

Š O L S K I  C E N T E R

Š K O F J A L O K A

Višja strokovna šola za strojništvo in lesarstvo



LTTA – Learning Trainig and Teaching Activity

PROJECT VACIDE ROBOT THOR

Overview of Pieces

- Review of pieces
- Determination of acceptability of pieces

No.	Component name	Quantity	make/buy	provider	Costs
1	Barrel Jack Connector Control PCB	1	PP	VHS BW	0.57 €
2	Female Pins Control PCB	112	PP	VHS BW	2.34 €
3	3 Wire female connectors Sensor PCBs	5	PP	VHS BW	2.02 €
5	Motor Nema 17; L=40mm; Holding torque: 39.22 N.cm	1	PP	VHS BW	124.99 €
6	Motor Nema 17; L=34mm; 5.18:1 mechanical reduction; Holding torque: 121.2 N.cm	3	PP	VHS BW	
7	Motor Nema 17 L=34mm; Holding torque: 21.57 N.cm	3	PP	VHS BW	
13	Cooper Plate 36x16mm Sensor PCBs	4	PP	VHS BW	4.98 €
24	Bus Wire 2x36 Control PCB	1	PP	VHS BW	29.90 €
35	40mm Fan Control PCB	6	PP	VHS BW	10.15 €
40	Arduino Mega	1	PP	VHS BW	7.84 €
41	Micro Endstop (Straight type)	1	PP	VHS BW	1.66 €
42	Cooper Plate 120x91mm Control PCB (9x15)	1	PP	VHS BW	1.10 €
43	A4988 Stepper Motor Driver Control PCB	7	PP	VHS BW	19.95 €
44	25V 100uF Capacitor Control PCB	7	PP	VHS BW	0.53 €
45	10kΩ Resistor Control PCB	7	PP	VHS BW	0.38 €
46	Male angled pin Sensor PCBs	12	PP	VHS BW	78.00 €
47	Male Pins Control PCB	97	PP	VHS BW	11.05 €
48	10kΩ Resisto Sensor PCBs	4	PP	VHS BW	0.83 €
49	220Ω Resistor Sensor PCBs	4	PP	VHS BW	0.79 €
50	Optocoupler Sensor PCBs	4	PP	VHS BW	0.88 €
51	Metters of wire Sensor PCBs	3	PP	VHS BW	55.50 €
					353.46 €

Overview of Mechanisms

- Inspected where everything could get into trouble
- Research how others approached of making and assembling a robot

Overview of 3D Printing Models

- Estimation of required material
- Overview of printing options
- Possibilities of using other materials (ABS, ACE)

Supply of Materials

- Finding filaments
- Searching for pulleys and belts in Europe
- Checking the length of the straps

Basebot

I redraw the piece from the original and made it possible to be milled in CNC

M3 screw holes on inner side, rounding R8 on outer side

Mounting for sensor with M3 screw holes

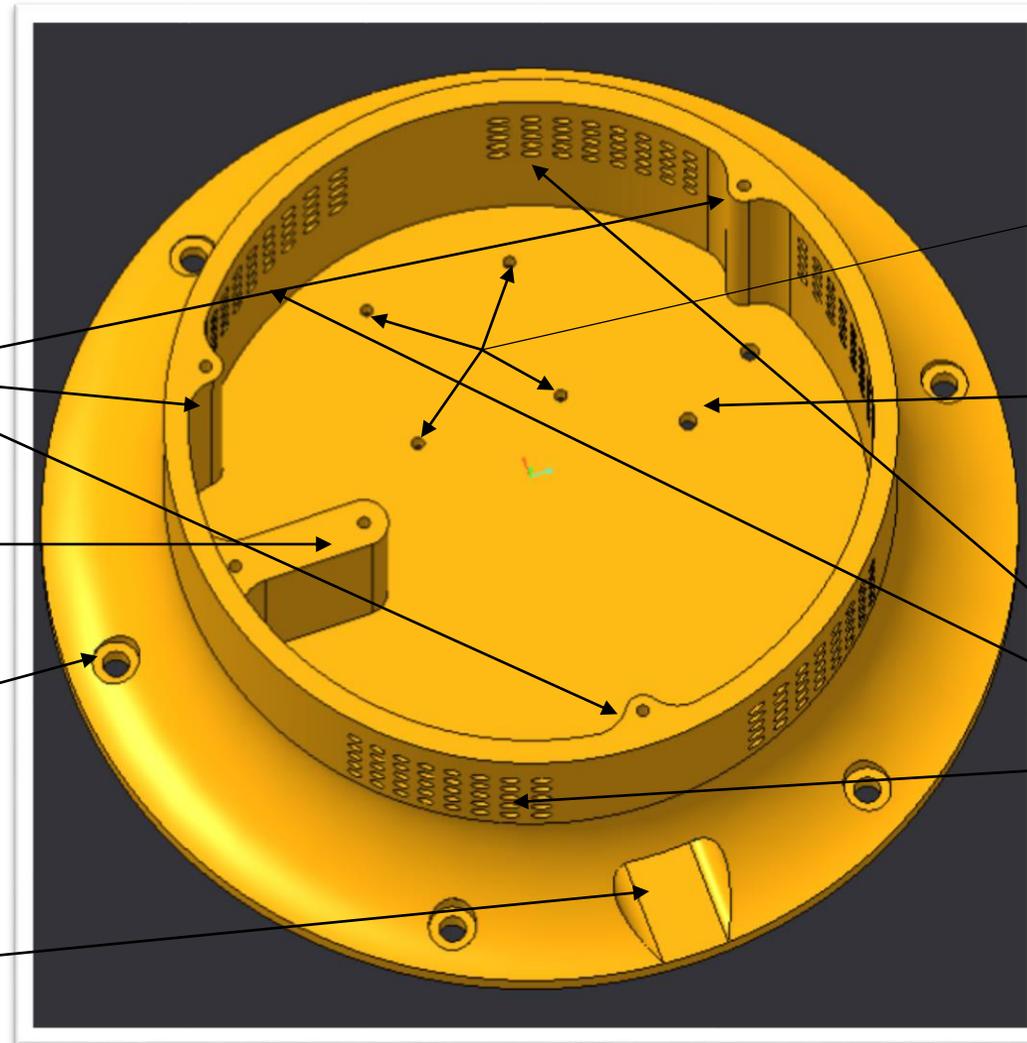
Holes M5 for mounting the base, counterbore DIN 74

Hole for cables

Holes for mounting the engine

Holes for mounting the engine

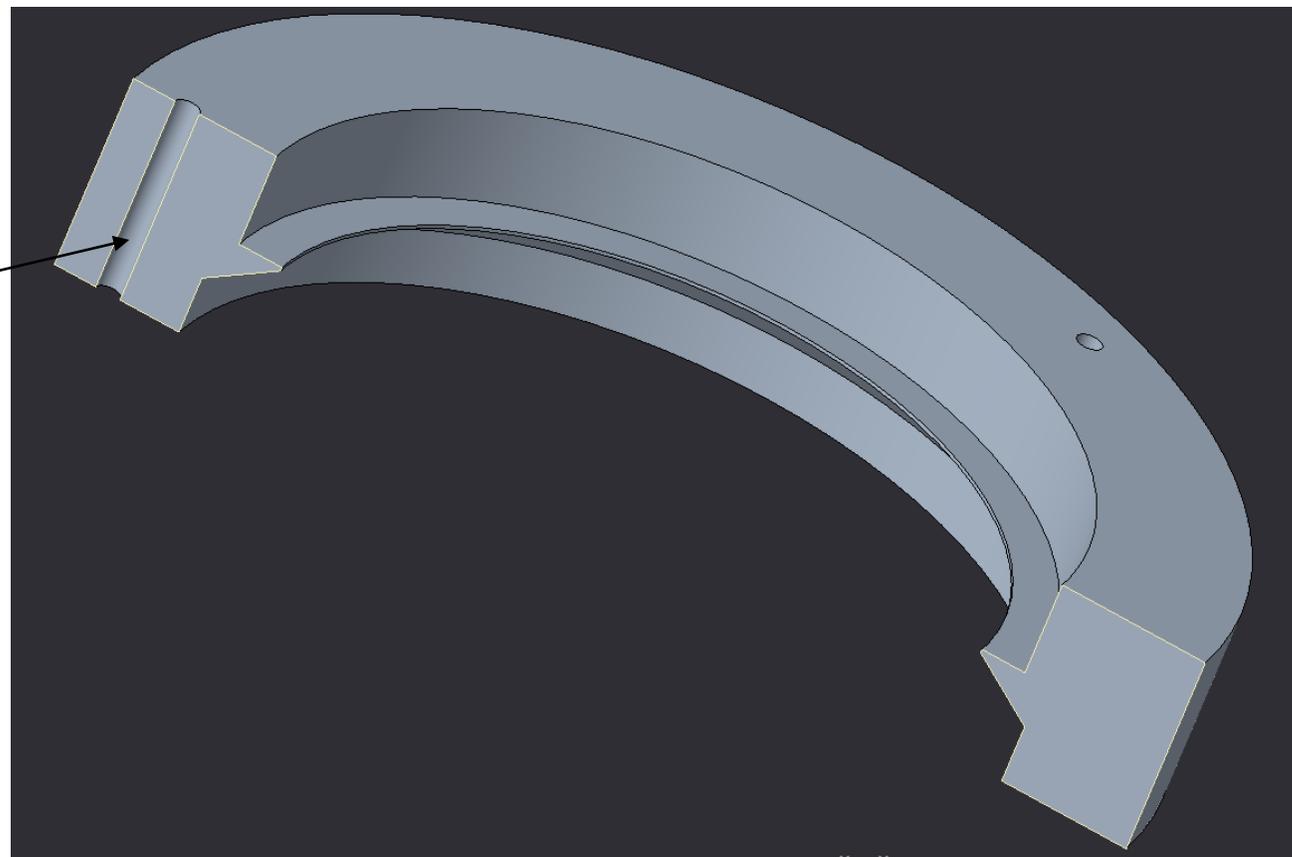
Holes for cooling



Basetop

I picked up the measurements from the model we got and drew the piece again

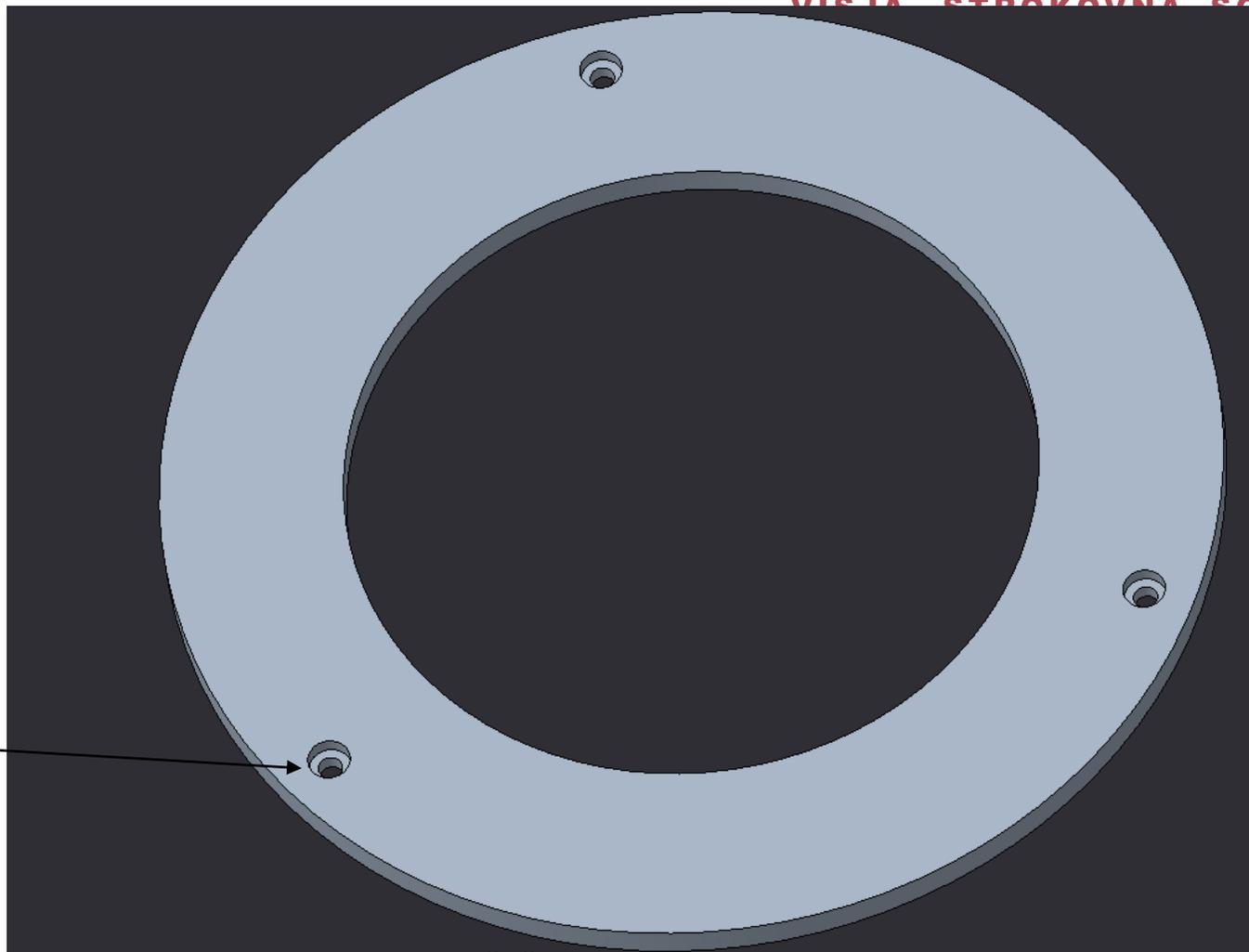
Clearance hole M3



Basebearingfix

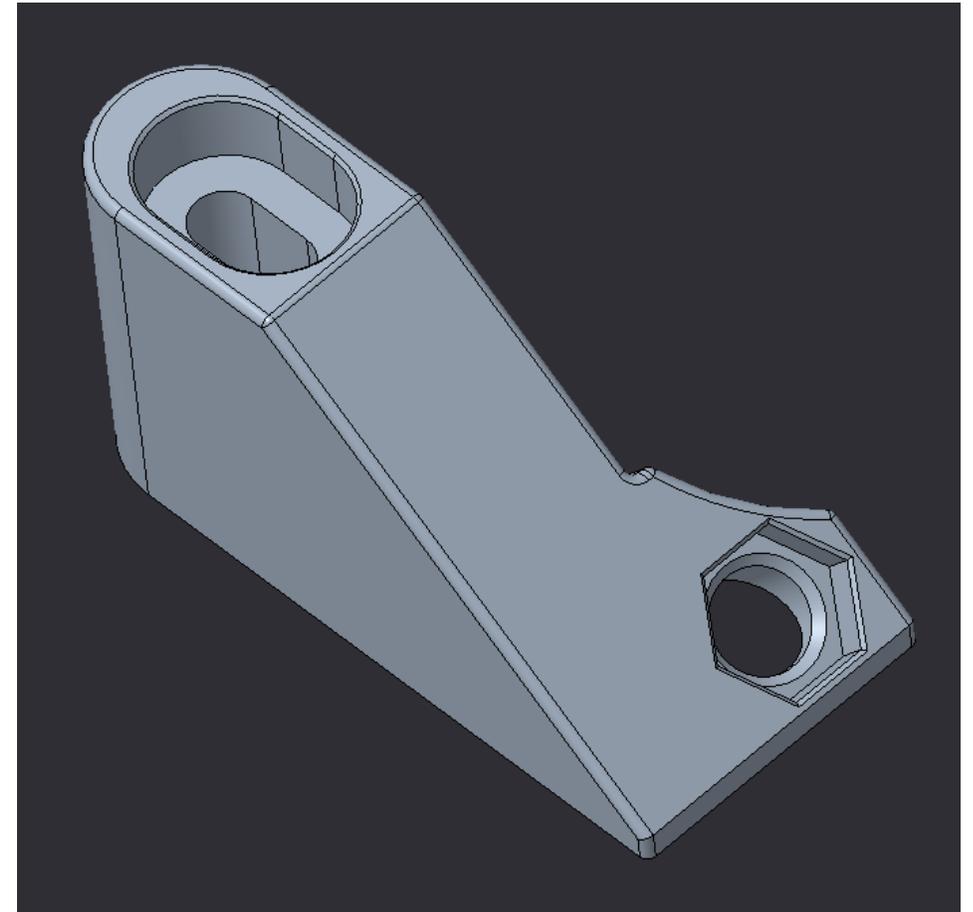
I picked up the measurements from the model we got and drew the piece again

