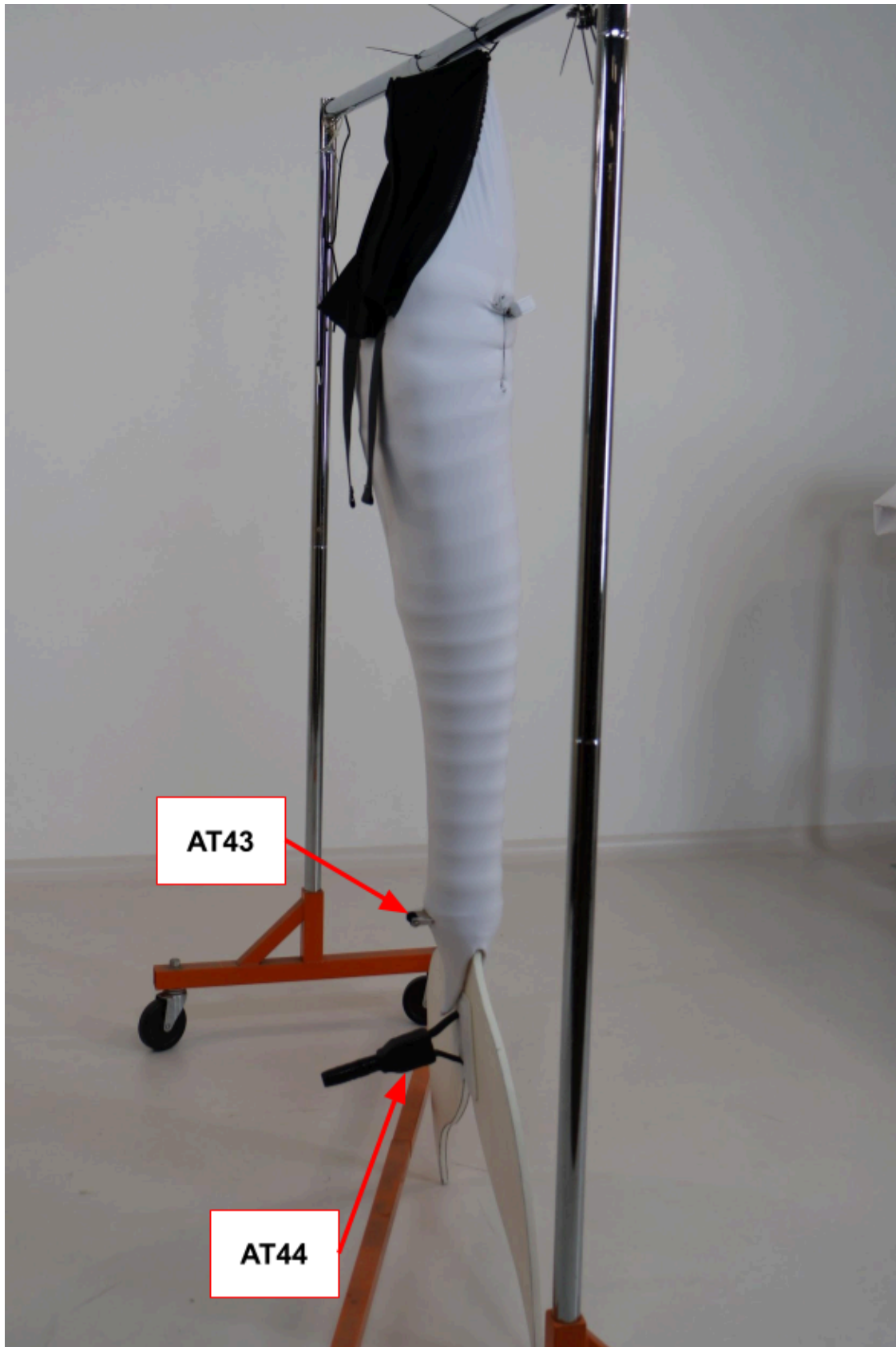
2.2 Rear View



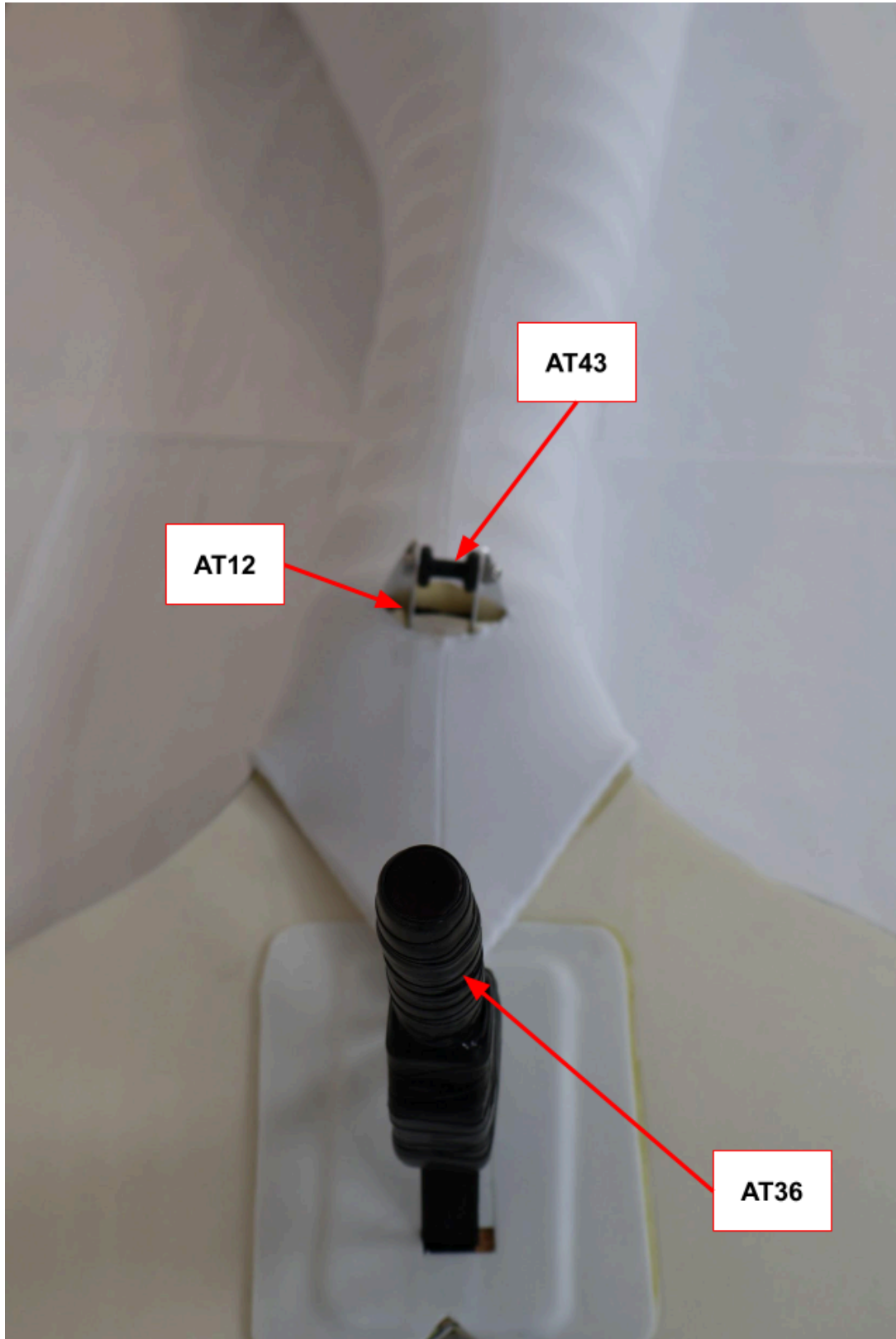
2.3 Left view



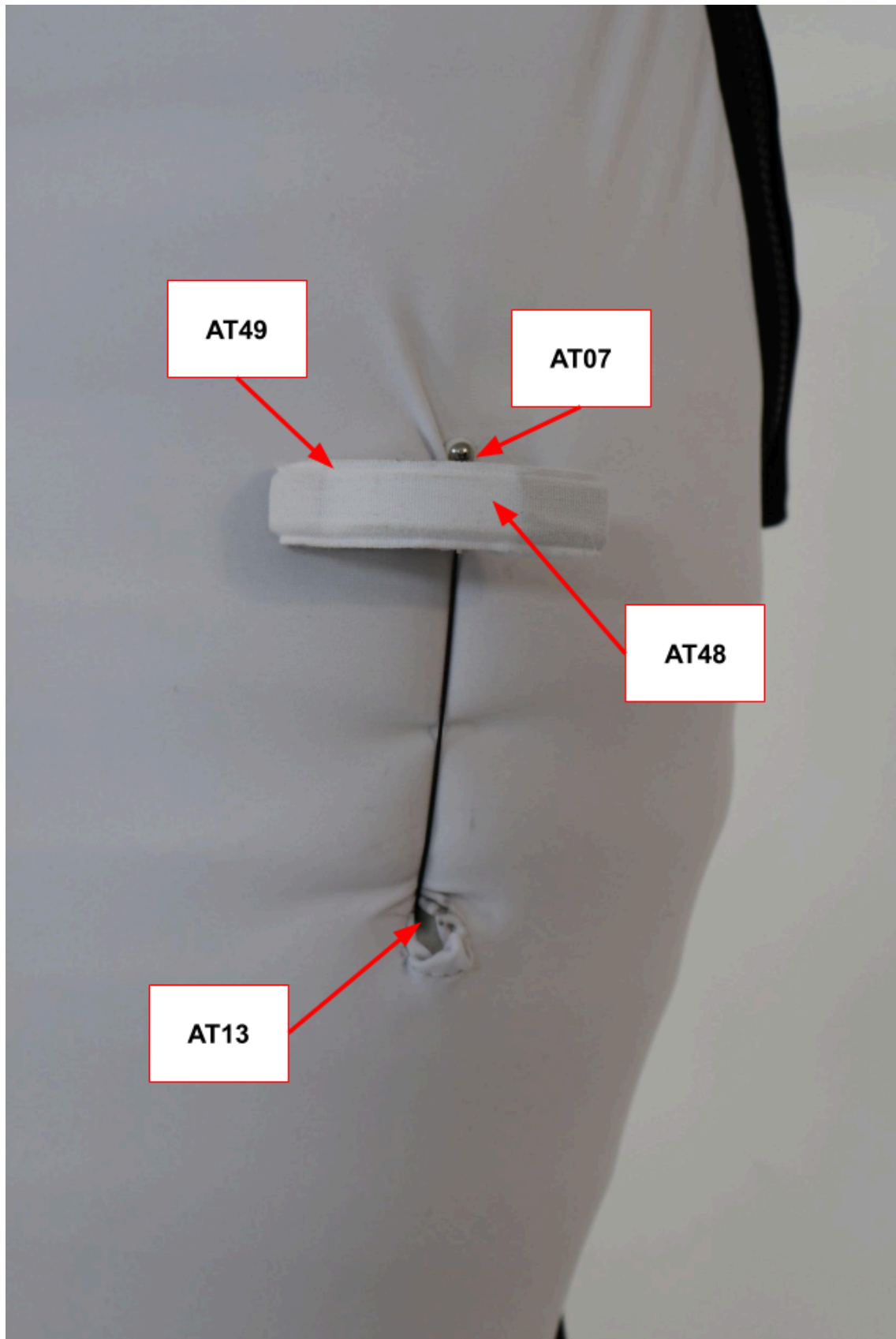
2.4 Right View



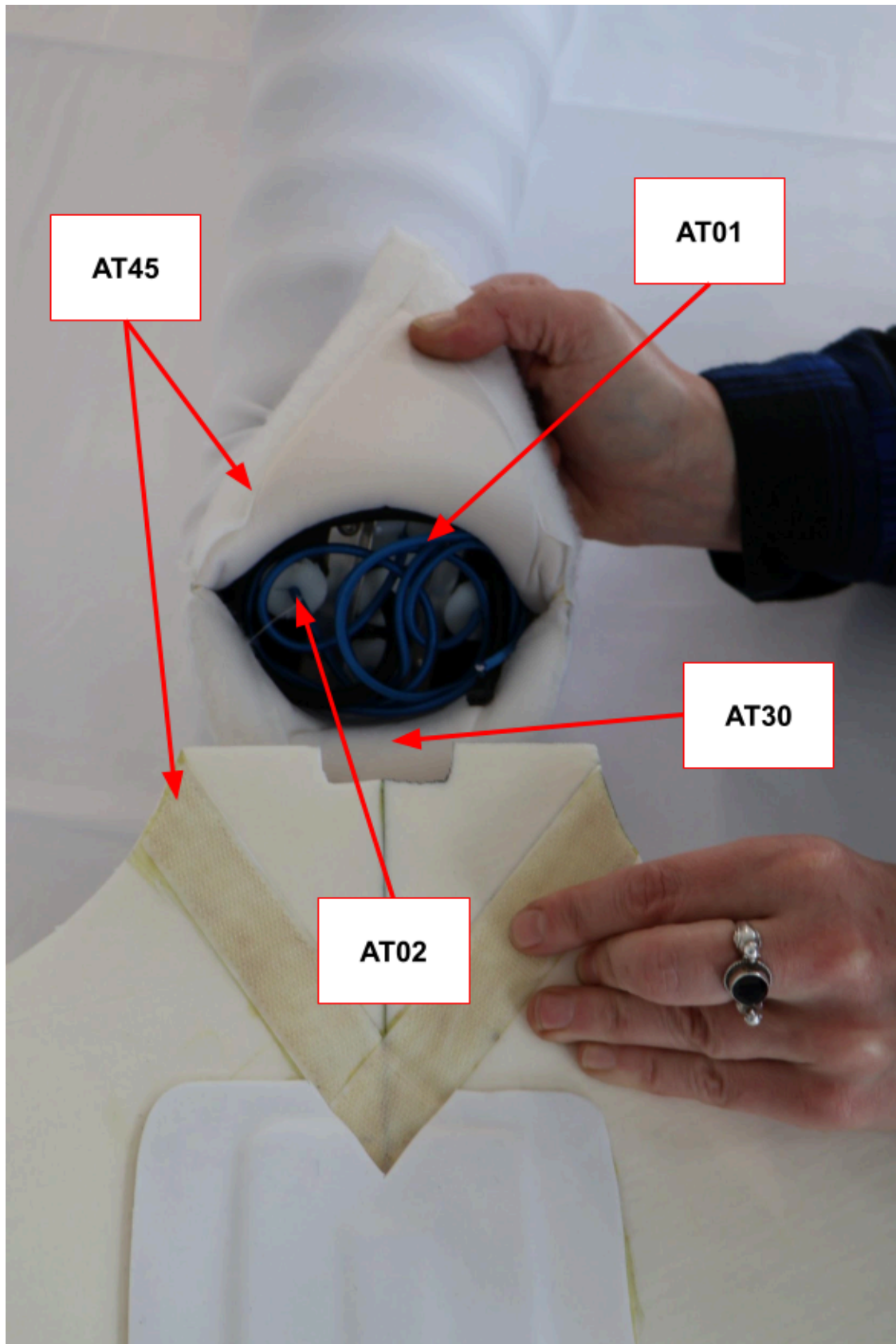
2.5 Closeup of Control Rod Mount and Fluke Handle



2.6 Closeup of Tail Lift Assist Handle



2.7 Closeup of Fluke Attachment Point



3 Description of Operating Modes

****All of this information pertains to the Tail BEFORE the outer skin is added****

3.1 Operating Modes

3.1.1 Storage

A storage plan for the Tail should be developed in conjunction with the Wardrobe department.

At no point should a puppet be stacked on top of or underneath another puppet or prop.

3.1.2 Performance

The puppet is worn by a single Performer, who operates the Tail Lift Assist handles. An additional Puppeteer moves the tail from below using a carbon fiber control pole and/or tail fluke handle.

3.2 Operating Procedures

3.2.1 Putting the puppet on

*****Please ensure that you have clean hands before handling this puppet.*****

The Performer will ALWAYS require assistance putting on the tail.

1. The Dresser should prepare the tail by releasing the belt buckle and opening the back panel by separating the hook and loop in the middle.



2. The Dresser should approach the Performer from the front, holding the tail so that the center front is facing the Performer.
3. The Performer should take the tail and use both hands to hold it at their waist. The Dresser should then step around to the rear of the Performer.



- a. The Dresser should clip the belt buckle together, and then cinch it so that the tail sits snugly against the Performer's stomach, with no gaps.



- b. After the belt is tight, the Dresser should ensure that the extra webbing hangs straight down behind the Performer's legs. It should not be twisted or bunched (You may find you wish to shorten the webbing belt on site)



4. The Dresser should then close the center back of the skirt by placing the soft side of the hook and loop over the rough side. The hook and loop should overlap completely and should lay completely flat. This may take some time.



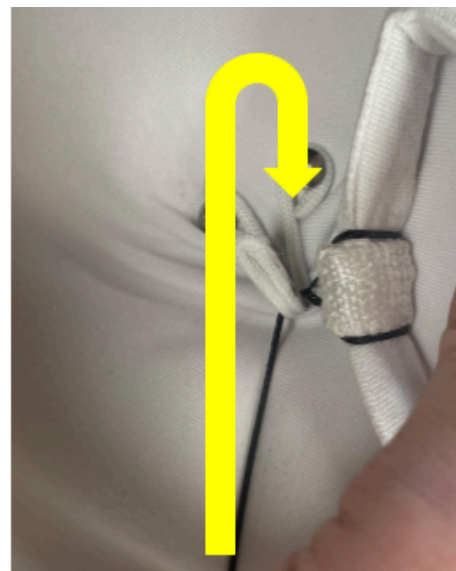
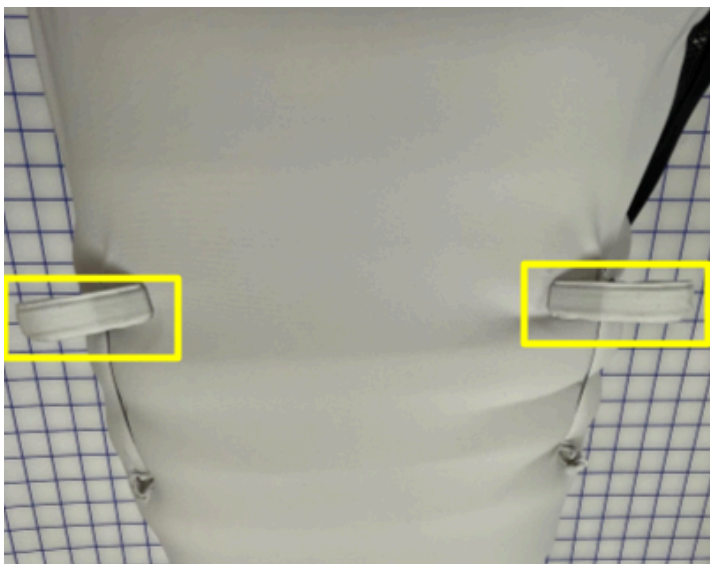
3.2.2 Action: Lifting the tail (Performer)

Ariel's Tail is neutral in a straight up and down position



. The only time the Performer should need to use the Tail Lift Assist is when they are on the pedestal tracking to one of the rock set pieces. The Tail Lift Assist is only designed for vertical movement for a short period of time, and to be used in conjunction with the Puppeteer lifting the tail from below.

1. The Tail Lift Assist Handles should be in a horizontal orientation, with the string going around the hook from the outside in



2. The Performer should slide their hands into each Tail Lift Assist Handle



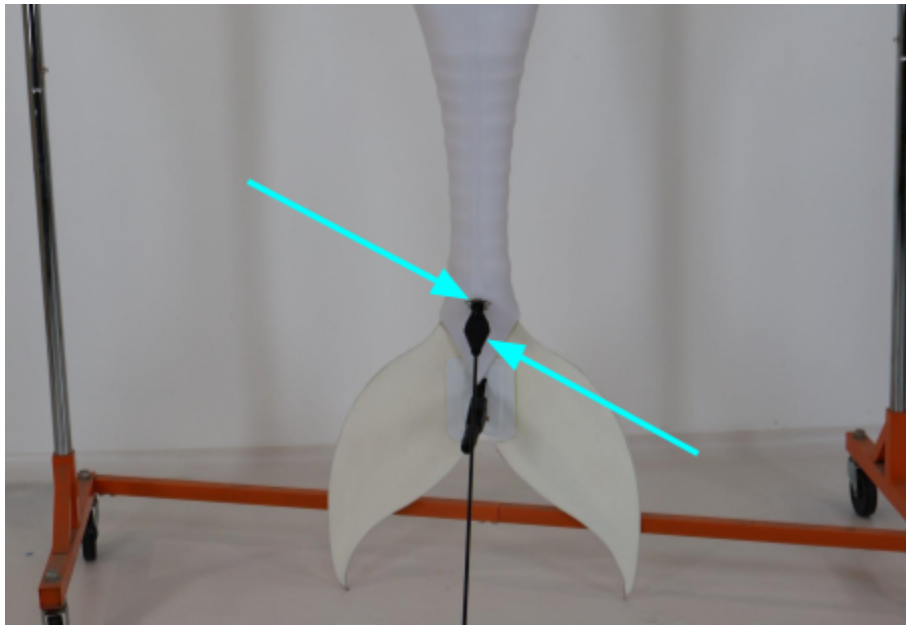
3. When choreographed to, and in concert with the Puppeteer, the Performer should simultaneously lift both Tail Lift Assist Handles in an upwards and outwards motion. **DO NOT TRY TO PULL THE TAIL LIFT ASSIST PAST ITS MAXIMUM EXTENSION.**



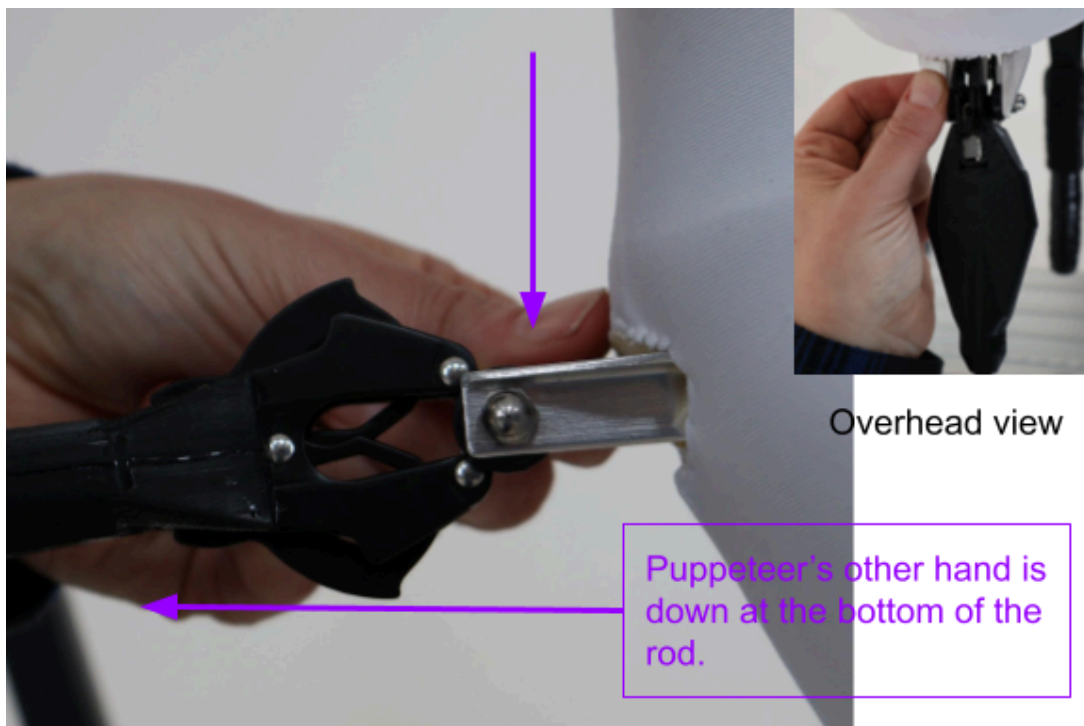
4. Once the rock is cleared, the Performer should retract the Tail Lift Assist by lowering the handles and slipping their hands out of them. They do not need to worry about resetting the Handles on the hooks. This can be done offstage.

