

Elad's Arcana Playing system

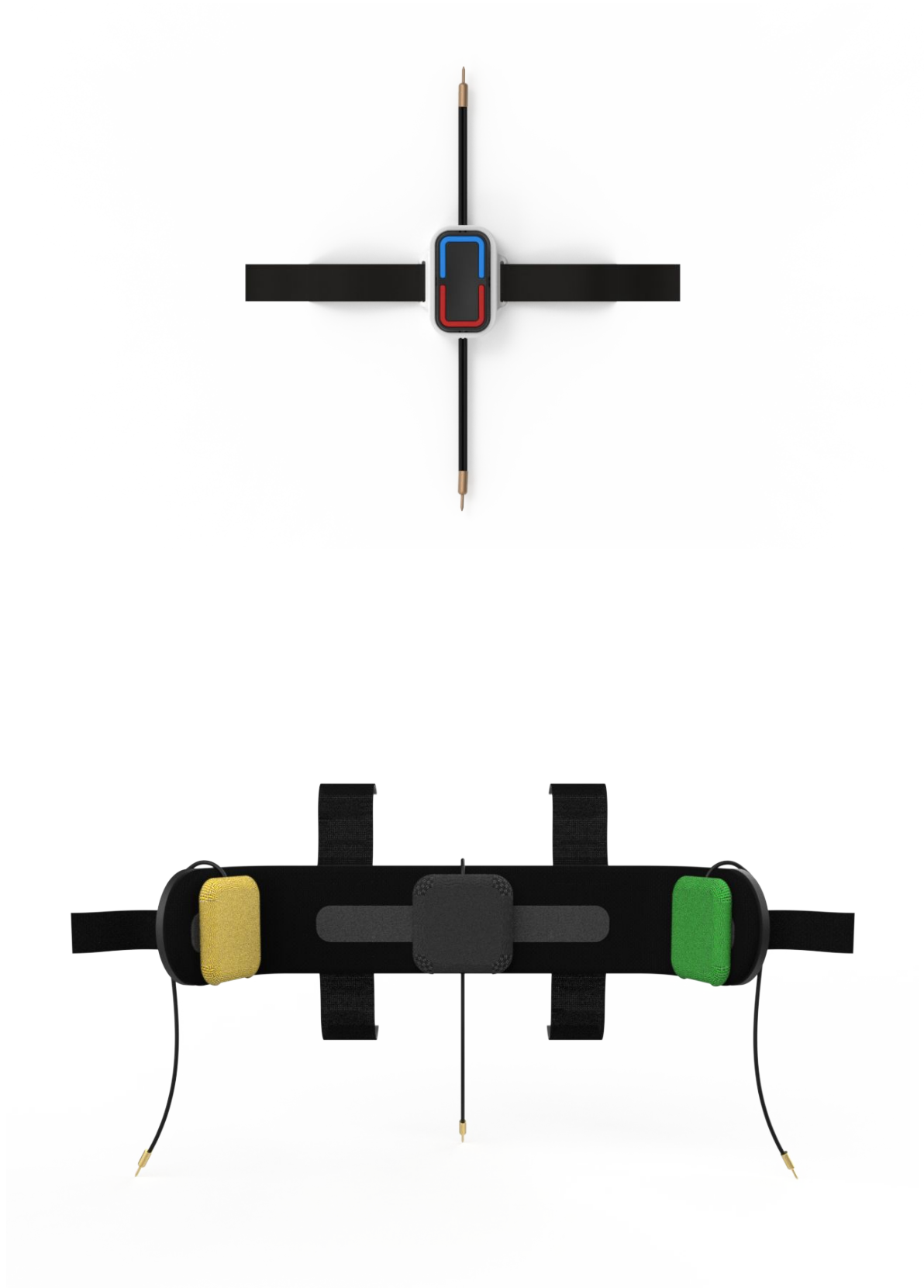


Design with Elad, "Tzaad Kadima" staff

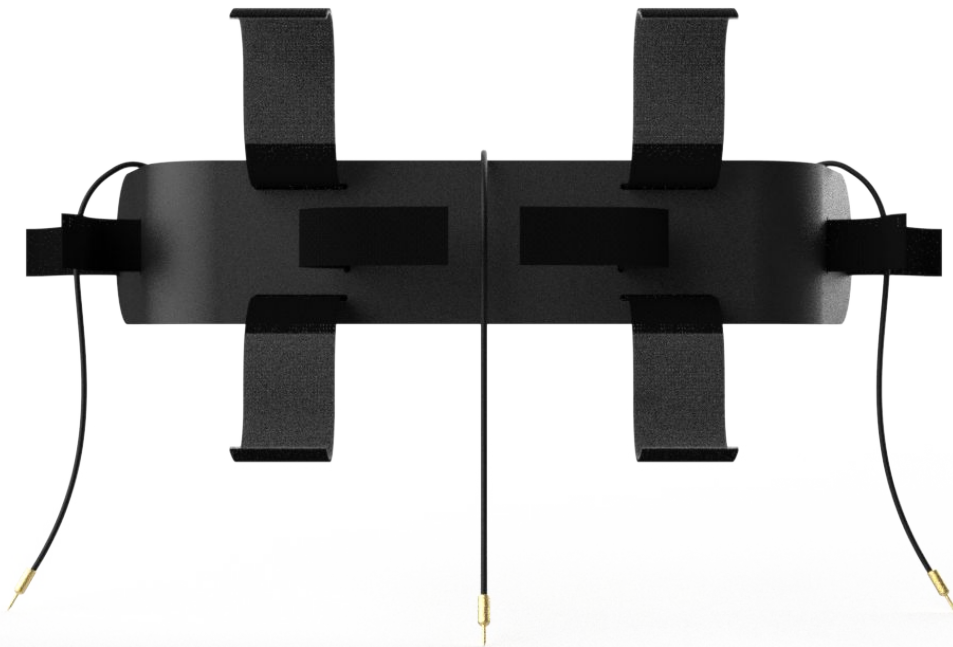
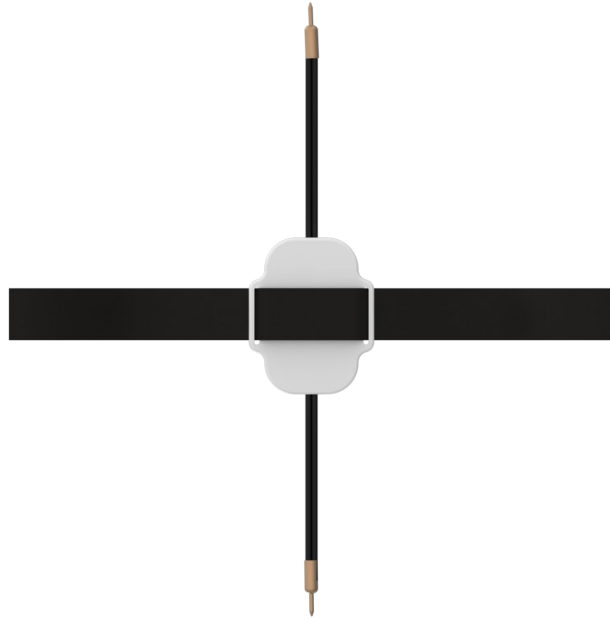
Designed By Meitar Gaon, Shaked Shasha, Amit Lavie