Clearance hole with counterbore DIN 74



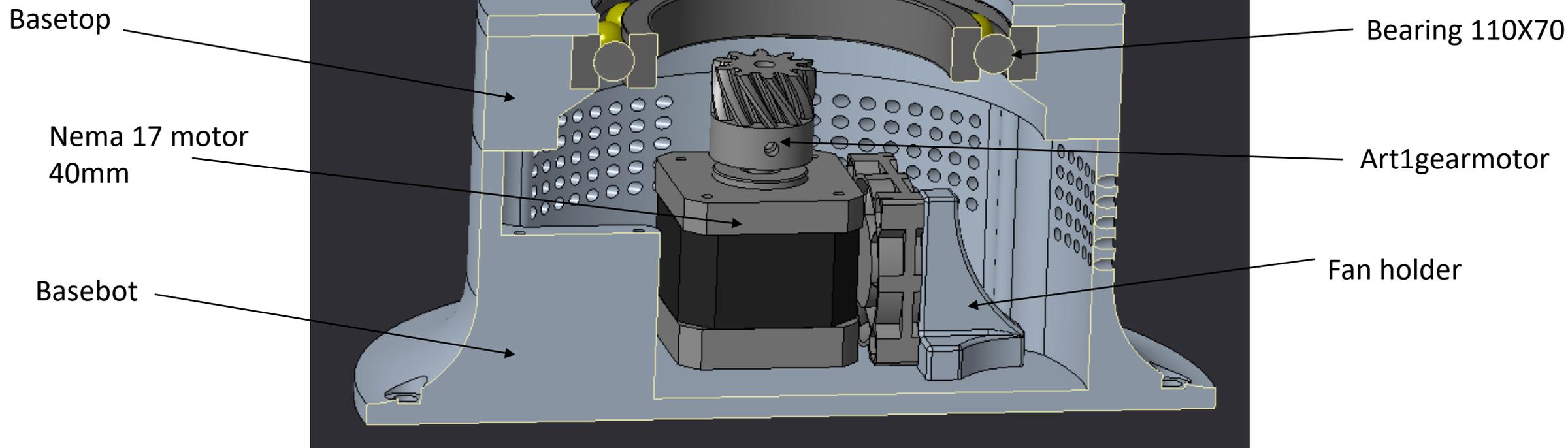
FAN MOUNTS V2

- New version of fan mounts allows you to adjust the distance between fans and motors



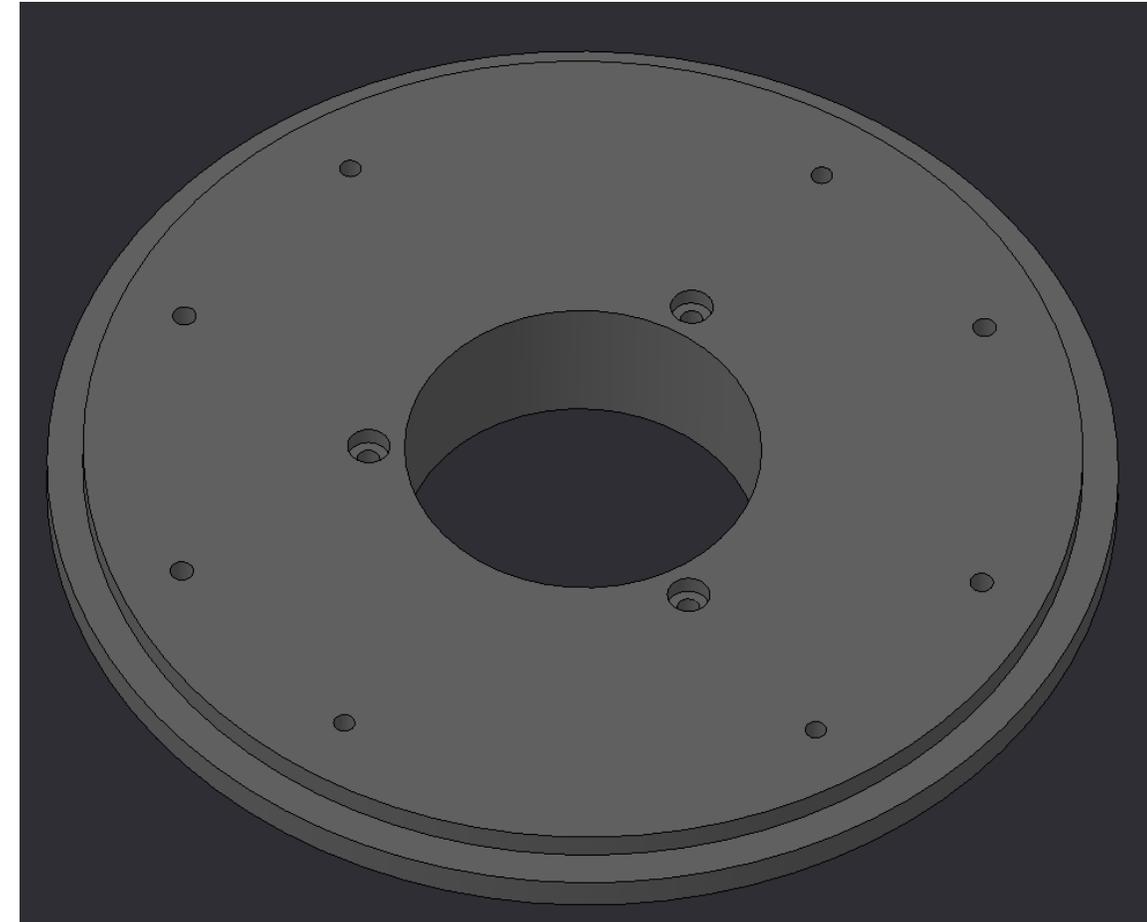
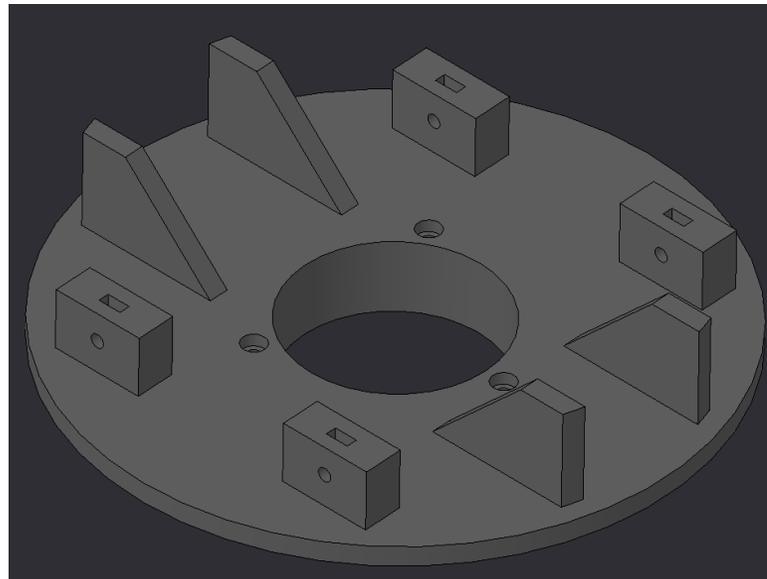
Assembly

Making the assembly using modified pieces



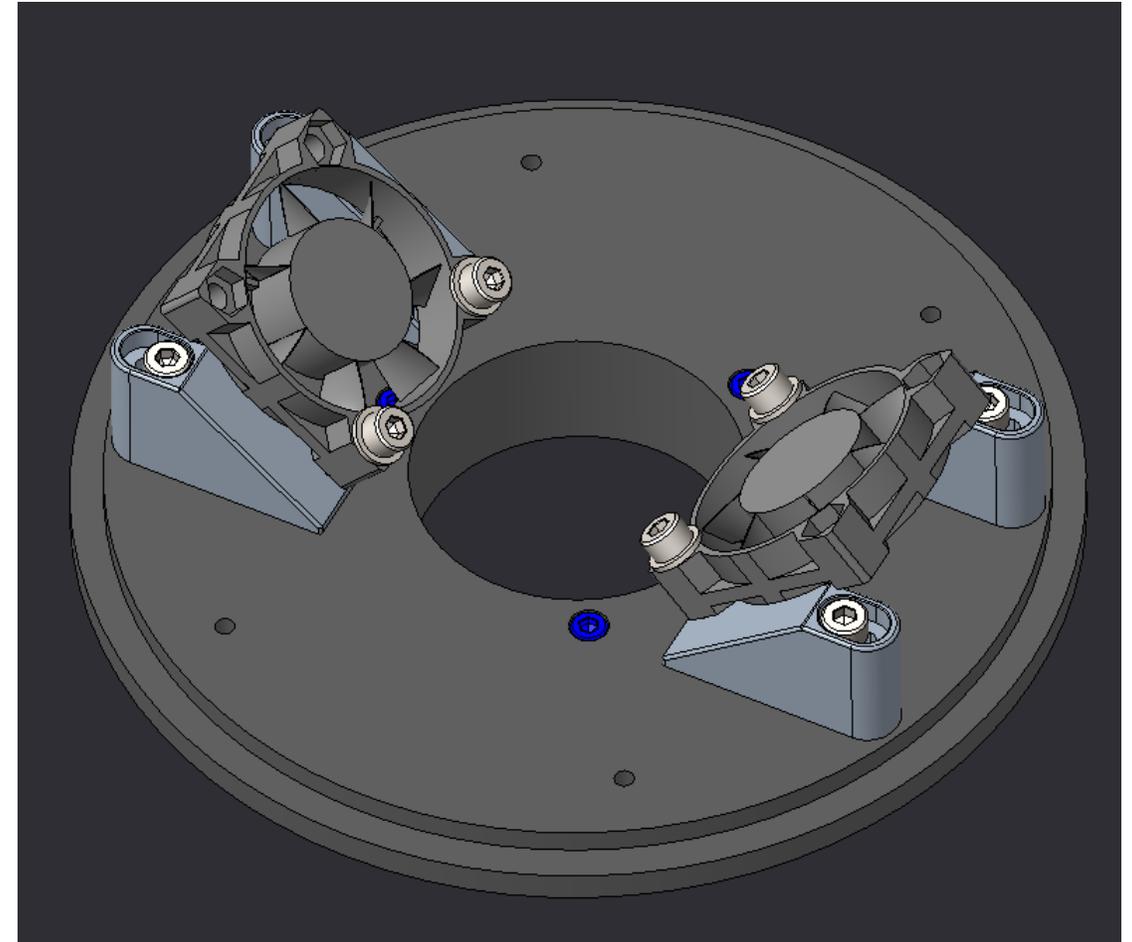
ART1TOP Old vs. New

- New version of ART1TOP base plate with counterbores for Allen screws
- All dimensions of counterbores and holes are standard



FAN MOUNTS V2

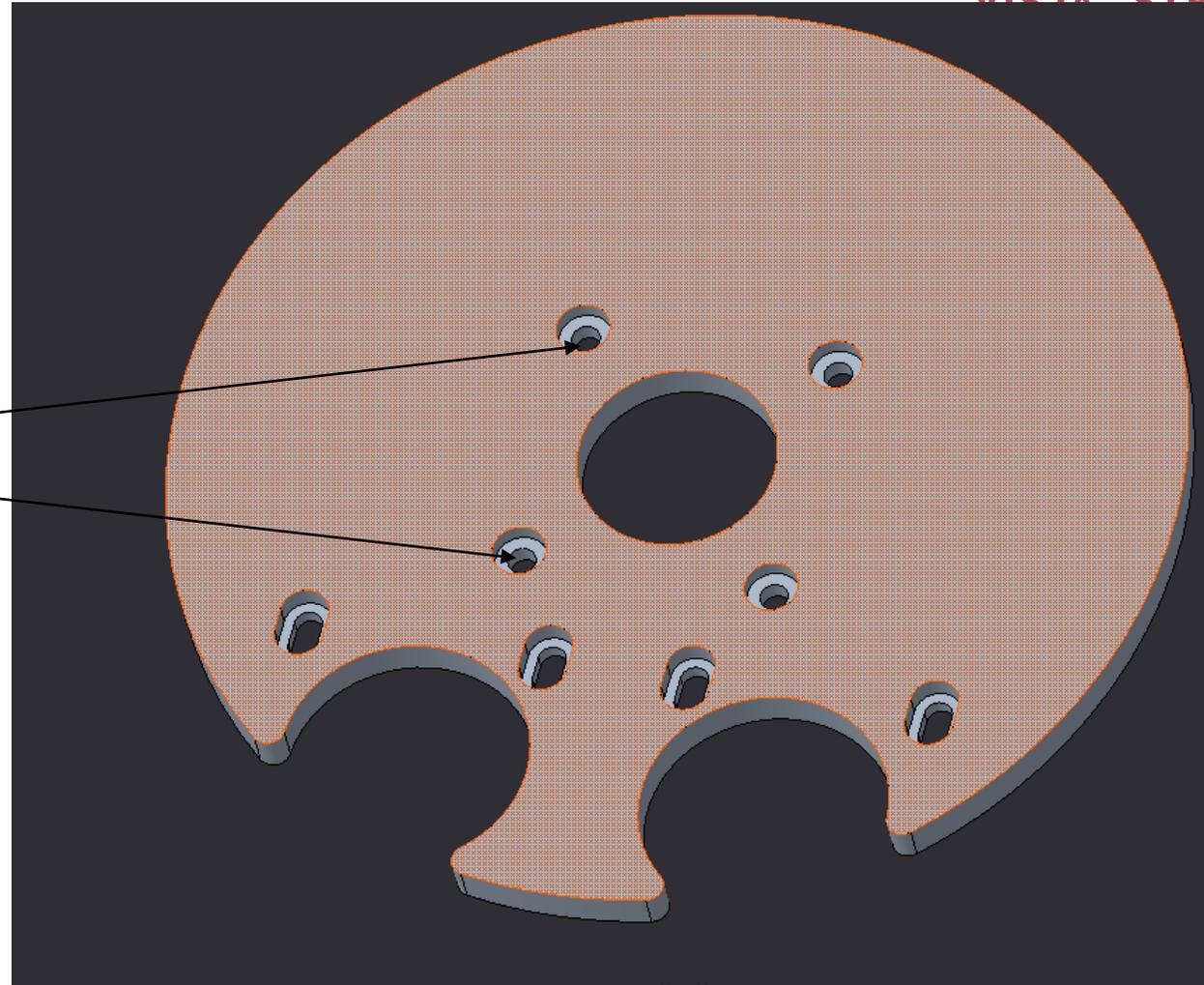
- New version of fan mounts
- Fans are attached using Allen bolts
- Fan mounts are 3D printed