3.2.3 Action: Attaching/Removing the Control Rod

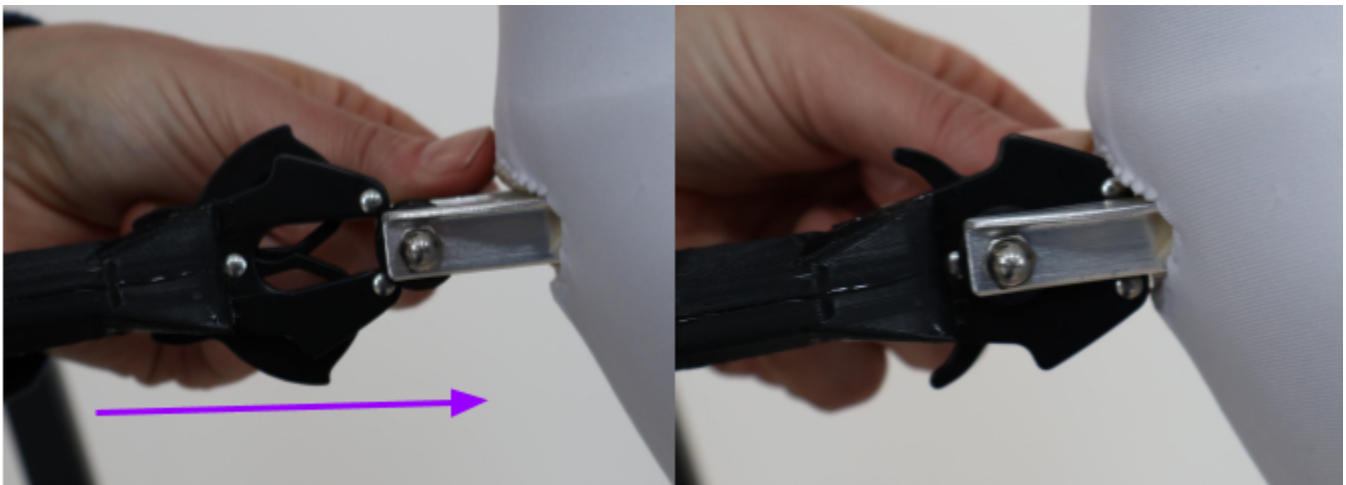
The Control Rod attaches to the tail via a heavy duty quick release frog clip just above the Fluke connection point.



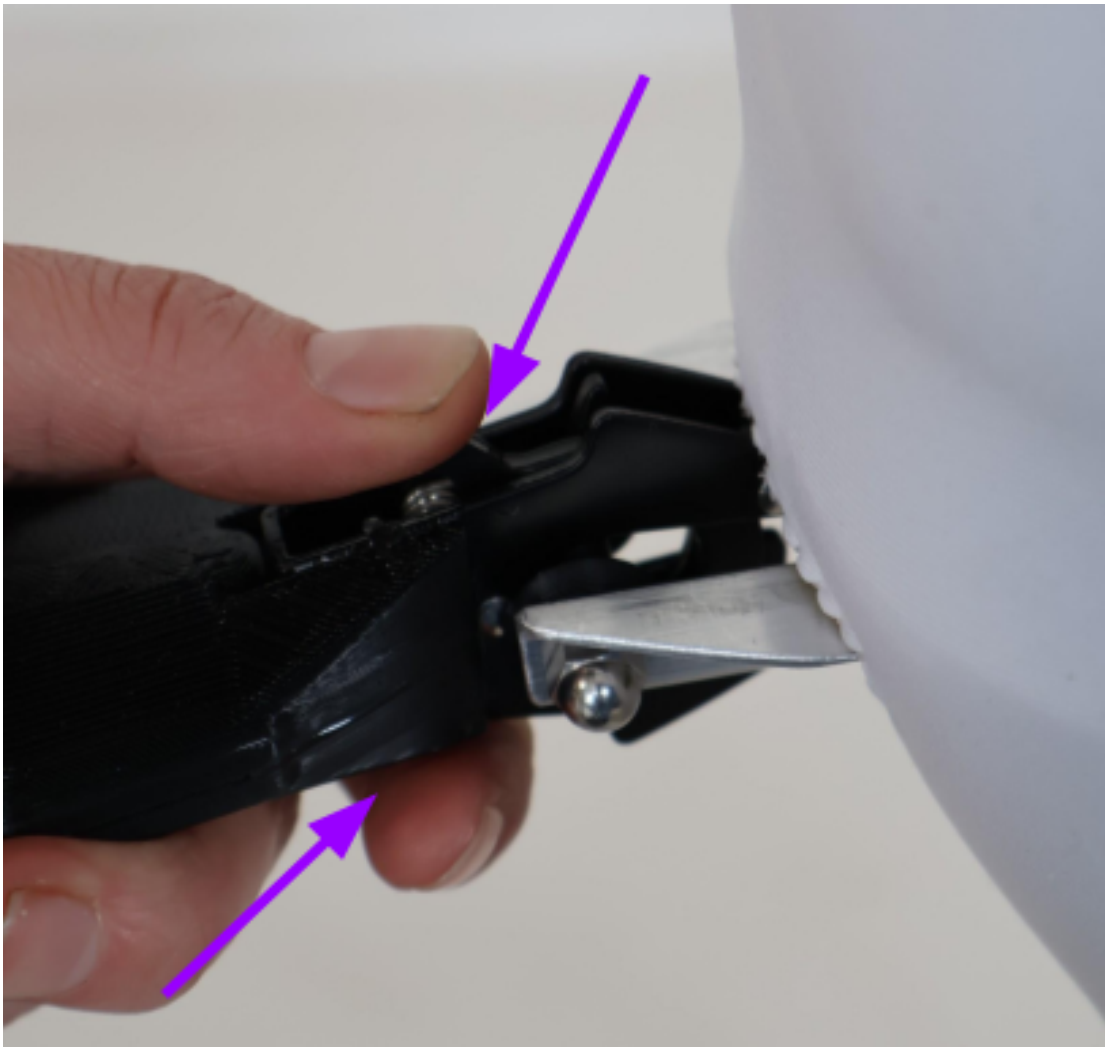
1. To attach the Control Rod, the Puppeteer should grasp the side of the Control Rod Mount with one hand, and the base of the Control Rod with the other.



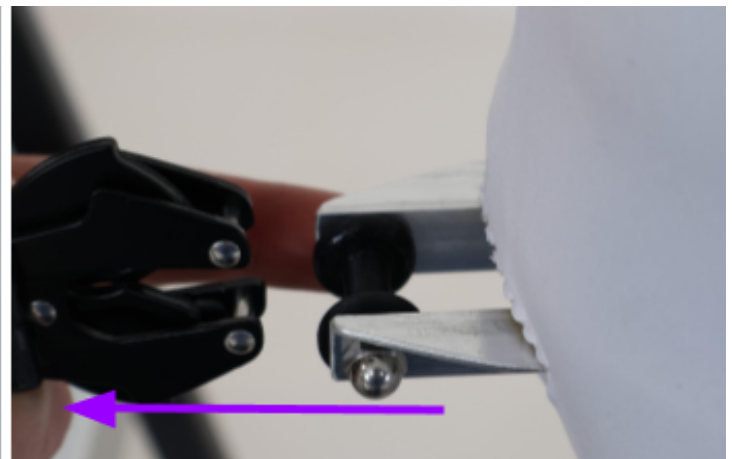
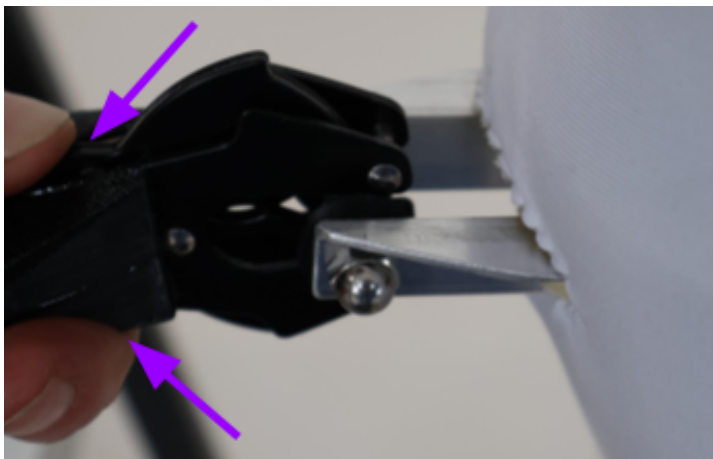
- a. While holding the Tail steady, push the Control Rod forward until the frog grip clicks into place.



2. To remove the Control Rod, the Puppeteer should hold the Control Rod below the hilt with one hand, and place the other on top of the quick Release clip, with the thumb and first finger on the top & bottom latches



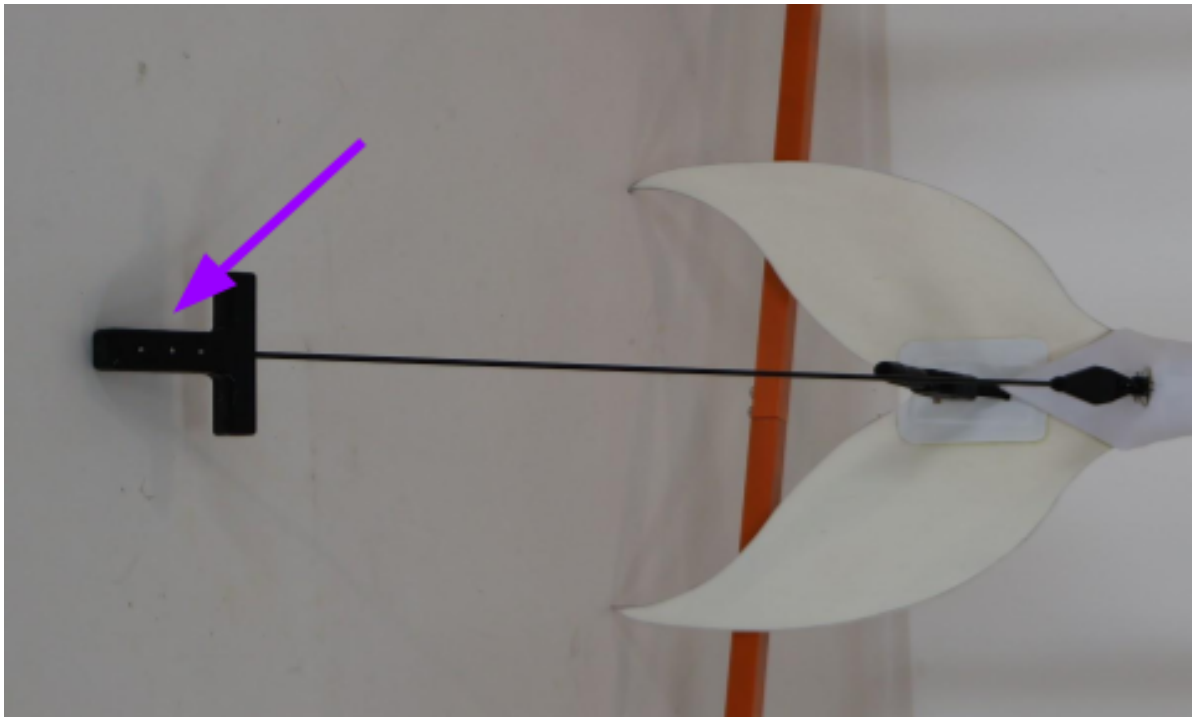
- a. Press the latches and pull the Control Rod back away from the Tail until the grip is clear.



3.2.4 Action: Moving the Tail (Puppeteer)

Ariel's Tail is neutral in a straight up and down position.

1. The Puppeteer can use the Control Rod for large, whole tail movements. The Puppeteer should grasp the pole below the hilt.



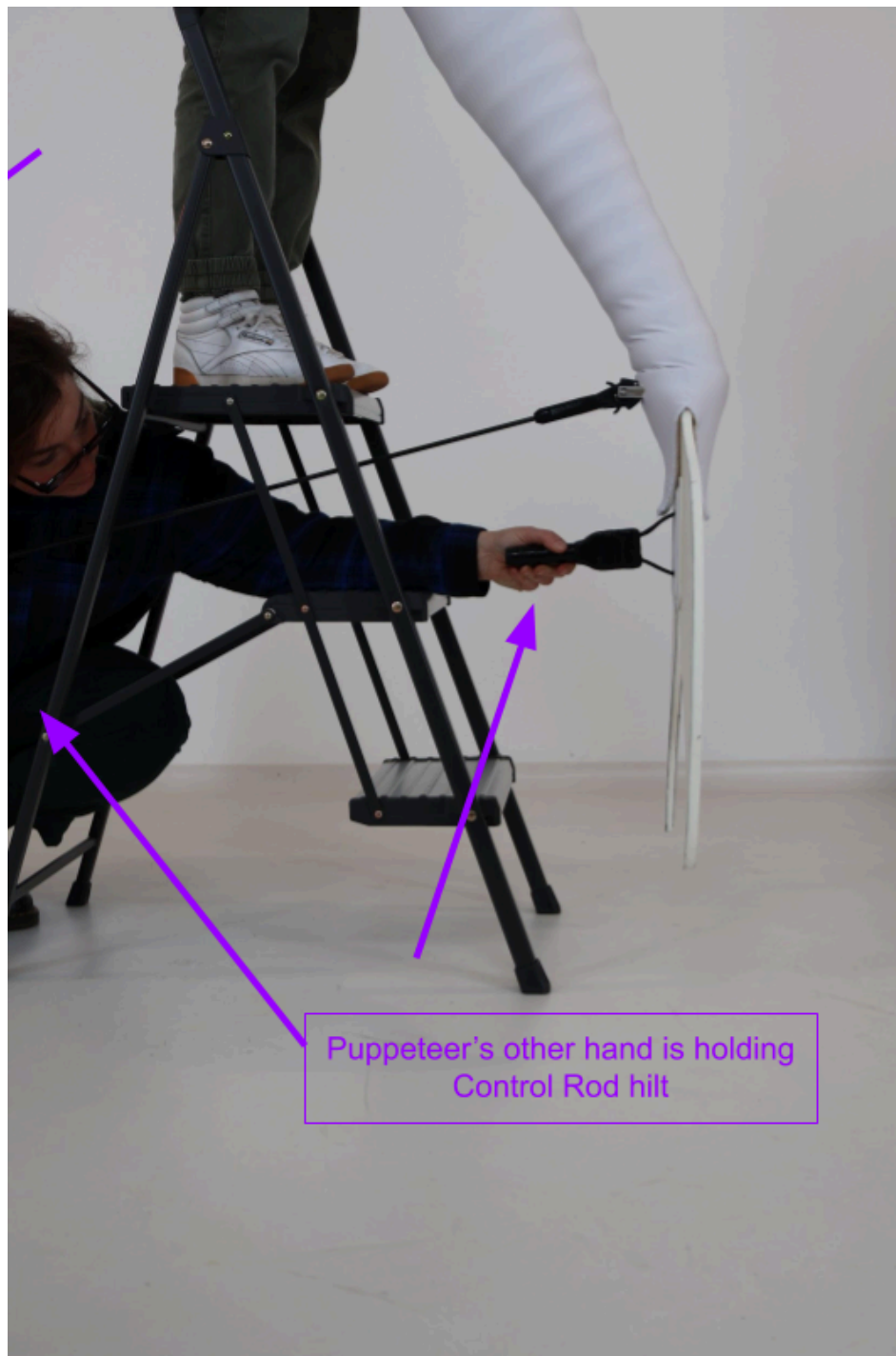
- a. To move the Tail forwards (in relation to Ariel), the Puppeteer should push the Control Rod away from their body.
- b. To move the Tail backwards, the Puppeteer should pull the Control Rod towards their body.
- c. To move the Tail from side to side, the Puppeteer should push the Control Rod in the direction of desired movement.



- d. The Puppeteer can achieve some Fluke movement in addition to the Tail movement by twisting the Control Rod in combination with movements a-c.



2. The Puppeteer can use the Fluke Handle to achieve a greater range of Fluke-specific movements
 - a. To move the Fluke in concert with the Tail, the Puppeteer should grasp the Fluke handle in their free hand and manipulate it in the same manner as the Control Rod (1a-c).



- b. To move ONLY the Fluke, the Puppeteer should release the Control Rod and manipulate the Fluke Handle in the same manner as the Contoil Rod (1a-c).
3. When lifting the Tail over Scenic elements, the Puppeteer and Performer need to work in a pre-choreographed sequence to ensure the Tail clears various obstacles (see Section 3.2.2 for more information)

3.2.5 Taking the puppet off

There are two ways to remove the Tail.

1. With the Performer holding the Tail at the waist, the Dresser can step behind the Performer.
 - a. The Dresser should first open the hook & loop by pulling the left side apart from the right at center back.



- b. Once this is open, the Dresser should release the belt buckle and take the Tail from the Performer.



OR

2. With the Performer holding the Tail at the waist, the Dresser can step to either side of the Performer
 - a. The Dresser should grab the tab of the zipper located where front of the tail joins the back

- i. Pull the tab up, then quickly down, until the zipper separates.



- b. Moving to the back, the Dresser can release the belt buckle and take the Tail from the Performer



****It is possible for the Performer to undo the zipper themselves, and then the belt, if needed. We are not confident that the Performer could open the hook & loop without assistance.****

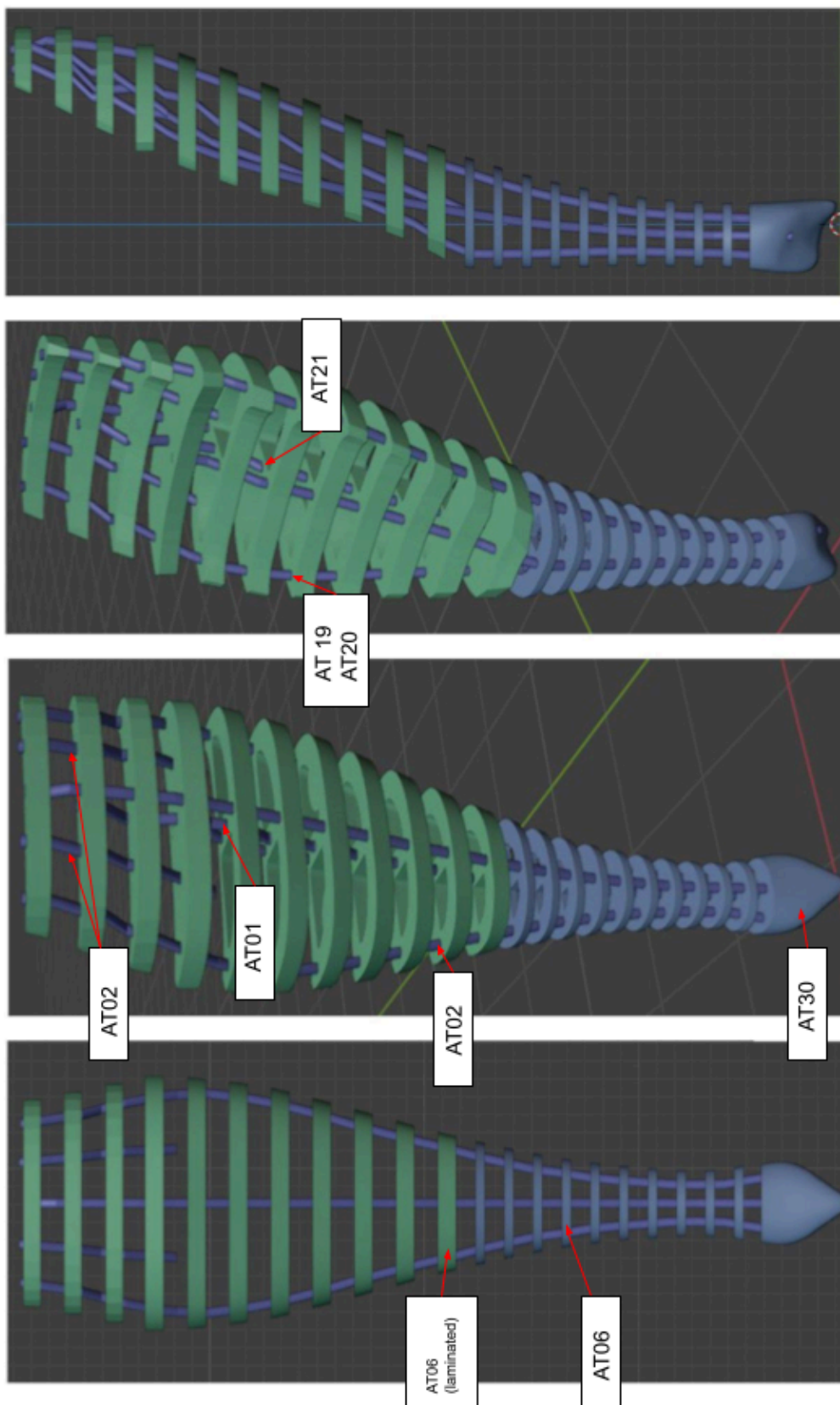
NOTE: Option 2 is only possible if the final tail cover allows access to the side zippers. We highly recommend Option 2 for Quick Change Removals, as the hook & loop is strong and loud.

3.2.6 Storage

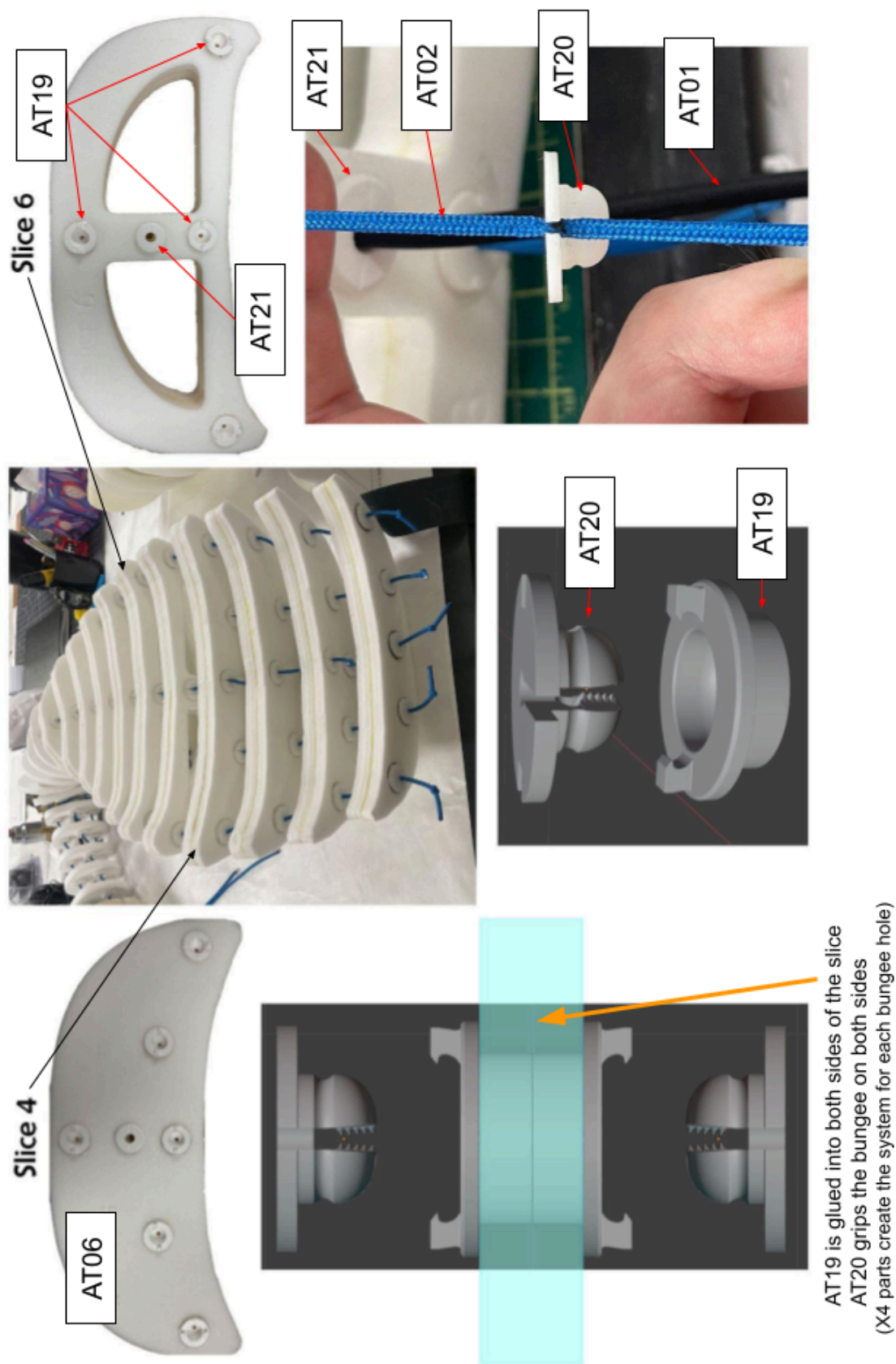
See section 3.1.1.