Professors: Prof. Gad Cherny, Dana Yichye-Shwachman

Product views / Front View



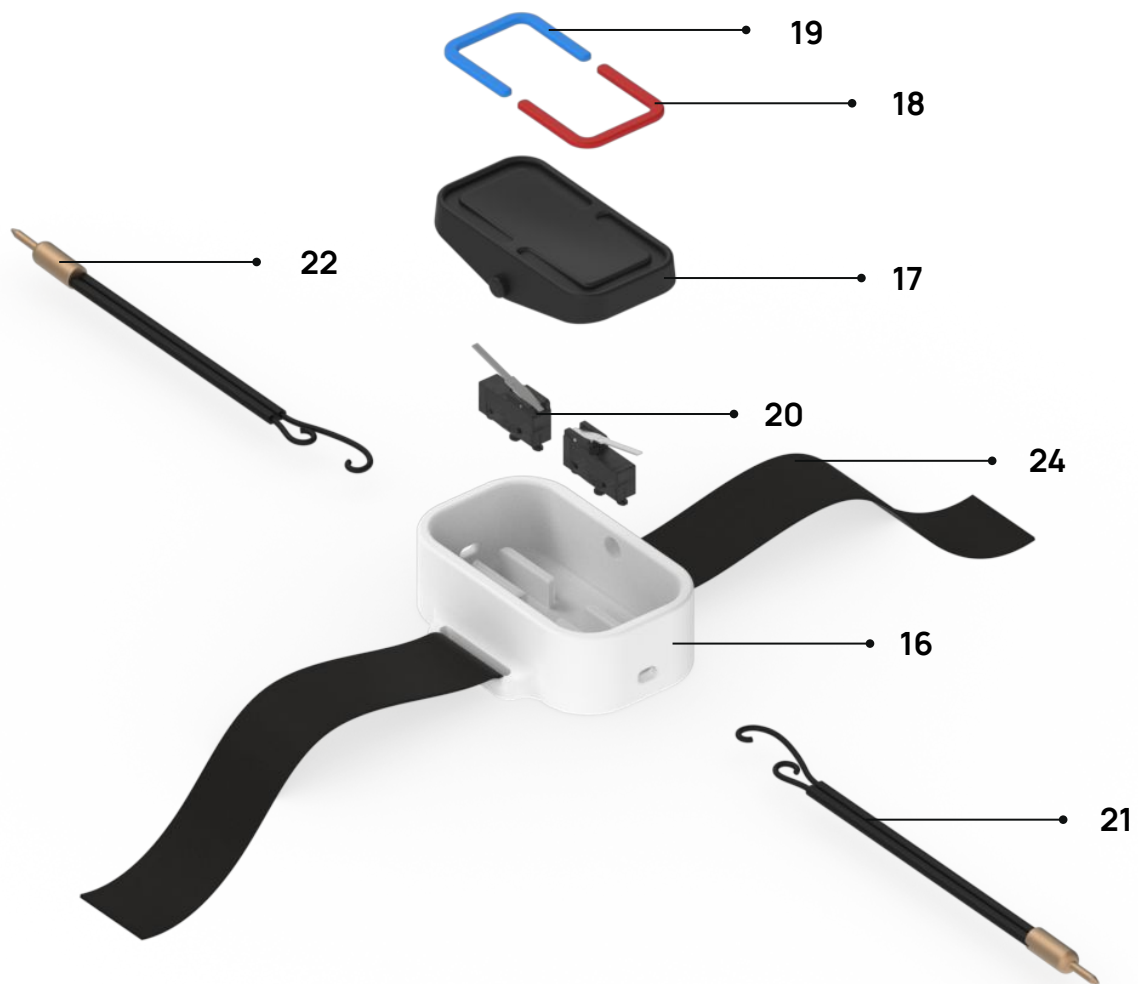
Product views / Back View



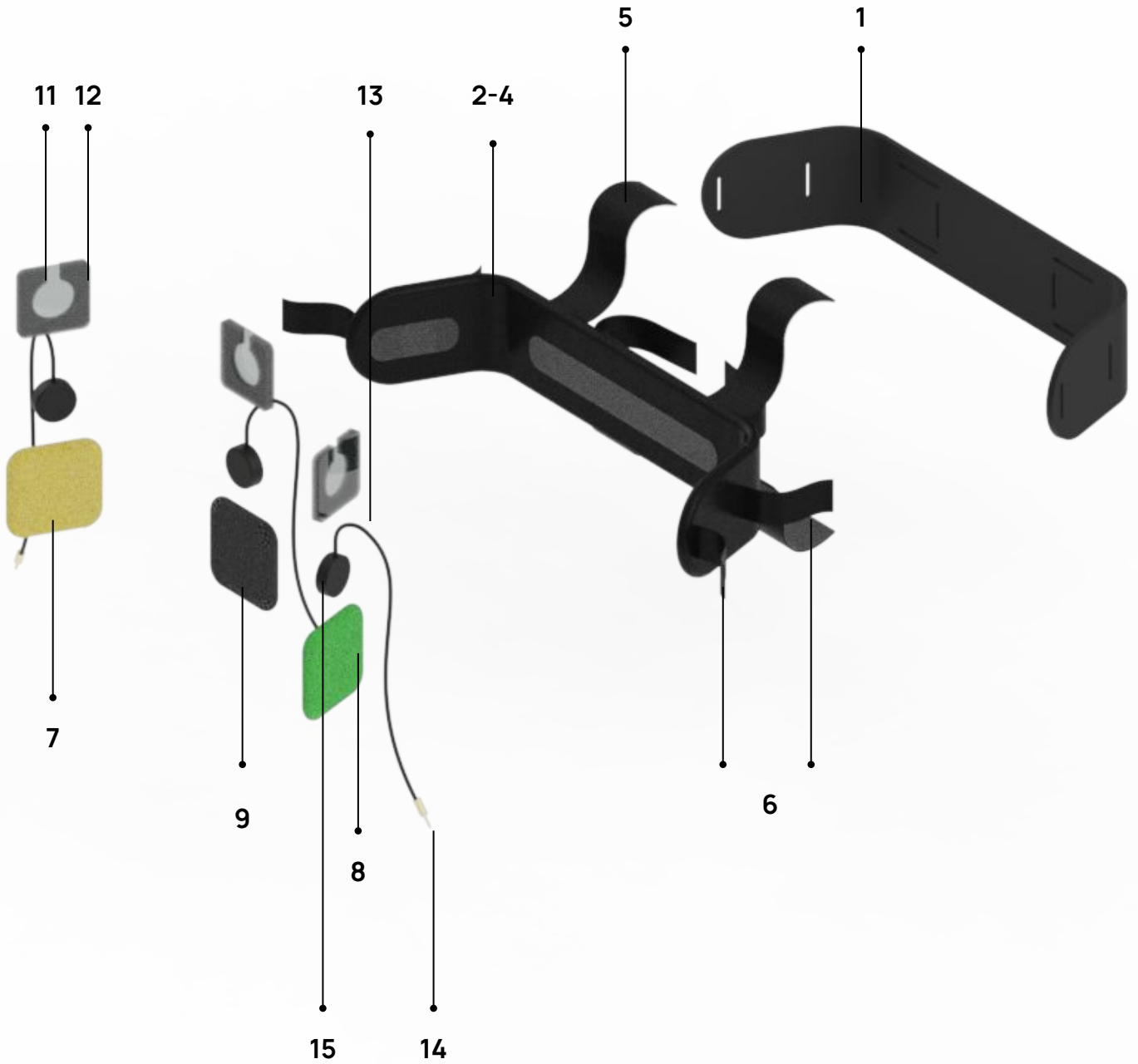
Product views / Side View



Product views / Exploded View




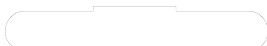



Product views / Exploded View












Tools Needed

- Laser Cutting Machine
- Sewing Machine
- 3D printer
- Heating Gut
- Scissors
- Cutter
- measuring tape
- Protractor
- Soldering Iron + Tin
- *Camera (For Documenting head range of motion)











Bill Of Materials / Page 1

ITEM NUM	ITEM DESCRIPTION	IMAGE	MATERIAL	MANUFACTURING INSTRUCTIONS	DIMENSIONS	QTY	PURCHASE LINK / SUPPLIER
Headrest							
1	Headrest Base		Perspex 5mm	Laser cutting	550*75	1	Perspex 5mm Amazon
2	Front fabric		Mesh fabric	Laser cutting	570*95mm	1	Mesh fabric Amazon
3	Back fabric		Black cordura fabric	Laser cutting	570*95mm	1	Cordora fabric Amazon
4	Padding Foam		Foam 10mm	Laser cutting	550*75mm	1	EVA 10mm foam Amazon
5	Headrest Straps		Nylon strap 40mm	Sewing	500mm	2	Nylon strap 1.5 inch Amazon
6	Double-Sided Hook & Loop		Nylon hook&loop strap 20mm	Sewing	100mm	8	Hook & Loop Amazon

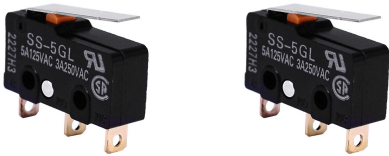
Bill Of Materials / Page 2

Pockets						
7	Black pocket		Black cordura fabric	Laser cutting	200*85mm	1 Cordora fabric
8	Green pocket		Green cordura fabric	Laser cutting	200*85mm	1 Cordora fabric Amazon
9	Yellow pocket		Yellow cordura fabric	Laser cutting	200*85mm	1 Cordora fabric Amazon
10	Double-Sided Hook & Loop		Nylon hook&loop strap 20mm	Sewing	50mm	3 Hook & Loop Amazon
11	Hand Switch polypropylene covers		polypropylene 0.3mm	Laser cutting	75*75mm	Polypropylene 0.3mm AliExpress
12	Padding Foam		eva foam 5mm	Laser cutting	75*75mm	3 EVA 5mm foam Amazon
13	2 core wire cable		2 core wire cable 22AWG	Soldering	150mm	3 2 core wire cable 22AWG
14	3.5 mono connector		3.5 mono connector	Soldering	50*9mm	3 3.5 Mono connector Amazon
15	Headrest switches		Switch button	Soldering	30*30mm	3 Switch button AliExpress

Bill Of Materials / Page 3

Hand toggle switch						
16	Base		PETG	3D printing	60*75*24mm	1
17	Top		PETG	3D printing	65*40*15mm	1
18	Tab indicator - Red		PLA	3D printing	19*28*2mm	1
19	Tab indicator - Blue		PLA	3D printing	19*28*2mm	1
20	Toggle Micro-Switch		Toggle Micro-Switch	Soldering	20*6*21mm	2 Toggle Micro Switch
21	2 core wire cable		2 core wire cable 22AWG	Soldering	150mm	2 2 core wire cable 22AWG
22	3.5 mono connector		3.5 mono connector	Soldering	50*9mm	2 3.5 Mono connector Amazon
23	Soldering tin		Soldering tin	Soldering		1 Soldering tin Amazon
24	Flexible Strap		Stretch Elastic Band Spool 25mm	Sewing	400mm	1 Heavy Stretch Elastic Bands 1 inch
25	Double-Sided Hook & Loop		Nylon hook&loop strap 20mm	Sewing	65mm	2 Hook & Loop Amazon

Parts / Off the Shelf



Toggle Micro-Switch X 2



Two core wire cable X 5 meter

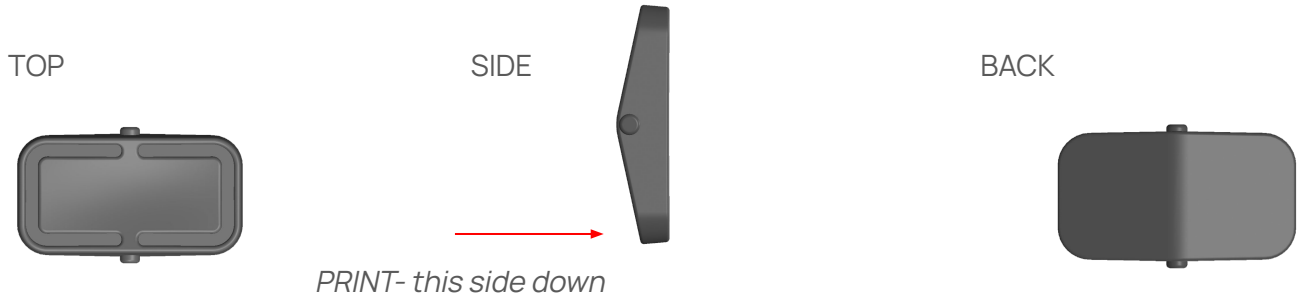


3.5 connector X 2



Switch Button

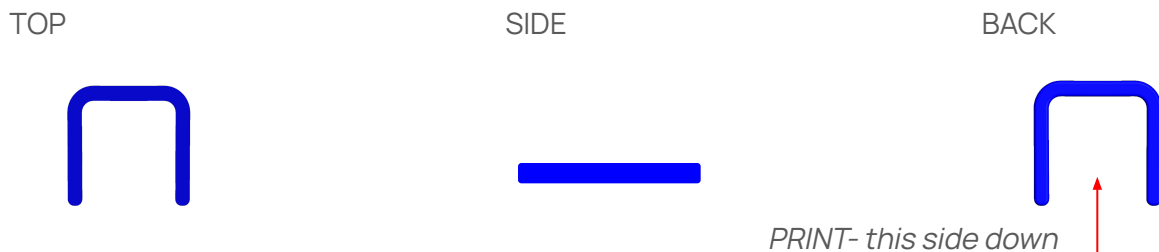
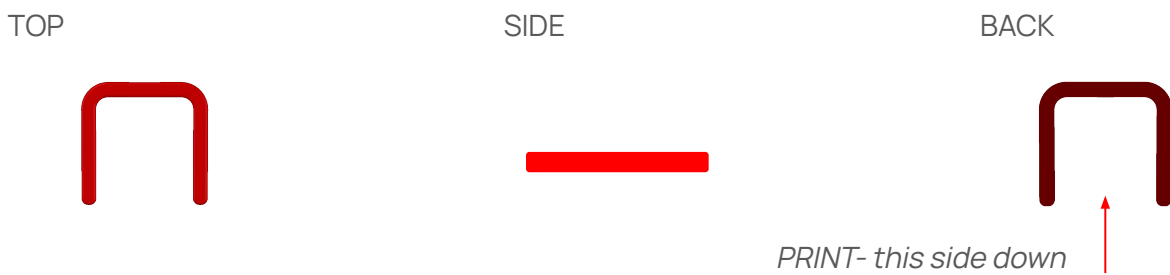
Parts / 3D Printed