Art2bodyAcover1

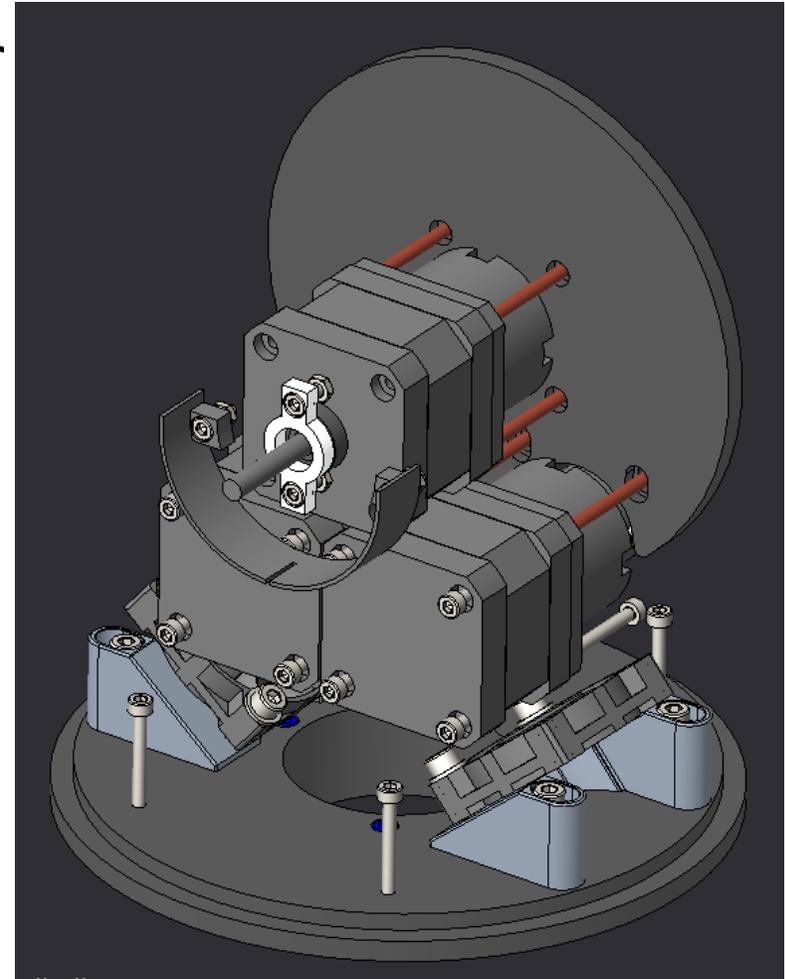
I picked up the measurements from the model we got and drew the piece again

Clarence hole M3 with counterbore DIN 74



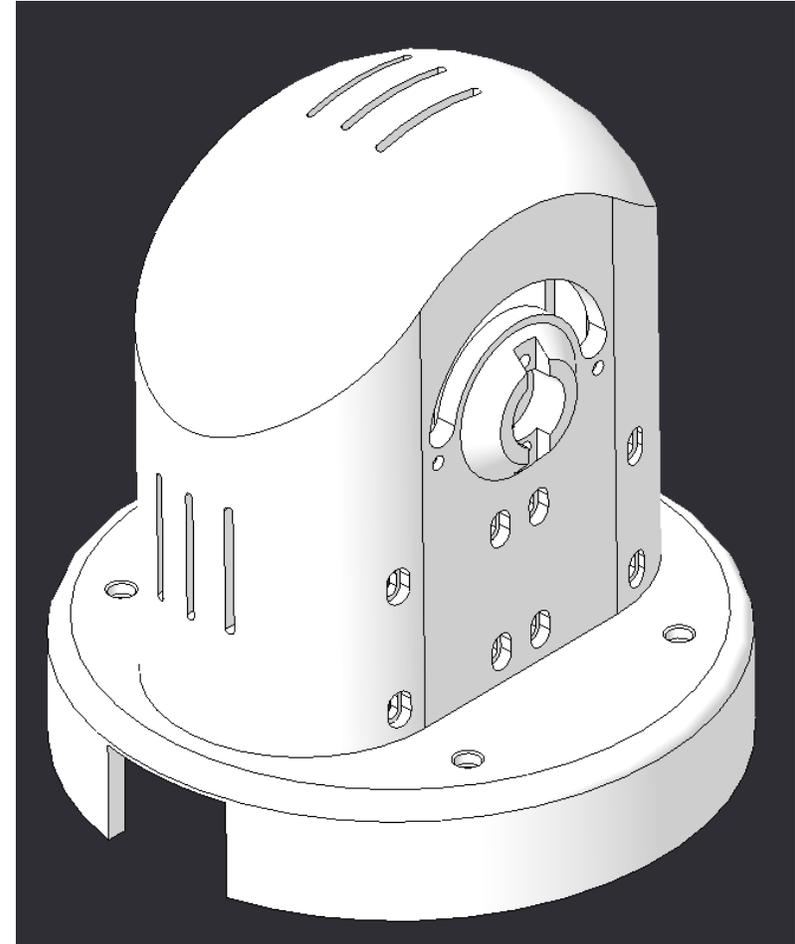
THOR_ART_1 WITH HIDDEN COVER V2

- THOR_ART_1 assembly with hidden cover part
- Screws, bearings and nuts are visible



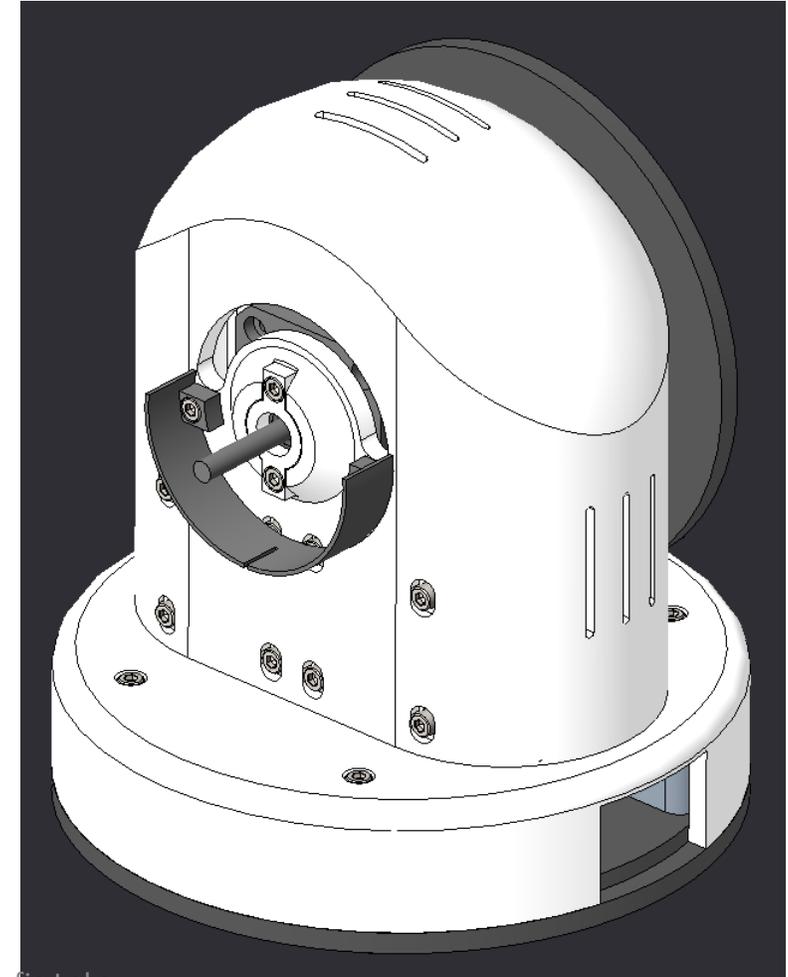
ART1BODY V2

- New version of ART1BODY cover includes counterbores for Allen screws and spacers on the inside



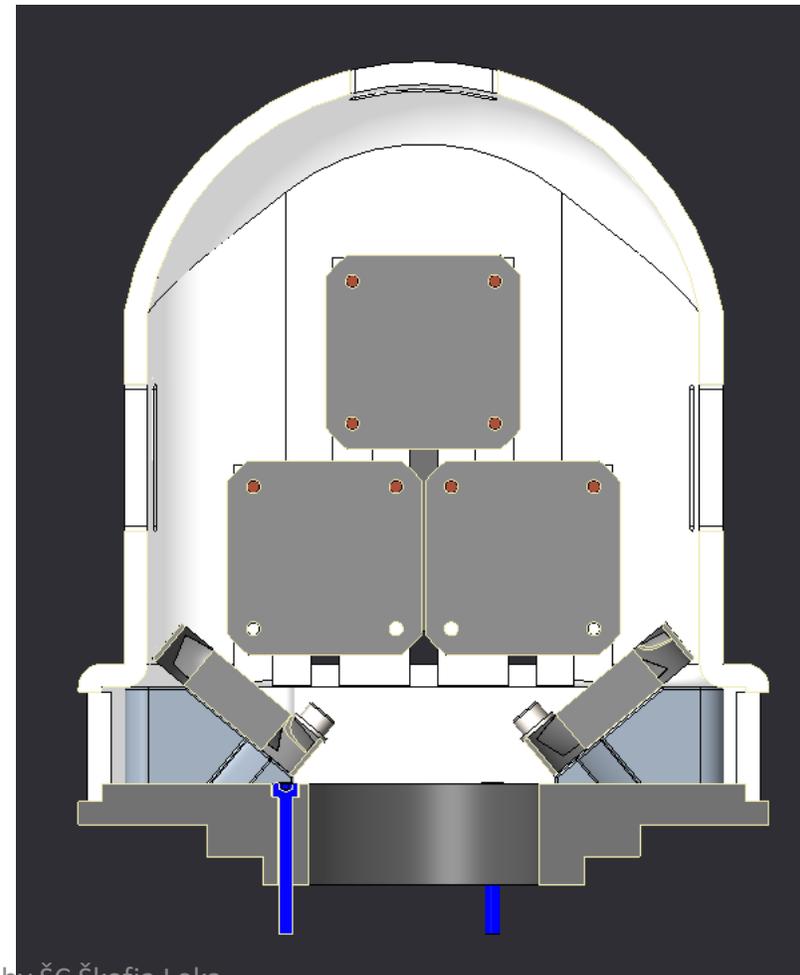
THOR_ART_1 ASSEMBLY V2

- THOR_ART_1 assembly with inserted bolts, nuts, washers and bearings



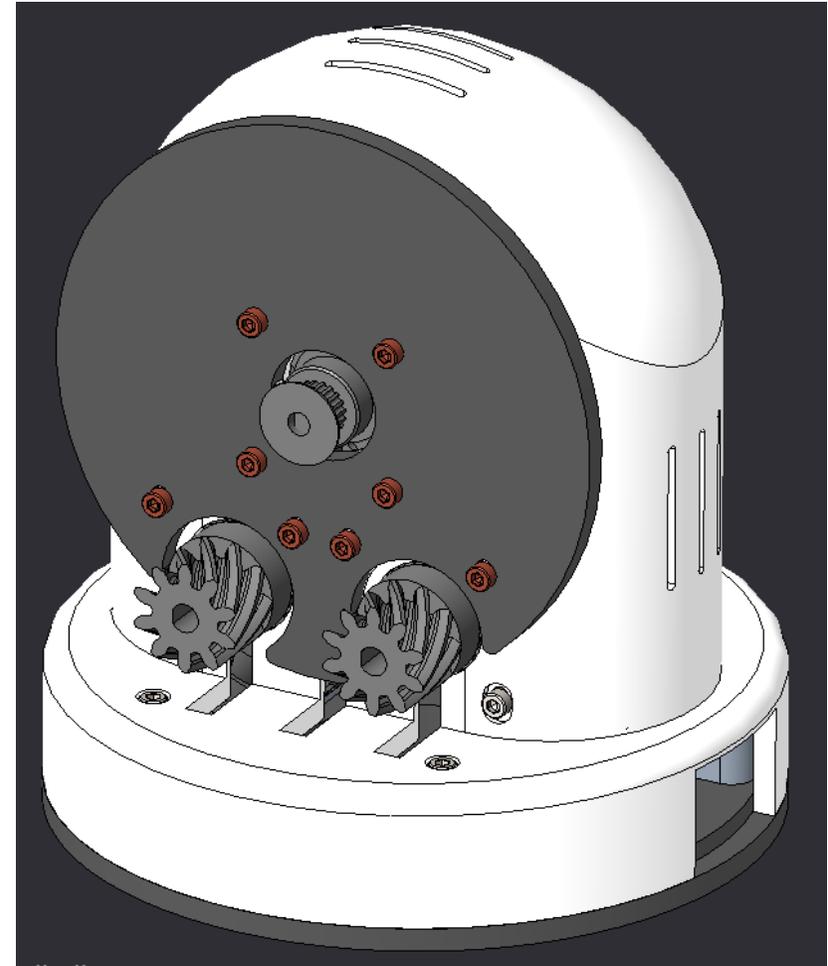
THOR_ART_1 ASSEMBLY CROSS-SECTION VIEW V2

- Cross-section of THOR_ART_1 assembly



THOR_ART_1 ASSEMBLY V2

- THOR_ART_1 assembly with inserted bolts, nuts, washers and bearings



ART2BODYACOVER

- Addition of threaded holes
- Addition of threaded hole to fix ART2BODYACOVER onto ART2UNION
- Material removal for the purpose of making ART2BODYACOVER lighter



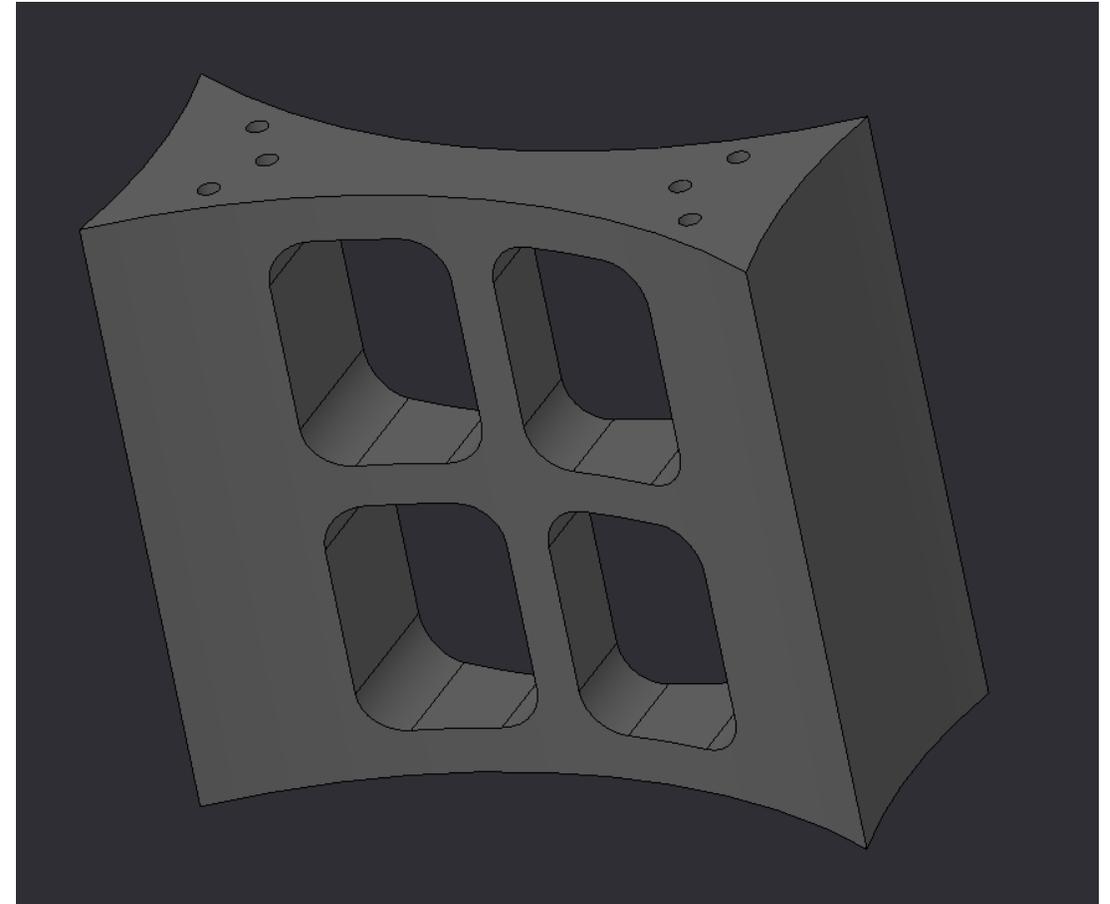
ART2BODYCOVER

- Addition of threaded holes
- Addition of threaded hole to fix ART2BODYCOVER onto ART2UNION
- Material removal for the purpose of making ART2BODYCOVER lighter