4 Detailed Diagrams of Mechanisms and Hardware

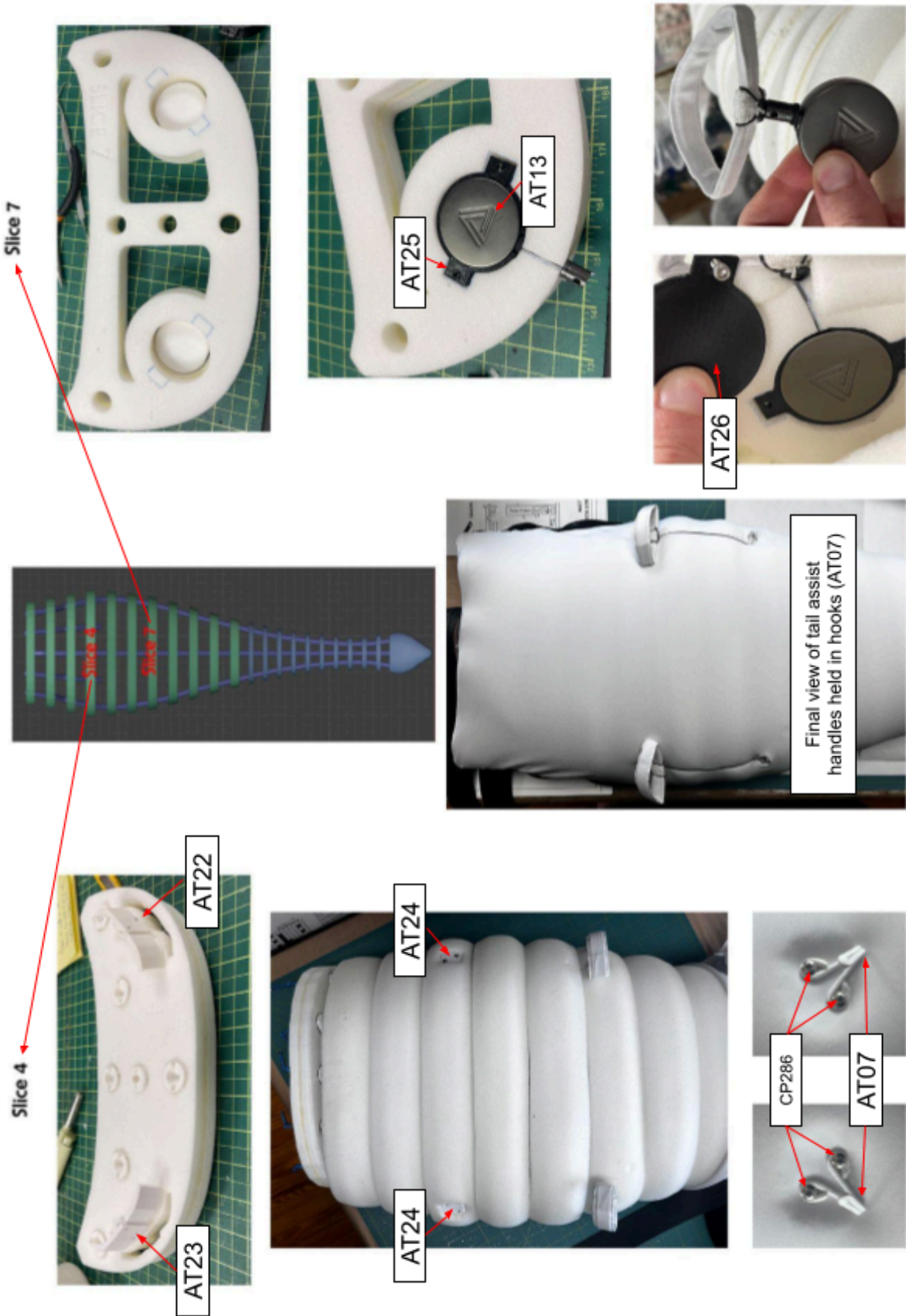
4.1 Internal skeleton



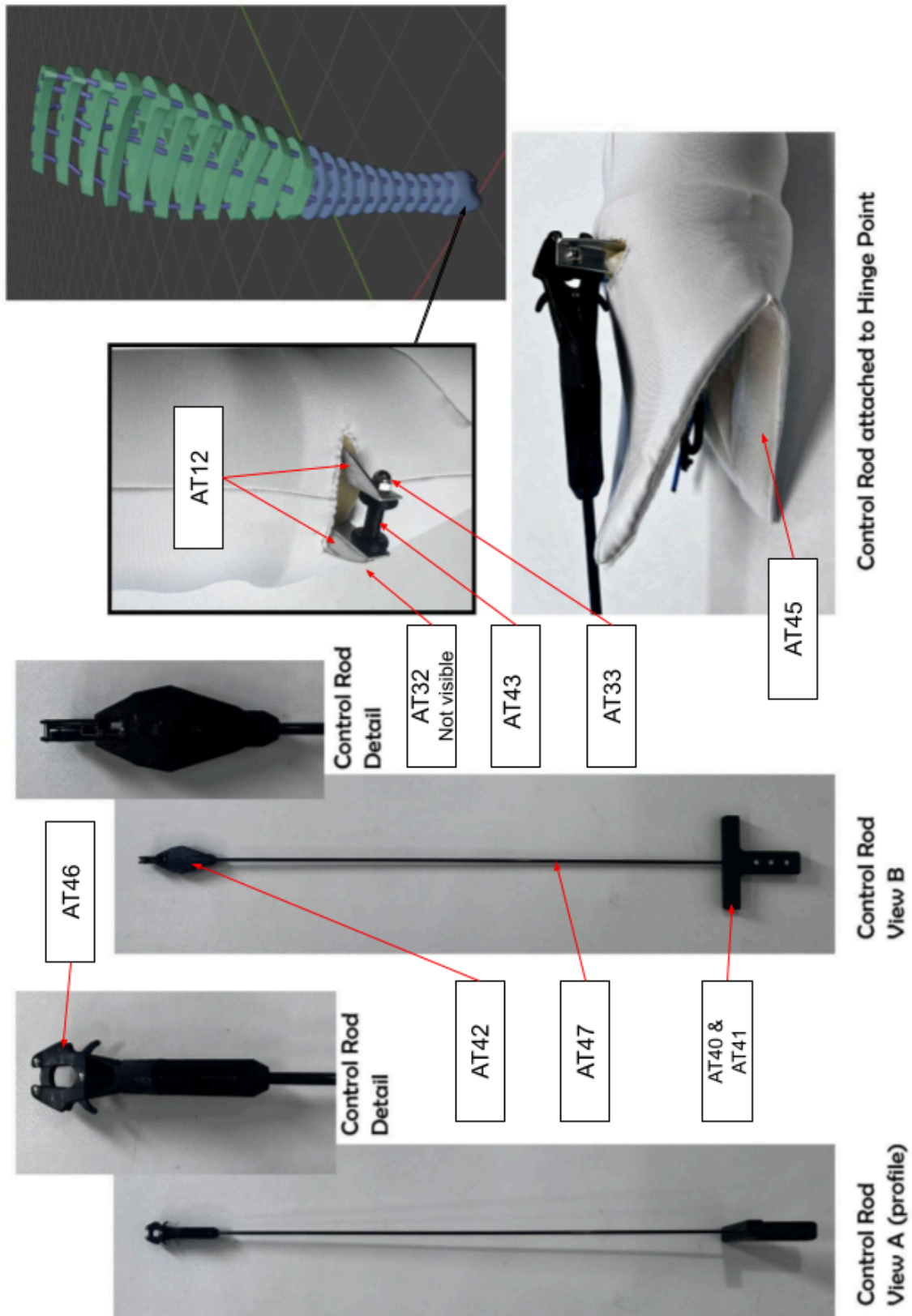
4.2 Closeup of Bungee & Bushing system



4.3 Tail Assist System



4.4 Control Rod, Mount & Fin Hinge



5 Safety and Hazards

5.1 Safety Precautions and Hazard Identification

As is the case with any puppet, care must be taken when handling this item to make sure that the item does not become damaged beyond normal expectations.

- Care should be taken that the puppet and its accessories do not crash against walls, doorframes, other props, or other items. This could cause the puppet to become damaged or soiled.
- If the hardware on the puppet becomes loosened, pieces of the puppet will be likely to behave erratically. Care should be taken to ensure that all hardware is present and properly tightened at all times.
- The Tail Lift Assist system is designed to be used *in conjunction with* the Puppeteer. At no time should the Performer be expected to bear the entire weight of the puppet using the tail lift Assist Handles alone. Doing so will result in damage to the puppet, and possible injury to the Performer.

5.2 Hazard Mitigation Strategy

There is always a chance of breakage and small injury when handling puppets and props, but Monkey Boys Productions has done their best to keep these chances low and keep both Performers and technicians safe. All items have been built to be safe to handle with little chance of injury when handled correctly.

- All carbon fiber parts have been sanded to a smooth surface and sealed or covered.
- Weights and distribution of weight have been thought through to make the carrying and handling of the puppets easier on the Performers to avoid muscular injury or strain.

These puppets are not a hazard to the environment or the performance location.

6 Repair & Service

6.1 Pre-performance Checks and Inspections

The following list is provided as a basis for pre-performance inspection of the puppet. Items may be added to or removed from this list as the on-site technical director sees fit.

Check Point	How to Inspect
belt buckle	clip & unclip to check connection
control rod connection point	visually and manually inspect for any loose points
fluke control handle	visually and manually inspect for any loose points

6.2 Periodic Testing

The following list is provided as a basis for periodic testing of the puppet. Items may be added to or removed from this list as the on-site technical director sees fit.

Check Point	How to Inspect	When to Inspect
Hooks for Tail Assist Handles	visually & manually check the attachment points	before the first show of the day
Tail Assist	pull out and release handles	before the first show of the day
Control rod to tail connection	engage and disengage the frog clip	before the first show of the day
"Skirt" zippers	make sure they're zipped completely	before the first show of the day
Bungee & bushing inspection	Remove the skin and visually check for fraying and/or breaking	weekly

6.3 Routine Corrective Maintenance

The following list is provided as a basis for routine maintenance of items that will commonly need replacement or adjustment. Items may be added to or removed from this list as the on-site technical director sees fit.

Check Point	Corrective Action	When to Address
Control Rod Button Head Nut	Tighten, add Blue locktite, replace as needed	Every 15 performances
Bungees	Restring—See section 7.3	As needed
Bushings	Replace—See section 7.4	As needed
Fabric hook mount Square nuts	Replace—See section 7.9	As needed
Center-back velcro	replace	As needed

6.4 Puppet-specific Service Items

A basic service kit has been supplied for use with this specific prop. Refills of the items in this kit can be handled by direct purchase from the source or by emailing contact@monkeyboysproductions.com. A full manifest of these items is supplied inside the kit and is included on the final page of this manual.

6.5 Cleaning Fabrics

*****Please note that using liquids or detergents on UV treated fabrics may cause the UV reactivity to fade and that these instructions are for the puppet portion of the tail ONLY—not the final layer from Costuming.*****

6.5.1 Spot Cleaning

- Spot clean as soon as dirt and grime are noticed.
- Gently wipe with Shout or Tide wipe.
- Dab product into deeper stains.
- Blot and gently wipe with a clean, white towel.
- Make sure that the area dries well.

6.5.2 Deep Cleaning Option 1 for widespread stains

- Dilute a drop of Woolite detergent in room temperature water.
- Dab on with a white cloth.
- Gently wipe & dab with a clean white towel.

6.5.3 Deep Cleaning Option 2 for deep stains

- Spray Bissell Pro Carpet Cleaner on the worst spot.
- Allow it to rest for 1 minute.
- Carefully dab and wipe with a clean towel, being mindful that fabric doesn't pull away from the material beneath.

6.5.4 In all cases

- DO NOT rub, twist, or pull when cleaning
- DO NOT use heat, steam, or pressure
- DO NOT use bleach or other harsh chemicals
- DO NOT immerse in or saturate with water

6.6 Cleaning Hard Surfaces

*****Please note that using liquids or detergents on UV treated surfaces may cause the UV reactivity to fade*****

- Hard surfaces (Carbon fiber, plastic, aluminum, grip tapes, etc.) can be wiped clean with water or a mild cleanser such as Dawn dish detergent diluted in water.
- Always use a soft cloth and work carefully to avoid scratching or damaging any coatings or paints.
- Always wipe all surfaces dry immediately after cleaning to avoid leaving water spots or otherwise damaging finishes.

7 Detailed Maintenance Procedures

7.1 Specialty information about replacing the belt buckle

1. Remove the damaged belt buckle and grab your replacement. **Fig 1**



2. Rethread the belt through the top hole of the new buckle. **Fig 2 - Fig 3**



3. Slide the end of the belt down into the bottom hole. **Fig 4 - Fig 5**



4. Tighten and adjust to the Performer. **Fig 6 - Fig 7**



7.2 Specialty information about removing the inner skin

1. To start, first unscrew the two covered hooks with a Phillips head screwdriver and set aside the four screws and the two hooks in a safe location. **Fig 1 - Fig 2**



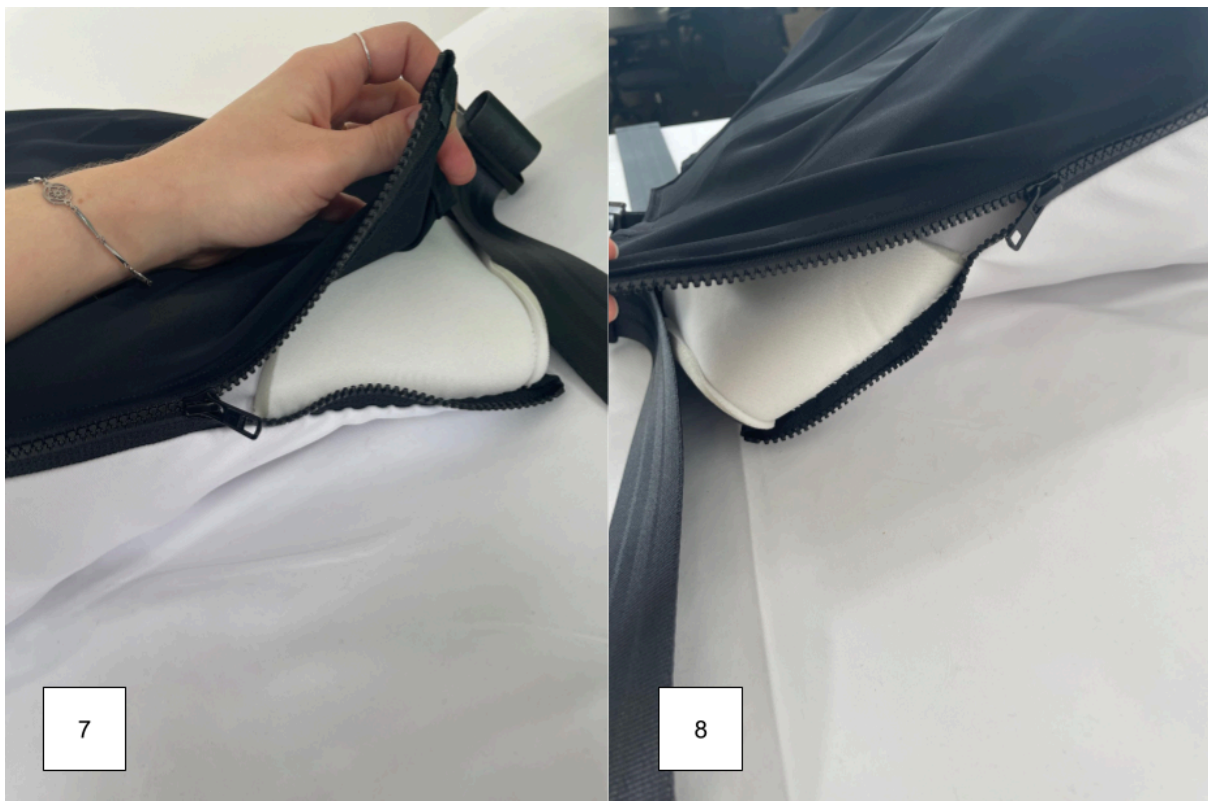
2. Thread the handles of the Lift Assist into their designated holes carefully. **Fig 3 - Fig 4**



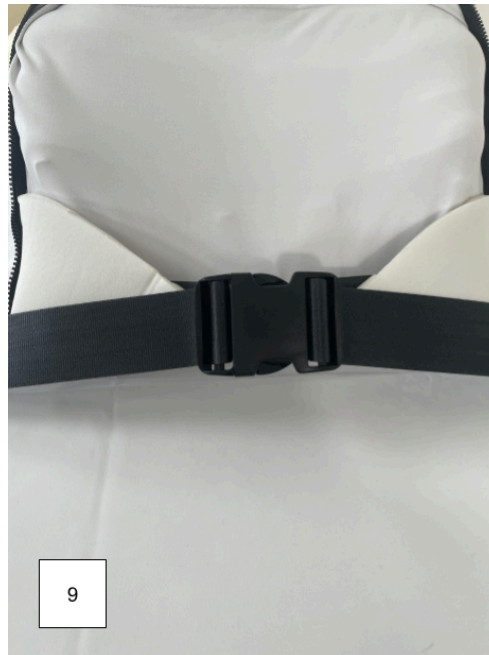
3. Undo the velcro at the center-back of the black “mini skirt”. **Fig 5 - Fig 6**



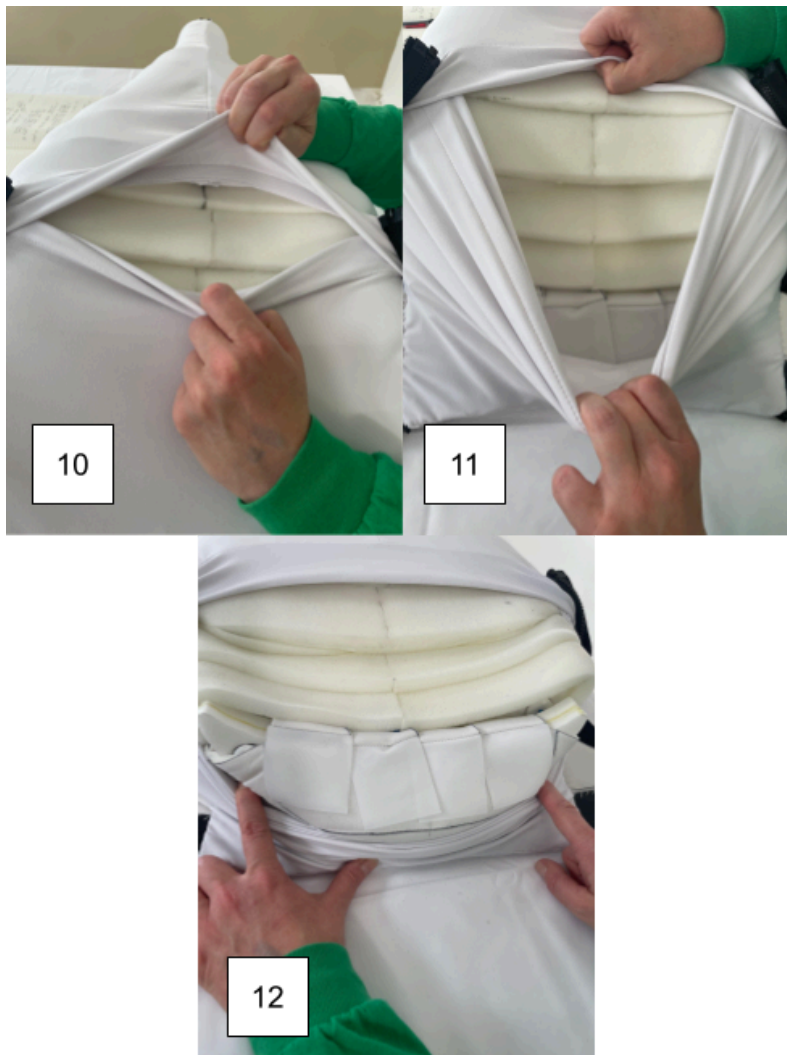
- a. You can also remove the whole skirt by unzipping the zippers on either side of the skirt without undoing the velcro. **Fig 7 - Fig 8**



4. Unbuckle the Belt. **Fig 9**



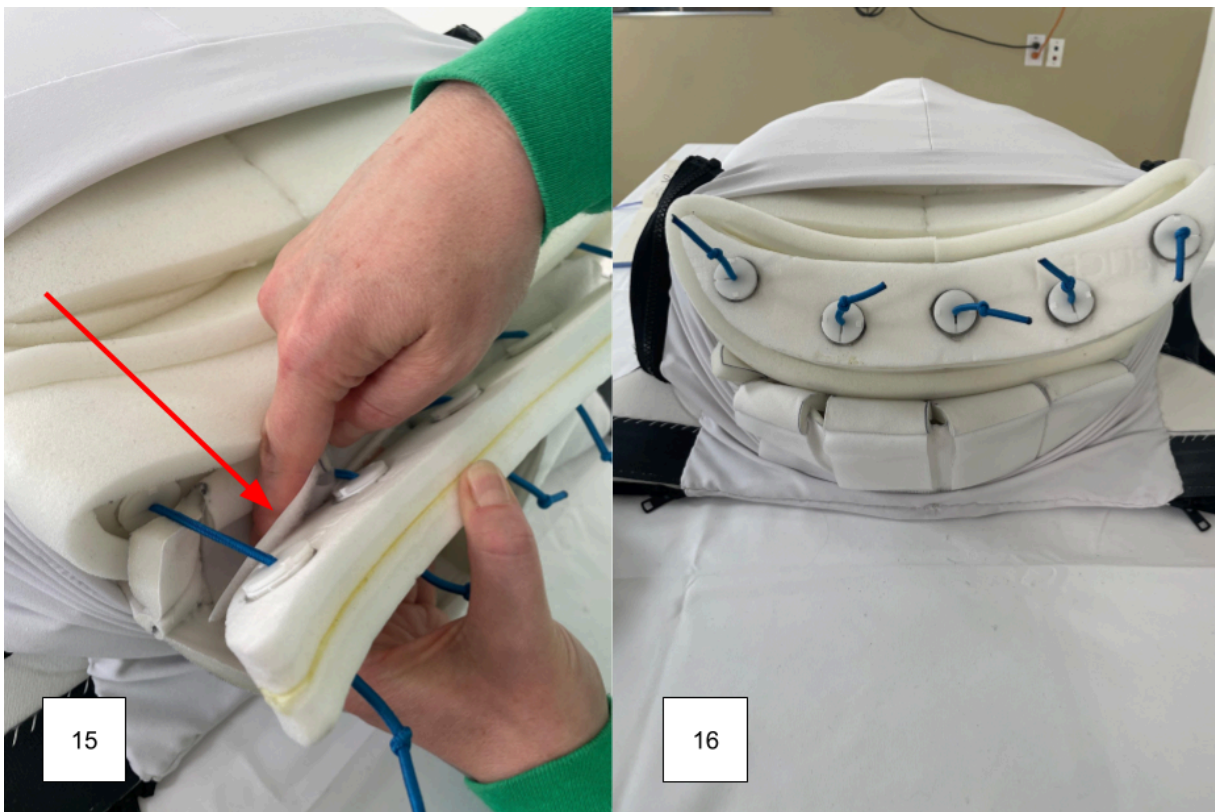
5. Open the overlapping fabric and pull the top forward to expose the top slice. **Fig 10 - Fig 12**



6. Undo the four velcro tabs, and pull out the first slice. **Fig 13 - Fig 14**



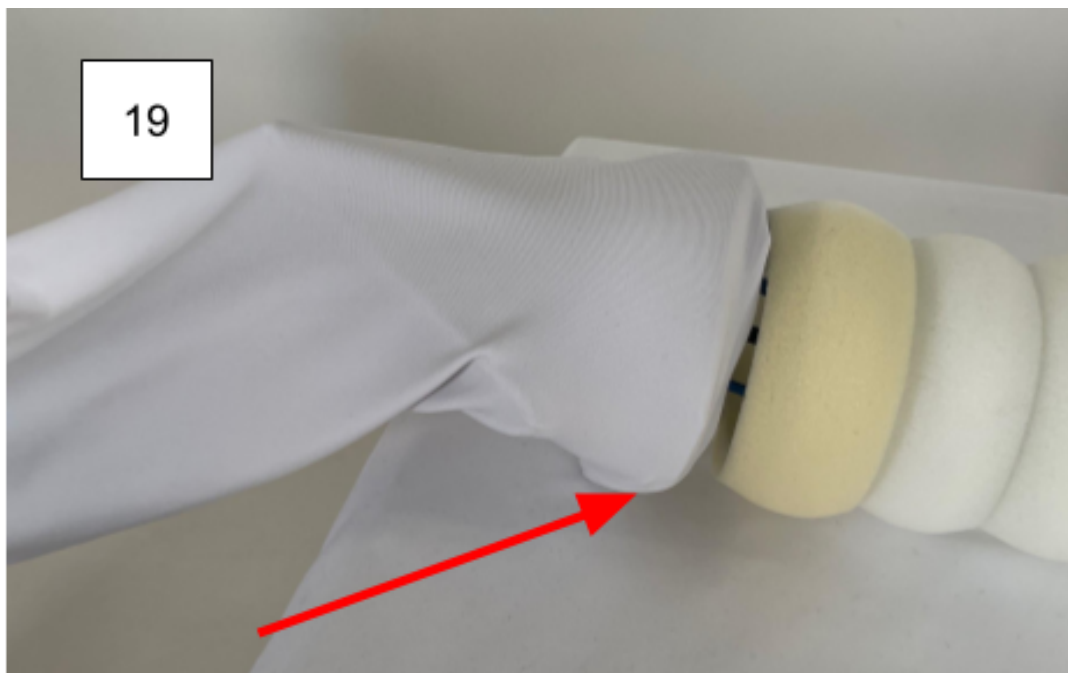
- a. Do Not Lose the packing foam insert that sits under the velcro and the slice. Pull out and set aside in a safe location.
- b. Tuck the Velcro tabs behind the slice for safekeeping. **Fig 15 - Fig 16**



7. Carefully pull the skin down the tail. **Fig 17 - Fig 18**



- a. Note: The tail will not come off completely. It will stop at the last slice at the end of the tail. Be aware that any maintenance on both the tail and the skin will have to keep this in mind. (ex: Make sure the skin is secured in a clean, safe position while working on the tail) **Fig 19**



8. Put the skin back on after maintenance is complete. Shimmy the skin up so that the spandex is evenly distributed and line up the handles with their corresponding holes.
 - a. Note: Make sure that the Center Back Seam lines up with the Center Back of the Foam Slices. The skin shouldn't be baggy anywhere. **Fig 20**

