

<Design>

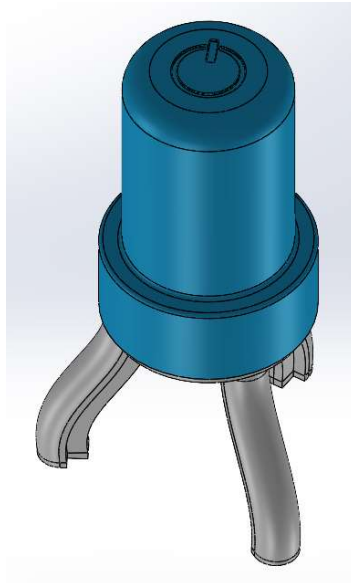


Figure 1. Assembled Product

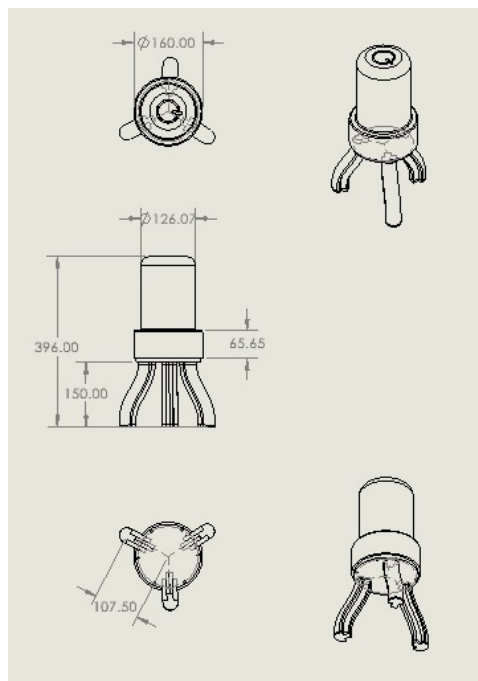


Figure 2. Engineering Drawing with Dimensions [in mm]