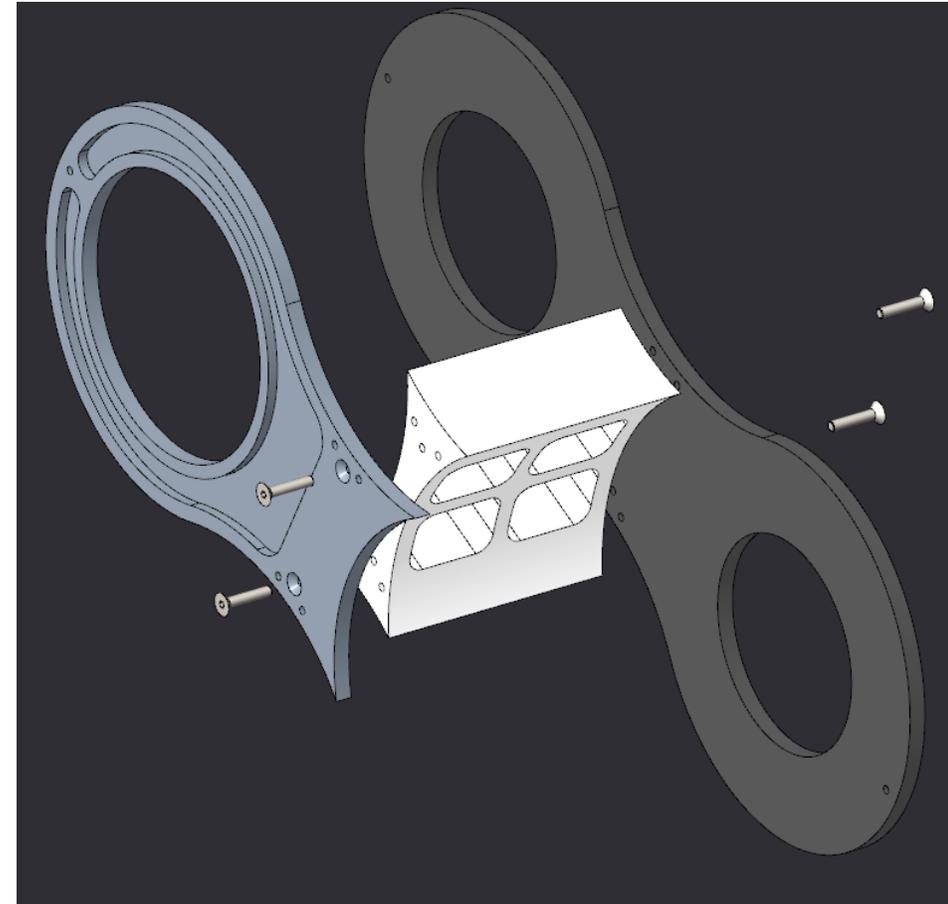


ART2UNION

- Removal of all holes, replaced with 8 shorter threaded holes
- Extra threaded holes added to fix ART2BODYCOVER and ART2BODYACOVER to ART2UNION separately
- Reduction of weight of ART2UNION by removing excess material

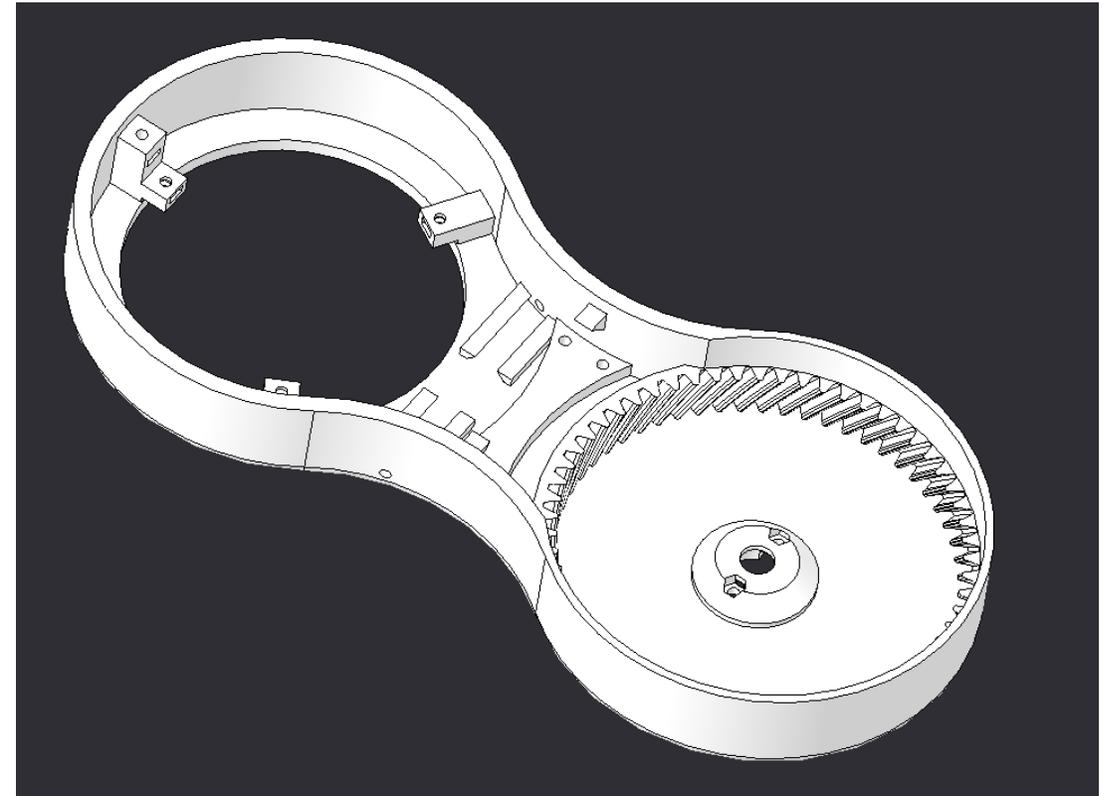


- ART2BODYCOVER and ART2BODYACOVER aluminum plates are attached to ART2UNION with screws
- Skeleton is prepared for further assembly
- Easier assembly and disassembly is enabled
- Faster access to components



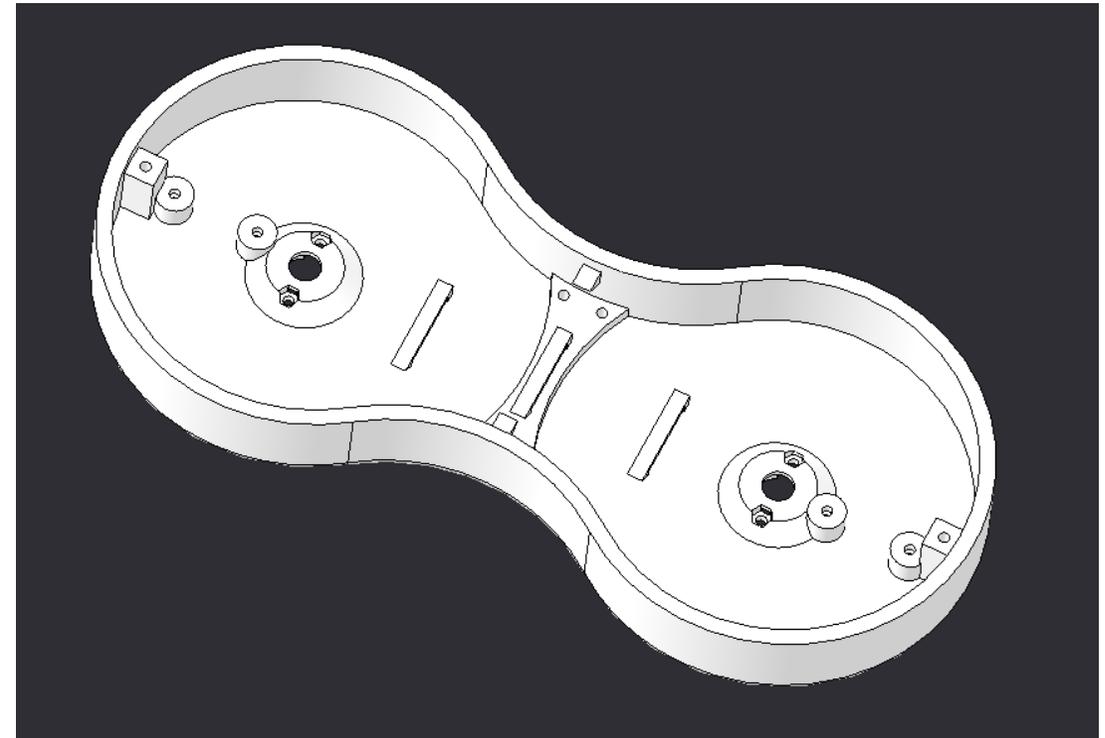
ART2BODY-A

- Extended support for aluminum plate
- Solution enables screws to be inserted from the outside



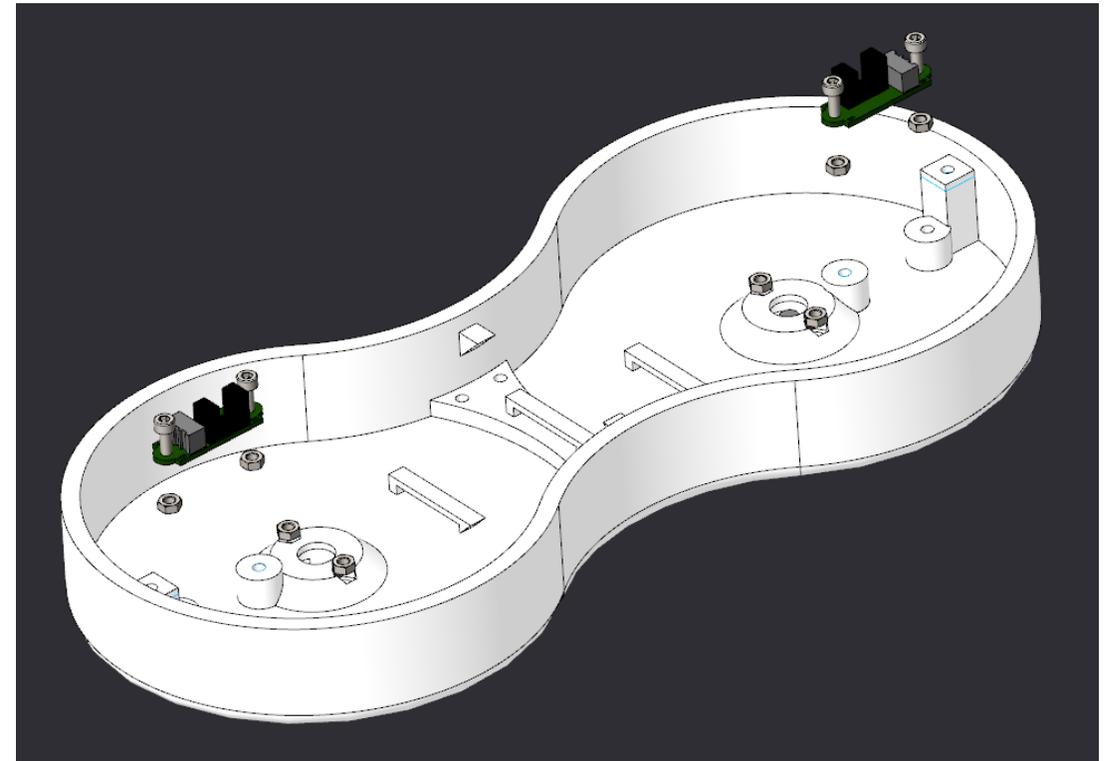
ART2BODY-B

- Extended support for aluminum plate

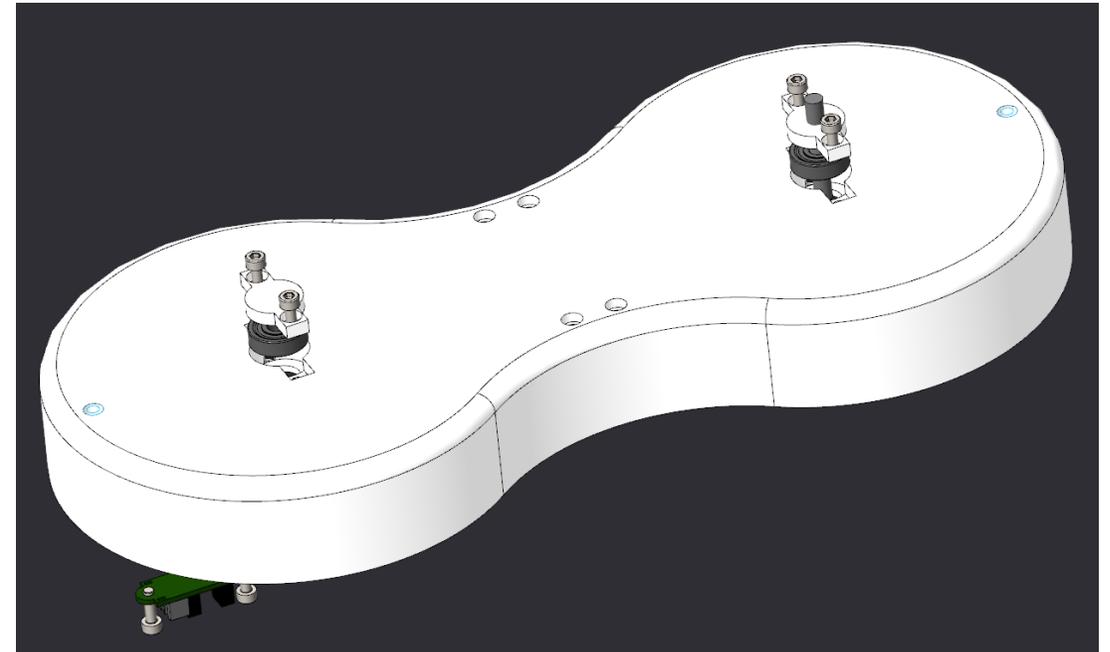


THOR_ART_2B

- Attachment of sensors on the inside of shell
- Detection of pulley movement

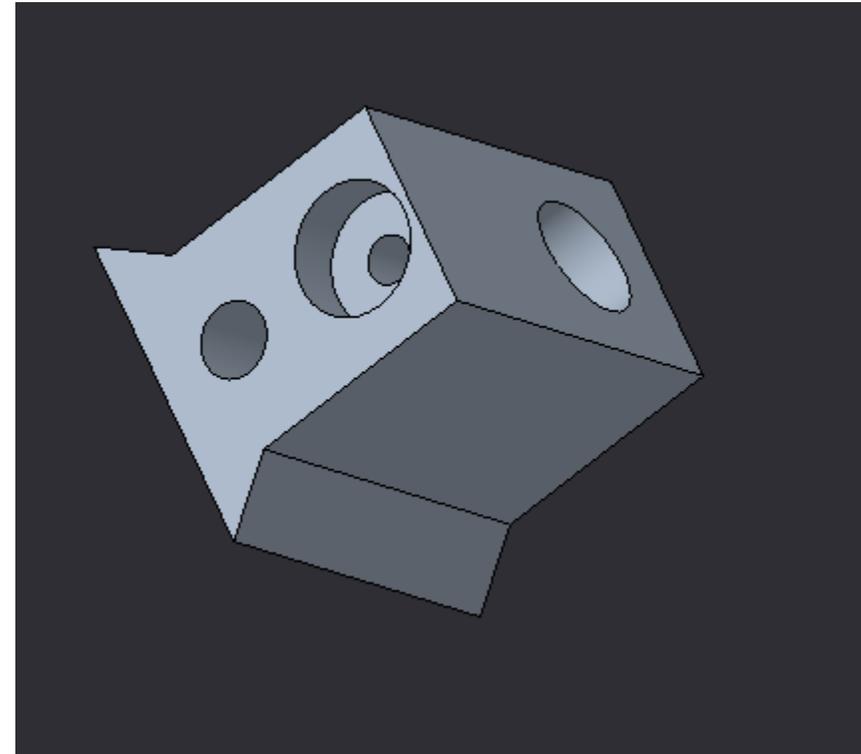


- Ball bearings are attached from the outer side
- Bearings are covered by a cover