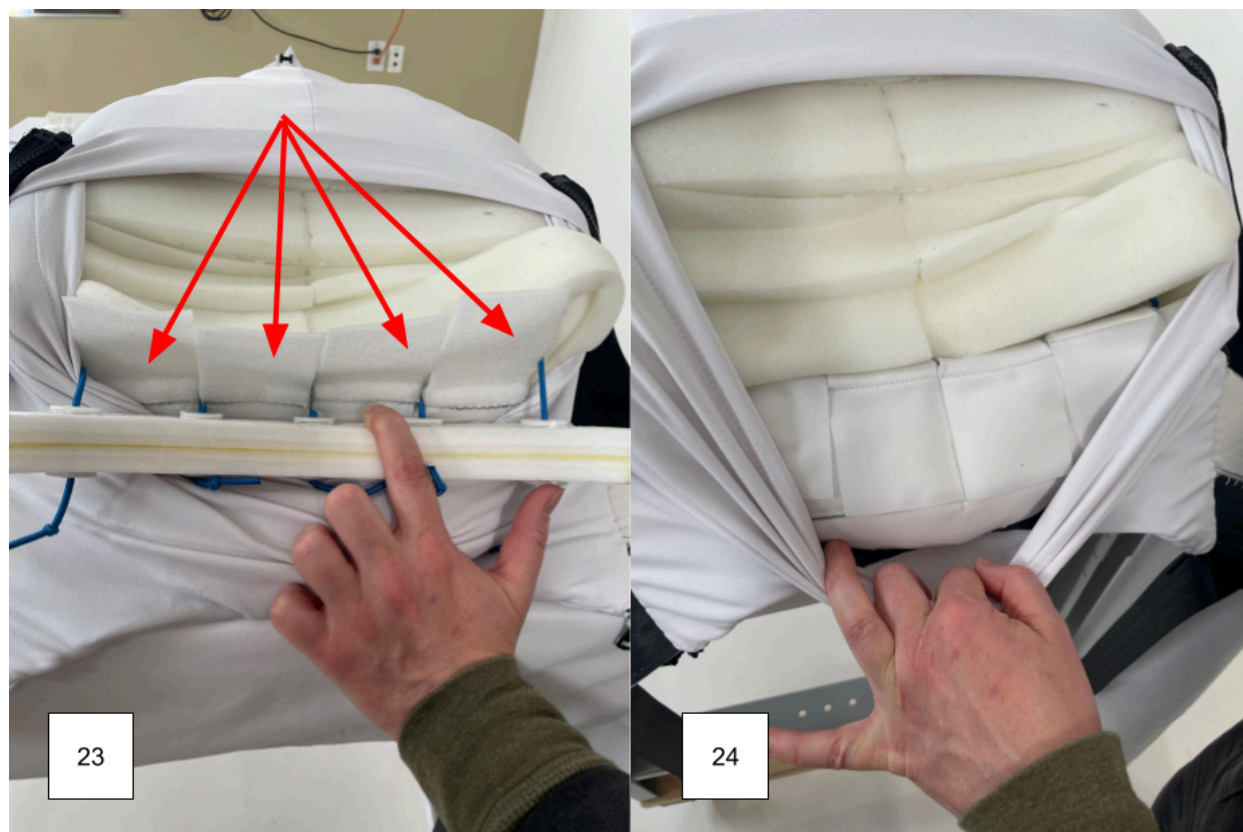


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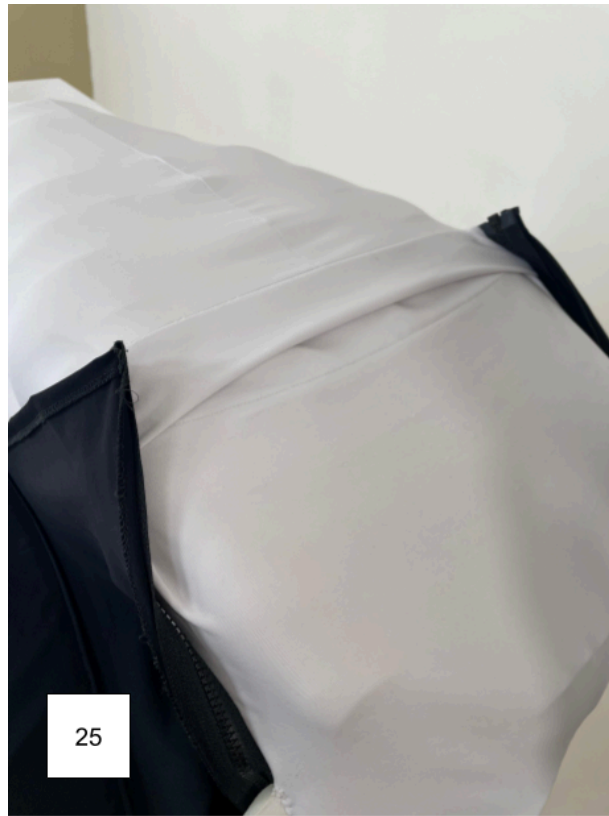
9. Pull the handles out vertically and carefully. Once they are out, tuck in the facing. **Fig 21 - Fig 22**



10. Reinsert the top slice and the foam insert. Make sure it goes into the pocket and the loop side of the velcro is up and threaded alternating between the bungees. Attach the velcro over the slice and the foam insert. **Fig 23 - Fig 24**



11. Overlap the fabric once more. **Fig 25**



12. Attach the velcro for the mini skirt (or zip the miniskirt back into place). **Fig 26**

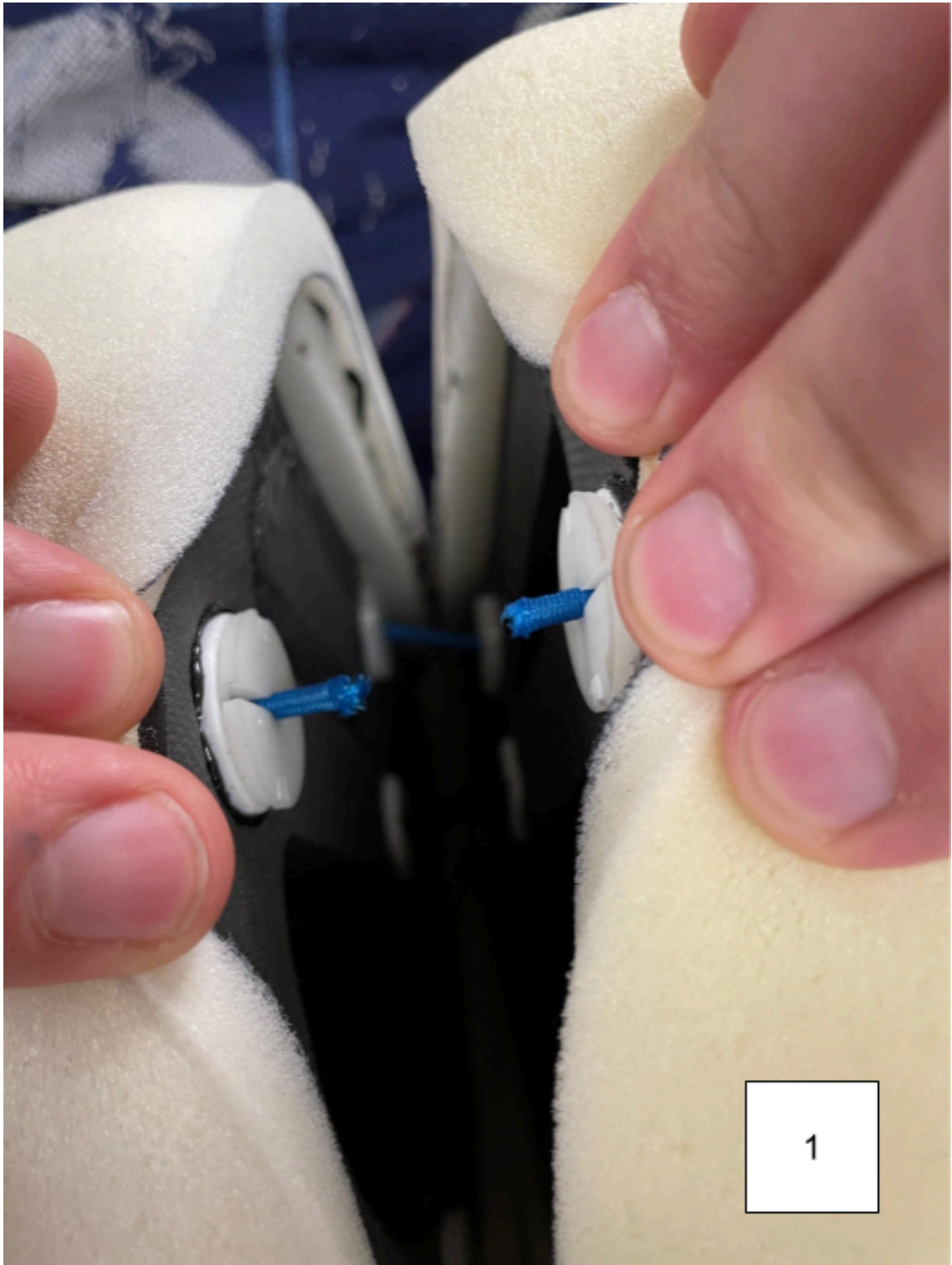


13. Buckle the Belt.

7.3 Specialty information about restringing the bungees

Note: This maintenance is extensive and will require at least a day's worth of time dedicated to it. This is not a procedure to be performed in between shows.

1. Remove both the costume skin and the second skin. You can follow the procedure detailed in section 7.2.
2. Determine the extent of the damage as well as which bungee(s) are affected. Once the problem is diagnosed, remove all of the Part B bushings on the affected bungee. **Fig 1**

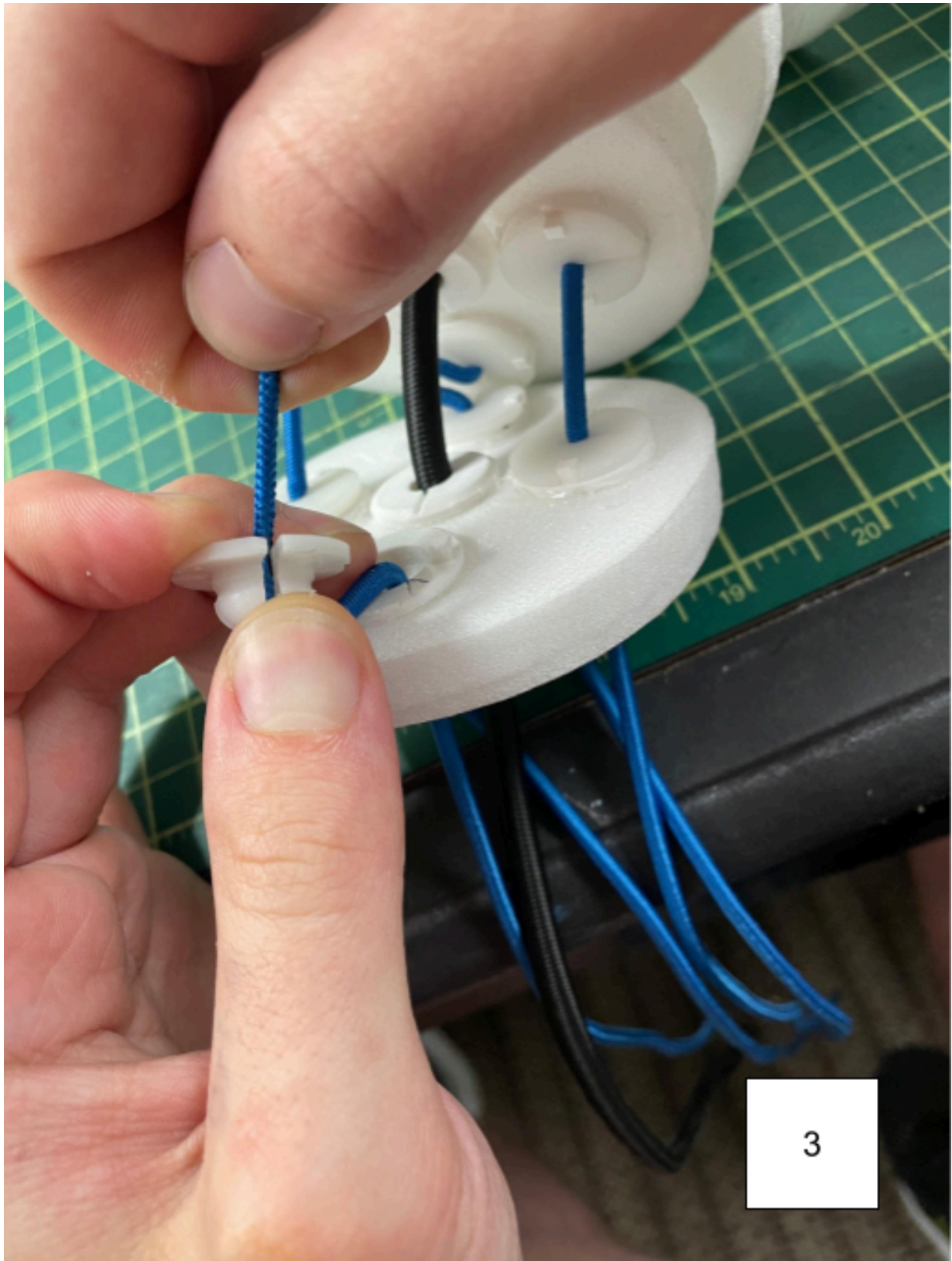


- a. Take a flathead screwdriver, and work the head between the "A" and "B" sections of the Bushing. Do so gently and slowly, starting at the split in the Part B Bushing. **Fig 2**



2

- b. Remove Part B from the bungee. Stretch the bungee as much as possible to thin out the diameter. Pull the bungee towards the split in the Part B component until you bring it forward. Thin out the bungee to work it out of the teeth. **Fig 3**



- c. Set these bushings aside, you may be able to reuse them. Be careful not to damage the Part Bs while you are taking them out. **Fig 4**



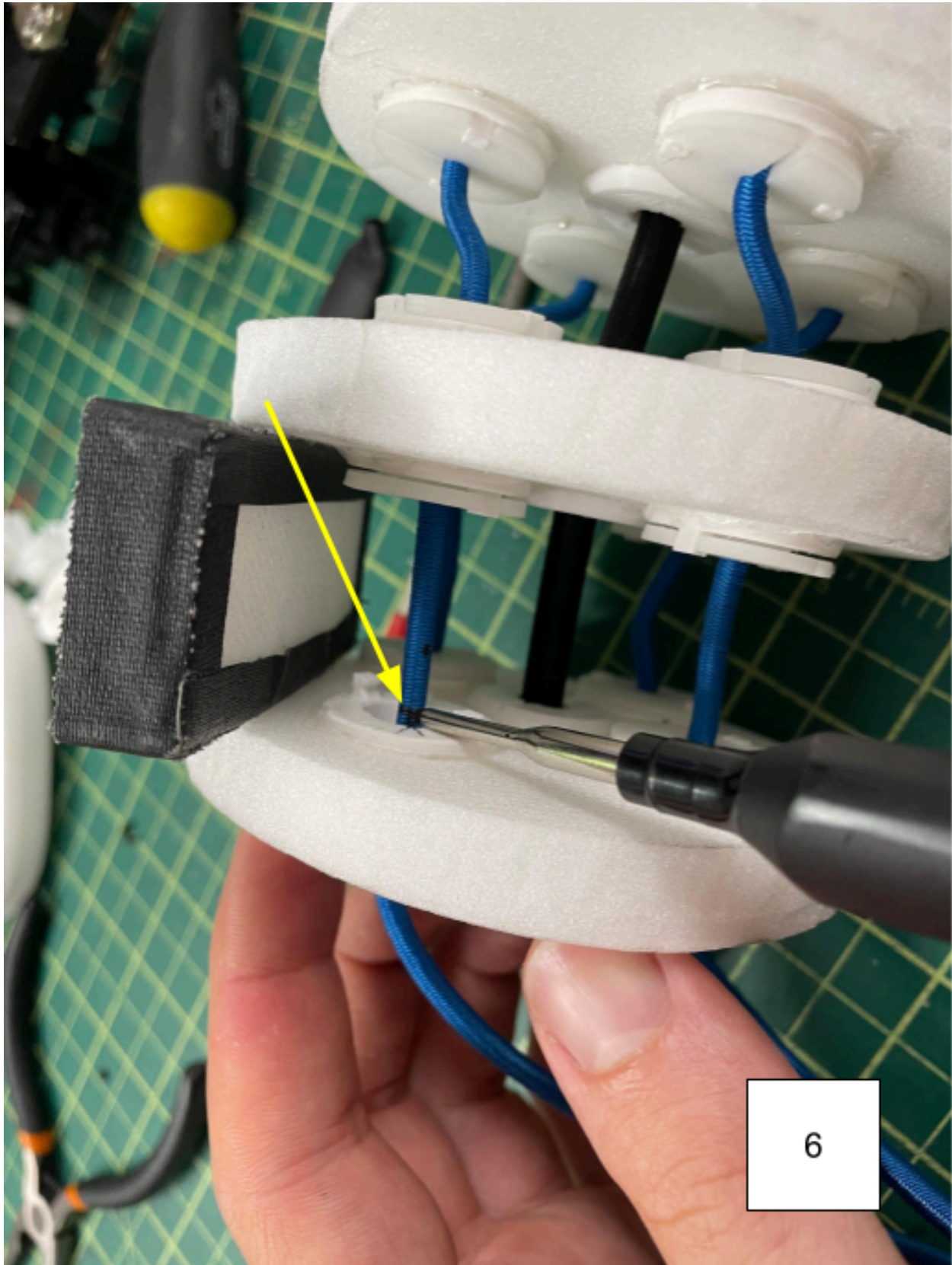
3. The Bungee is knotted at the top and the bottom of the tail. If you need to, cut the knot off before removing it. Carefully pull out the damaged bungee.
4. Cut a new length of bungee cord. It should be longer than what you need, about 50in long. Knot one end of the bungee, melting the end to prevent fraying.
5. Take a razor and cut the other end of the bungee at an angle. This makes it easier to feed through the slices. Melt the end to prevent fraying.

6. Starting at the top and working your way down, feed the bungee through the tail. **Fig 5**

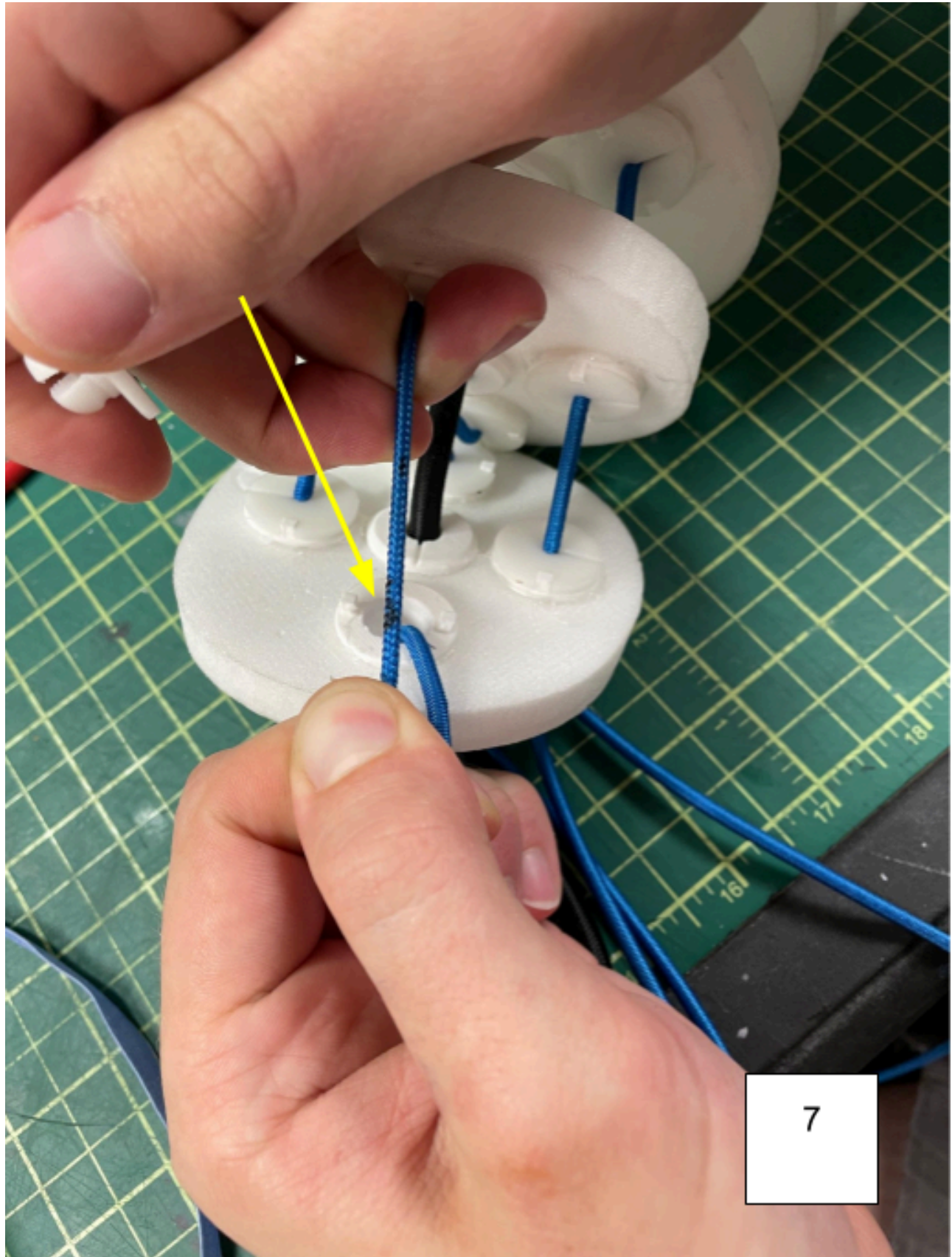


- a. Note: You will work each slice at a time. Once the bungee is threaded through a slice, stop and place the Part B bushings back into the slice on the bungee. There are **22** slices in all.

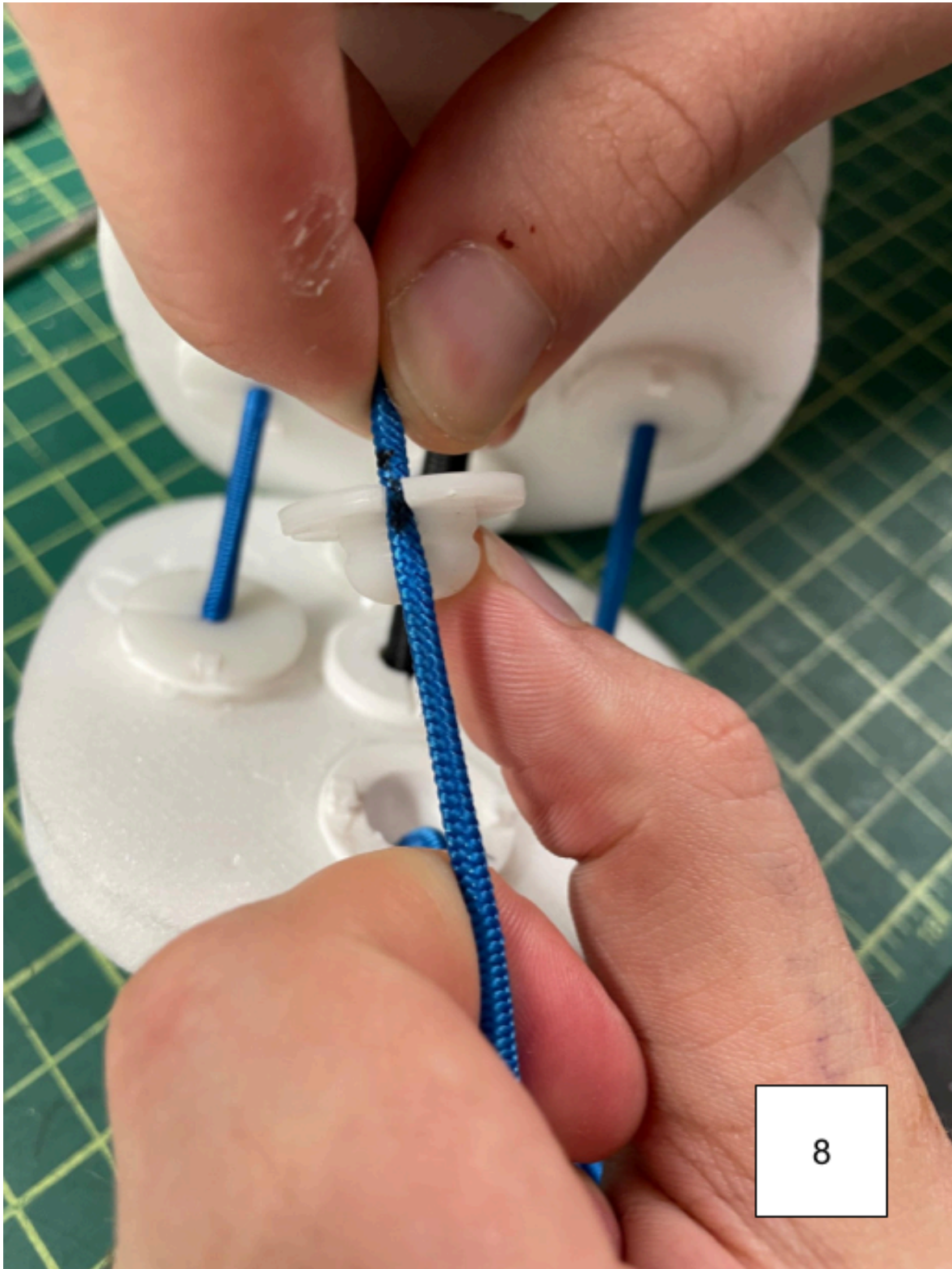
- i. Use the 1/32-inch spacer in your repair kit to gauge the area between the foam slices. Mark the bungee for your reference with a Sharpie marker. **Fig 6**

**6**

- ii. To place the Part B bushing, put as much slack on the bungee as possible to give yourself ample room. **Fig 7**



- iii. Slip the Part B bushing onto the bungee through the split in the plastic. You want to make sure that your Sharpie mark is just below the top of the bushing. **Fig 8**



1. Note: When you slip the Part B bushing onto the bungee, start with the slot facing out. Do Not twist after placing. Twisting the bungee can misalign the piece.