<Part List>

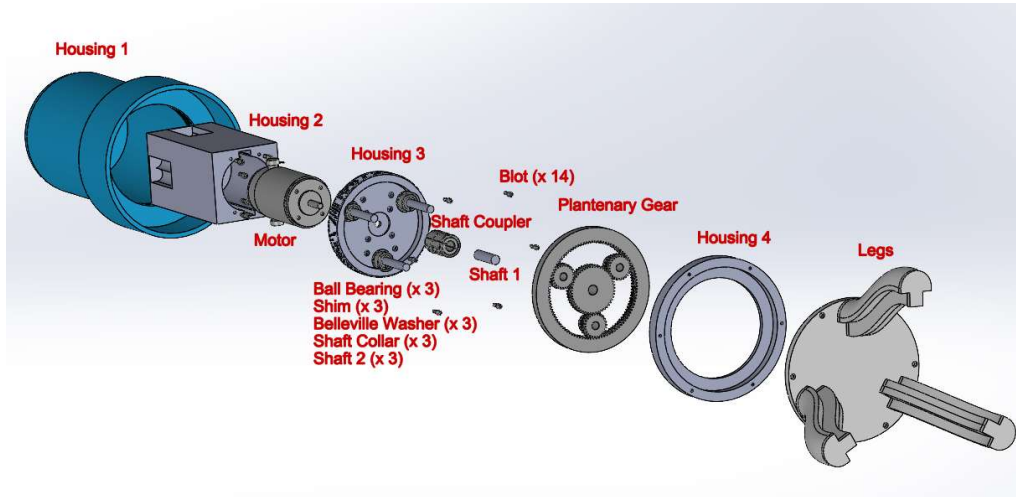


Figure 3. Disassemble Product

	Material	Quantity	Part Number	Manufacturer
Housing 1	Plastic (HDPE)	1	-	-
Housing 2	Plastic (HDPE)	1	-	-
Housing 3	Plastic (HDPE)	1	-	-
Housing 4	Plastic (HDPE)	1	-	-
Legs	Plastic (Nylon)	1	-	-
Motor	Steel (Enclosure Material)	1	6331K13	McMASTER-CARR
Planetary Gear Set	-	1	-	-
Shaft Coupler	303 Stainless Steel	1	3084K103	McMASTER-CARR
Shaft 1	303 Stainless Steel	1	-	-
Shaft 2	303 Stainless Steel	3	-	-
Shim	18-8 Stainless Steel	3	98089A293	McMASTER-CARR
Belleville Washer	Chrome-Vanadium Steel	3	96445K454	McMASTER-CARR
Shaft Collar	2024 Aluminum	3	9506T4	McMASTER-CARR
Ball Bearing	440C Stainless Steel (Ring & Ball) 304 Stainless Steel (Cage)	3	57155K514	McMASTER-CARR
#6-32 Thread Socket Head Cap Screw	Black-Oxide Alloy Steel	14	91864A023	McMASTER-CARR

Table 1. Parts Lists of Assemble

	Material	Quantity	Part Number	Manufacturer
Sun Gear	303 Stainless Steel	1	2664N554	McMASTER-CARR
Planet Gear	303 Stainless Steel	3	2664N543	McMASTER-CARR
Internal Ring Gear	Black-Oxide 1045 Carbon Steel	1	2696N26	McMASTER-CARR

Table 2. Parts Lists of Planetary Gear Set

	Material	Quantity
7/64" Hex Key Wrench	S2 Steel	1
8mm Hex Key Wrench	S2 Steel	1
10mm Hex Key Wrench	S2 Steel	1

Table 3. Tools to Assemble

<Descriptions of fabrication and assembly processes>

Fabrication Processes:

For the prototype, the housings are going to be produced by 3D printing with two different types of filaments that are HDPE and Nylon. The legs part is directly encounter to high temperature, so it is made by Nylon to withstand the high temperature, but other housing parts are going to be produced by HDPE. And, most of parts are going to be provided by McMaster-Carr. Since Shaft 1 and 2 are customized, they are going to be produced through CNC machining. In the future, the housings and legs parts are going to be produced through die casting to reduce time and cost to produce.

Assembly Processes:

1. Ball bearing is installed to Housing 3 with Shim, Belleville Washer, and Shaft Collar through Shaft 2. (x 3)

(Order of placement (left to right): Ball Bearing → Housing 3 → Shim → Belleville Washer → Shaft Collar)

2. A little force is applied to Ball bearing, and then the Shaft Collar is fix by tightening the preset M3 x 8mm socket head cap screw through 8mm Hex Key Wrench. (x 3)

(Preloading on Ball Bearing)

3. Motor is installed to Housing 2, and then the Housing 2 and the Housing 3 is attached and fixed by tightening 8 of #6-32 Thread Socket Head Cap Screw through 7/64" Hex Key Wrench.

(4 of #6-32 Thread Socket Head Cap Screw to Housing 2 and 3, 4 of #6-32 Thread Socket Head Cap Screw to Motor)

4. Shaft Coupler is installed to the shaft of Motor and fixed by tightening the preset M3 x 10 mm socket head cap screw through 10mm Hex Wrench.

5. Shaft 1 is installed to the Shaft Coupler and fixed the preset M3 x 10 mm socket head cap screw through 10mm Hex Wrench.

6. Planetary Gear Set is adjusted and made by 1 of Sun Gear,3 of Planet Gear and 1 of Internal Ring Gear.

7. The Planetary Gear Set is attached to Housing 4, and then, the Planetary Gear Set is installed to shaft 1 and 2 by force fits.
8. Legs is attached to Housing 4 and fixed by tightening 6 of #6-32 Thread Socket Head Cap Screw through 7/64" Hex Key Wrench.
9. 8 of AA battery, which is 1.5 V, is attached to Housing 2.
10. Housing 1 is attached and tightened through the 1-12 thread at Housing 1 and Housing 3.

<Description of the product>

When people are cooking a soup, it is sometime burned at the bottom, so they need to stir all the time during the soup is boiling. "Hands Free Stirrer" is designed for not to stir all the time, so this product is stirring itself during the soup is boiling by turning the legs of the product.