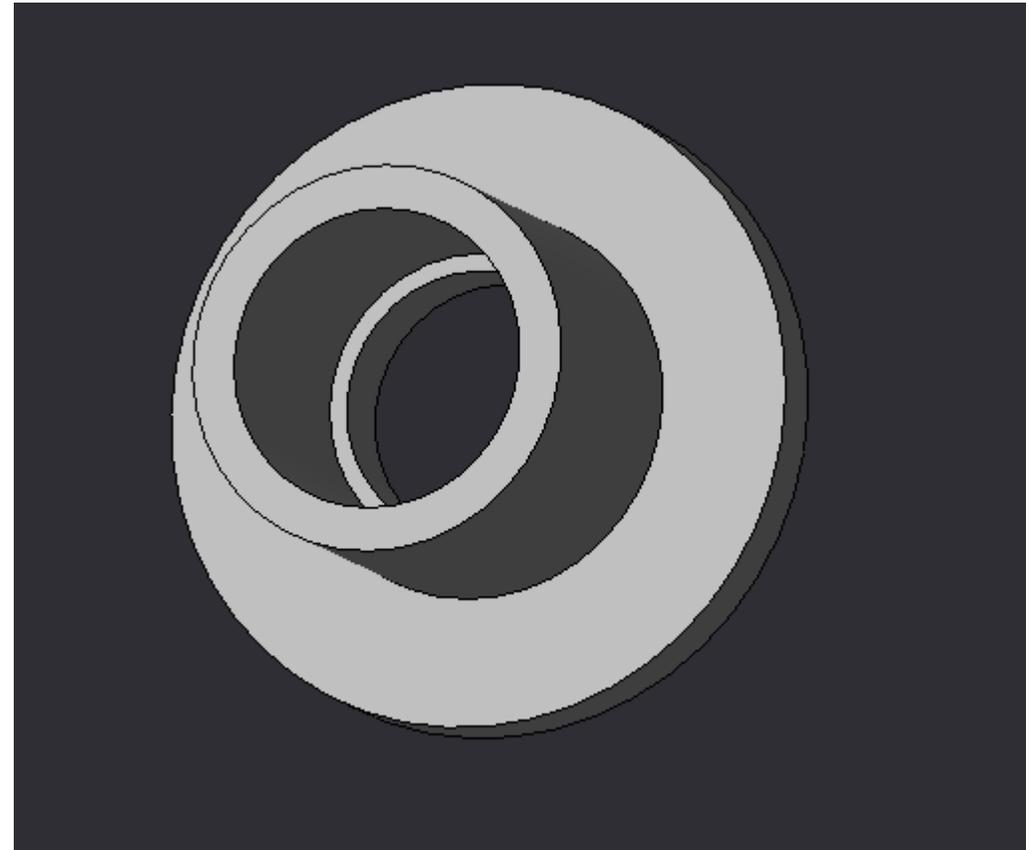
ART3TENSIONERBODY

- New addition of two threaded holes
- Solution enables fixing of axis with a screw that can be adjusted



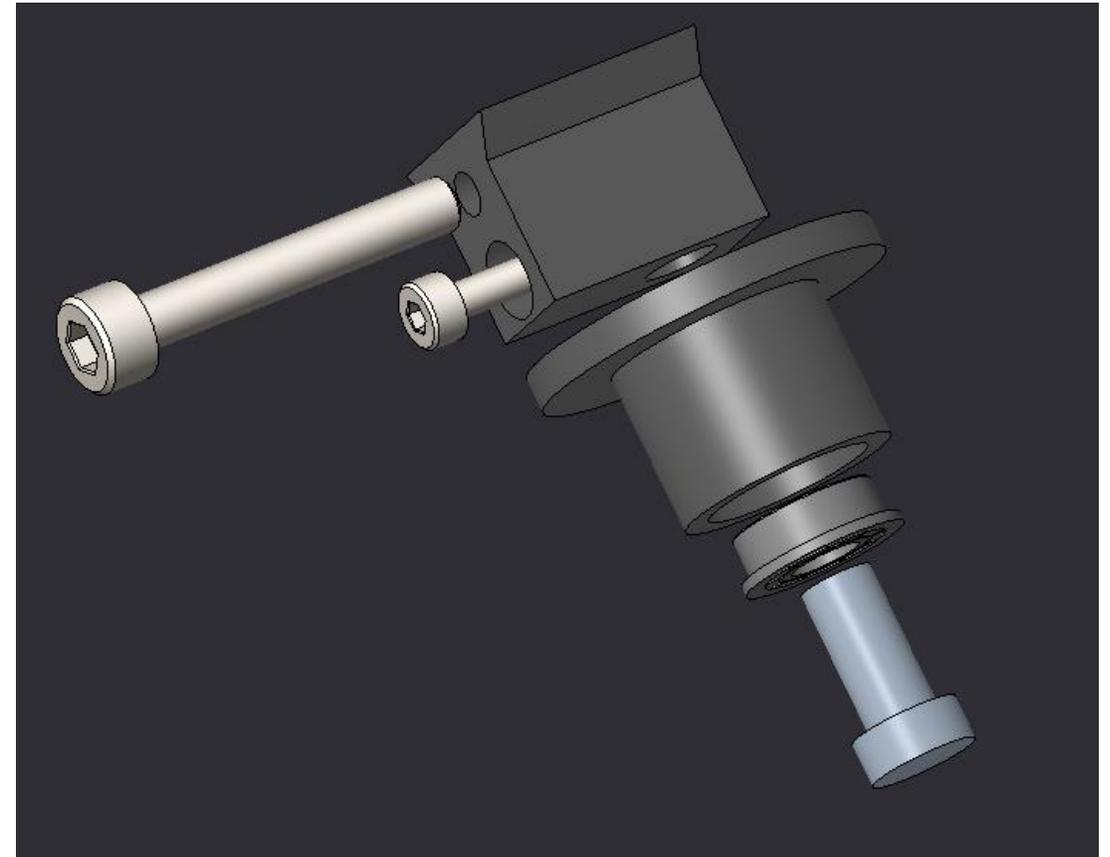
ART3TENSIONERPULLEY

- ART3TENSIONERPULLEY was extended by 2 mm
- Part was remade for easier assembly



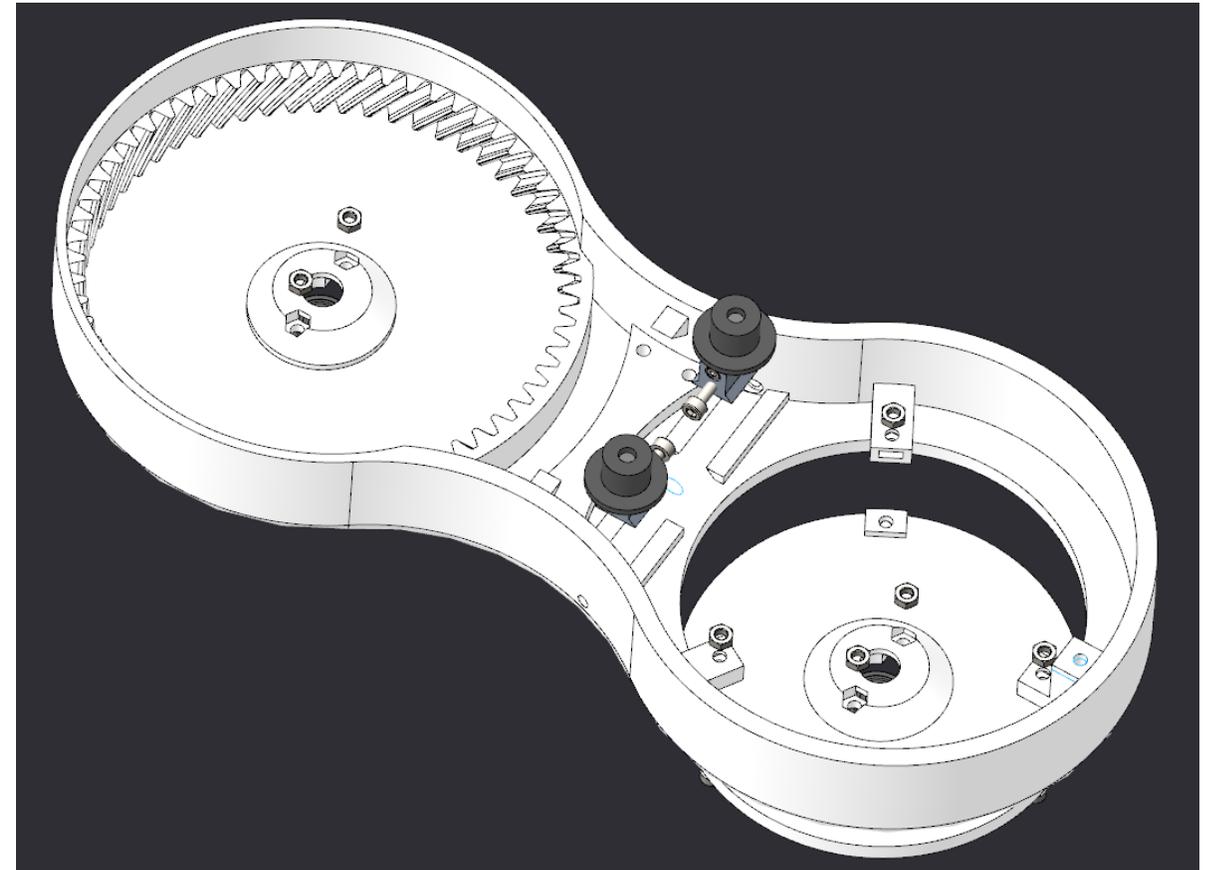
ROLLERPIN

- Subassembly of the belt tensioner
- Axis is held in place by an M2 screw (the smaller screw)
- Ledge holds the bearing at a certain position and restricts movement

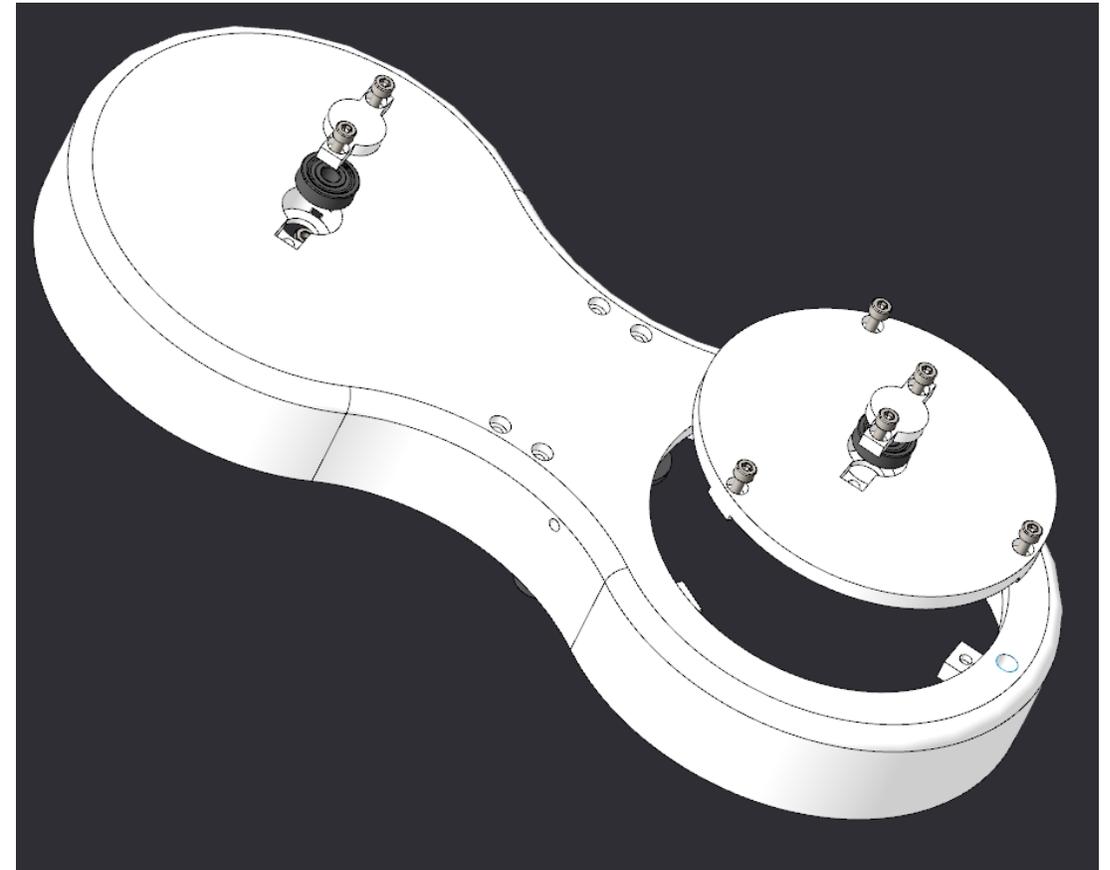


THOR_ART_2A

- Nuts and belt tensioners are placed in the inside of the shell
- Extra nuts hold the subassembly, that is fitted with a bearing

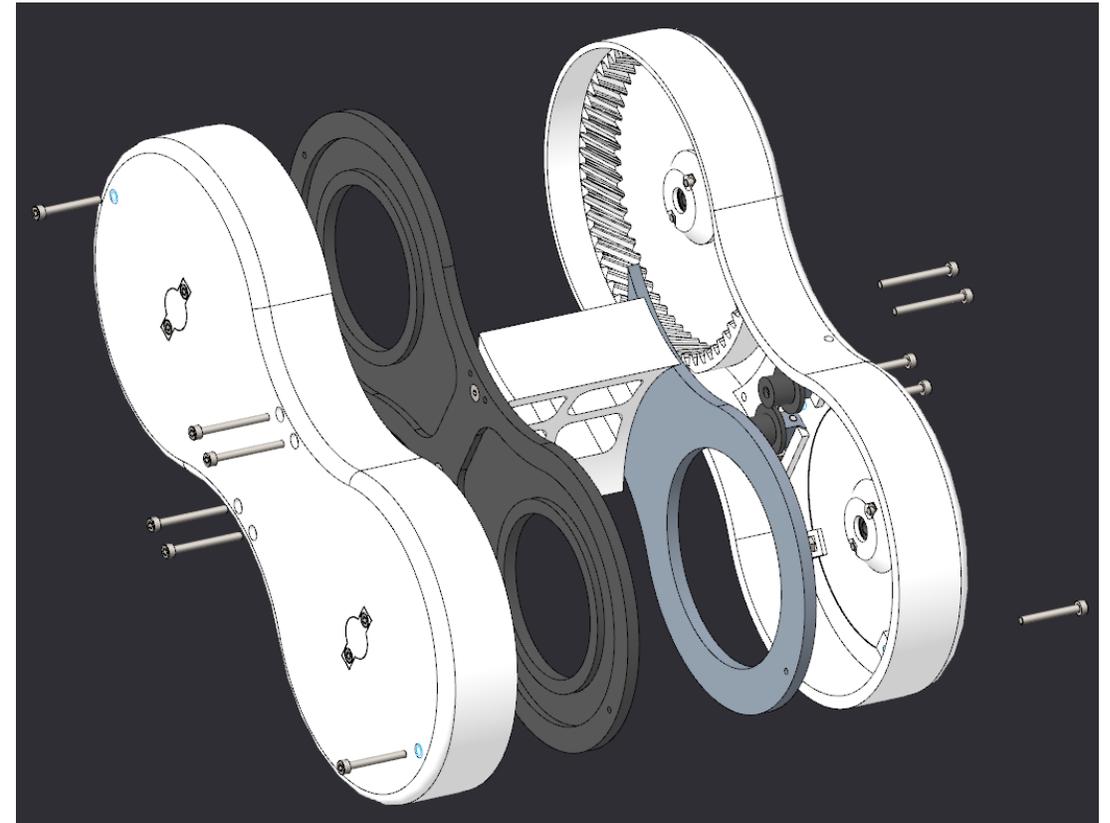


- Ball bearings are attached from the outer side
- Bearings are covered by a cover
- One bearing is attached on a separate piece