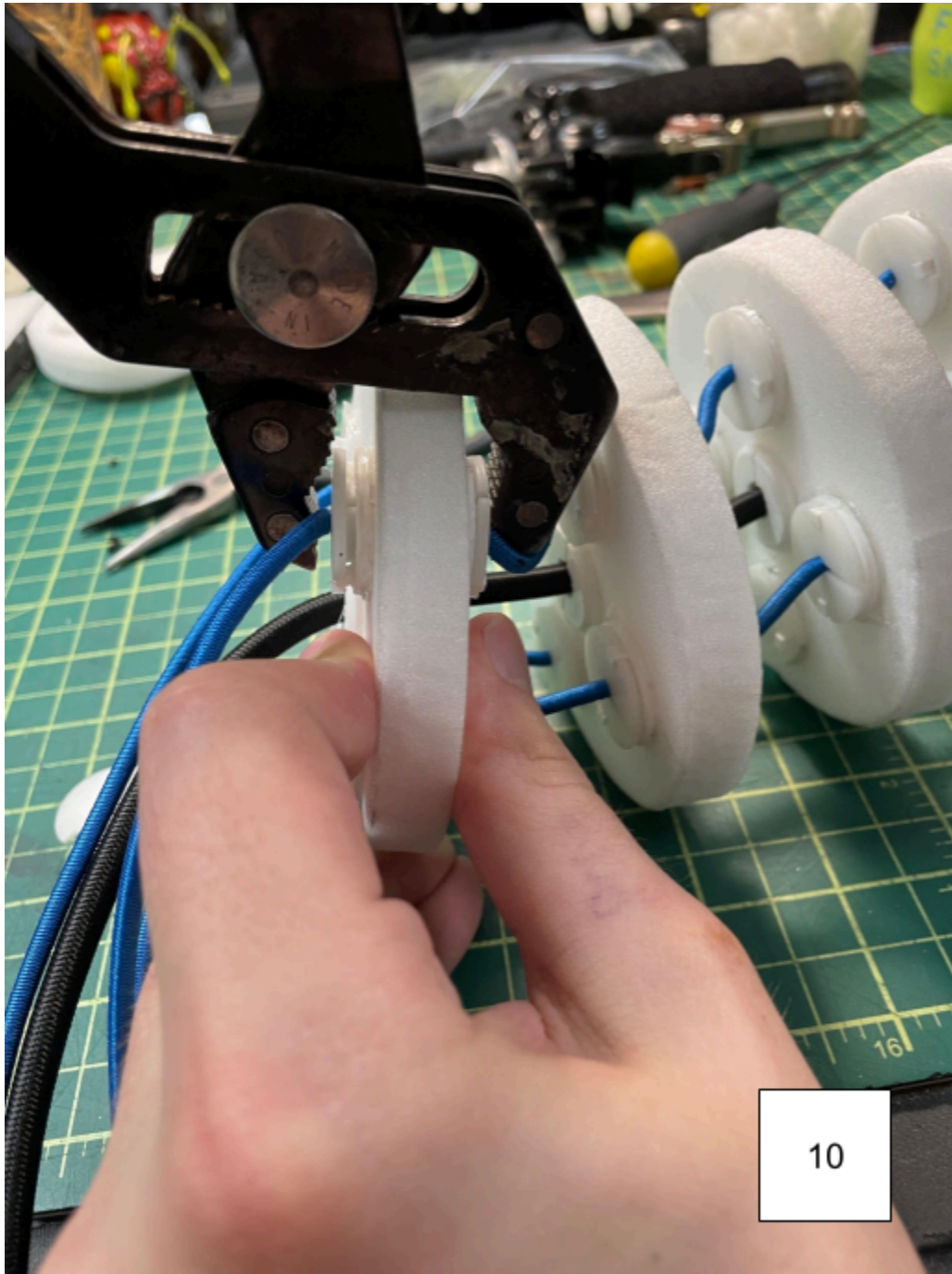
- iv. Pull the Bungee taut. By pushing on the bungee from behind, walk the bungee into the teeth into the teeth of the bushing.

1. **Note: Some of the bushing's teeth may break. If this occurs you can still use it. A few teeth can break on the inside of the bushing and it will be fine.**

- v. Pull the bungee from the bottom past the Part A bushing. Then align the cutouts in the Part B bushing and the tabs on the Part A bushing. With a walking motion, snap in one side first and then walk back to snap the other side. **Fig 9**



- vi. Use Robogrip Channel Lock pliers to gently clamp by walking the pliers around the bushings to evenly press down. **Fig 10**



b. Note: When you get to the bottom, be advised that you will have to work around the second skin of the tail.

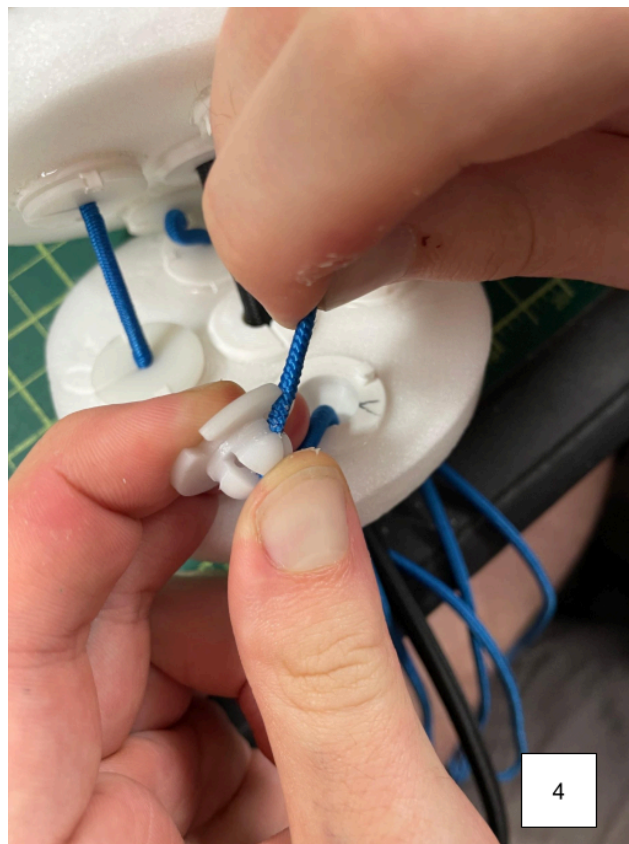
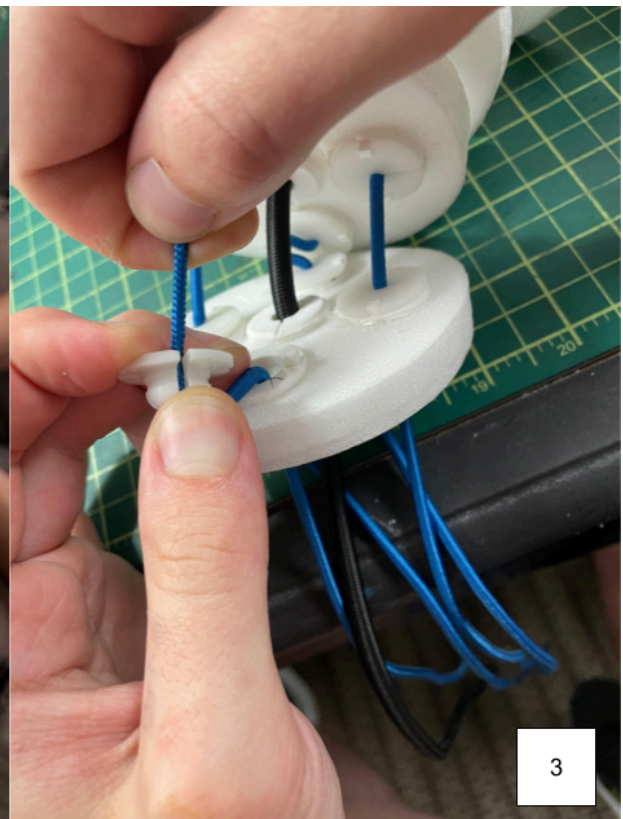
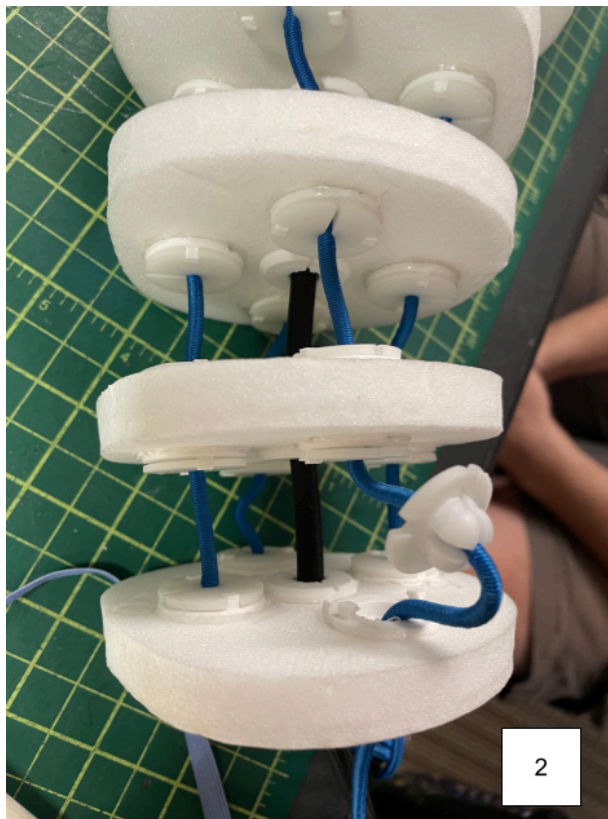
7. Tie off the bungee and cut off any excess. Melt the ends to prevent fraying.
8. With the Bungee replaced, you can now replace the second skin.

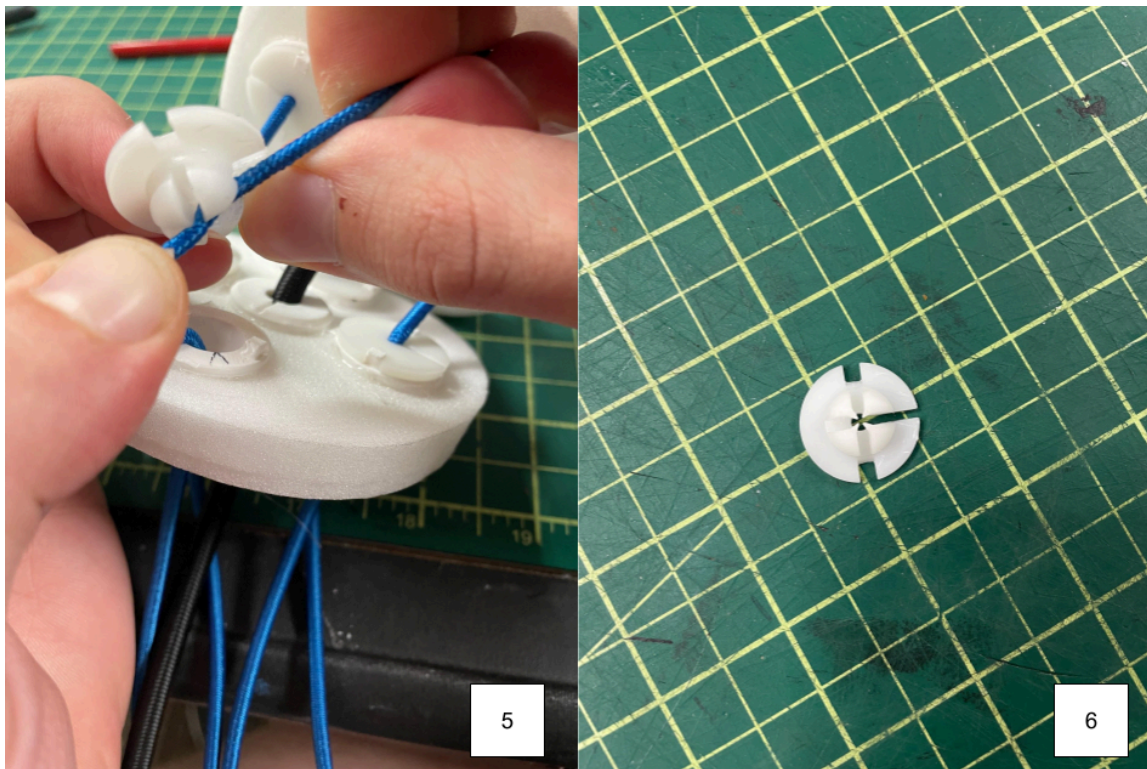
7.4 Specialty information about replacing a Part B bushing

1. Taking out the Damaged Part B Bushing
 - a. Follow the steps in Section 7.2 to expose the inside of the tail.
 - b. Inspect the Tail to find the damaged bushing. (possible regular inspections necessary.)
 - c. Take a flathead screwdriver, and work the head between the "A" and "B" sections of the Bushing. Do so gently and slowly, starting at the split in the Part B Bushing. **Fig 1**



- d. Remove Part B from the bungee. Stretch the bungee as much as possible to thin out the diameter. Pull the bungee towards the split in the Part B component until you bring it forward. Thin out the bungee to work it out of the teeth. **Fig 2 - Fig 6**

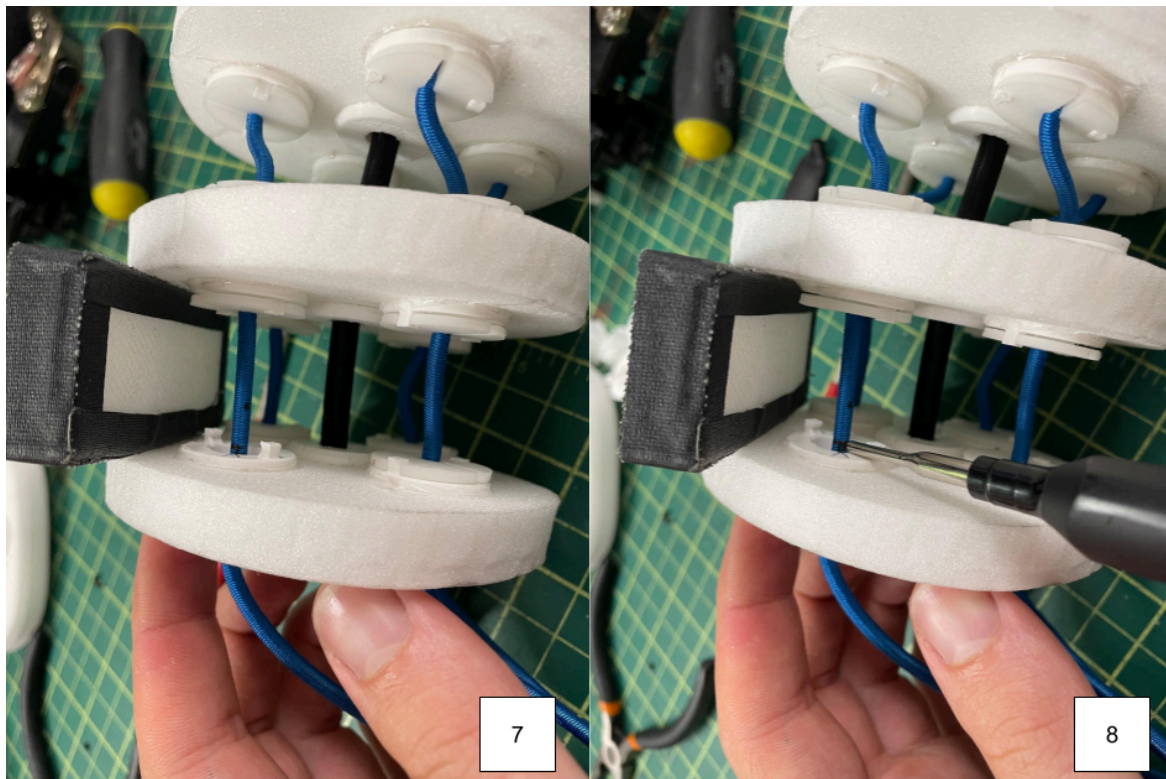




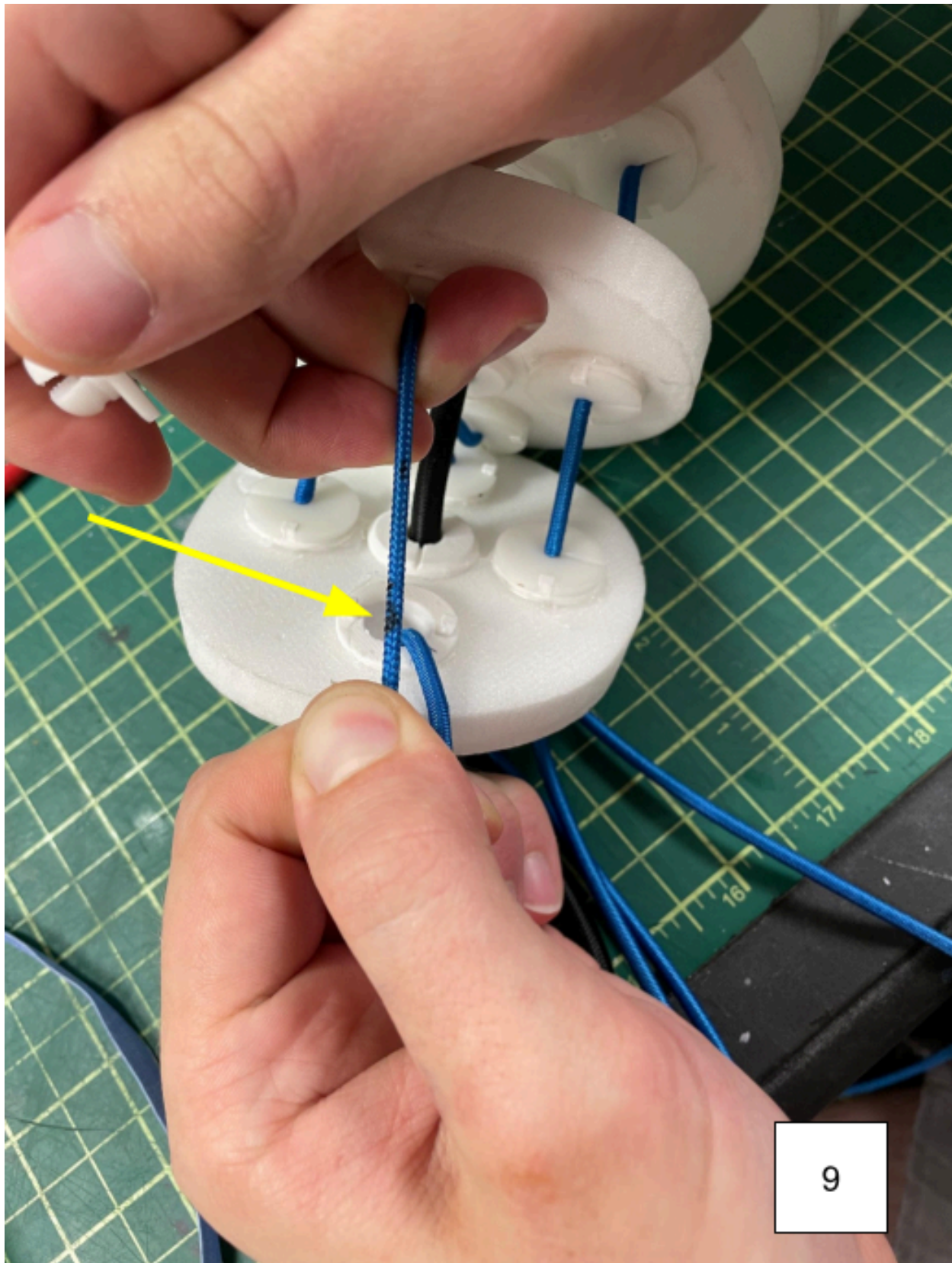
2. How to Put in a New Bushing

- a. If the Sharpie mark is still visible from the previous bushing, you can use this mark as a guide to place the new bushing.

i. **Note: If there is no mark, use the 1/32-inch spacer in your repair kit to gauge the area between the foam slices. Mark the bungee for your reference. Fig 7 - Fig 8**

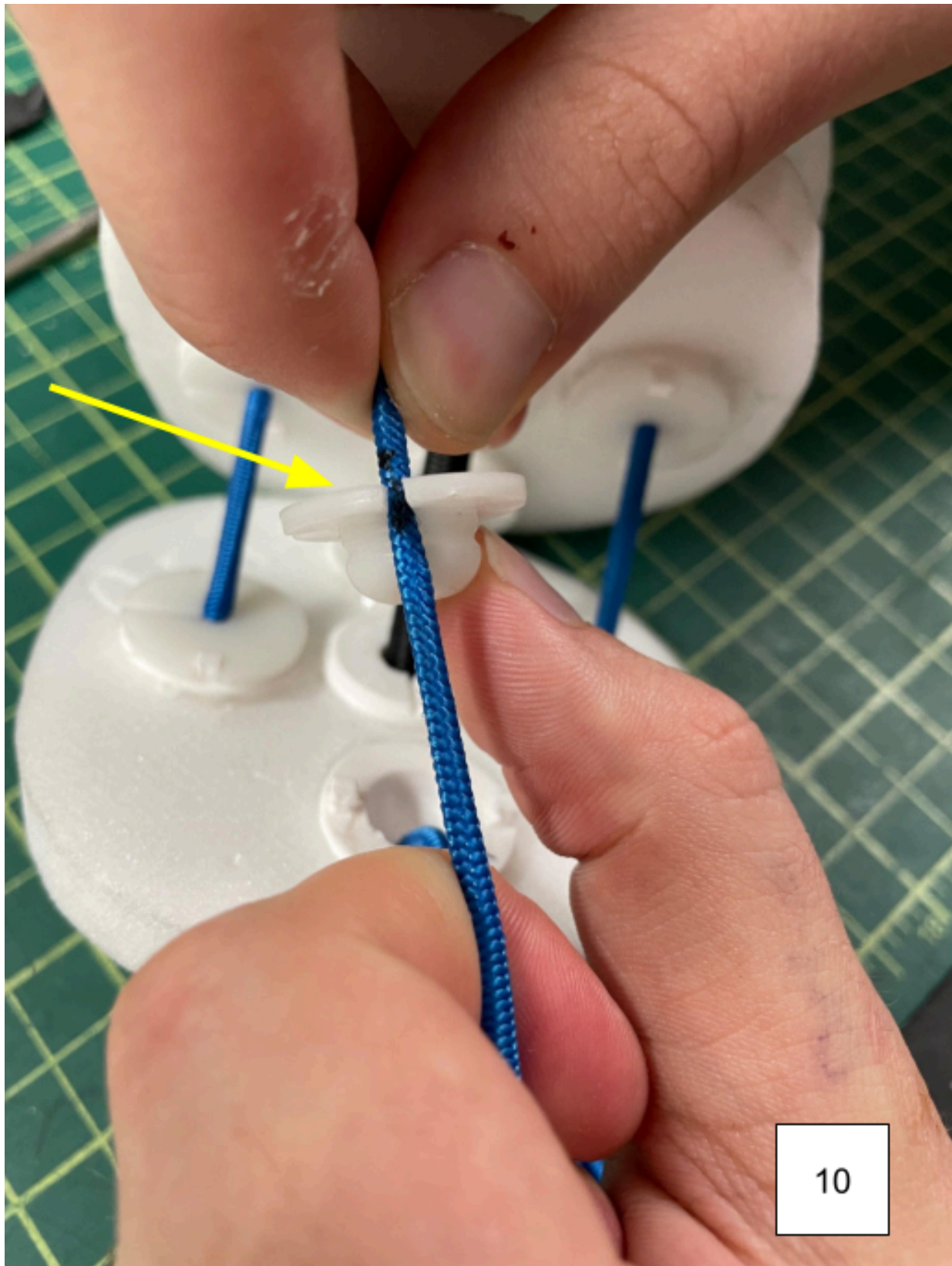


- b. To place the Part B bushing, put as much slack on the bungee as possible to give yourself ample room. **Fig 9**