The operating design is being used a planetary gear set which can be designed linear way with 1 of Sun Gear, 3 of Planet Gear and 1 of Internal Ring Gear. And, the planetary gear set has some advantages that increased repeatability, perfect precision, lower noise, great durability, and great efficient. The increased repeatability is due to greater speed radial and axial load that bring reliability and robustness, minimizing the misalignment between the gears, and perfect precision is due to rotating angular stability that improves the accuracy. The contacted surface area is larger than the regular gear set, so the noise is lower. The great durability is because of the torsional rigidity and better rolling. Due to the planetary reducers that minimize the energy loss, the efficient is great.

"Hands Free Stirrer" is mainly made by 12V DC motor and the planetary gear set. The motor provides input power to sun gear, and then, the sun gear passes the power to 3 planet gears. The planet gears produce power to internal ring gear that produce output power to the legs of the product.

Appendix: Engineering Drawings of Parts [in mm]

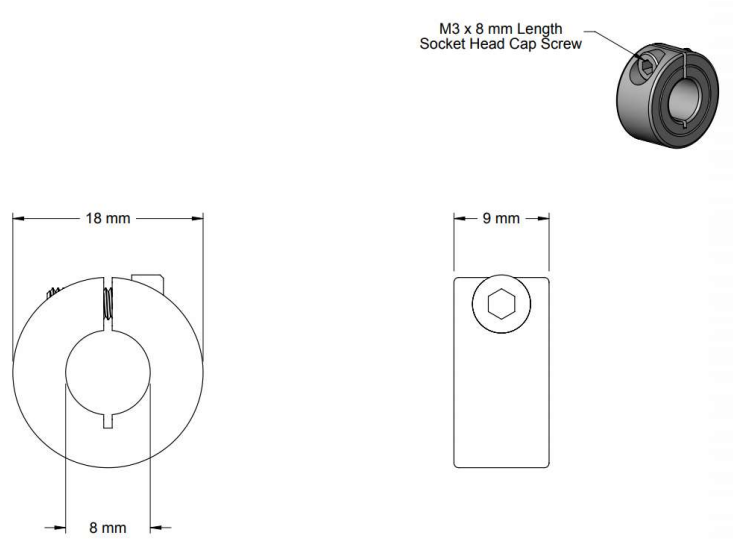


Figure 1: Shaft Collar

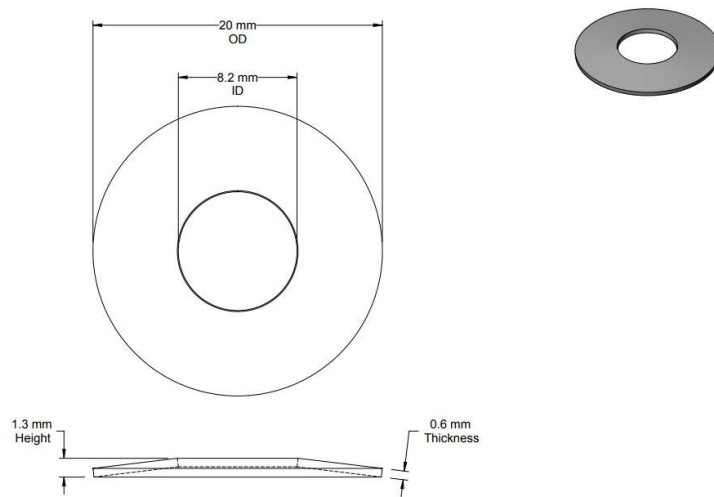


Figure 2: Belleville Washer

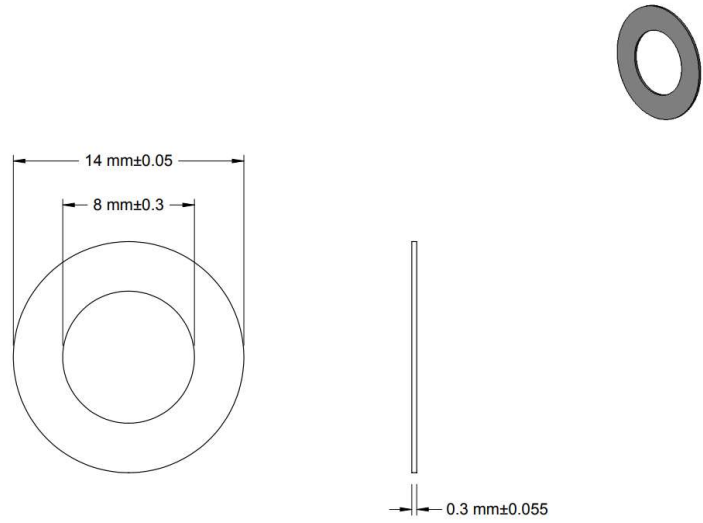


Figure 3: Shim

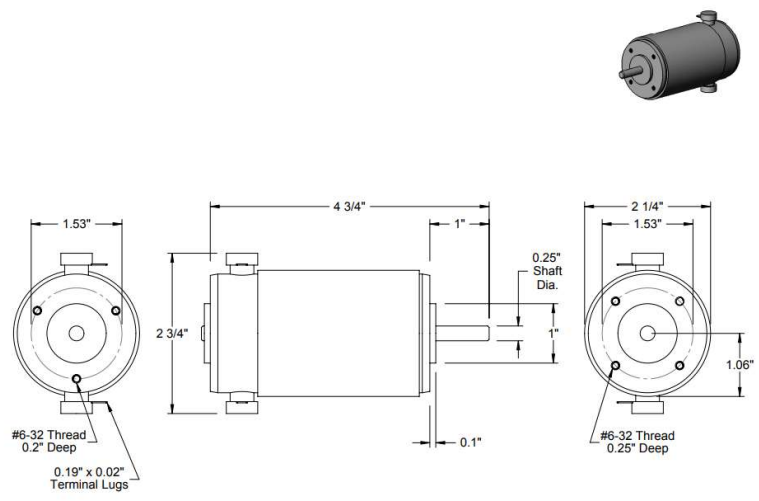


Figure 4: Motor



Trade Number: 608H

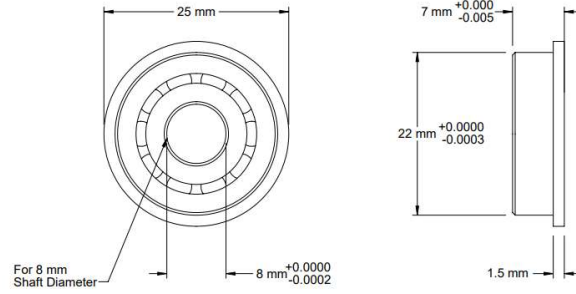


Figure 5: Ball Bearing

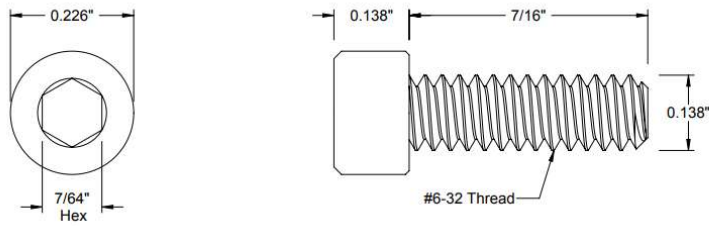
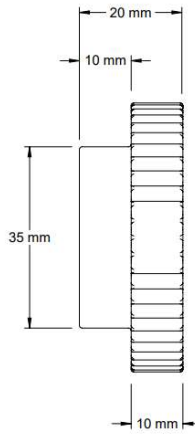
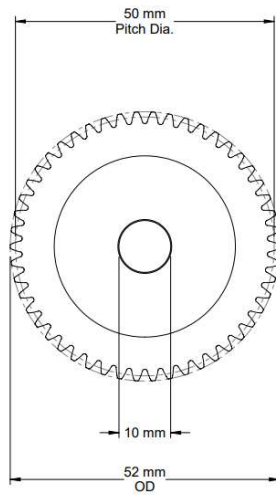
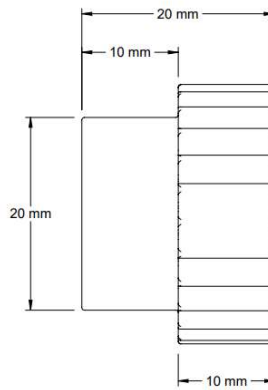
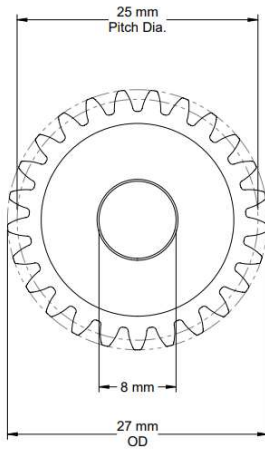