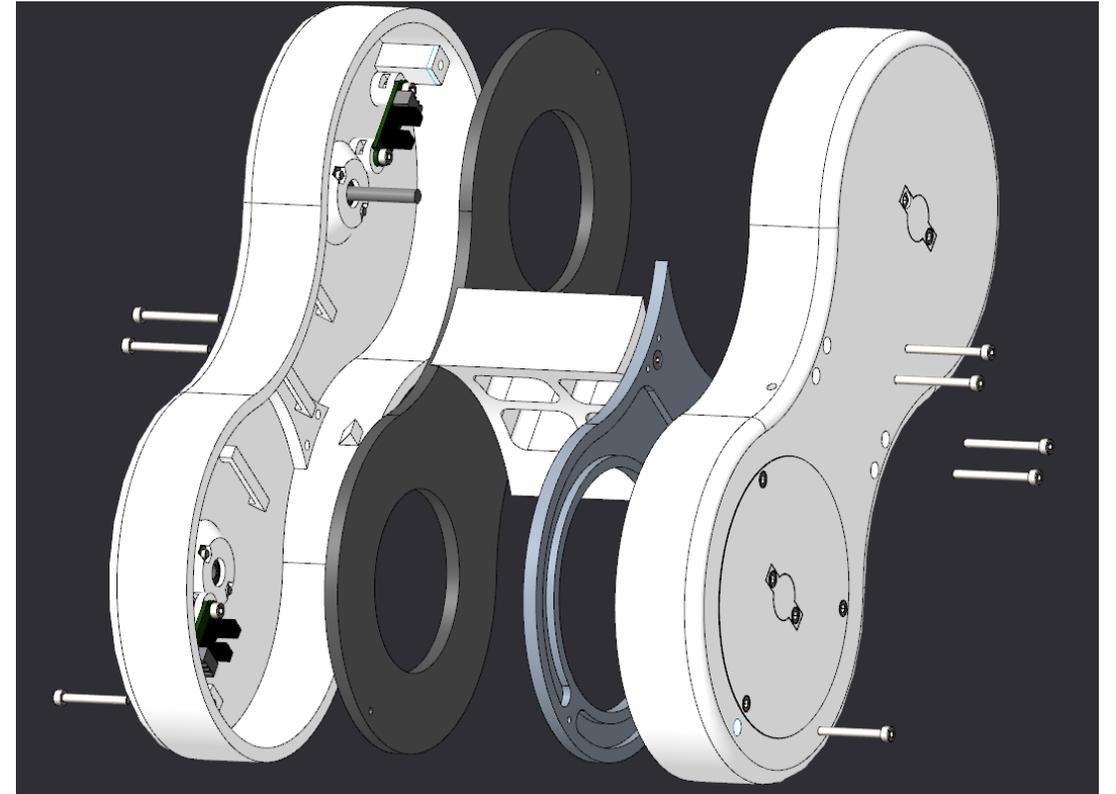


THOR_ART_2

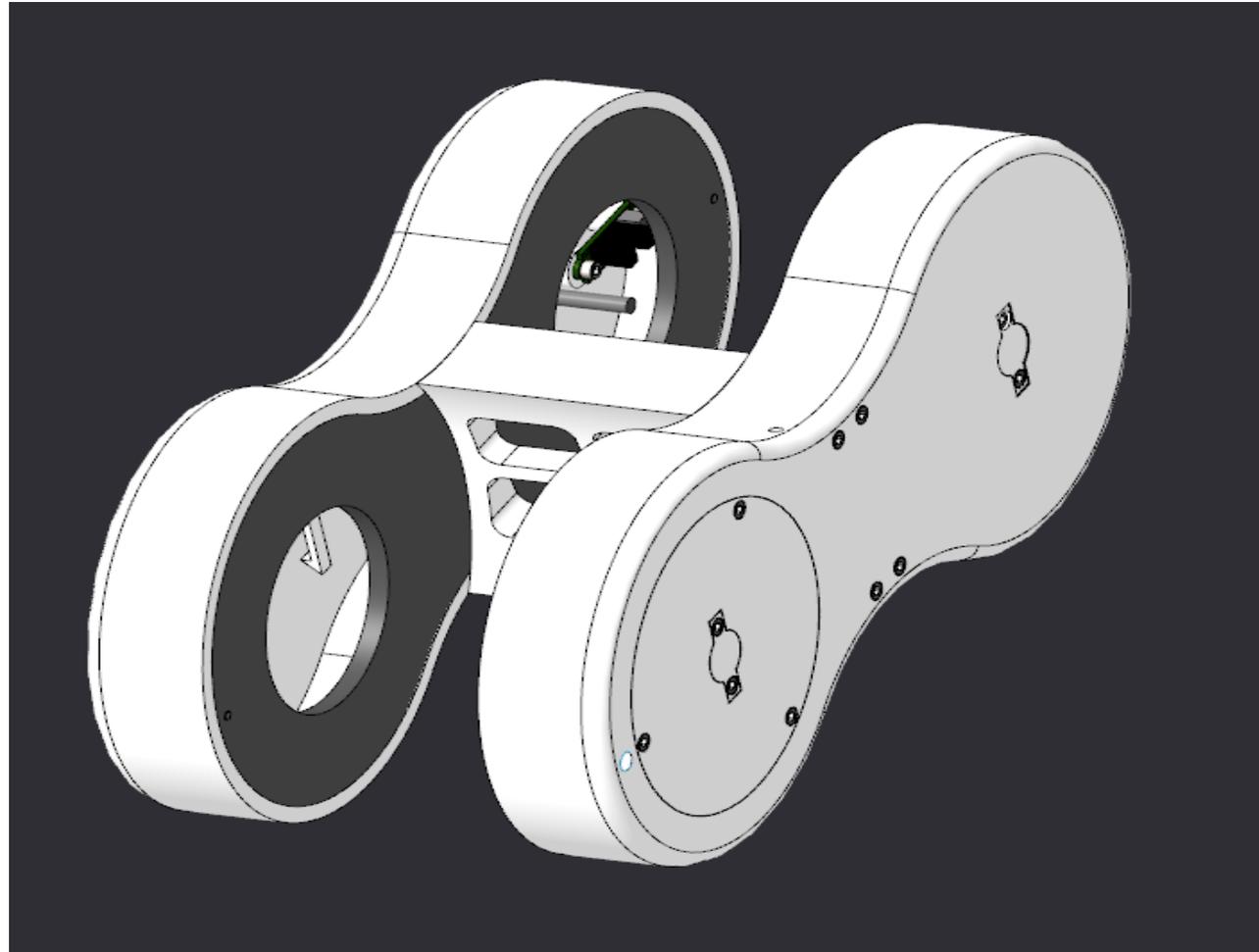
- THOR_ART_2A and THOR_ART_2B are mounted on aluminum plates with five and six screws



- View from another perspective



Complete Assembly of Thor_art_2

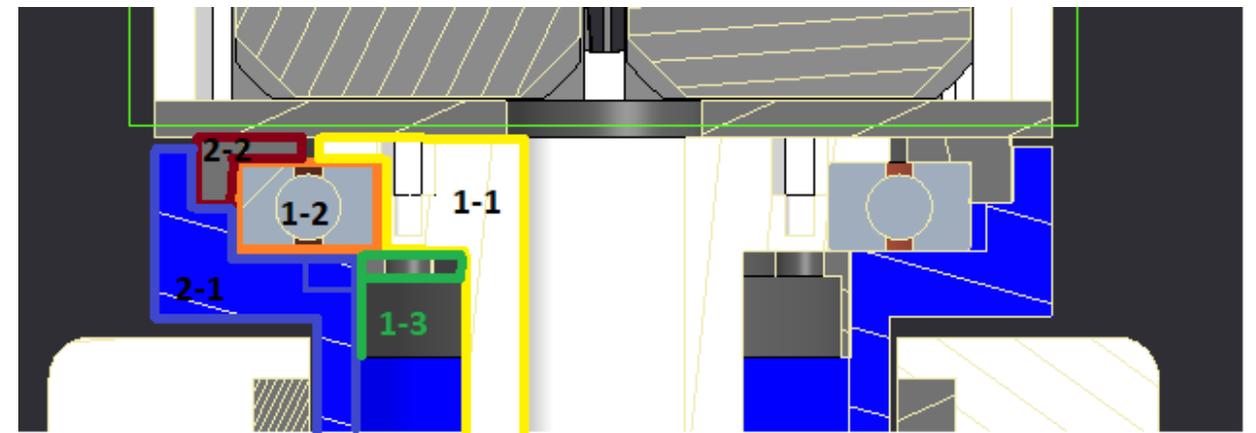
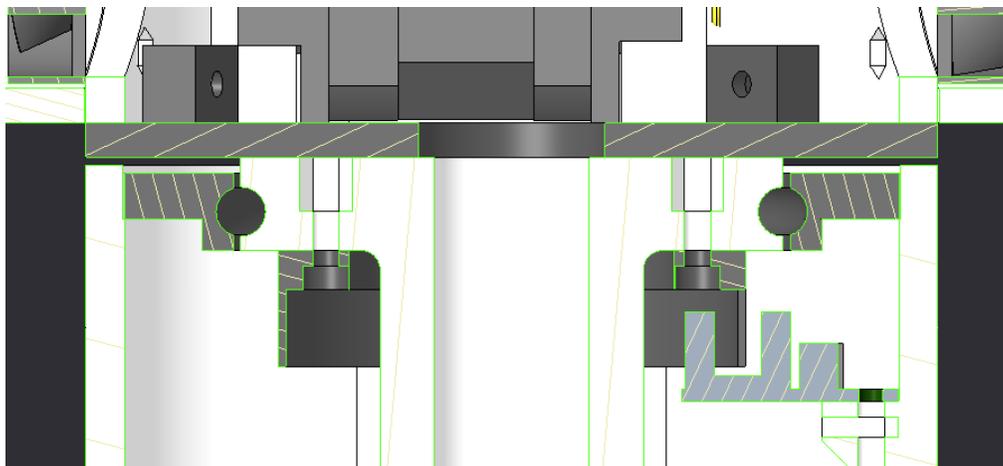


Weight of Components in Thor_art_2 Assembly

Name	Quantity	Material	Weight	Combined weight	Discription	Label
ART2BODYB_V-1	1	PLA	0.3242	0.3242 kg	X	
OPTOSWITCH	2	STEEL	0.0104	0.0208 kg	X	
625_2Z_PART1	4		0.0015	0.0060 kg		
625_2Z_PART2	4		0.0031	0.0124 kg		
625_2Z_PART3	32		0.0001	0.0032 kg		
625_2Z_PART4	32		0.0000	0.0000 kg		
32MMAXIS	1	STEEL	0.0049	0.0049 kg	X	
622ZZBEARINGFIX	4	PLA	0.0012	0.0048 kg	X	
ART2BODYCOVER_V-1	1	AL_ALUMINIUM	0.1948	0.1948 kg	X	
DIN934_8_10-M3	15	STEEL_CUSTOM	0.0004	0.0060 kg	Nut	M3
DIN912-M3X10	7	STEEL_CUSTOM	0.0010	0.0070 kg	Hex screw	M3X10
DIN912-M3X8	8	STEEL_CUSTOM	0.0009	0.0072 kg	Hex screw	M3X8
ART2UNION_V-1	1	AL_ALUMINIUM	0.1799	0.1799 kg	X	
ART2BODYA_V-1	1	PLA	0.2424	0.2424 kg	X	
ART2BODYACOVER_V-1	1	AL_ALUMINIUM	0.0893	0.0893 kg	X	
ART2BODYAWINDOW	1	PLA	0.0488	0.0488 kg	X	
ART3TENSIONERBODY_V	2	AL_ALUMINIUM	0.0027	0.0054 kg	X	
4MMAXIS_V-1	2	AL_ALUMINIUM	0.0005	0.0010 kg	X	
CLONE_OF_MF84ZZ_1	2	STEEL	0.0002	0.0004 kg	X	
CLONE_OF_MF84ZZ_2	2	STEEL	0.0004	0.0008 kg	X	
CLONE_OF_MF84ZZ_3	2	STEEL	0.0004	0.0008 kg	X	
DIN912-M3X20	2	STEEL_CUSTOM	0.0016	0.0032 kg	Hex screw	M3X20
DIN912-M2X6	2	STEEL_CUSTOM	0.0003	0.0006 kg	Hex screw	M2X6
ART3TENSIONERPULLEY	2	AL6061	0.0037	0.0074 kg	X	
DIN912-M3X25	3	STEEL_CUSTOM	0.0019	0.0057 kg	Hex screw	M3X25
DIN912-M3X30	8	STEEL_CUSTOM	0.0021	0.0168 kg	Hex screw	M3X30
DIN7991-M3X16	4	STEEL_CUSTOM	0.0010	0.0040 kg	Hex screw	M3X16
Sum	146			1.1978 kg		

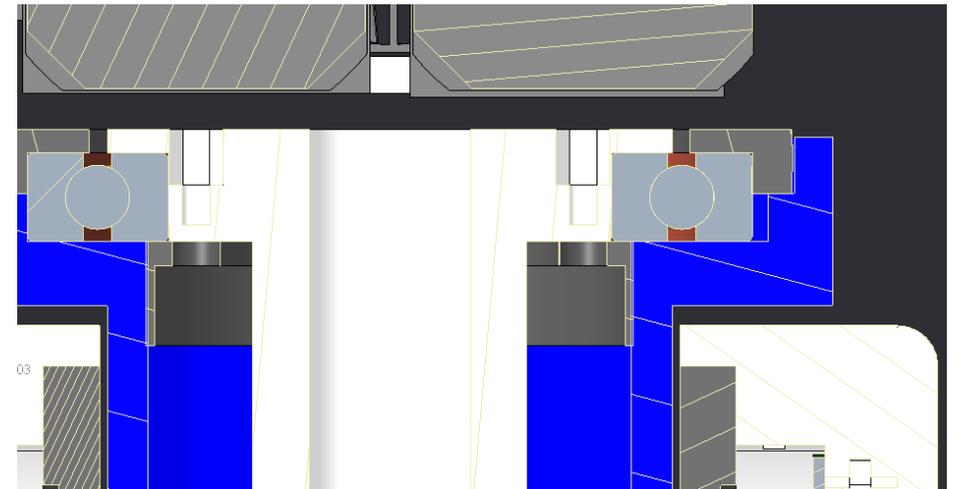
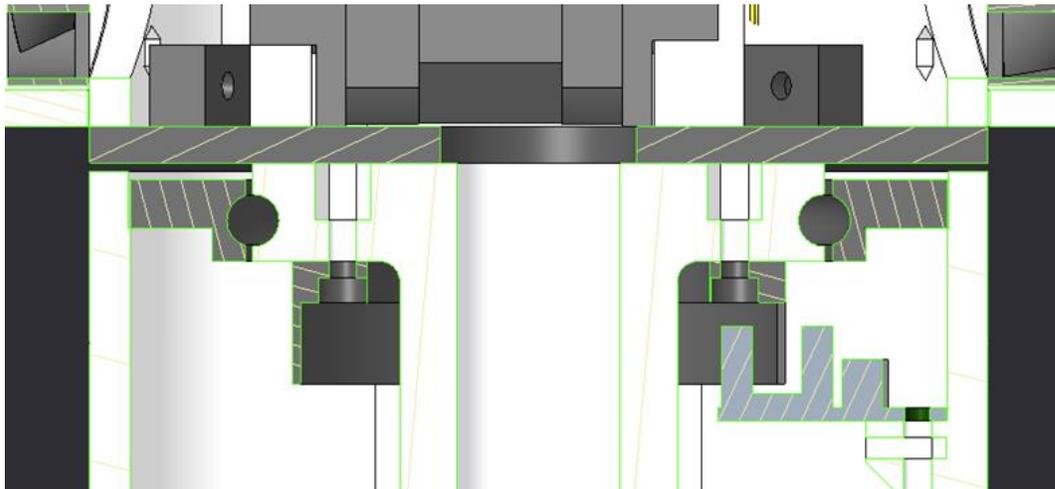
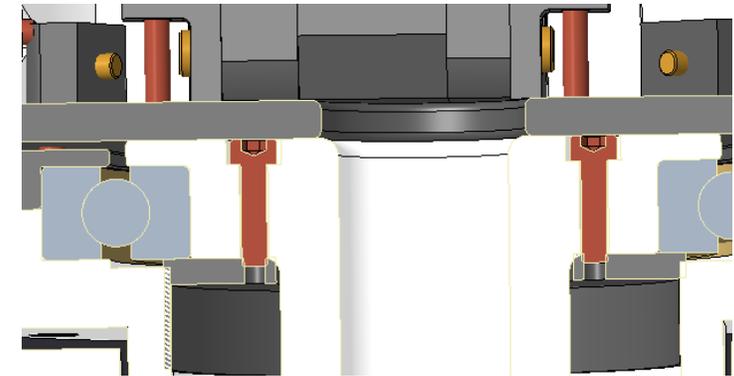
Adjusting and inserting the radial bearing