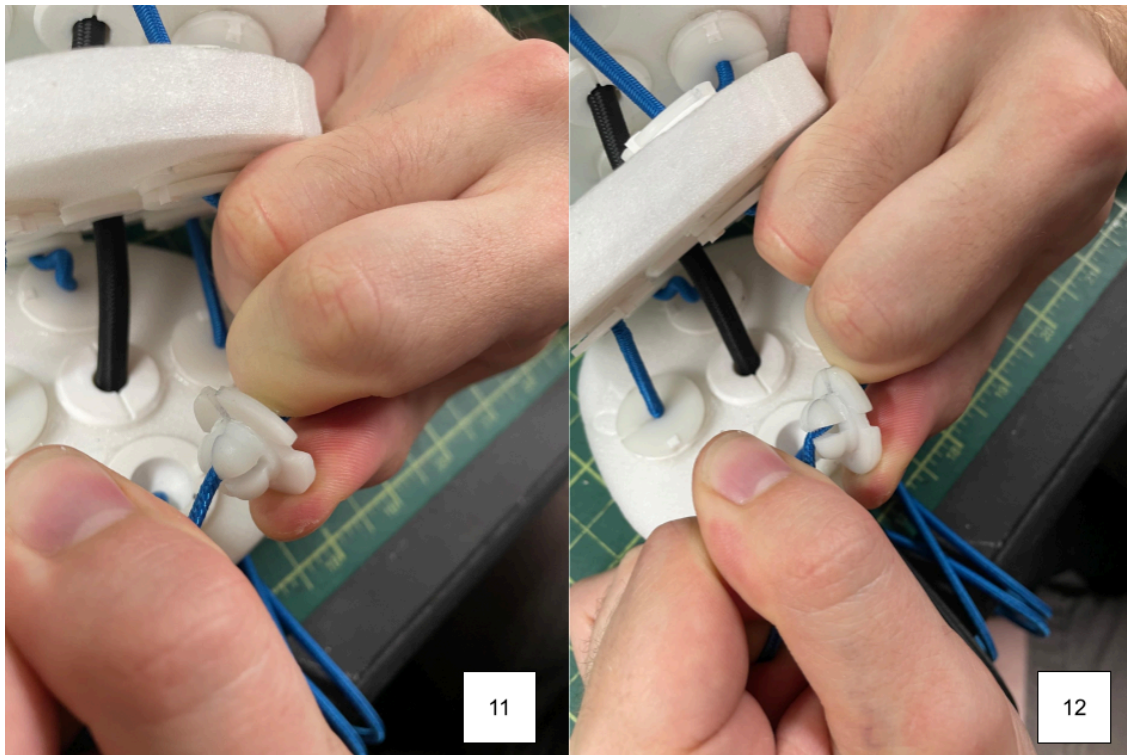
9

- c. Slip the Part B bushing onto the bungee through the split in the plastic. You want to make sure that your Sharpie mark is just below the top of the bushing. **Fig 10**

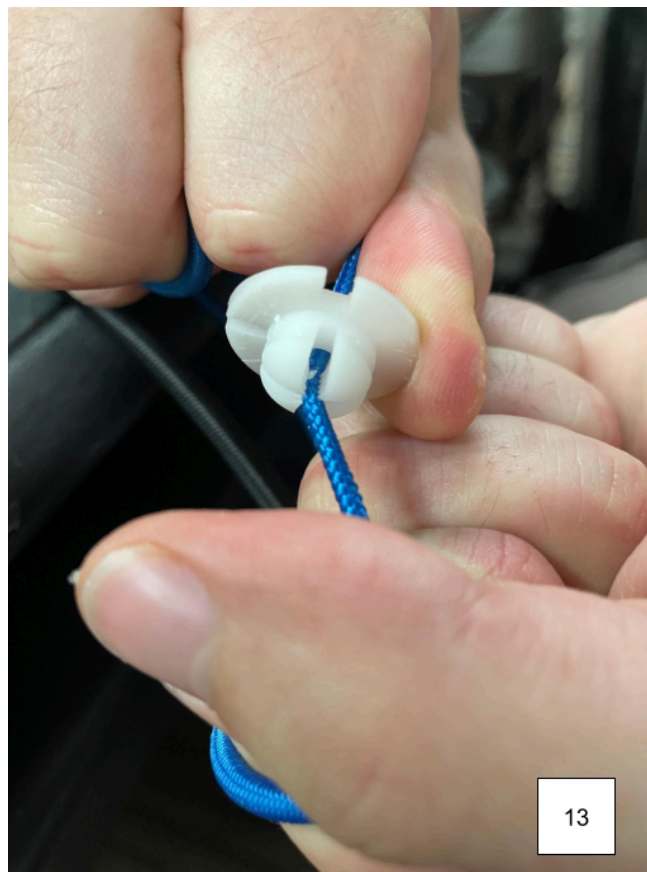


- i. **Note: When you slip the Part B onto the bungee, start with the slot facing out. Do Not twist after placing. Twisting the bungee can misalign the piece.**

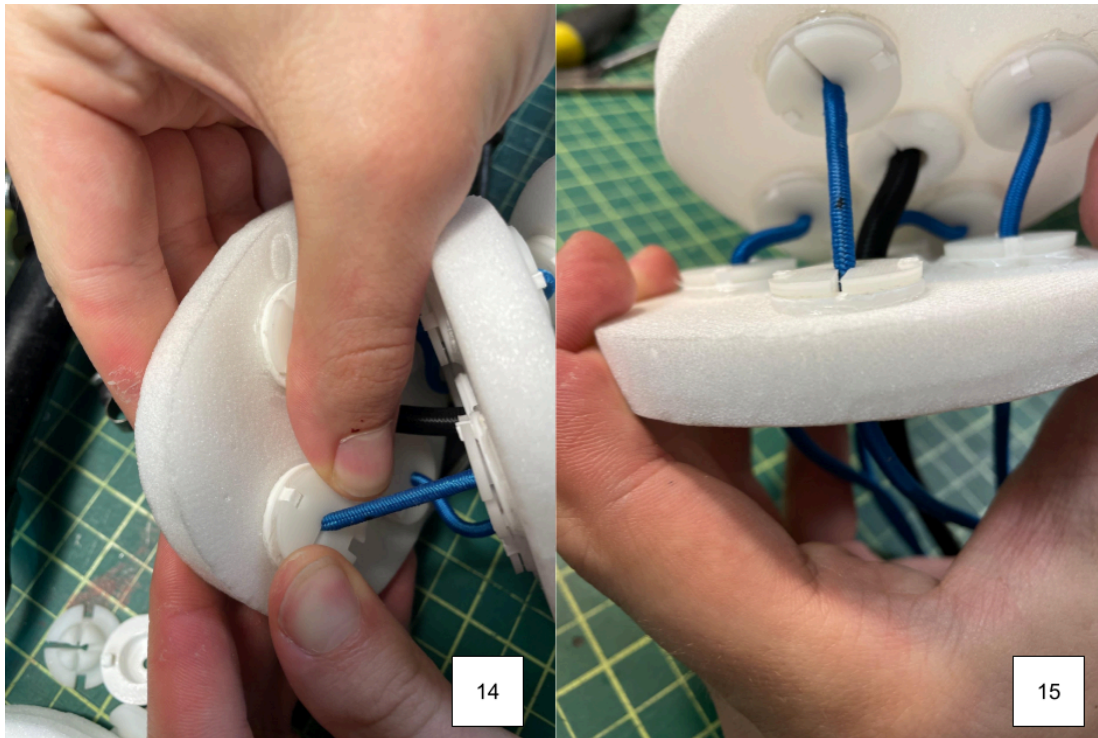
- d. Pull the Bungee taut. By pushing on the bungee from behind, walk the bungee into the teeth of the bushing. **Fig 11 - Fig 12**



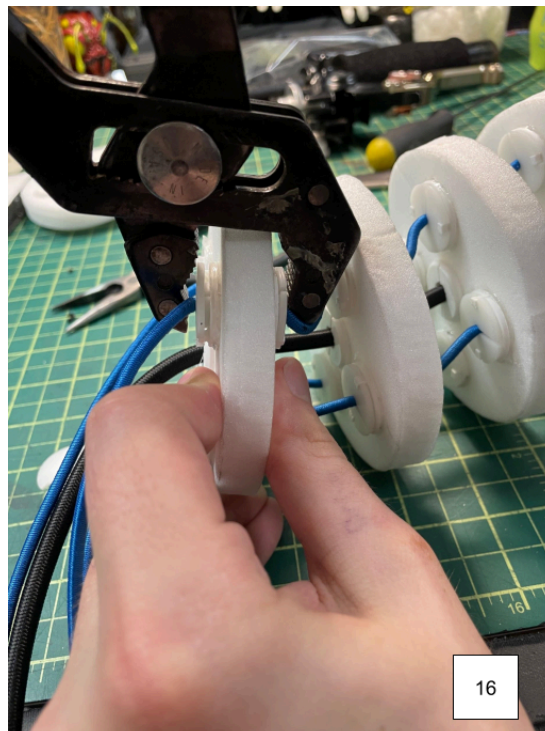
- i. Note: Some of the bushing's teeth may break. If this occurs you can still use it. A few teeth can break on the inside of the bushing and it will be fine. **Fig 13**



- e. Pull the bungee from the bottom past the Part A bushing. Then align the cutouts in the Part B bushing with the tabs on the Part A bushing. With a walking motion, snap in one side first and then walk back to snap the other side. **Fig 14 - Fig 15**

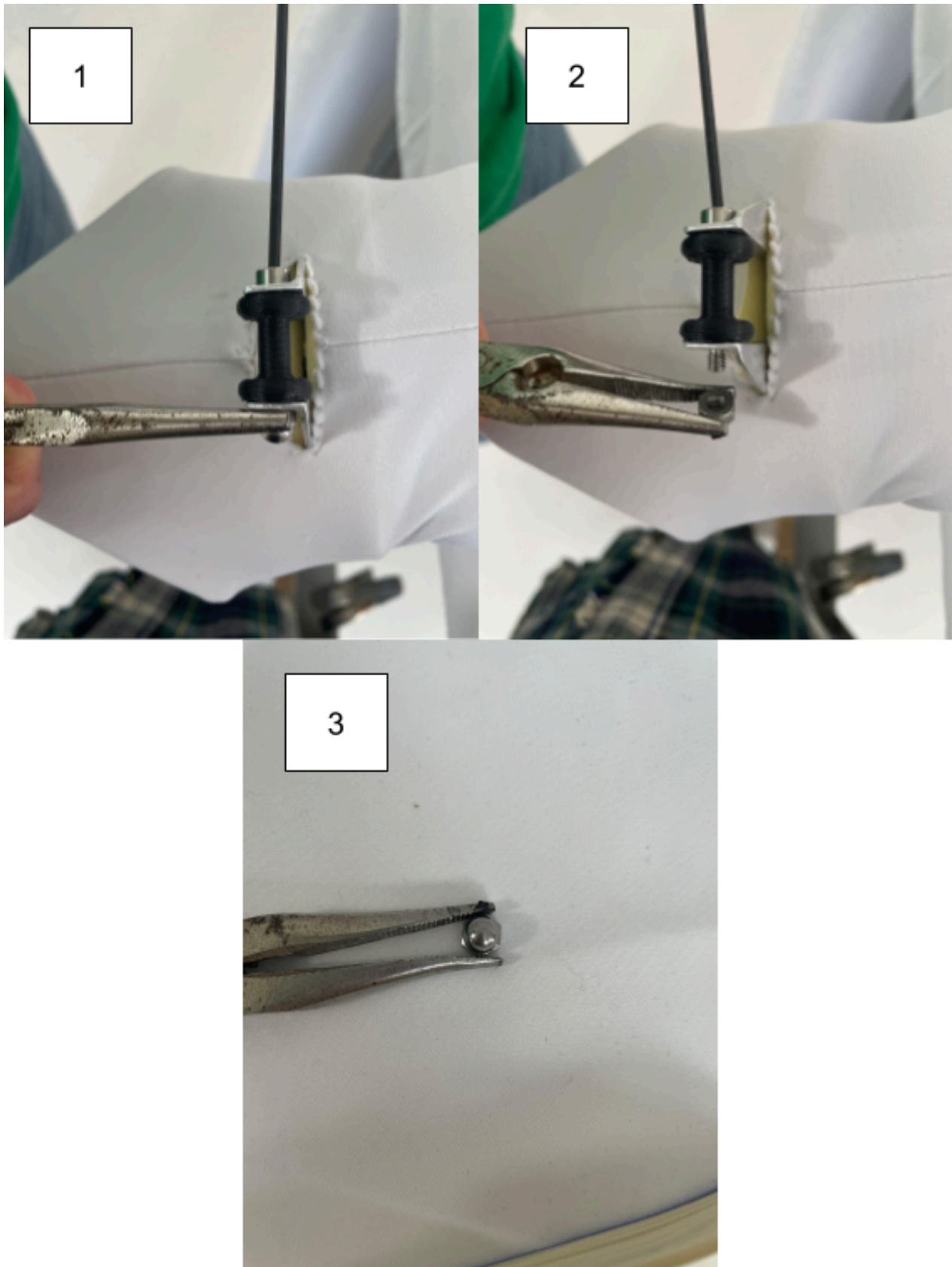


- i. **Note: If both Part B sections of the affected bushing are damaged, make sure to repeat the above process and use spacers to confirm the correct spacing between the sections.**
- f. Use Robogrip Channel Lock pliers to gently clamp by walking the pliers around the bushings to evenly press down. **Fig 16**

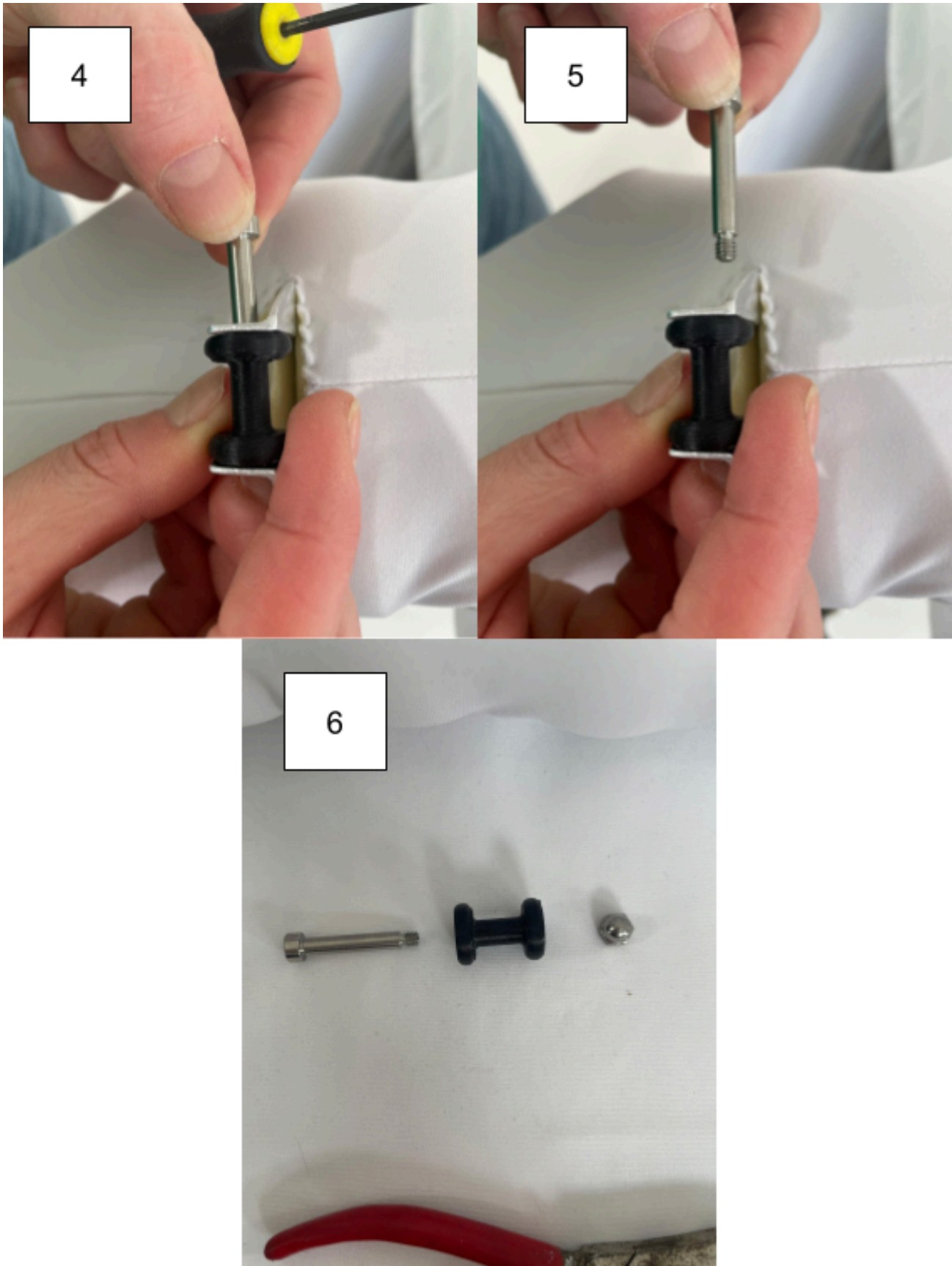


7.5 Specialty information about repairing the control rod connection point

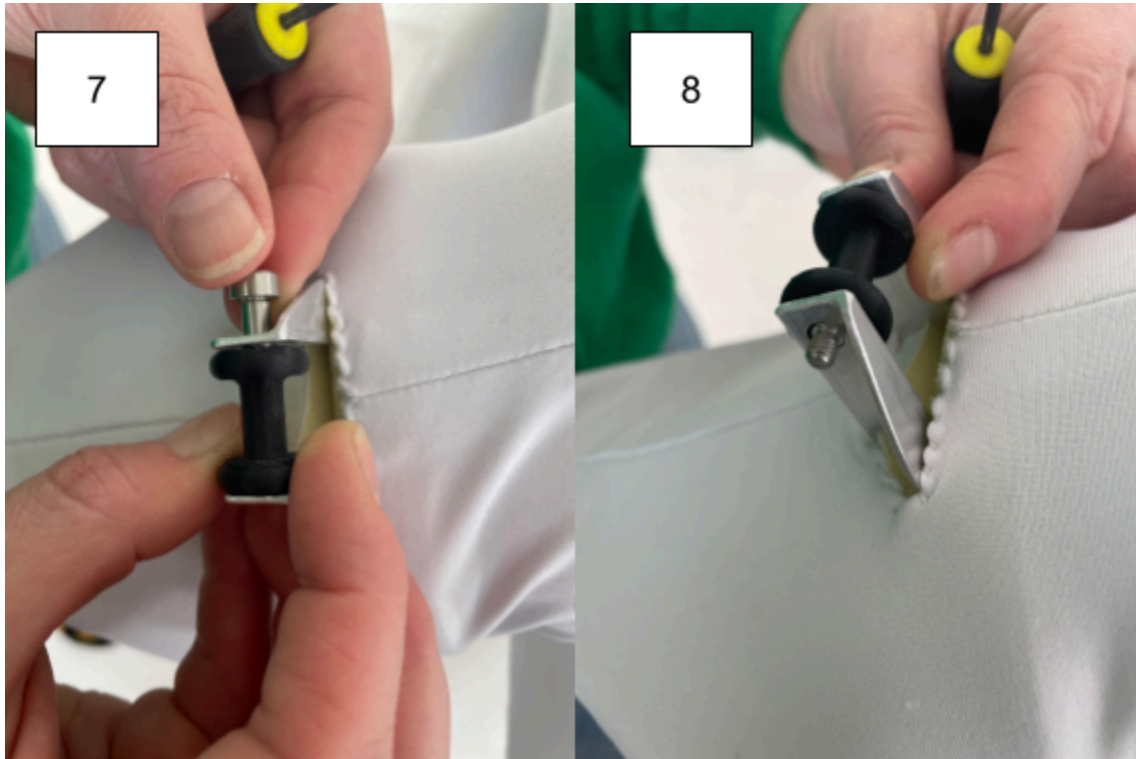
1. Loosen the button head nut by holding the nut with a pair of pliers and unscrewing the shoulder bolt with a 3/32 Allen driver. **Fig 1 - Fig 3**



2. Slide out the shoulder bolt and remove the Control Rod Grab Point. Set aside in a safe area. **Fig 4 - Fig 6**



3. To replace the Control Rod Grab Point, line it up with the holes in the L brackets, then thread the shoulder bolt through everything. **Fig 7 - Fig 8**



4. Hand tighten the button head nut, then use pliers and the Allen driver. **Fig 9**



a. Note: Check Button Head Nut every 15 shows to make sure it is tight. Use Blue Locktite as needed and each time it is replaced.

7.6 Specialty information about replacing the Tail Lift Assists

1. After removing the second skin, move to the 7th slice that houses the Lift Assist Mechanism. **Fig 1**



2. Locate the affected/damaged Lift Assist. Use a hex-head wrench to unscrew the two 4-40s to remove the lid from the Retracting Mech Housing. Set aside the hardware and the lid in a safe location. **Fig 2 - Fig 3**



3. Pop out the damaged Retracting Mech then take your replacement from the provided repair kit and place it in the slot. **Fig 4**



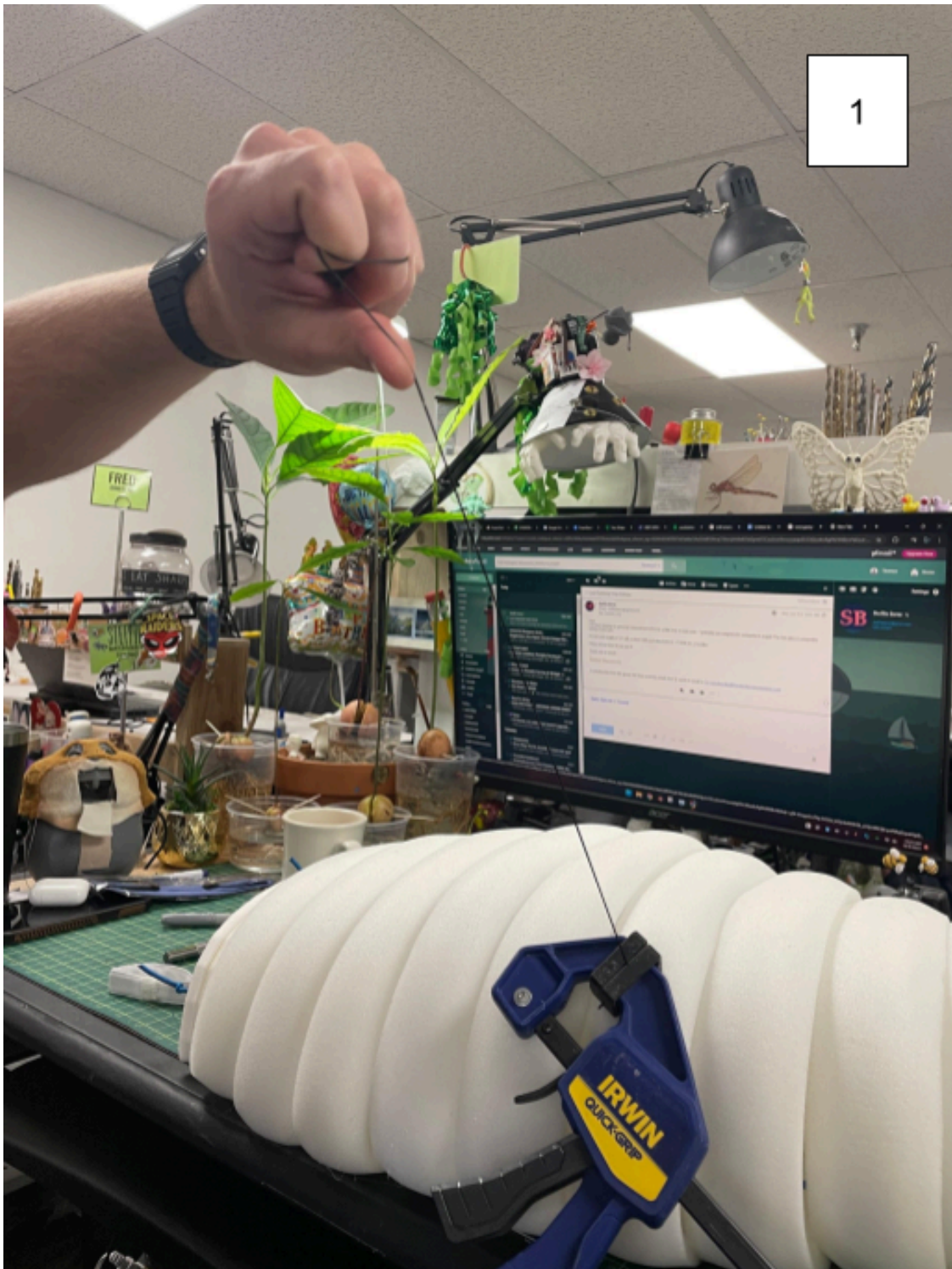
- a. Note: You can tie the mech to the handle before placing it. If you would like to do this before placing the new mech, follow the instructions for section 7.6. **Fig 5**



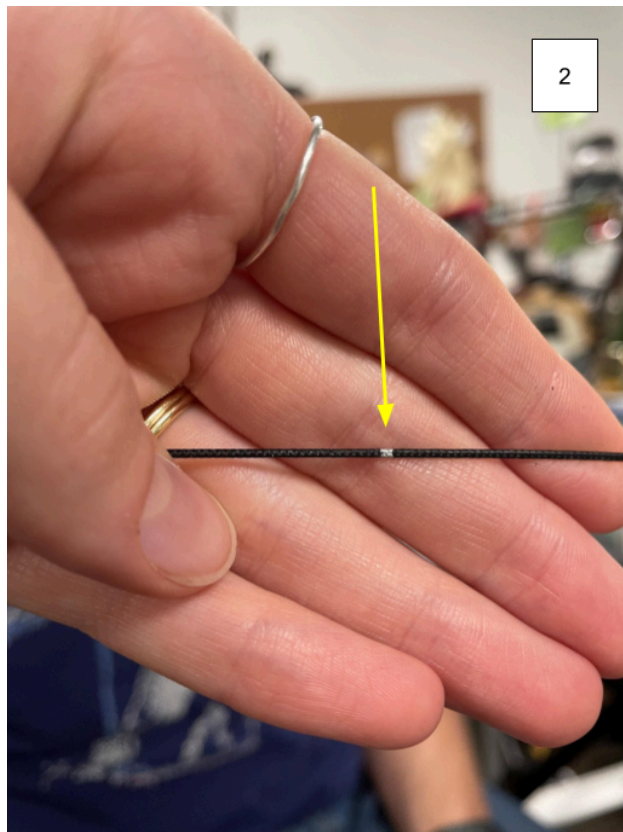
4. Once in place, you can now replace the lid of the housing and secure it with the 4-40s.