Figure 6: #6-32 Thread Socket Head Cap Screw



Module: 1
Number of Teeth: 50

Figure 7: Sun Gear



Module: 1
Number of Teeth: 25

Figure 8: Planet Gear

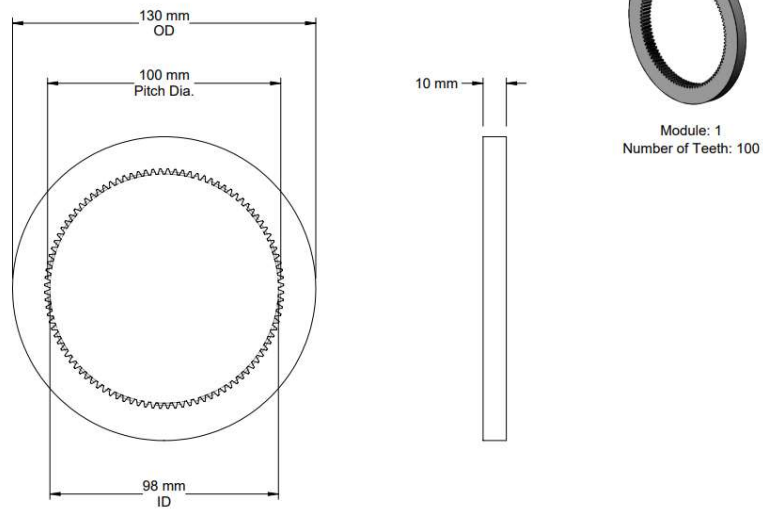


Figure 9: Internal Ring Gear