- Preparing suggestions for changes and assembly
- Creation of sketches



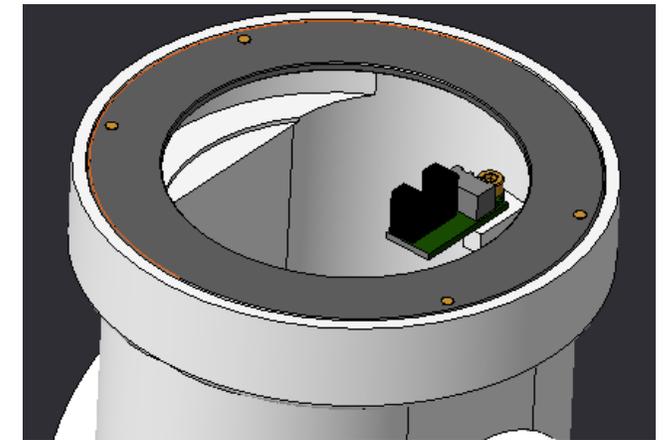
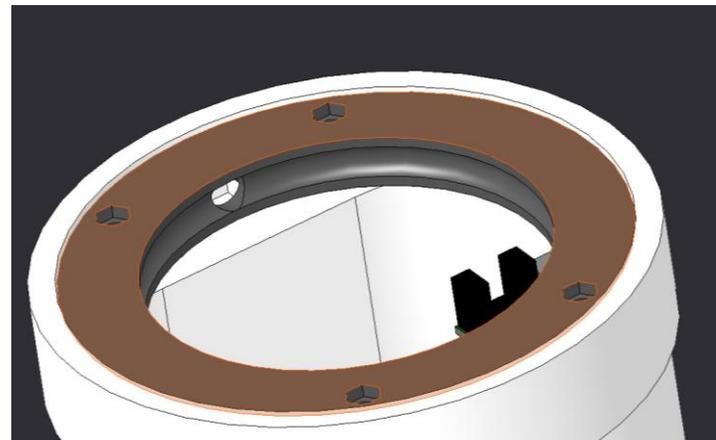
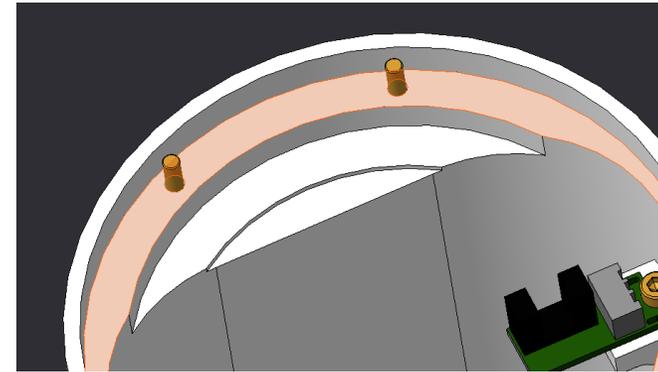
ART4 Alteration

- Remodeling for instalment of different bearings
- Alteration of screw holes on art3body



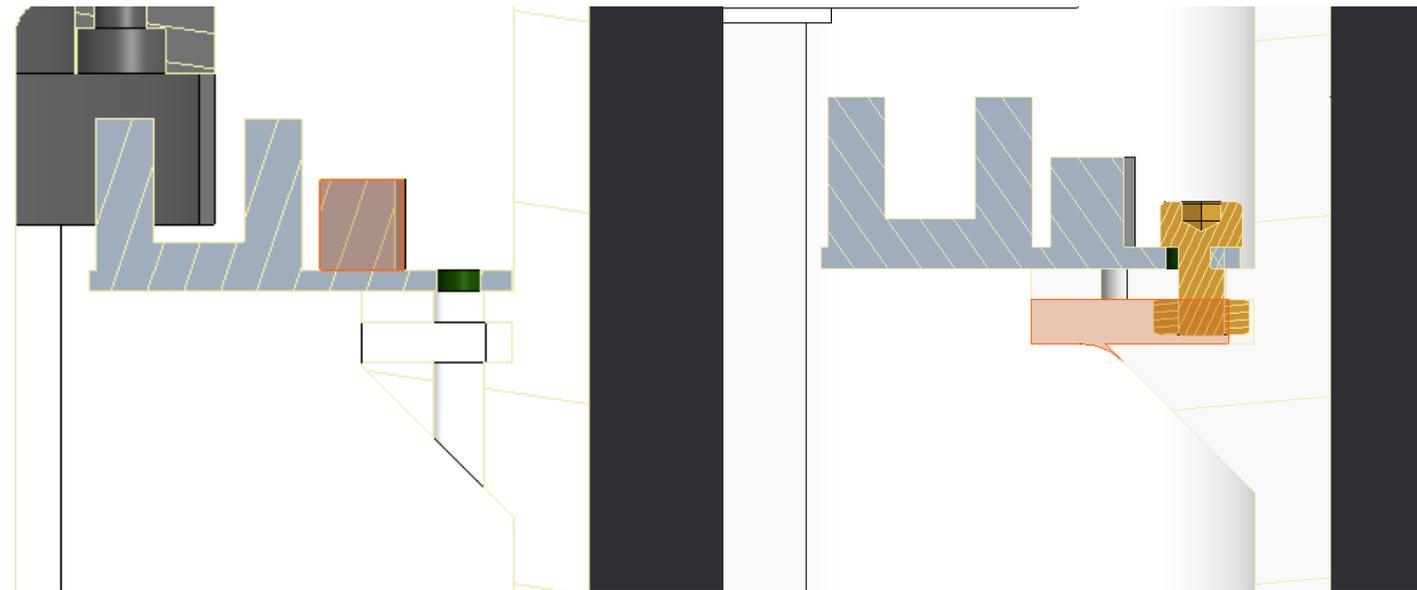
ART3 Change

- Positioning of screw holes altered
- Adjustment of plate for insertion of bearing



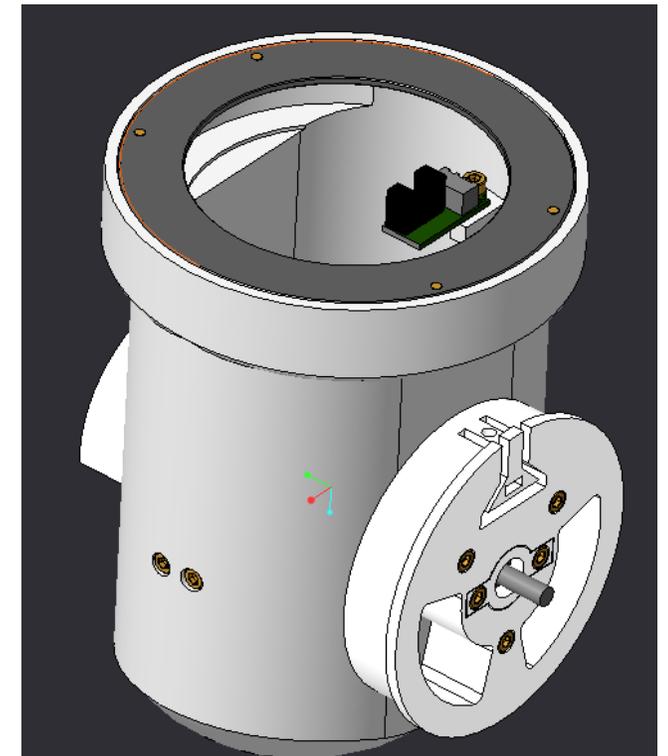
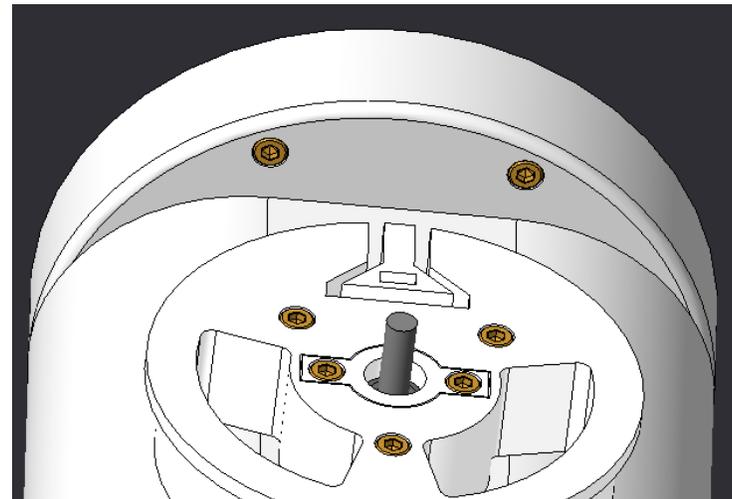
ART3_Body Change

- Modification of sensor positioning
- Change of sensor mounting for fine adjustment
- Adding of counterbore for better adjustment of position sensor during assembly



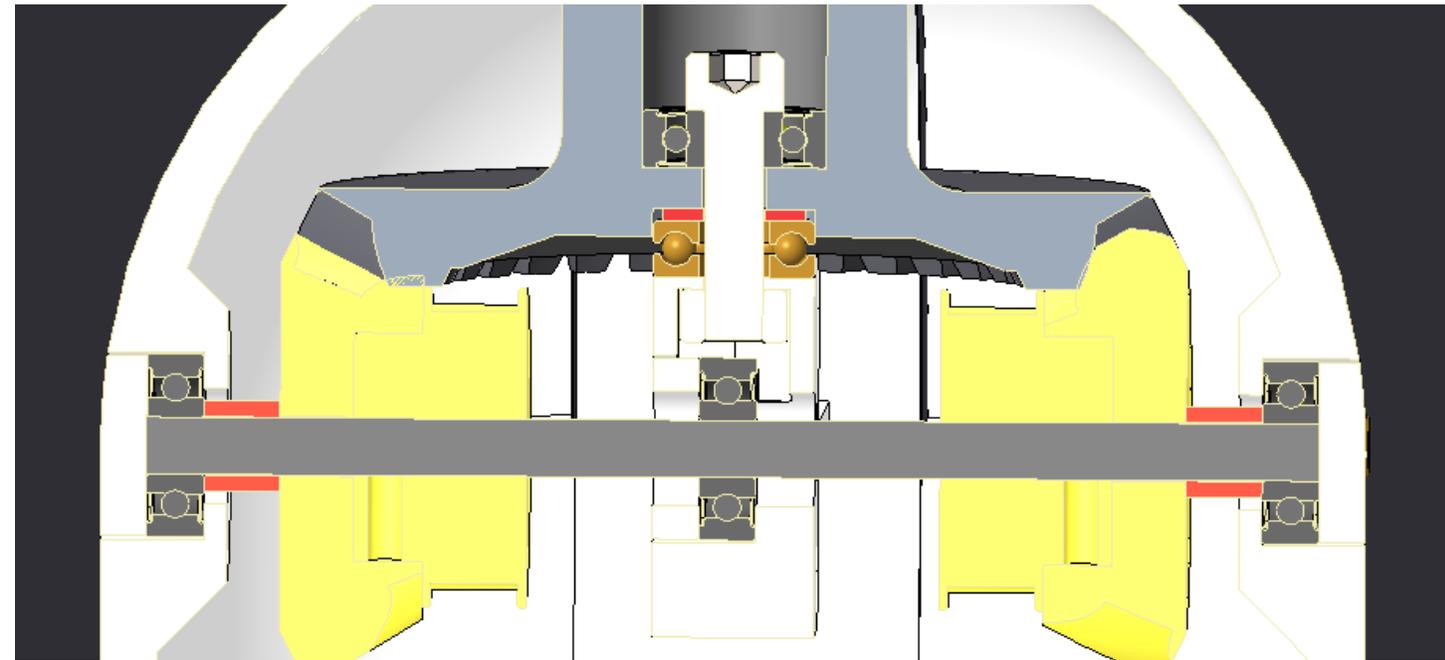
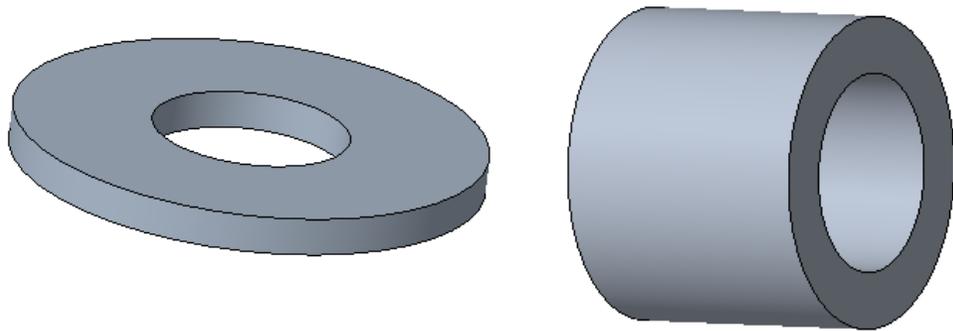
ART3 Assembly

- Insertion of models with all bolts and nuts
- Verification of fitting



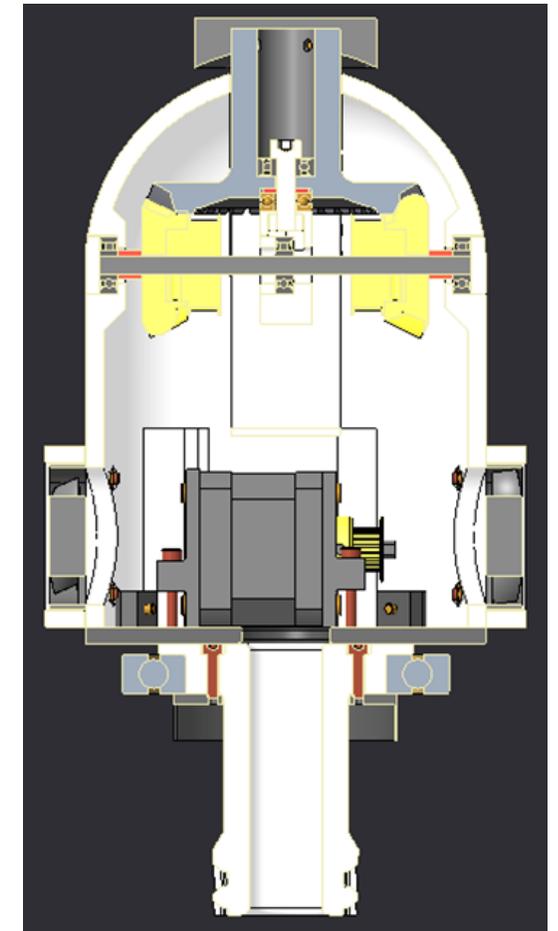
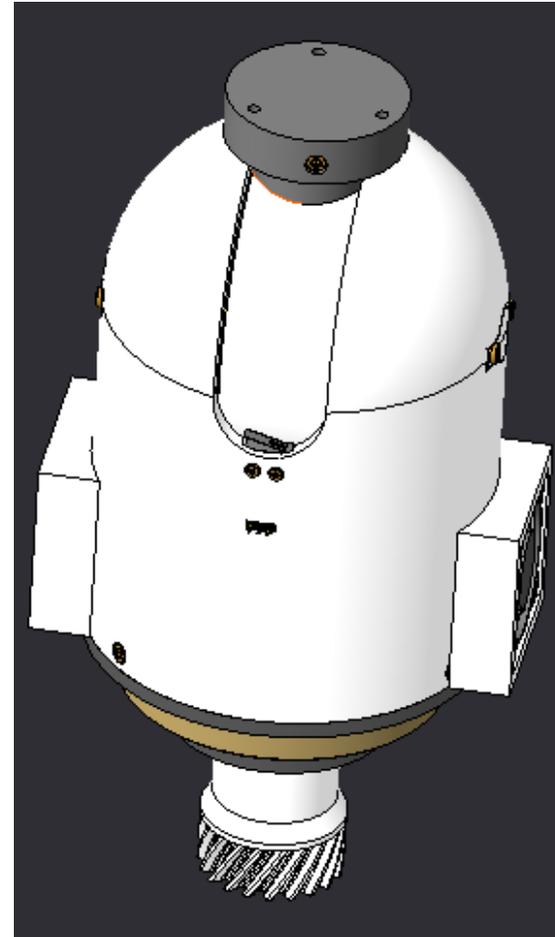
Making Spacer Models