7.7 Specialty information about securing the Tail Lift Handles

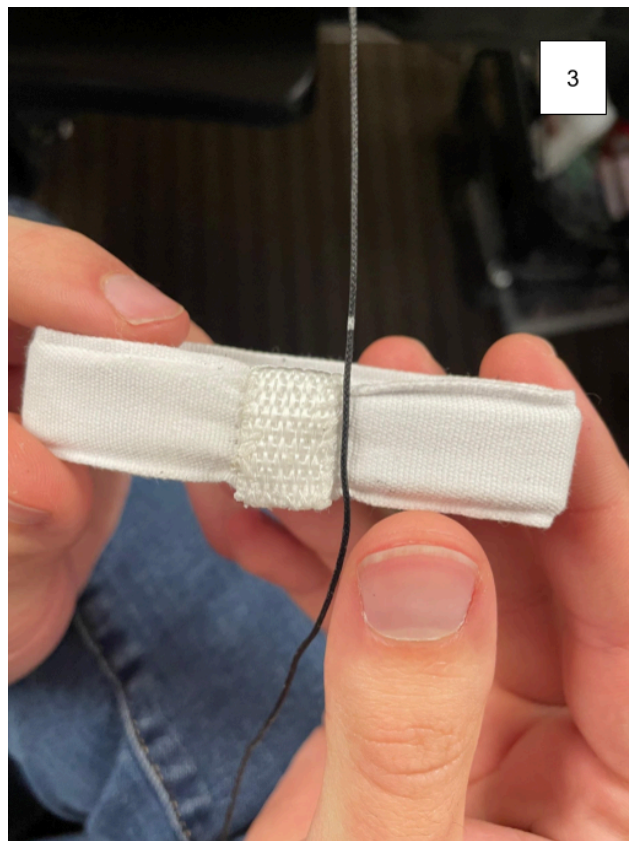
1. If replacing a Handle on the Lift Assist, pull out the retracting line to the maximum and clamp at the base to keep it slack. **Fig 1**



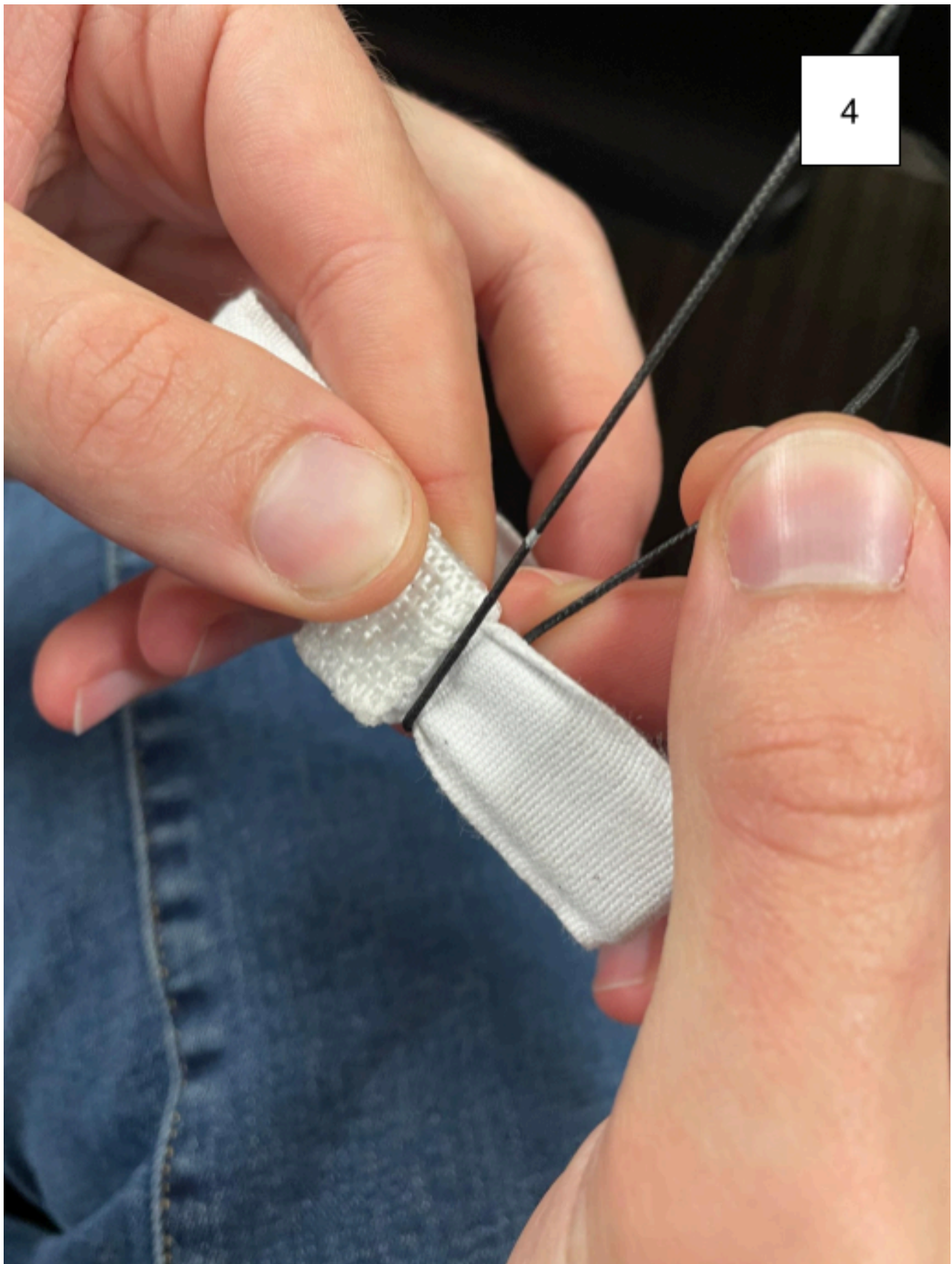
2. Measuring from the base, mark 13 inches with a silver Sharpie. **Fig 2**



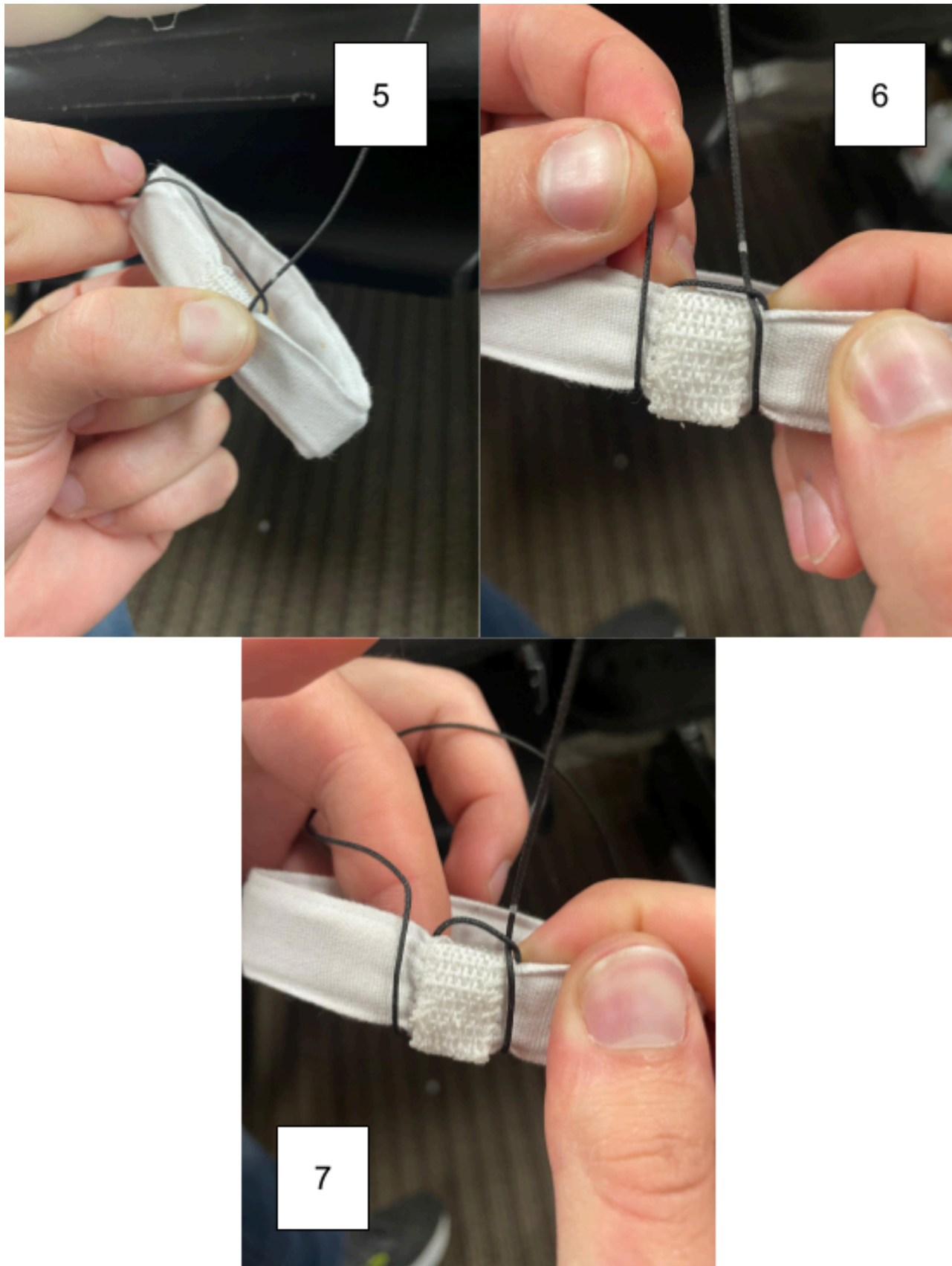
3. To secure the handle, first hold the handle upside down with the webbing wrap facing you. The mark you made should be about level with the handle. **Fig 3**



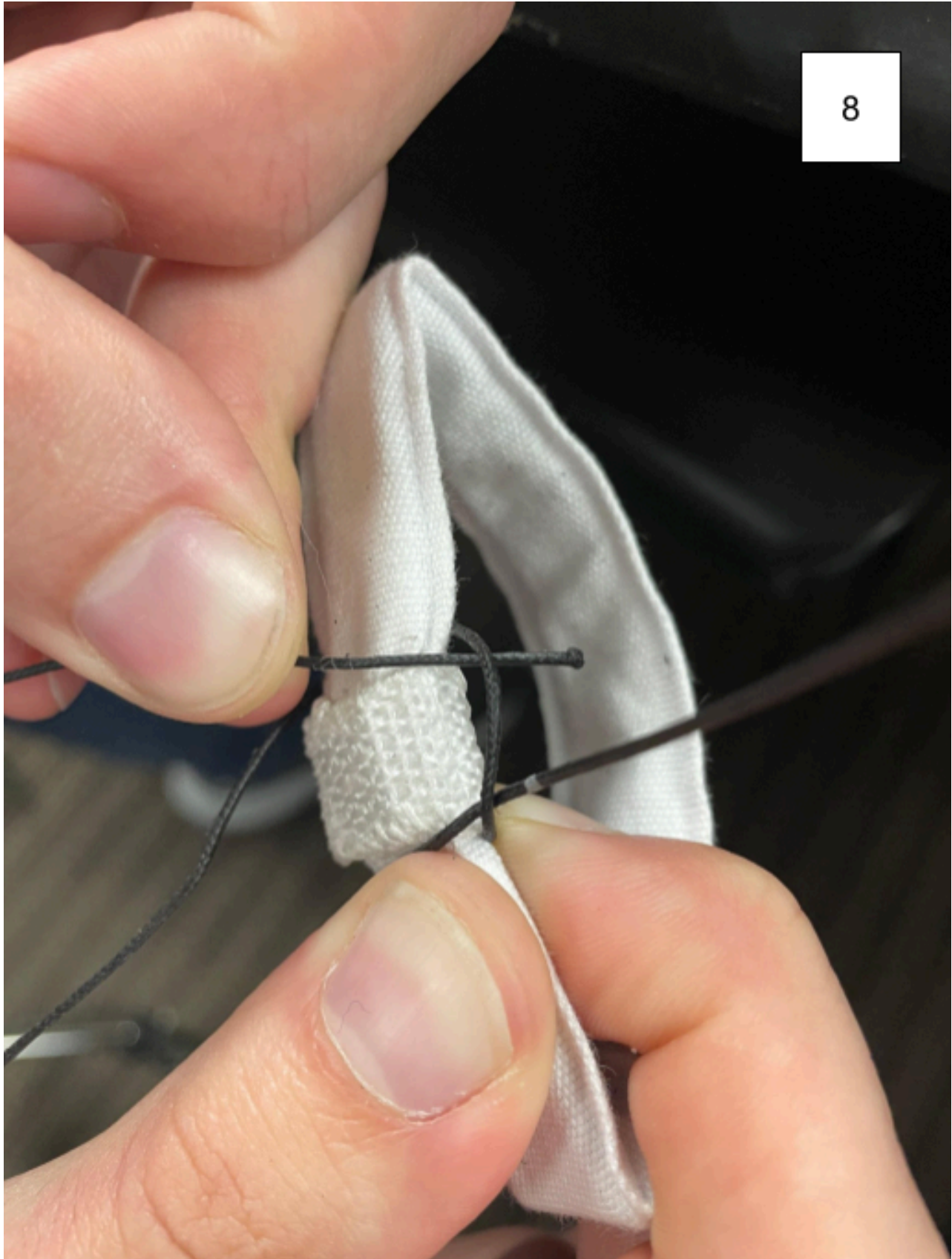
4. Wrap the string around the handle with the lead on the right side. **Fig 4**



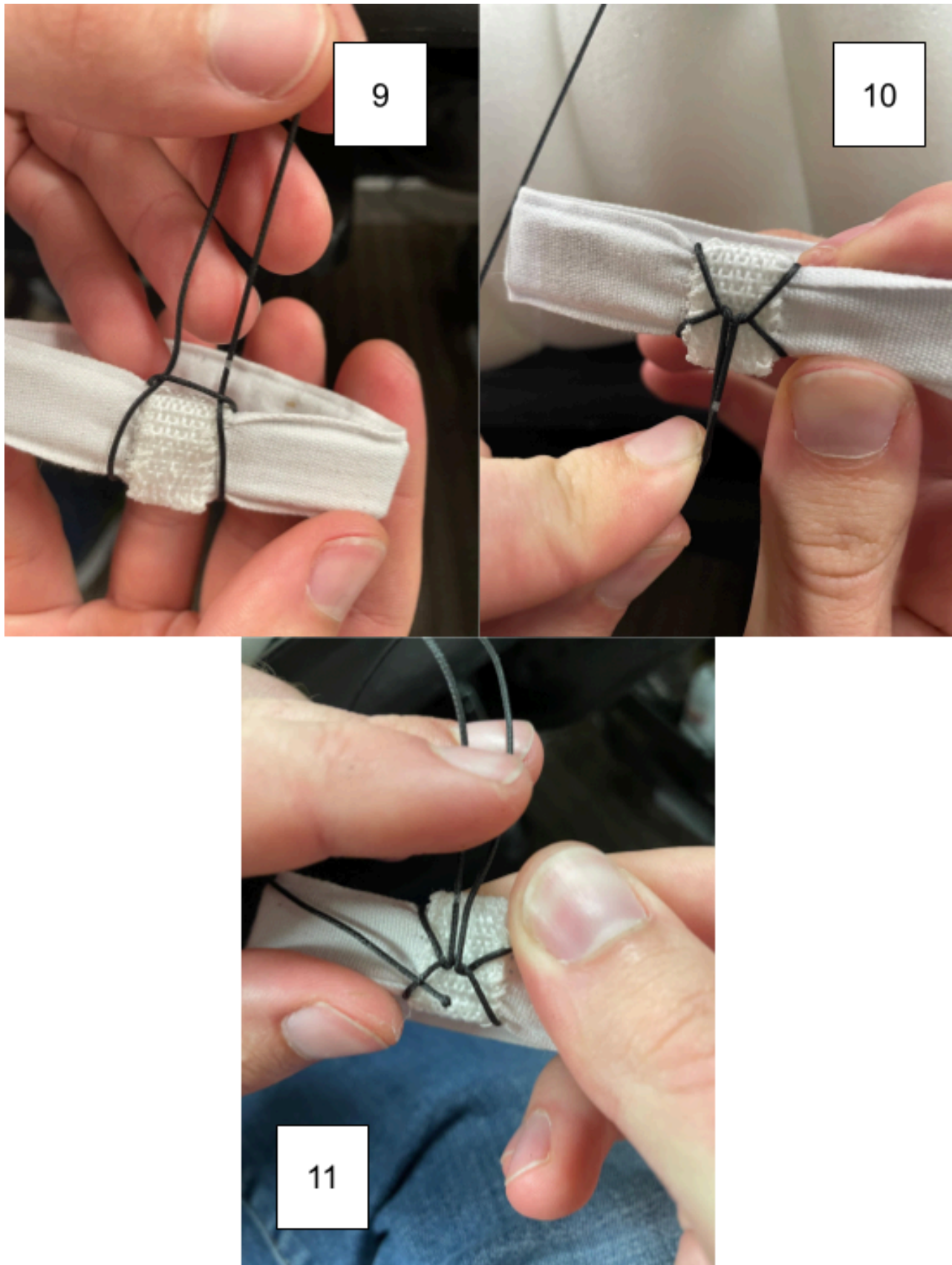
5. Pull over the top of the main string, then run the string along the top of the webbing and pull down the wrap upwards to the other side of the webbing. **Fig 5 - Fig 7**



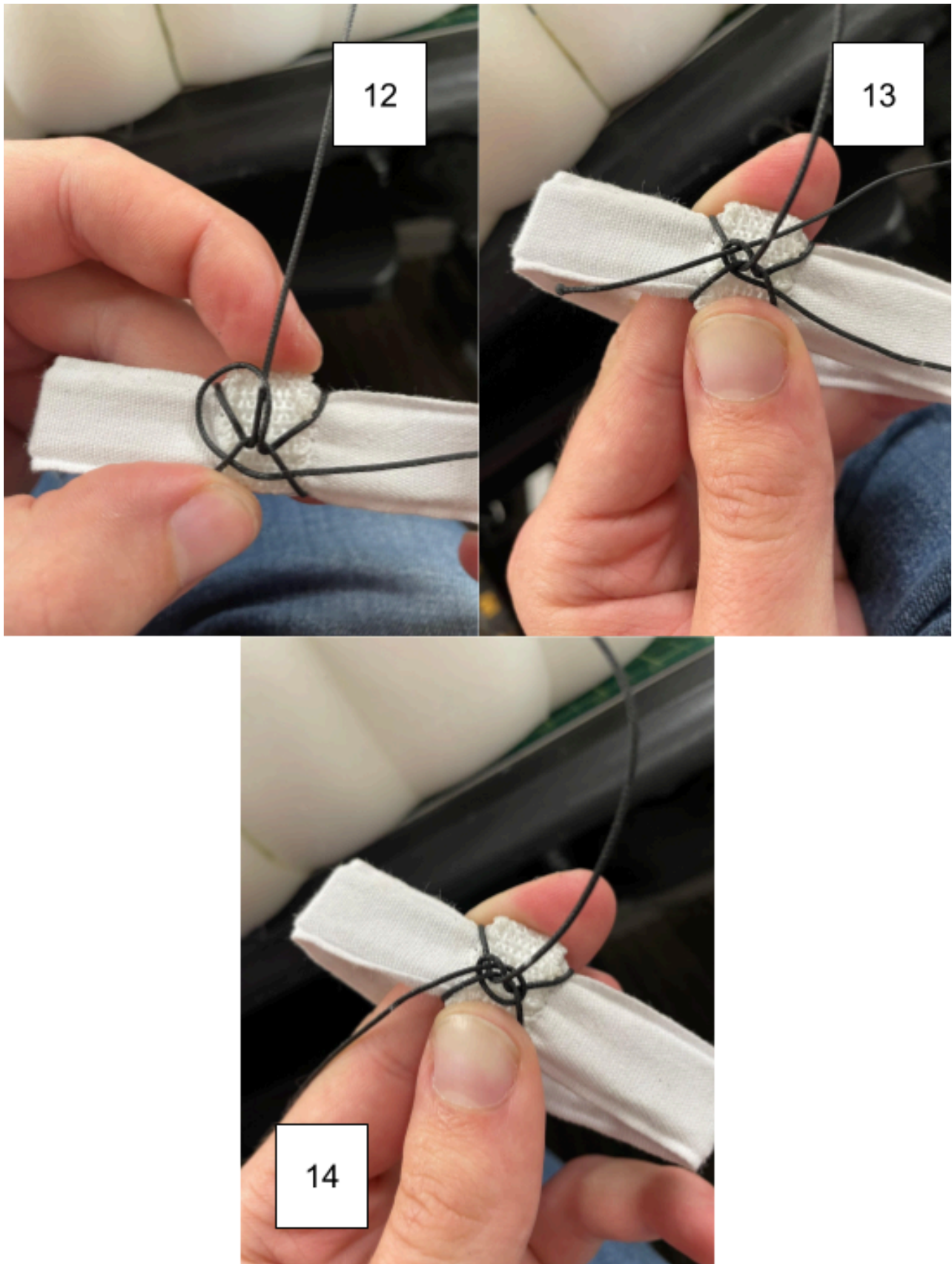
6. Take the lead and slip through the loop at the top. **Fig 8**



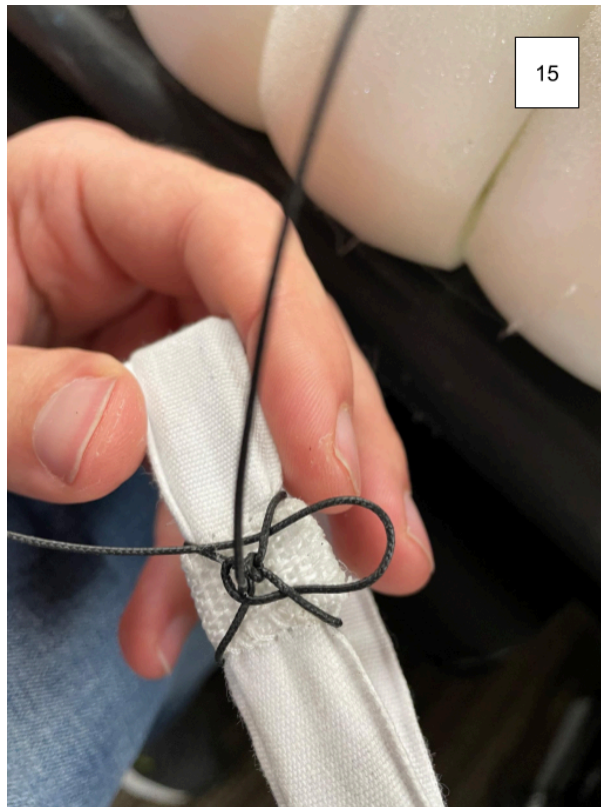
7. Keeping the tension, pull the lead and the main end of the string out towards you and then down. Holding secure, flip 180 degrees. **Fig 9 - Fig 11**