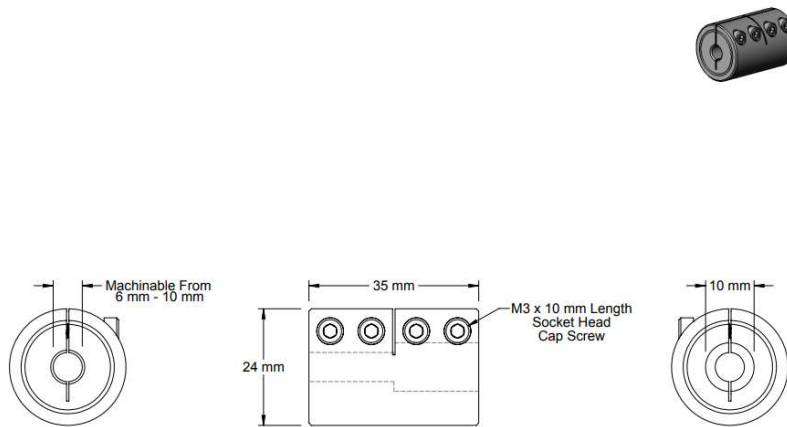


Figure 10: Shaft Coupler

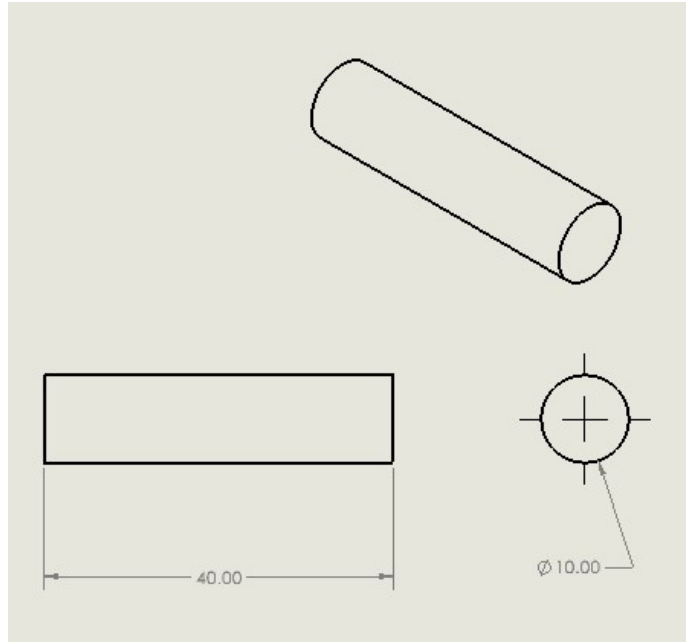


Figure 11: Shaft 1

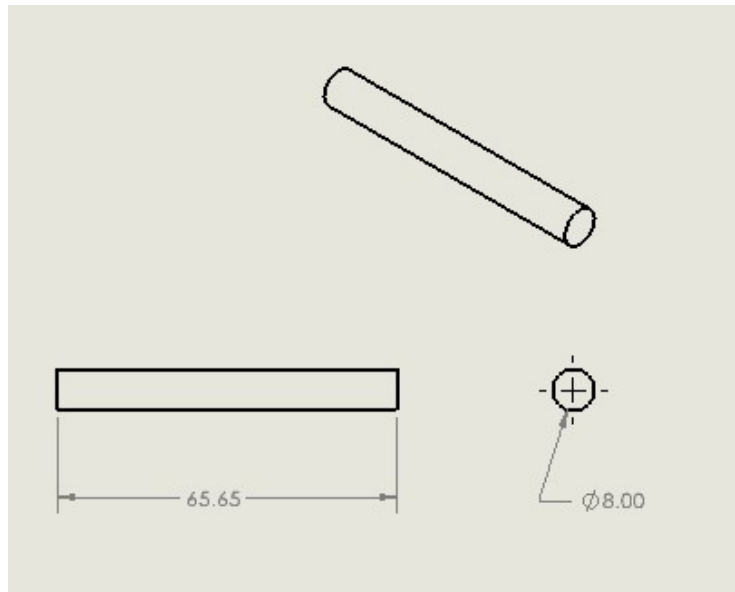


Figure 12: Shaft 2

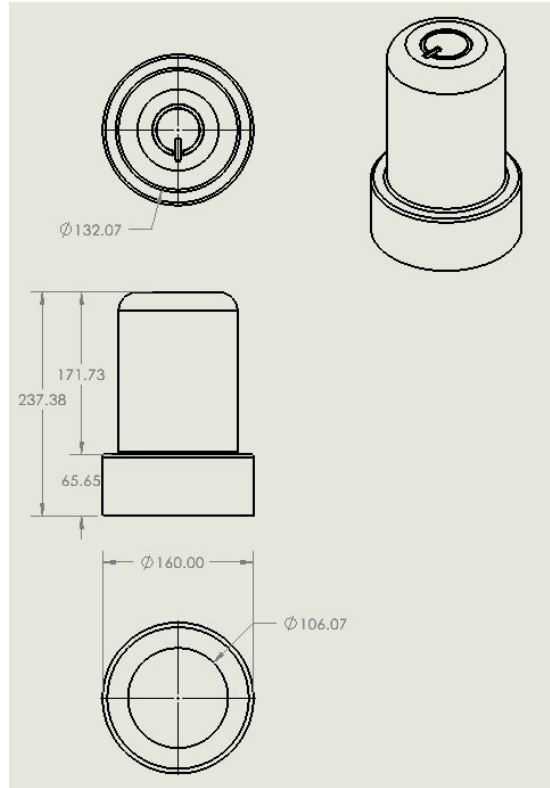