Hand switch button



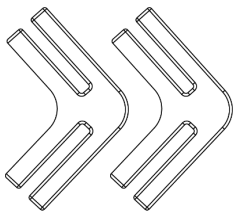
Hand switch Base



Tab indicator - color difference

Parts / 3D Printed

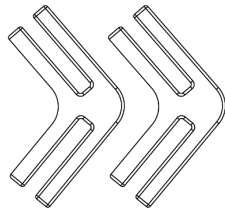
TOP



95°

Angle Jig

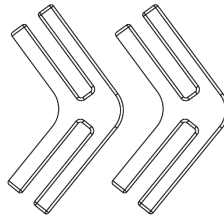
52.5*49.5*30mm



100°

Angle Jig

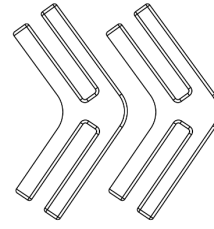
56*50*30mm



105°

Angle Jig

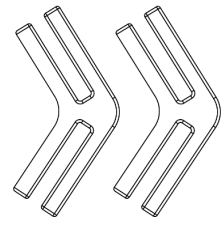
59*50*30mm



110°

Angle Jig

61*49*30mm

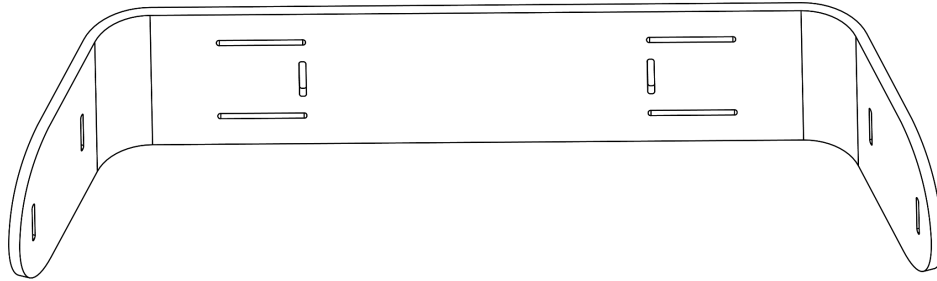


115°

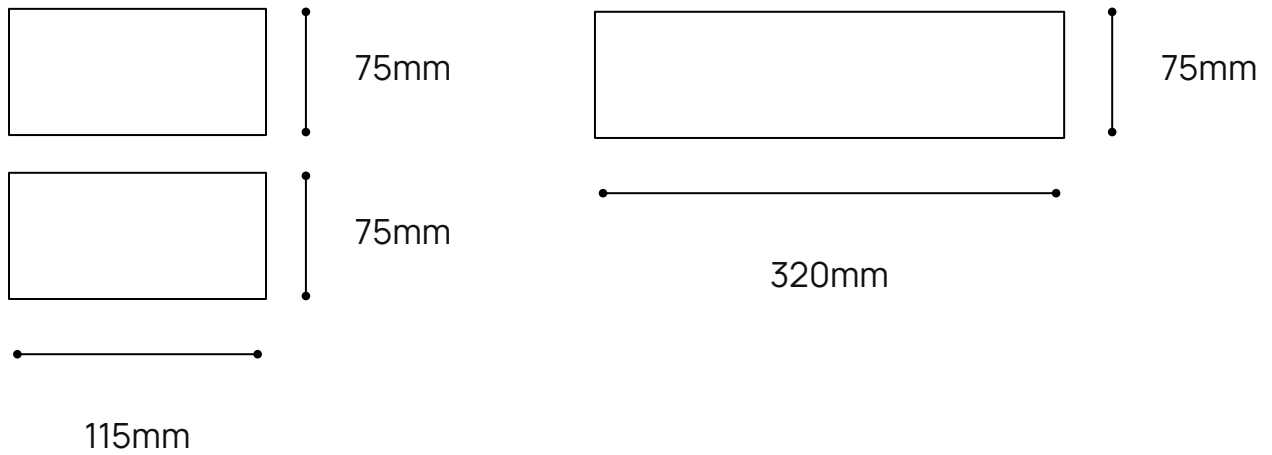
Angle Jig

63*48*30mm

Parts / Laser cutted parts

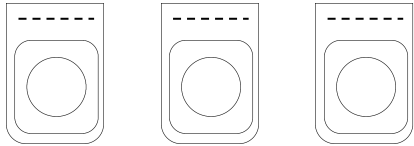


Headrest Base

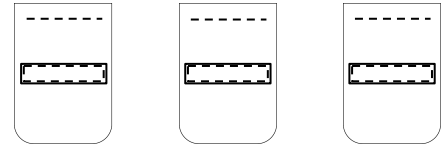


Headrest Jig

Parts / Sewing

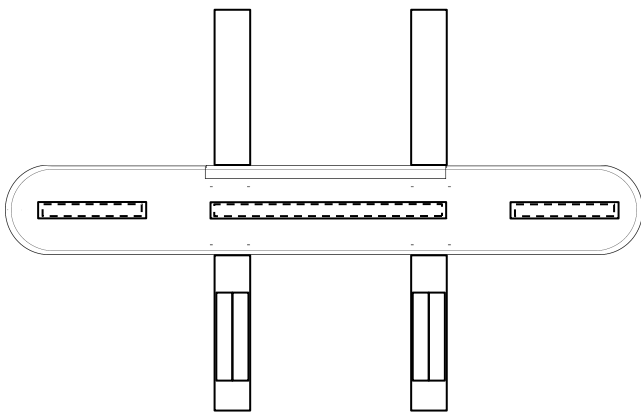


Front view

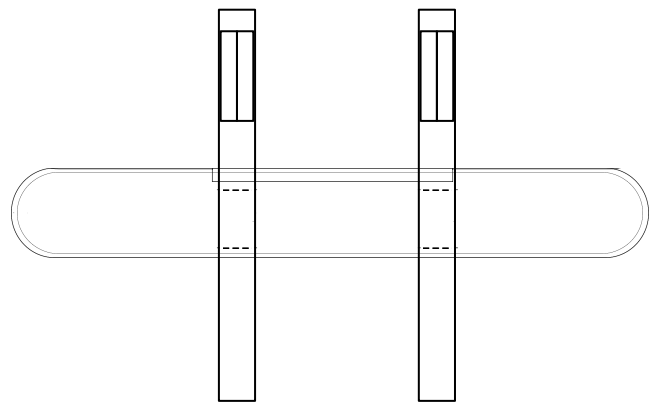


Back view

Switch pockets



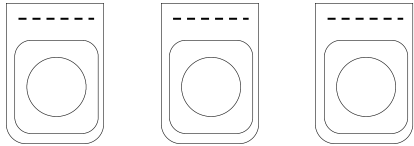
Front view



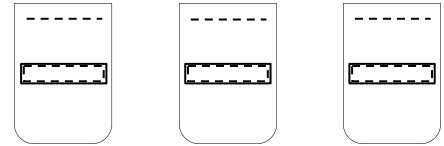
Back view

Headrest Padding

Parts / 3D Printed

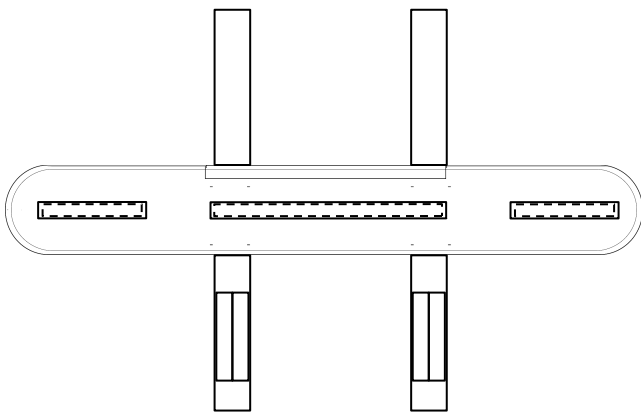


Front view

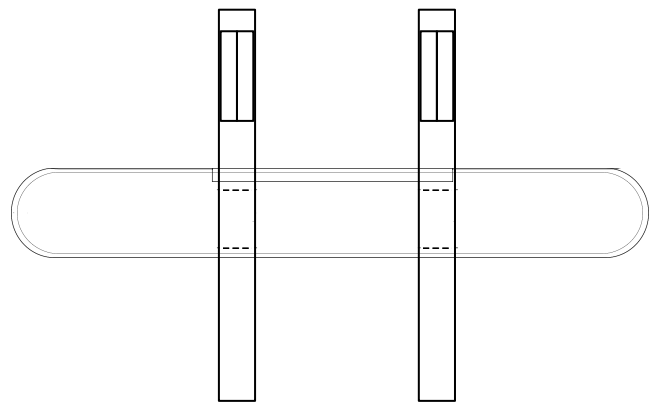


Back view

Switch pockets



Front view



Back view

Headrest Padding

Adapt measurements / Page 1

Step 1 / Make a jig

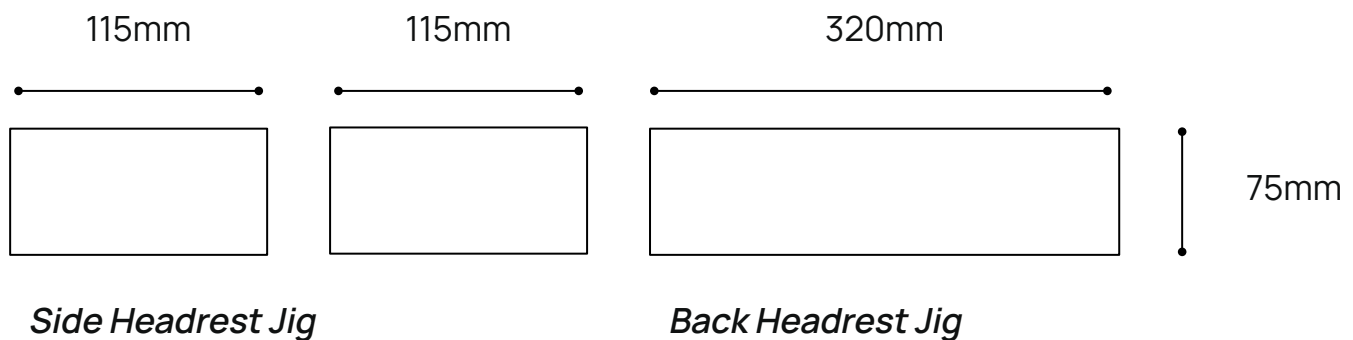