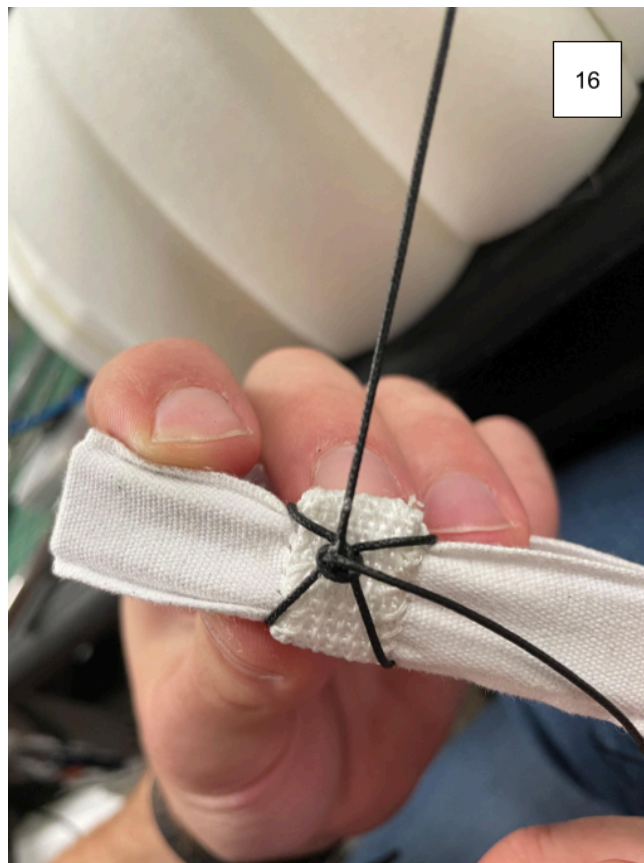
8. While keeping the tension, take the lead and slide it into the loops now on the bottom. Loop back to the start, pull, and tighten. **Fig 12 - Fig 14**



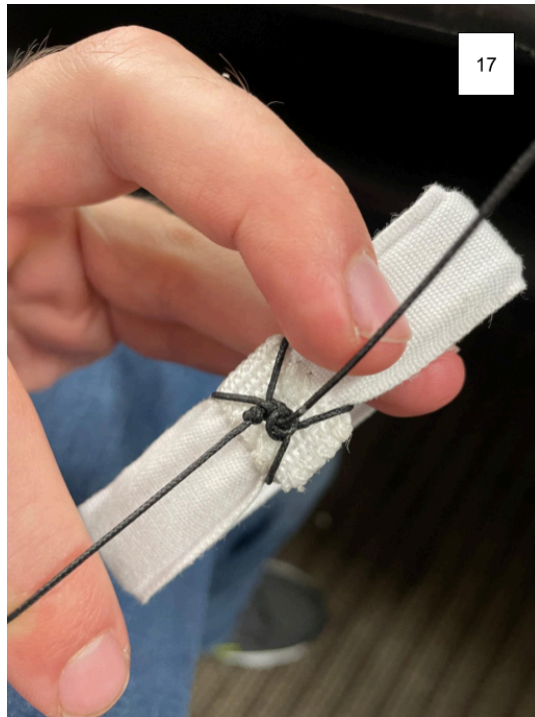
9. Using the rest of the lead, tie knots by tucking under the loop, alternating around the branches like a clock. This may take 2-3 times. Keep the tension. **Fig 15**



10. You want the main line to point from the bottom. **Fig 16**



11. Tie off with a secure knot and tuck the final knot under everything. **Fig 17**



12. Whip stitch around the branches of the string through the webbing. You can also go through the knots as well to make sure everything is secure. **Fig 18**

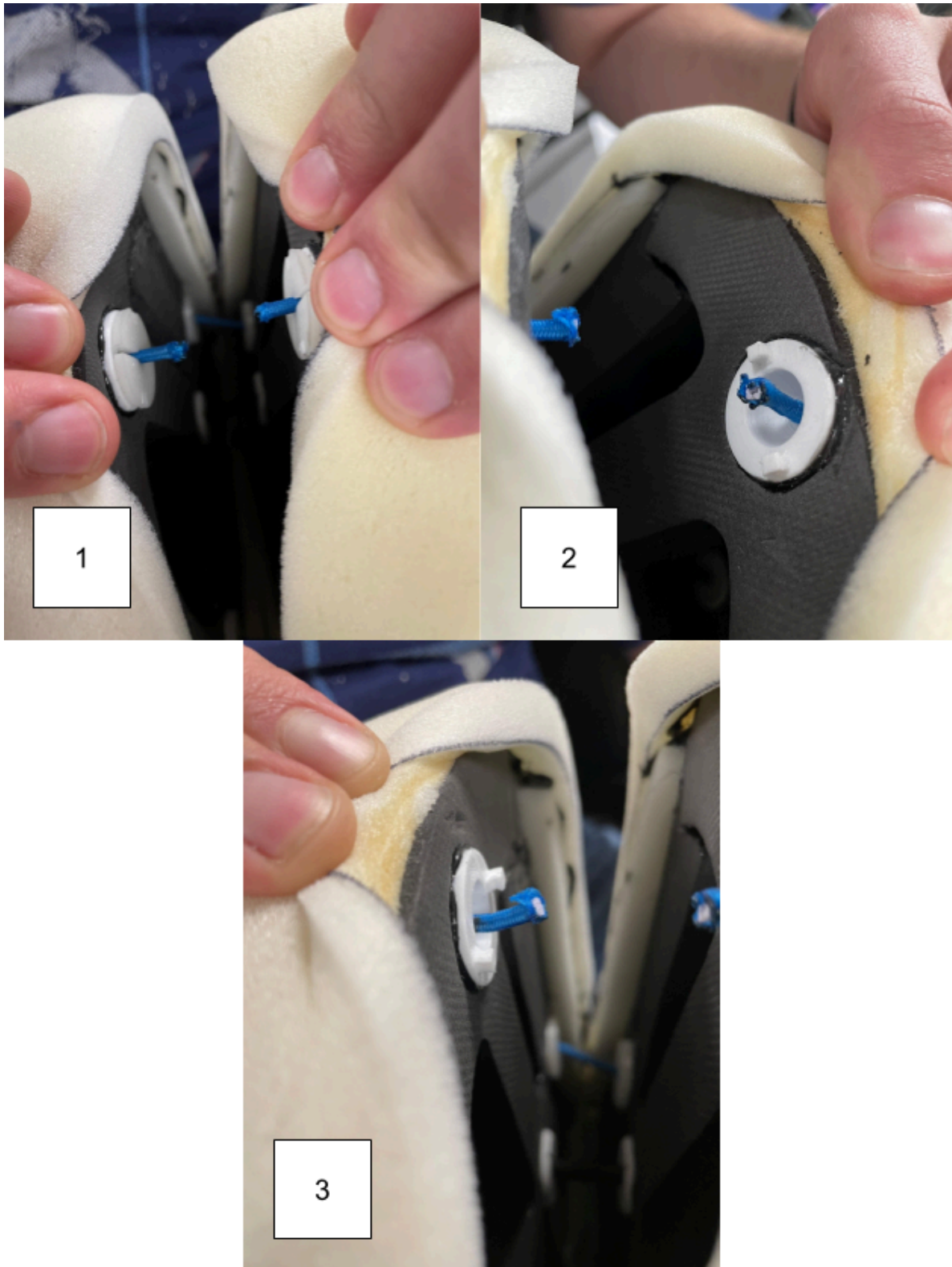


13. Tuck the lead one more time then cut the excess on the lead. Melt the ends to prevent fraying.

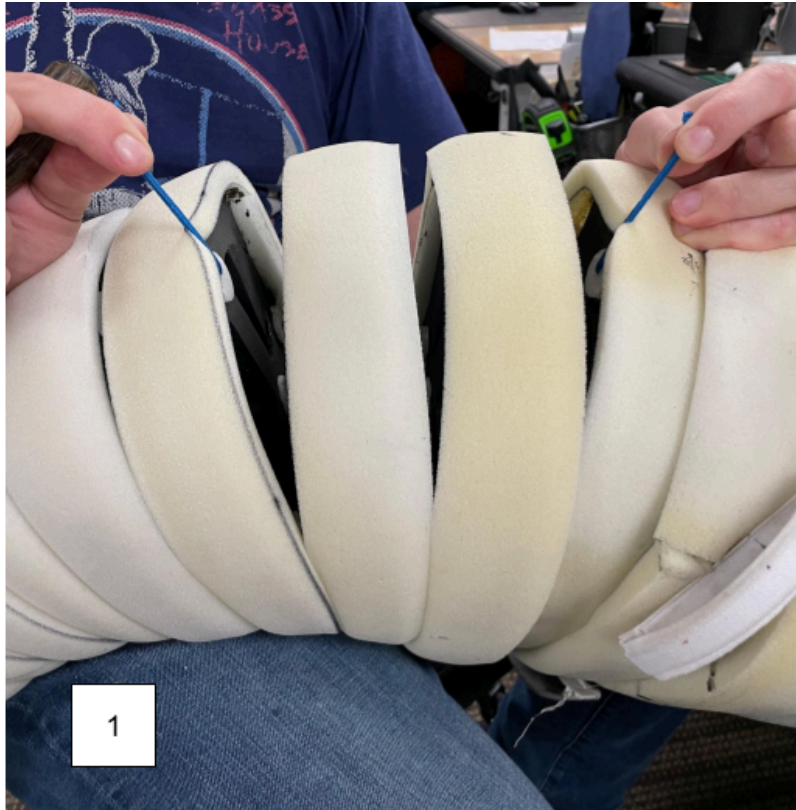
7.8 Specialty information about “Quick Fix” Repairing the bungee

If the bungee frays or breaks completely, you can implement a quick fix when needed.

1. Survey the damage and then pop out the Part B bushings in the affected area. The goal is to give yourself enough slack to work with. You will carefully remove two slices worth of bushings, top and bottom from the affected bungee. **Fig 1 - Fig 3**



2. Pull the damaged bungee out of these two sections. **Fig 4**

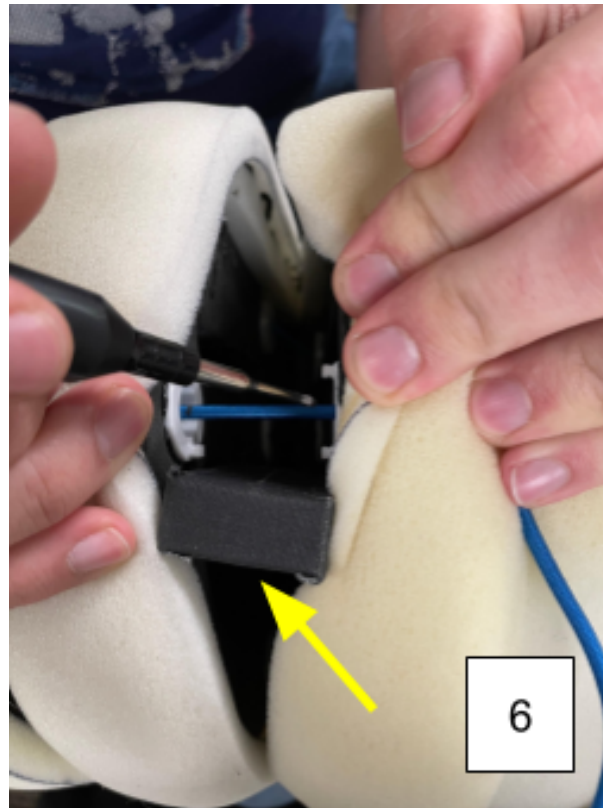


3. Clean up the damaged bungee. If the edges are frayed, cut down to a clean edge. Use a lighter to melt the ends to prevent future fraying. **Fig 5**



4. Cut another length of bungee that is longer than you may need. String this length of bungee through the two sections. You can use a dental hook to carefully maneuver the bungee through the sections.

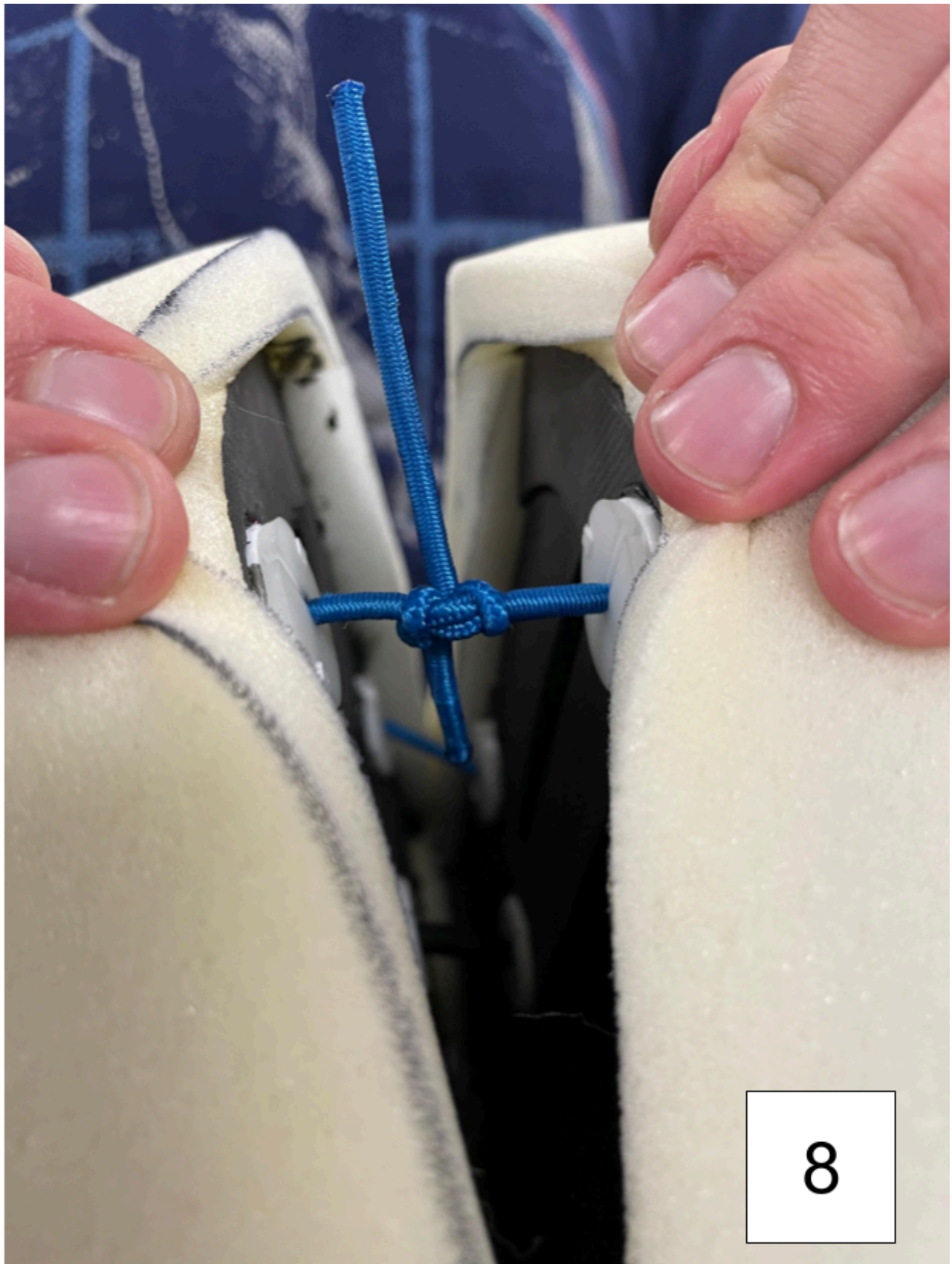
5. Use the provided spacer to mark the new bungee for both the top and bottom. **Fig 6**



6. Put the Part B Bushings back in on the new bungee, corresponding with the marks that you have made. Follow the instructions for Bushing replacement in Section 7.4. **Fig 7**



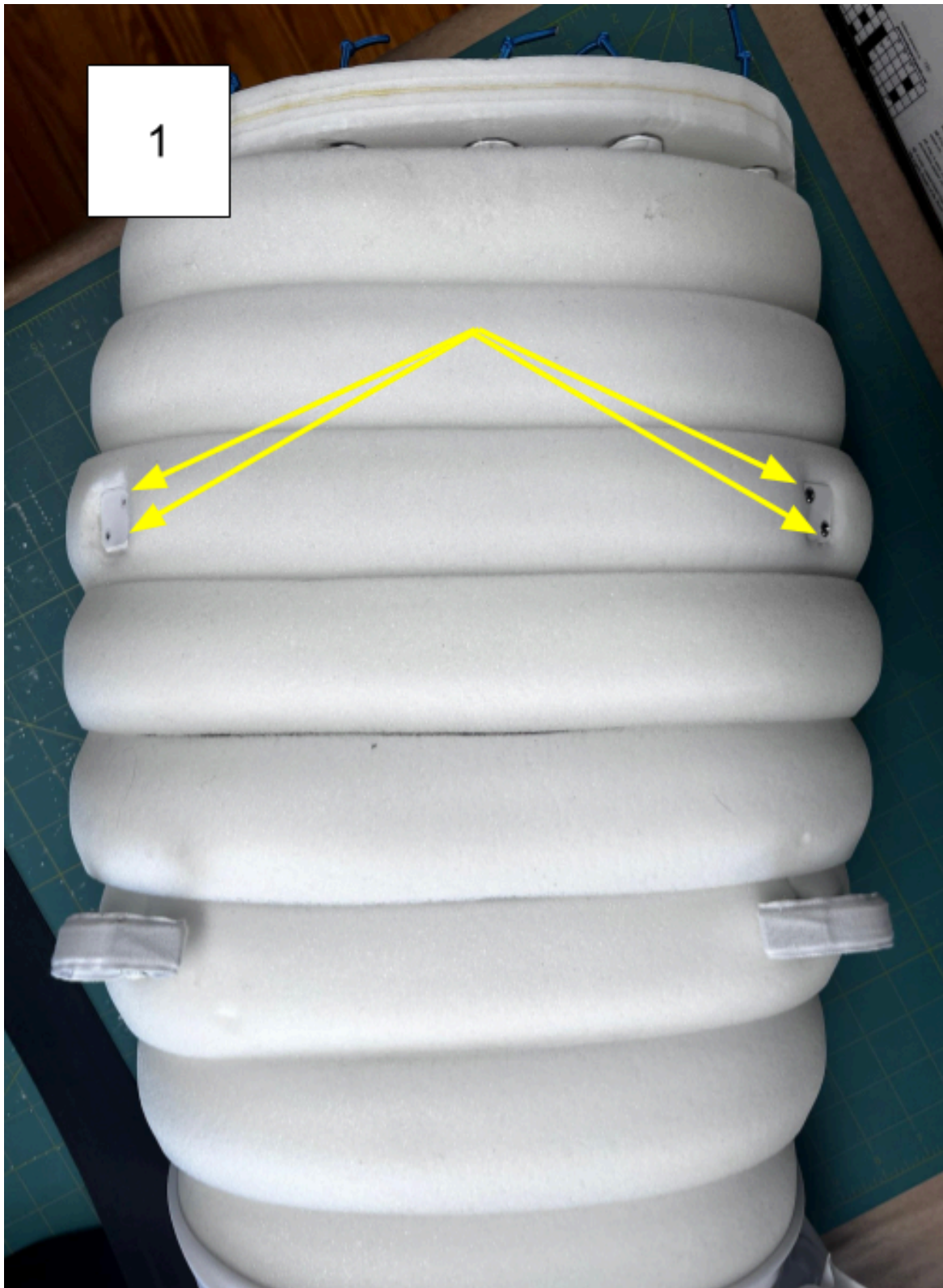
7. Using the spacer to keep your sections at the correct distance, tie the new bungee to the old sections of the bungee. Use a secure knot. **Fig 8**



8

7.9 Specialty information about removing and replacing fabric hook mount square nuts

There are instances where the Square Nuts may become cross-threaded. If this occurs, you will need to replace them **Fig 1**



1. Take a pin or an equivalent tool and push it through the hole corresponding to the square nut you want to replace. **Fig 2**



- a. To push out the Top Square Nut, place your pin into the hole on the underside of the Fabric Hook Mount.
 - b. To push out the Bottom Square Nut, place the pin into the hole on the top of the Fabric Hook Mount.
 - c. **Note: When sliding these out, it is easy to lose them. Be ready to catch the Square Nut!**
2. Once removed, take your new Square Nuts and carefully slide them into the slots, and align them accordingly. You can use the pin from earlier to adjust as needed.

8 Comprehensive Parts List

8.1 Understructure and Base

Part #	Part	Usage	Vendor	Vendor Part ID
AT01	1/4in bungee	center bungee in the tail	Amazon	B007FJZX5Q
AT02	1/8in bungee	4 strands run thru the tail slices	Amazon	B078NBBL48
AT03	Rigid 4k resin	Bushings	Formlabs	RS-F2-RGWH-01
AT04	1/2in Soft foam	smoothes out transitions between slices	Katz Foam and Fabrics	N/A
AT05	PETG Bamboo filament	retracting mech case	Bamboo	N/A
AT06	1/2in HD80 zote foam	slices of the tail	Worldwide Foam	N/A
AT30	1/2in bra foam	upper transition piece padding	FineBrand	N/A
AT31	4in soft foam	upper transition piece stuffing	Katz Foam and Fabrics	N/A
AT47	Carbon Rod ~ .250" x 48"	control rod	DragonPlate.com	SKU: FDPR.250*48
AT48	1/2in boning	handle for lift assist	CorsetmakingSupplies	CMS-PWB12-10
AT52	L200	Fluke	Foam Factory	XPE2

8.2 Hardware

Part #	Part	Quantity	Usage	Vendor	Vendor Part ID
AT07	Covered Hook & Eye Closures For Fur Coats - 1 1/2" - 2 Sets/Pack - White	2	upper hook for handle placement	wawak	HE150WH
CP17	Steel Square Nut	8	square nuts for holding covered hook and retract mech covers	mcmaster	94855A281
AT09	14" separating zipper	2	tail to Performer transition	wawak	MZ514BK
CP286	Stainless Steel 1" truss head 4-40	4	screw for square nuts to	mcmaster	91770A115

	screw		hold covered hook		
CP3	Stainless Steel 1/2" socket head screw	4	for securing lid to retracting mech cover	mcmaster	92196A110
AT10	Steel Tee Nut Zinc-Plated, 8-32 Thread Size	4	Used on last slice of tail to secure aluminum L bars	mcmaster	90975A014
AT11	8-32 3/4in long button head hex drive screw	4	Used on last slice of tail to secure aluminum L bars	mcmaster	98164A139
AT12	Multipurpose 6061 Aluminum 90 Degree Angle	1 foot per tail	used to make mount for tail control rod	mcmaster	8982K54
AT13	retracting carabiner	2	used for the retracting lift assist mech	amazon	B07Y17P9MG
AT32	Stainless Steel Precision Shoulder Screw	1	axle for control rod attachment on end of tail	mcmaster	94035A208
AT33	Stainless Steel Cap Nut	1	caps axle for control rod	mcmaster	99022A103
AT34	Stainless Steel Socket Head Screw	2	used in fluke handle printed part	mcmaster	92196A034
AT35	2" buckle for adjustable straps	1	waist belt attachment to Performer	amazon	B07N6B4CR5
AT36	Fusion grip tape	1 yard per tail	fluke handle grip and control rod handle	amazon	B0CLV95229
AT46	Heavy Duty Quick Release Frog Clip	1	quick connect between the control rod and the fluke hinge point	amazon	B0C6M8VDGW

8.3 Fabric and Fibers

Part #	Part	Usage	Vendor	Vendor Part ID
AT14	2" seatbelt webbing	waist belt	wawak	WEBS2BK
AT16	Disney provided spandex	cover	unknown	unknown
AT17	black spandex	Mini Skirt Transition from tail to Performer	Spandexhouse	MMT-55

AT18	white nylon thread	hand stitching	wawak	Stock # ATDP2000
AT37	black all purpose thread	machine stitching	wawak	Stock # GTDA000
AT38	3" sew in hook and loop velcro-black	skirt center back closure	wawak	Stock # VO55BK
AT39	3" sew in hook and loop velcro-white	upper transition piece closure	wawak	Stock # VO55WH
AT45	1" sew in hook and loop velcro	fluke to tail transition	wawak	VO52WH
AT49	1/2in boning casing	lift assist handle	Corset making Supplies	CMS-BC-W12YD
AT50	1/2in white webbing	lift assist handle	Strapworks	WSR-PRO-LWP-012-WHT

8.4 Custom Made Parts

Part #	Part	Quantity	Usage	Vendor	Filename
AT19	Bushing part A	180	holds bungee	Thomas Proske	All files in Box Drive here:
AT20	Bushing part B	180	holds bungee	Thomas Proske	https://disney.box.com/s/alo2yuugkwbqe04clb1mdk7scfmcgift
AT21	Thru bushing	46	guides center bungee	Lo	
AT22	hook mount left	1	mounts left handle hook	Thomas Proske	
AT23	hook mount right	1	mounts right handle hook	Thomas Proske	
AT24	hook mount plate	2	goes under handle hook and on top of foam	Thomas Proske	
AT25	retracting mech case	2	holds retracting mech	Thomas Proske	
AT26	retracting mech case lid	2	covers retracting mech case	Thomas Proske	
AT40	control rod handle A	1	screw head side of handle	Thomas Proske	
AT41	control rod handle B	1	square nut side of handle	Thomas Proske	
AT42	control rod clip adapter	2	holds control rod and frog clip	Thomas Proske	
AT43	control rod grab point	1	grab point for control rod frog clip	Thomas Proske	

AT44	fluke handle printed part	1	holds fluke handle	Thomas Proske	
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8.5 Glues, Treatments, Coatings, and Chemicals

SDS sheets are available in the separate SDS Project Packet.

Part #	Part	Usage	Vendor	Vendor Part ID
AT27	hot glue	gluing bushings into foam slices and soft foam cover	Amazon	B00OBC4CWK
AT28	barge	laminating foam slices together	Frankford Leather	BAPCPAR
AT51	gaffers tape	lift assist handles	Amazon	B07ZK518HP
AT29	Insta-Shield Flame Retardant	Fire treatment	Northeast FireShield	N/A