- Creation and adding of new model of spacer to assembly
- Solution prevents unnecessary pulley movement



ART4 Assembly

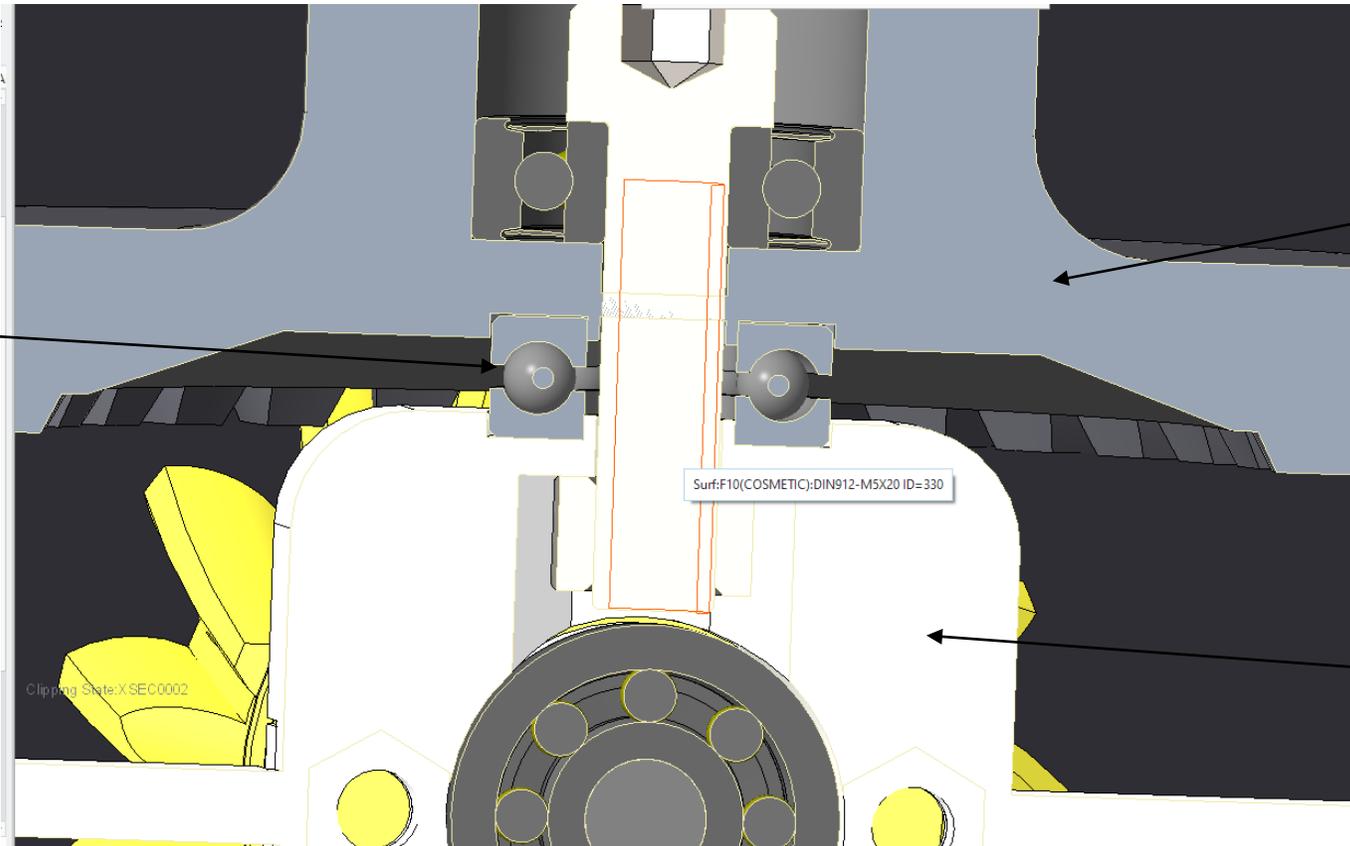
- Updating of assembly ART4 with all modified models
- Adding of all bolts and nuts



Art56 Gearplate, Motorcover

Made a counterbore into which the axial bearing enters

Axial bearing

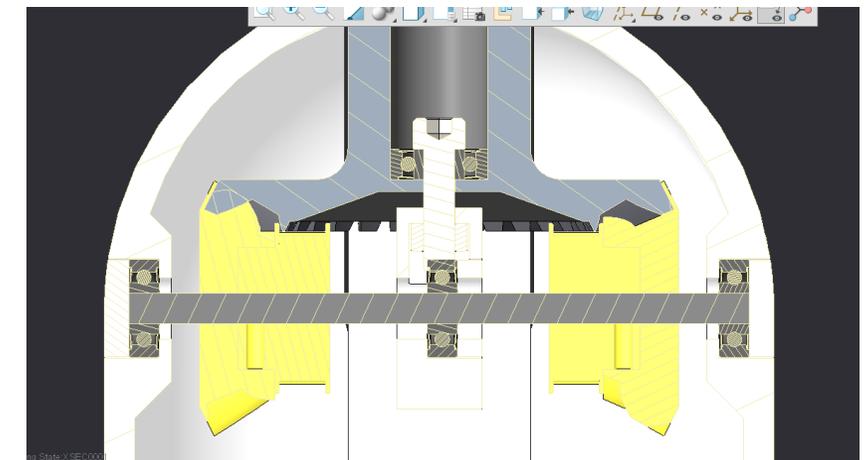
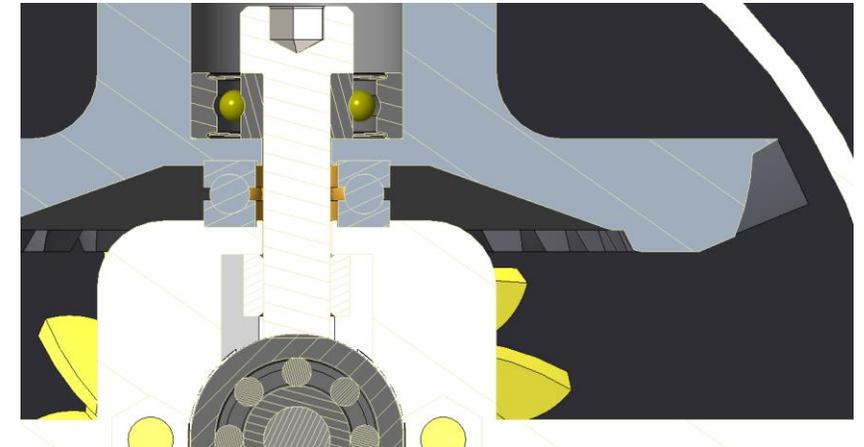
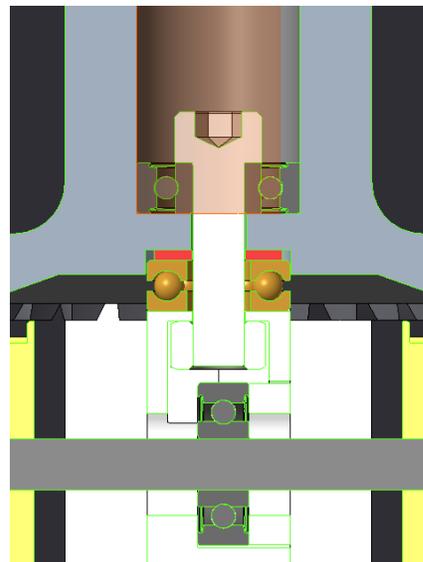


art56gearplate

art56motorcover

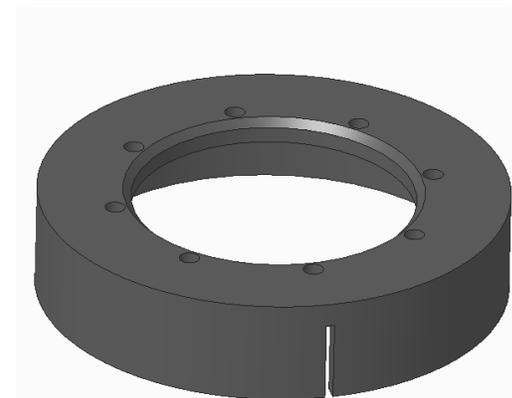
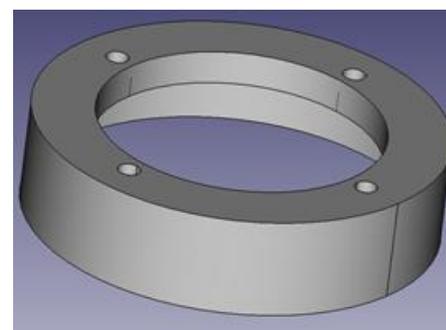
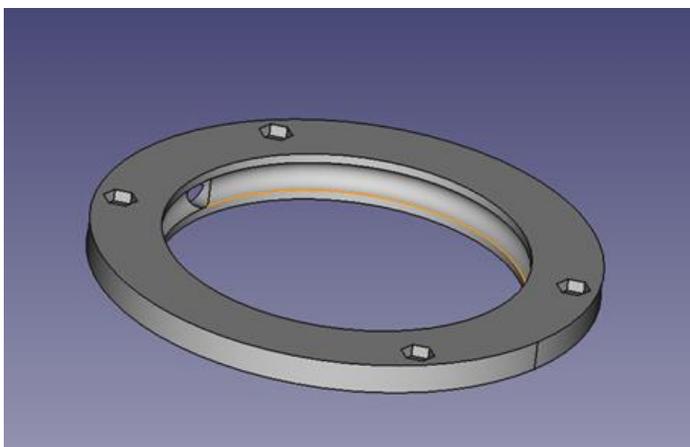
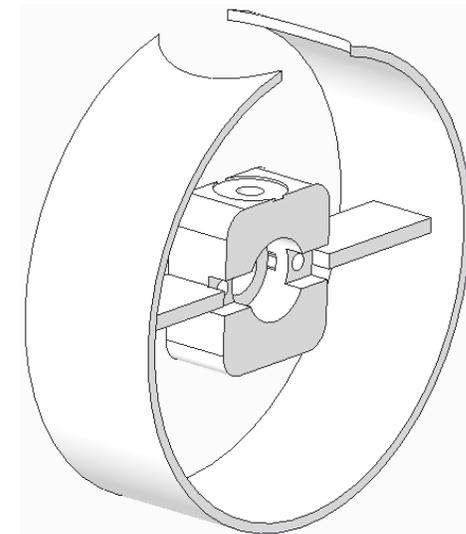
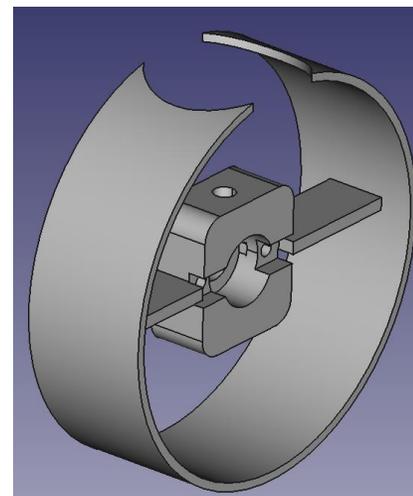
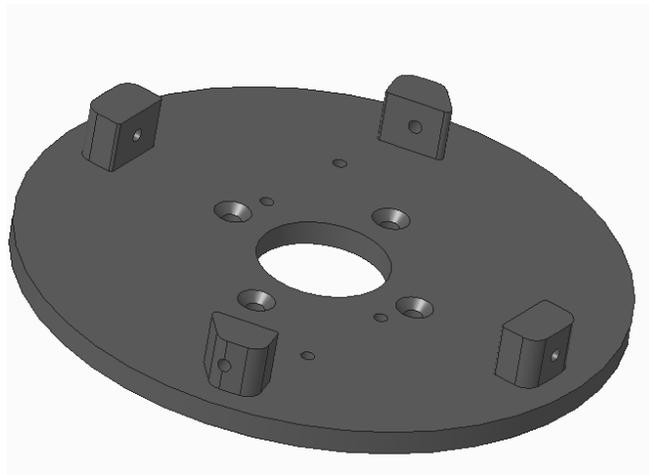
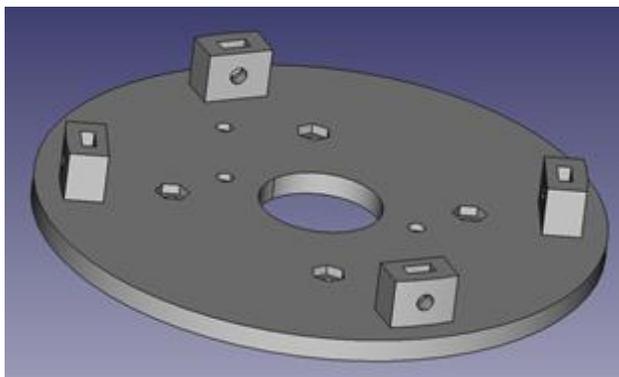
Changes in ART4

- Adding of axial bearing and spacer
- Confirmation of idea for model adjustment
- Insertion of composition

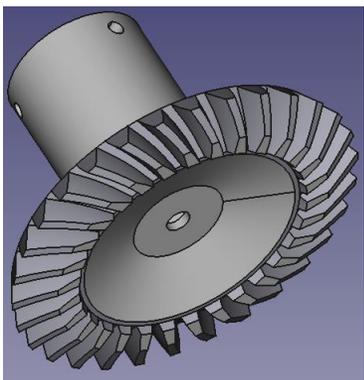
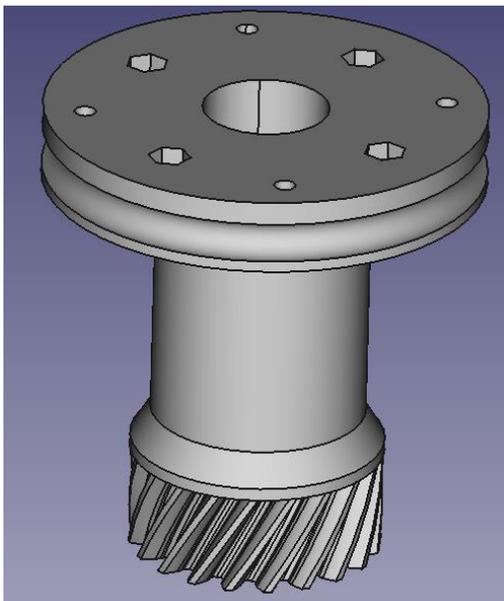


Before

After



Before



After