The *headrest* part is designed especially for Elad's neck and head range of motion. This are the guidelines for adapting the part on a meeting with your fix-partner.

Before your heading to meet your fix-partner, make sure to prepare:

Cuttet 115mm * 75mm * 5mm perspex - X2 Piece (*Headrest Jig*)

Cuttet 320mm * 75mm * 5mm perspex - X1 Piece (*Headrest Jig*)

you can use a laser cut machine, or a bend saw to cut the parts.



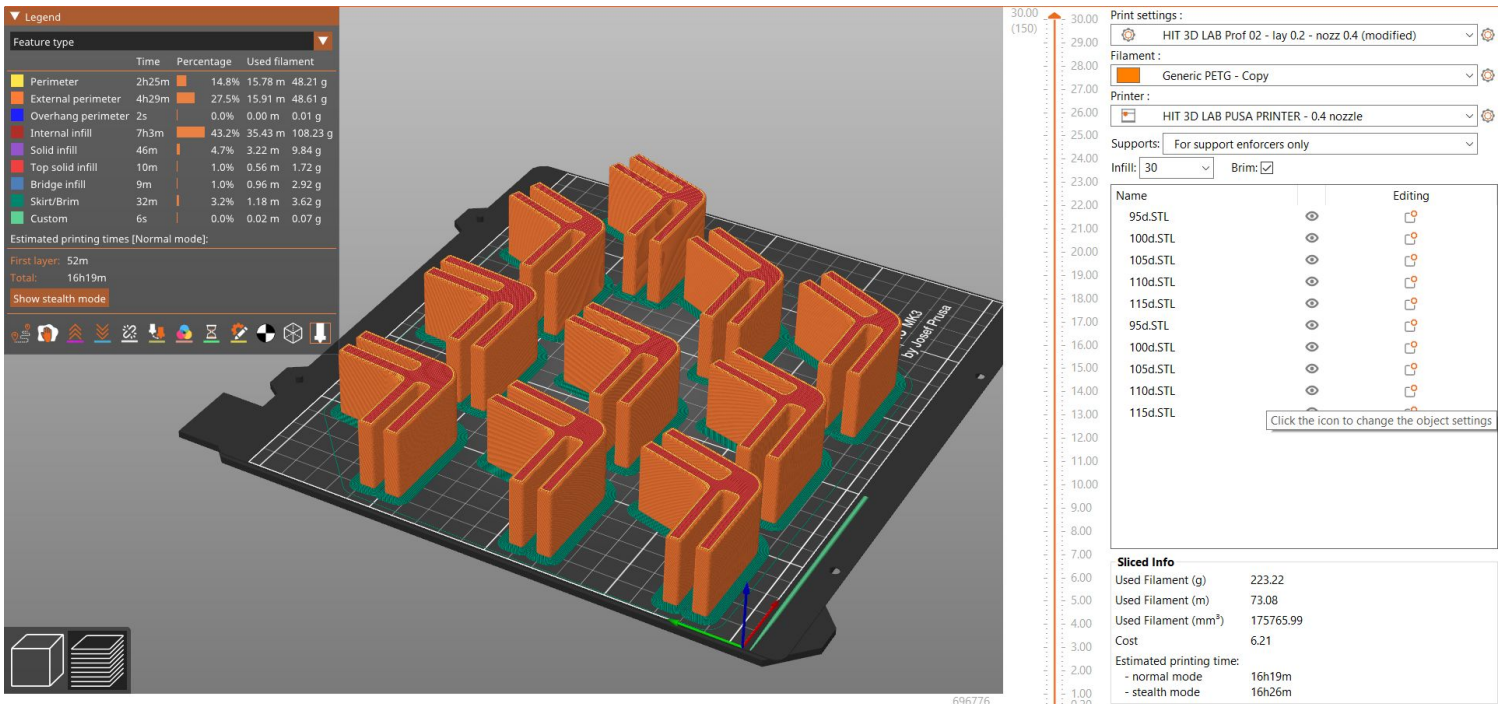
Make The Parts / Page 1

Step 2 / Make a jig

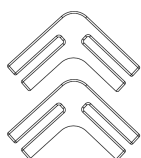
3D Print a couple of each angle of *Printed Angle Jigs*.

Material: PETG

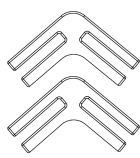
Infill: 30%



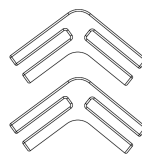
You should have:



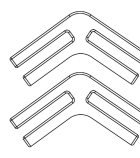
95°



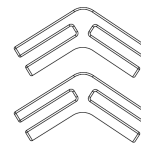
100°



105°



110°



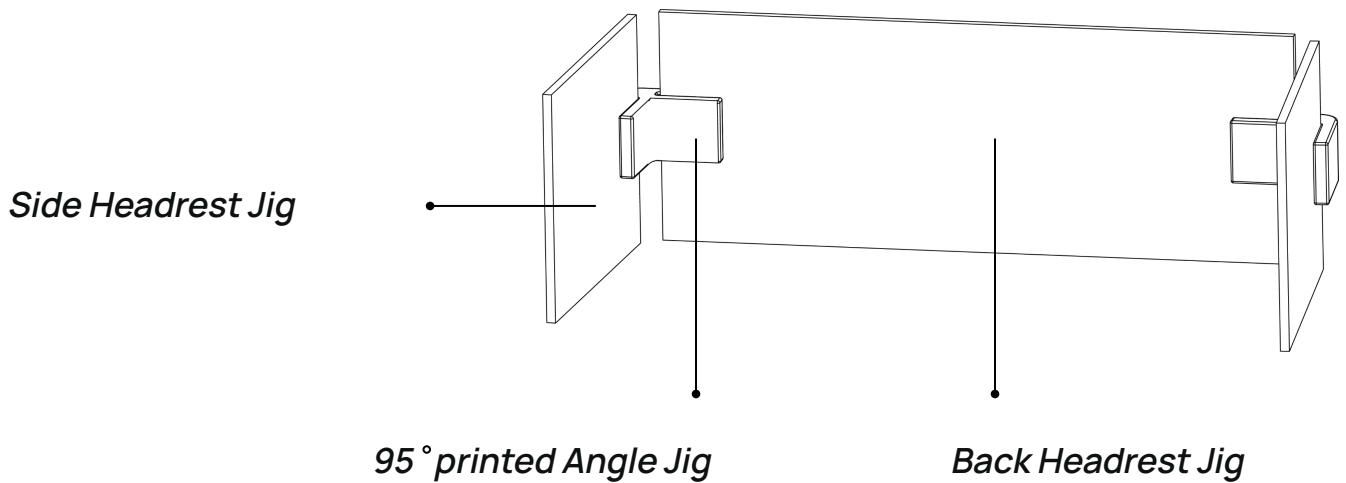
115°

Adapt measurements / Page 2

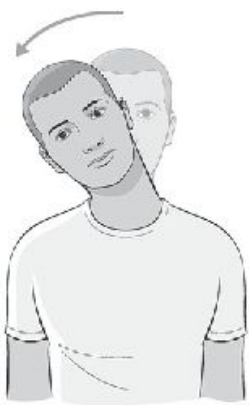
Step 3 / Adoption meeting with your fix-partner

This stage is about making a *Headrest bending jig*, in order to adapt the *headrest*'s angle to your partner's range of motion.

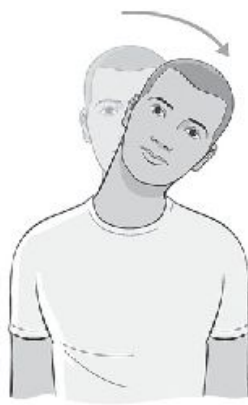
Start with with the smallest angle. Connect *95°printed Angle Jig* to *Back Headrest Jig* from right and left. After, a *side Headrest Jig* from each side.



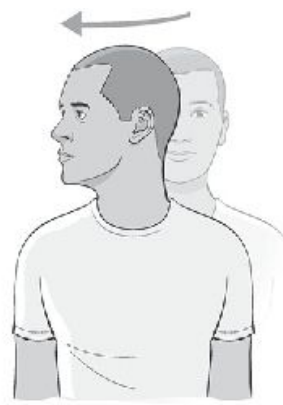
Relevant motions:



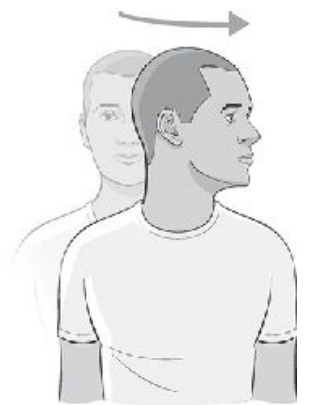
Right side flexion



Left side flexion



Right rotation



Left rotation

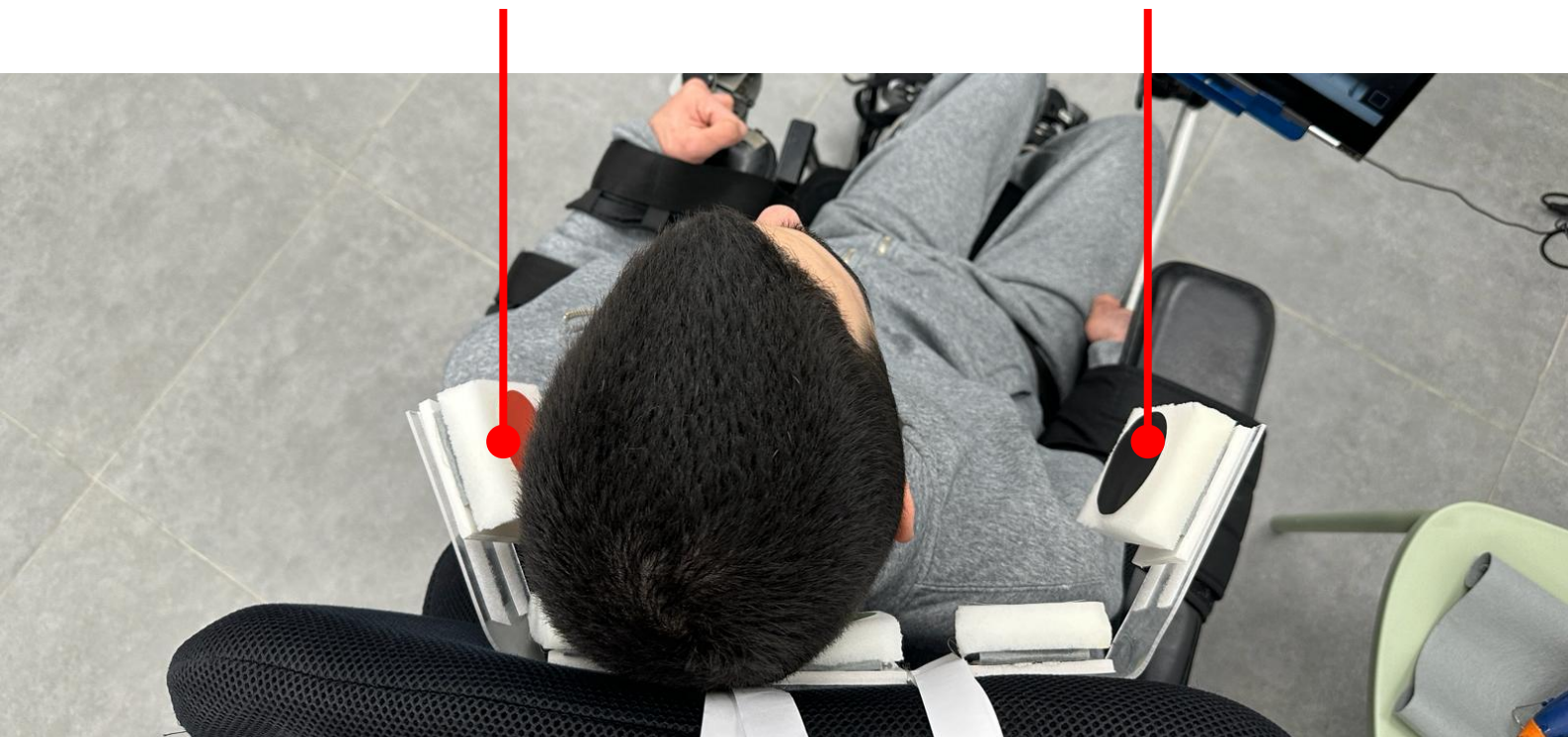
Adapt measurements / Page 3

Step 3 / Adoption meeting with your fix-partner

Hold the *Headrest bending jig* behind your partners head. Kindly ask him / her to try to reach the right, and then the left *side Headrest Jig* with his / her head.

Try to reach hear

Try to reach hear



Angle was too small? Repeat this step with a larger angled *printed Angle Jig*. until you find the optimal angle.

- *Reaching both sides should feel easy comfortable.
- * Sometimes the range of motion is not the same on both sides. If your headrest needs to be asymmetrical, it's totally fine.

Make The Parts / Page 1

Step 1 / 3D print

3D Print all the printable parts with the following settings:

Material: PETG

Supports: 45 degrees

Infill: 20%

Legend

Feature type	Time	Percentage	Used Filament
Perimeter	27m	22.8%	0.95 m 2.92 g
External perimeter	29m	24.4%	0.98 m 2.99 g
Overhang perimeter	7s	0.1%	0.01 m 0.04 g
Internal infill	38m	31.2%	1.23 m 3.76 g
Solid infill	3m	2.3%	0.08 m 0.25 g
Top solid infill	31s	0.4%	0.01 m 0.04 g
Bridge infill	28s	0.4%	0.04 m 0.13 g
Skirt/Brim	42s	0.6%	0.03 m 0.08 g
Support material	10m	8.3%	0.19 m 0.58 g
Support material interface	2m	1.5%	0.04 m 0.12 g
Custom	6s	0.1%	0.02 m 0.07 g

Estimated printing times:
First layer: 2m
Total: 2h11m

Print settings:
HIT 3D LAB Prof 02 - lay 0.2 - nozz 0.4 (modified)
Filament: Generic PETG - Copy
Printer: HIT 3D LAB PUSA PRINTER - 0.4 nozzle
Supports: For support enforcers only
Infill: 20 Brim:

Sliced Info
Used Filament (g): 10.97
Used Filament (m): 3.59
Used Filament (mm³): 8641.02
Cost: 0.31
Estimated printing time:
- normal mode: 2h11m
- stealth mode: 2h11m

Legend

Feature type	Time	Percentage	Used Filament
Perimeter	16m	14.5%	1.72 m 5.25 g
External perimeter	30m	27.8%	1.73 m 5.29 g
Overhang perimeter	2s	0.0%	0.00 m 0.01 g
Internal infill	25m	23.5%	1.79 m 5.46 g
Solid infill	15m	14.4%	1.40 m 4.28 g
Top solid infill	3m	3.1%	0.22 m 0.67 g
Bridge infill	3m	2.3%	0.27 m 0.82 g
Skirt/Brim	3m	2.6%	0.10 m 0.32 g
Support material	49s	0.8%	0.02 m 0.07 g
Support material interface	1m	1.0%	0.03 m 0.08 g
Custom	6s	0.1%	0.02 m 0.07 g

Estimated printing times [Normal mode]:
First Layer: 11m
Total: 1h48m
[Show stealth mode](#)

Print settings:
HIT 3D LAB Prof 02 - lay 0.2 - nozz 0.4 (modified)
Filament: Generic PETG - Copy
Printer: HIT 3D LAB PUSA PRINTER - 0.4 nozzle
Supports: For support enforcers only
Infill: 20 Brim:

Sliced Info
Used Filament (g): 22.32
Used Filament (m): 7.31
Used Filament (mm³): 17570.96
Cost: 0.62
Estimated printing time:
- normal mode: 1h48m
- stealth mode: 1h49m

Make The Parts / Page 2

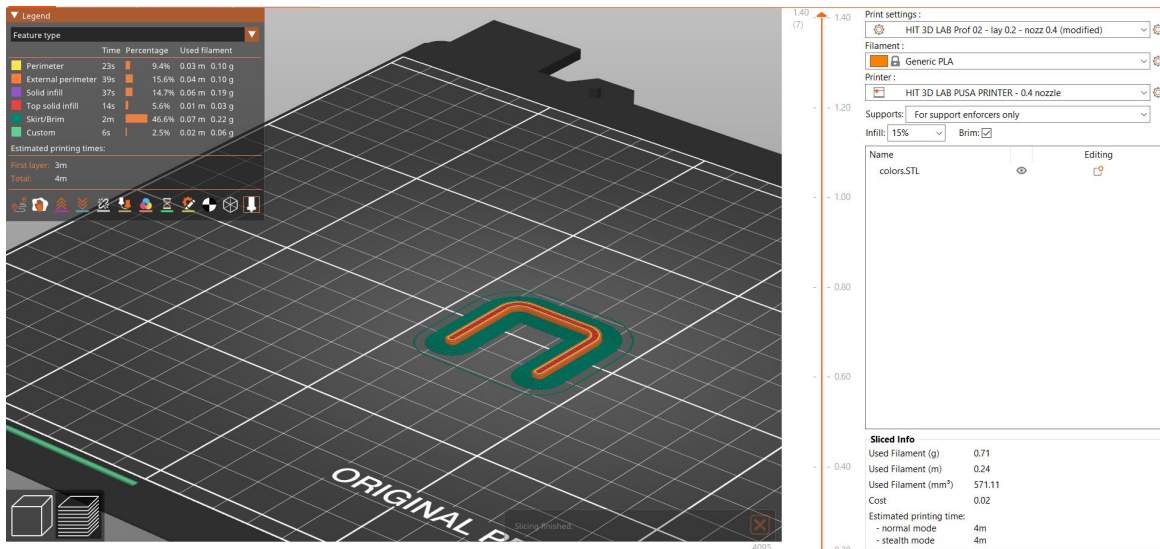
Step 1 / 3D print

3D Print all the printable parts with the following settings:

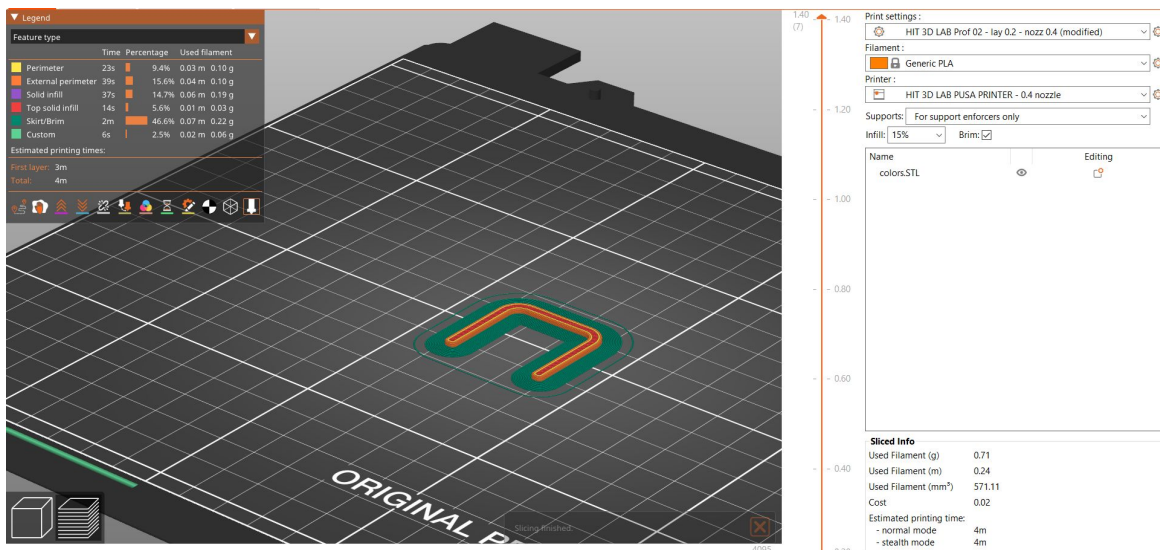
Material: PLA

Infill: 15%

Blue PLA



Red PLA



Make The Parts / Page 3

Step 2 / Laser cut

Laser cut the parts: *Front fabric*, *Back fabric*, *Padding Foam*, *Headrest Base*.

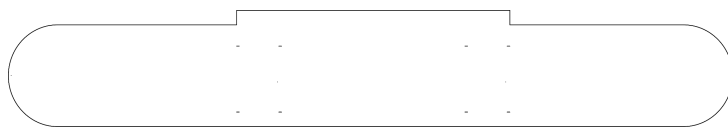
*Machine cutting Parameters (speed & power) may be changed between different machines. Make sure that you have entered appropriate parameters for the material according to the manufacturer's instructions



Front fabric



Mesh
Fabric



Back fabric



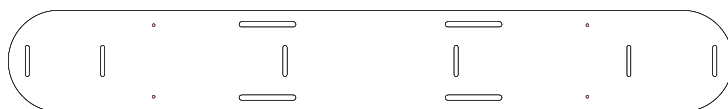
Cordura
fabric



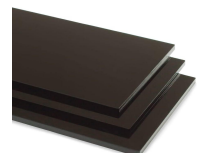
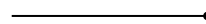
Padding Foam



Foam
10mm



Headrest Base

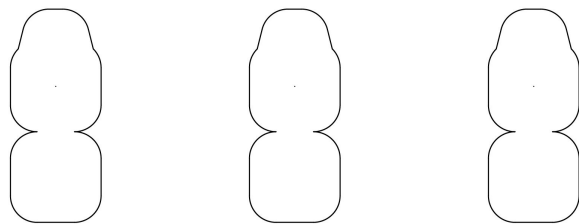


Perspex
5mm

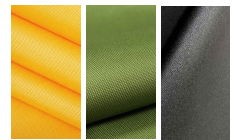
Make The Parts / Page 4

Step 2 / Laser cut

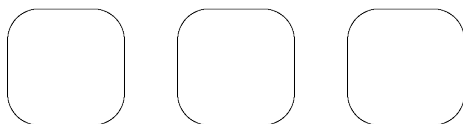
Laser cut the parts: *Switch Pockets Fabric*, *Hand Switch eva covers*, *Foam Switch Holder*.



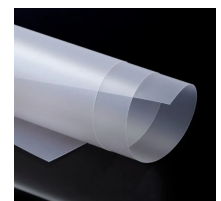
Switch Pockets Fabric



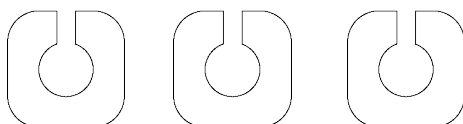
Cordura
Fabric



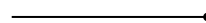
Hand Switch polypropylene covers



polypropylen
e 0.3mm



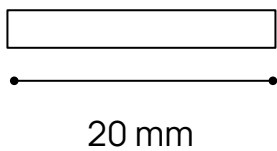
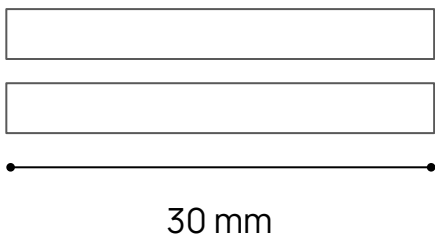
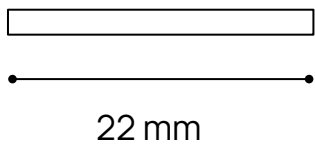
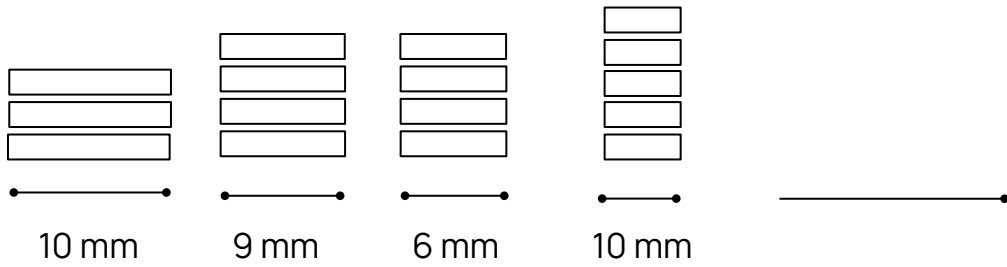
Foam Switch Holder



Eva 5mm

Make The Parts / Page 5

Step 3 / Scissors cut straps + hook & loops



Double sided
Hook & Loop -
20 mm



Nylon Strap -
40 mm

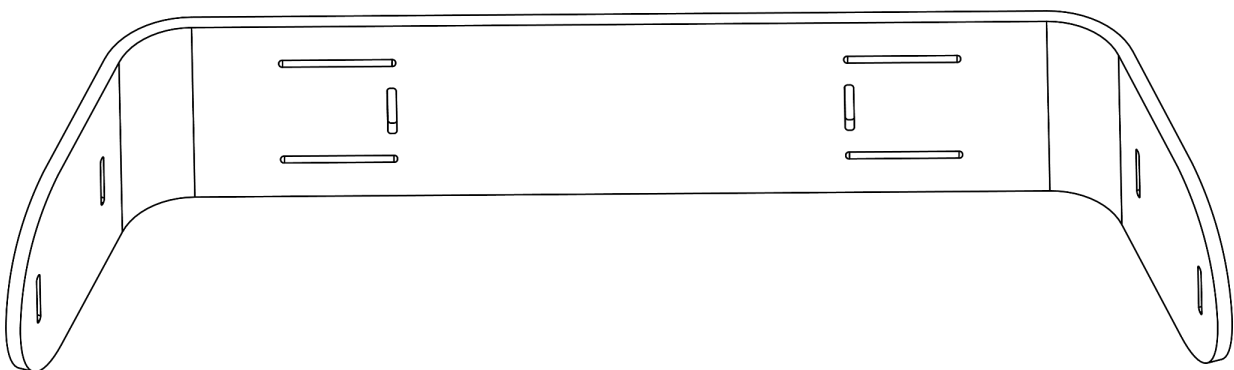
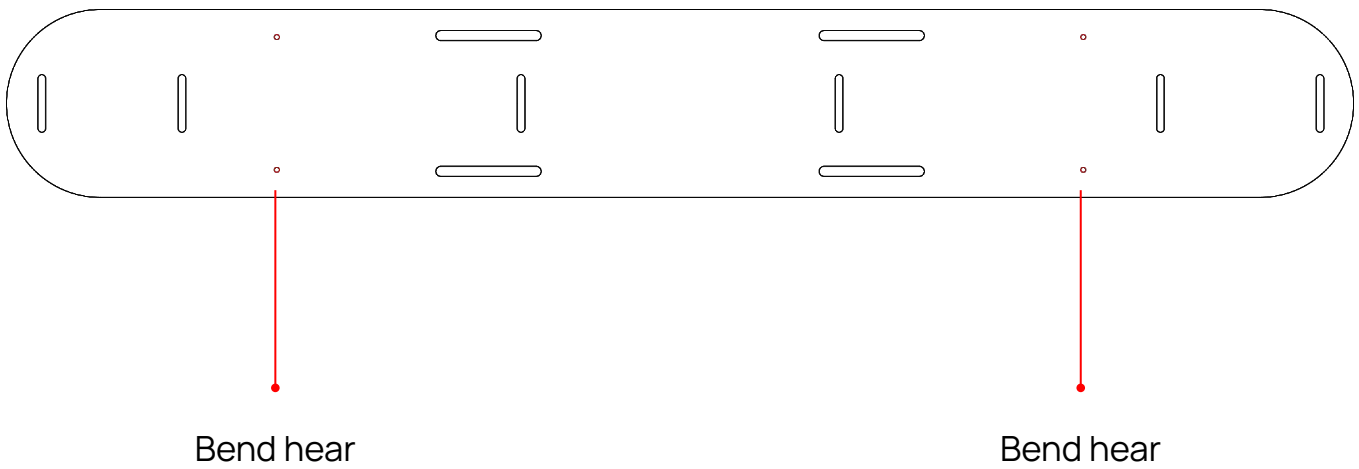


Flexible -
Strap 25mm

Make The Parts / Page 6

Step 4

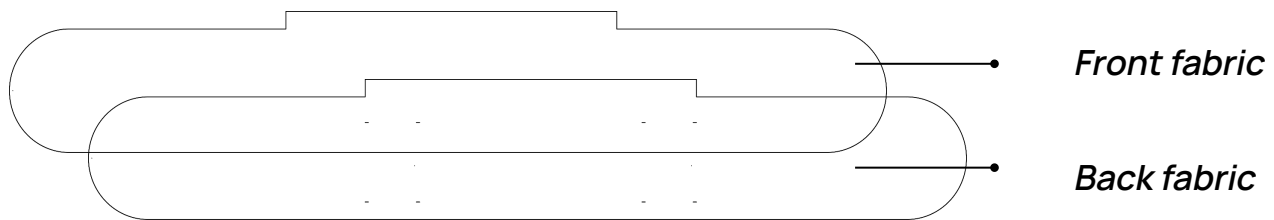
Bend *Headrest Base* using a hot gun. Use the *Headrest bending Jig* to reach the right angle.



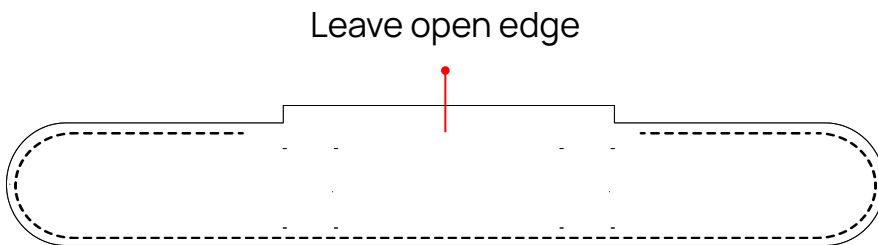
Assembly Guide / Page 1

Step 1 / sew

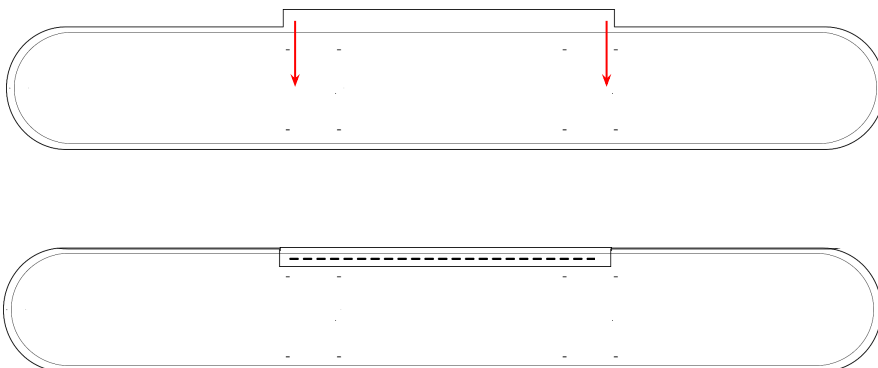
Place the *Front fabric* the on the *Back fabric*



Sew *Front fabric* to the *Back fabric*



Use the open edge to Flip the part inside out, and then place the *Padding Foam* inside. Flip the open edges inside, and sew the open edge, so your part will be fully closed.



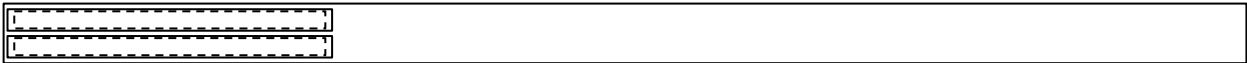
Assembly Guide / Page 2

Step 2 / sew

Sew the hook & loops to the *Headrest Straps*, and *Hand switch Strap*. Pay attention to the directions described bellow.

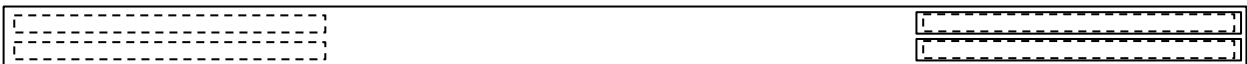
Headrest Straps

Hooks



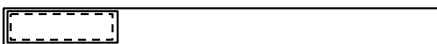
Flip the strips upside down

Loops



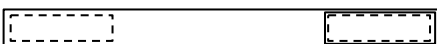
Hand switch Strap

Hook



Flip the strip upside down

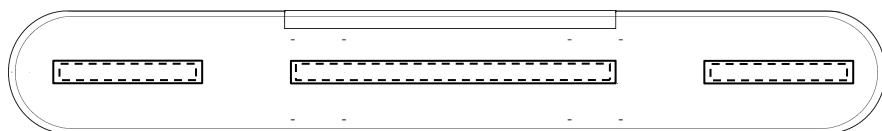
Loop



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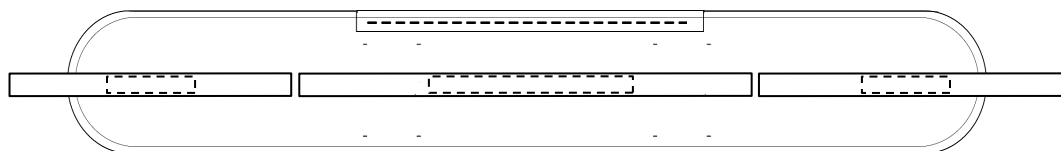
Step 3 / sew

Sew the *Head switch hook & loop* on the front side of the part (*Front Fabric*). **The loop should face out.**



Step 4 / sew

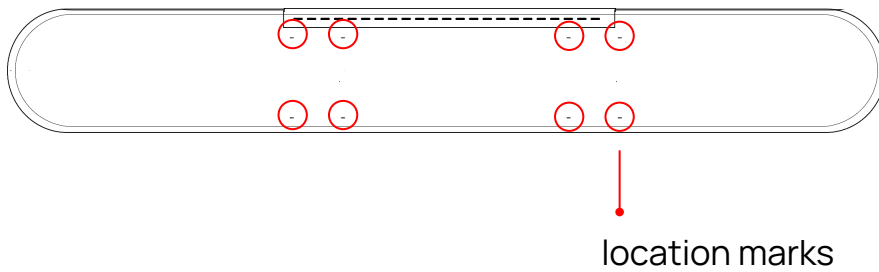
Sew the *Hook and loop connectors* to the back side of the part (*Back Fabric*), following the stitching line from the previous step. **The hook should face out.**



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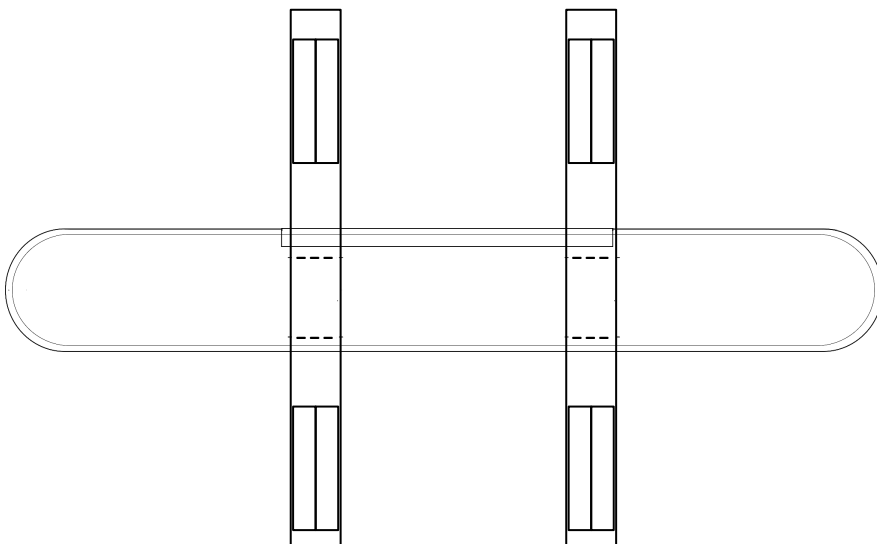
Step 5 / sew

Sew the *Headrest Straps* to the back side of the part (*Back Fabric*), paying attention to the location marks.



Step 6 / sew

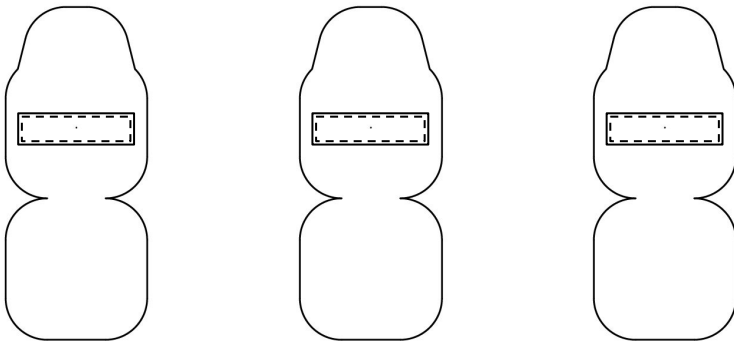
Sew the *Headrest Straps*.



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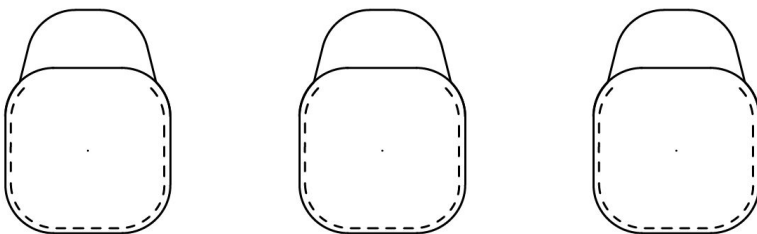
Step 7 / sew

Sew *Pocket's hook & loop* to the *Switch Pockets Fabric*. The hook should face out.



Step 8 / sew

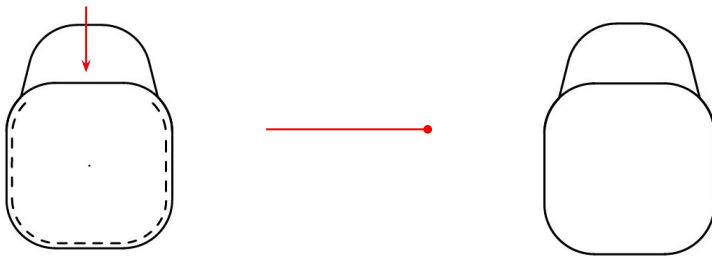
Fold the the *Switch Pocket Fabric* in two, make sure that the hook & loop face inside, and not outside. In the next step, you will flip the pocket inside out. Repeat in the two other *Switch Pocket Fabrics*.



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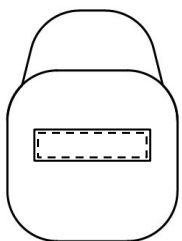
Step 9 / sew

Flip the part inside out, so now the hook face out. Repeat in the two other *Switch Pocket Fabrics*.

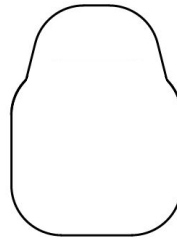


Step 10 / sew

Flip the part inside out, so now the hook face out. Repeat in the two other *Switch Pocket Fabrics*.



This is how your pocket needs to look from the back

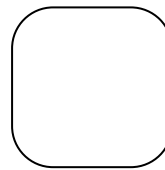
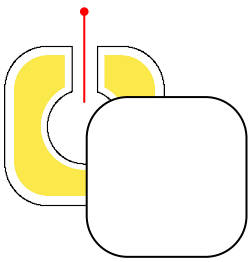


This is how your pocket needs to look from the front

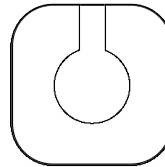
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Step 11 / sew

Place the *Hand Switch polypropylene covers* on top of the *Foam Switch Holder*. using Double-sided tape. repeat in the two other *Hand Switch polypropylene covers* and *Foam Switch Holders*.



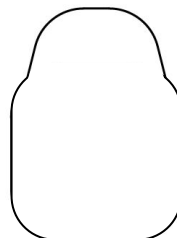
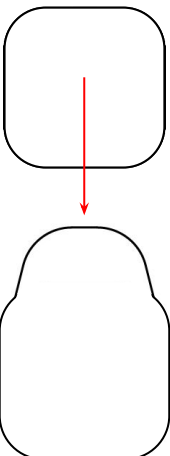
This is how your Foam Switch Holders needs to look from the front



This is how your Foam Switch Holders needs to look from the back

Step 12 / Assemble the headrest pockets parts

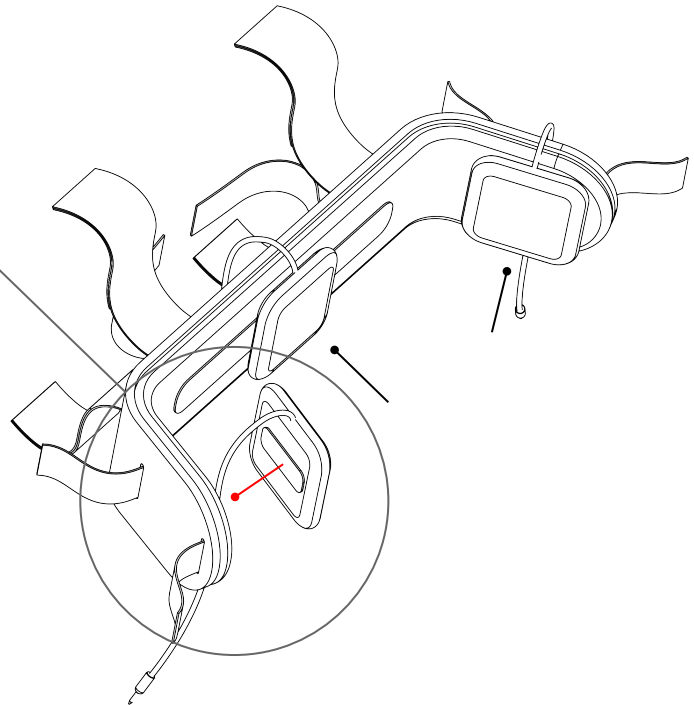
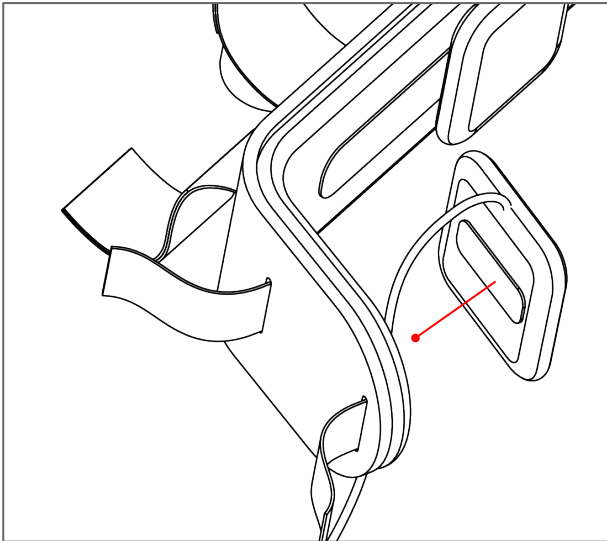
Place the *Foam Switch Holder* inside the *Switch Pocket*. repeat in the two other *Switch Pocket Fabrics*.



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Step 13 / Connect the headrest parts

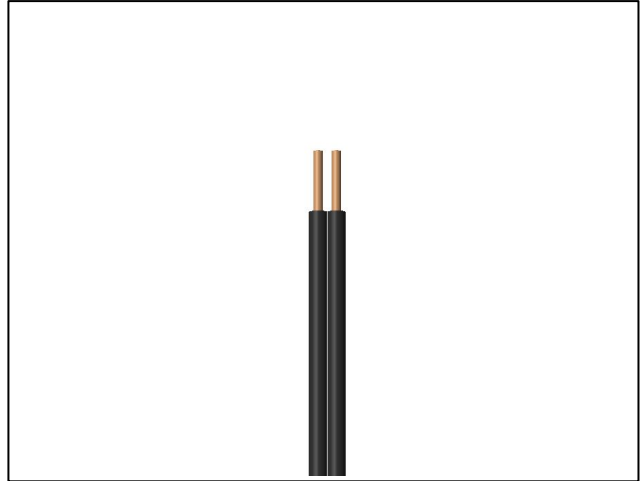
Attach *Switch Pocket Attach* to *Head switch hook & loop*.



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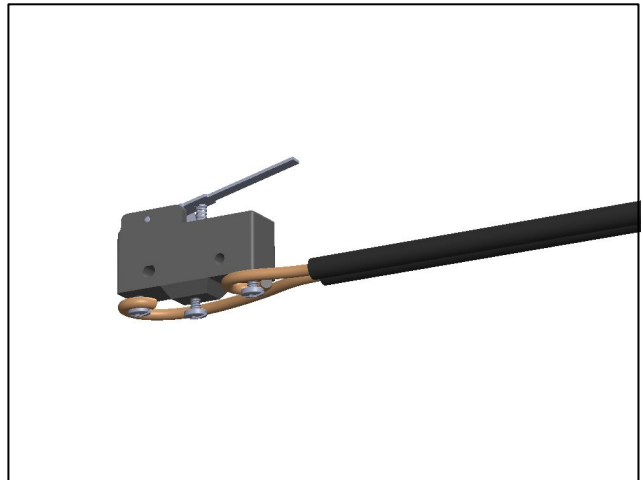
Step 1

Exposing the copper wires



Step 2

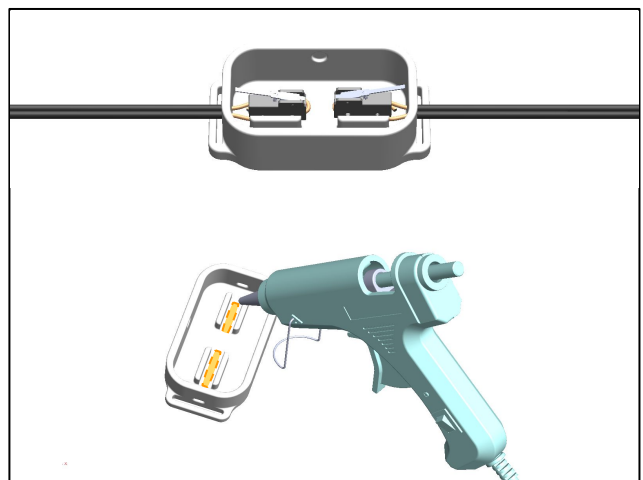
Soldering the Toggle Micro-Switch to NC and C connections X2



Step 3

threading the wires thru the designated holes

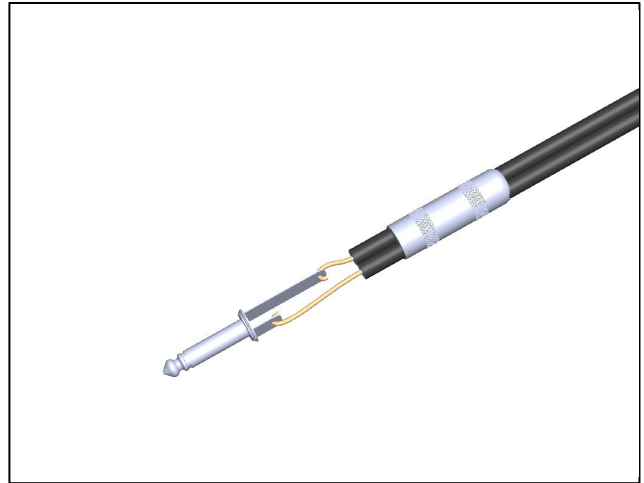
Placing the Toggle Micro-Switch to the base part of the switch X2



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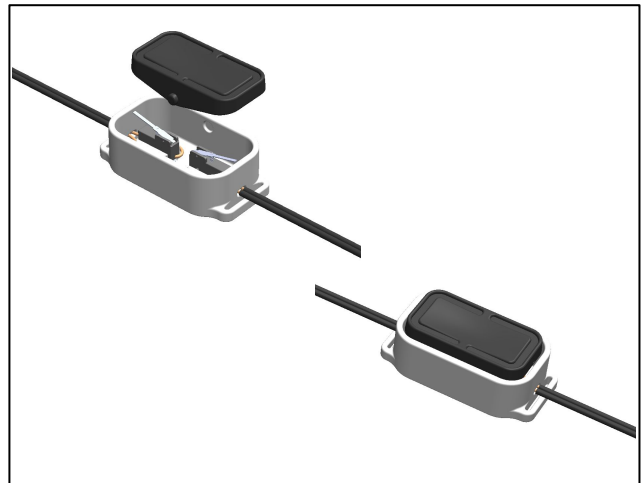
Step 4

Soldering the Toggle 3.5 mono connector to the wire edges X2
Screw it in



Step 5

Placing the top part of the switch



Step 6

Placing the tab indicator - color difference using perspex glue