Figure 13: Housing 1

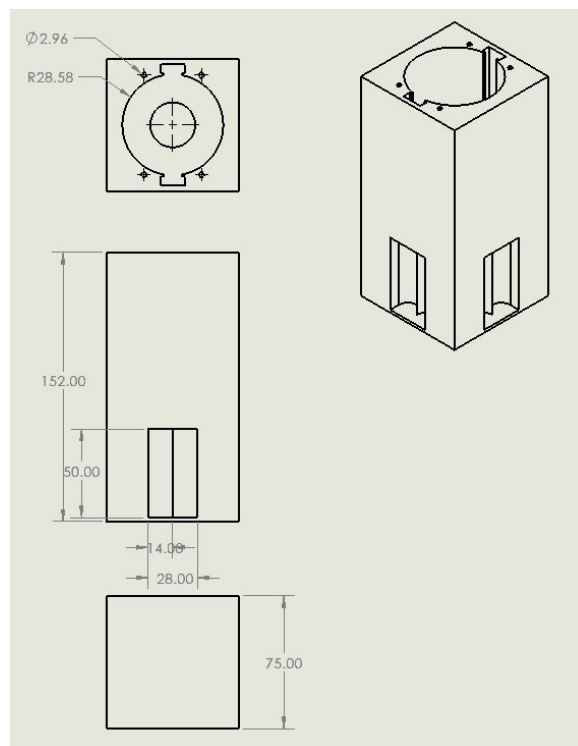


Figure 14: Housing 2

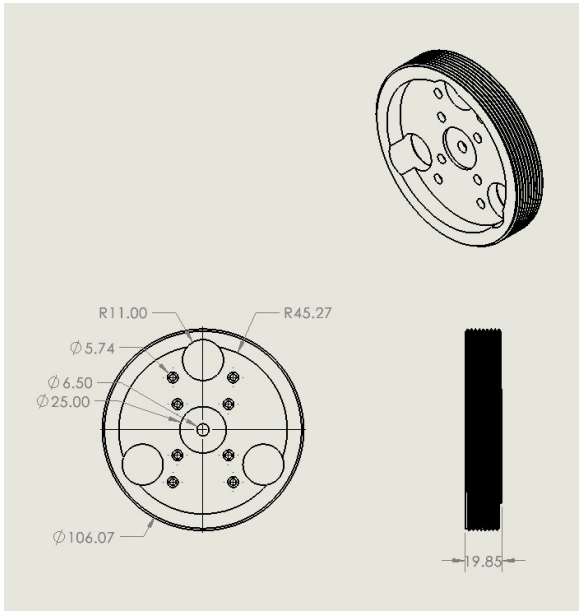


Figure 15: Housing 3

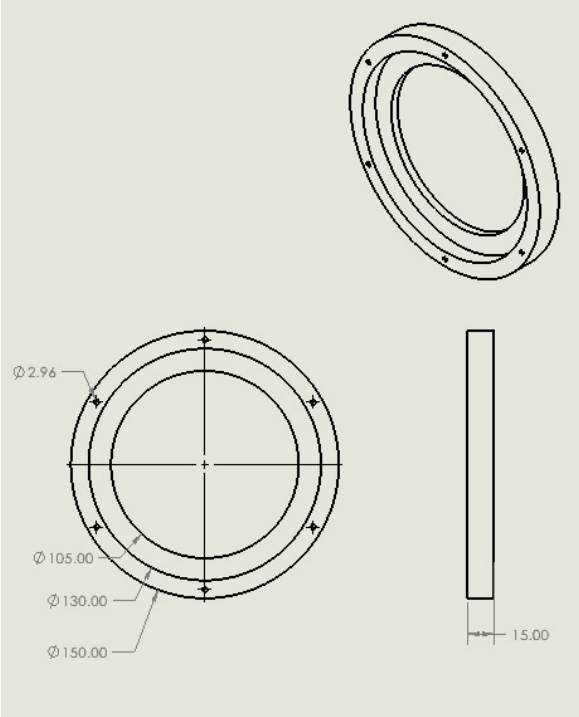


Figure 16: Housing 4

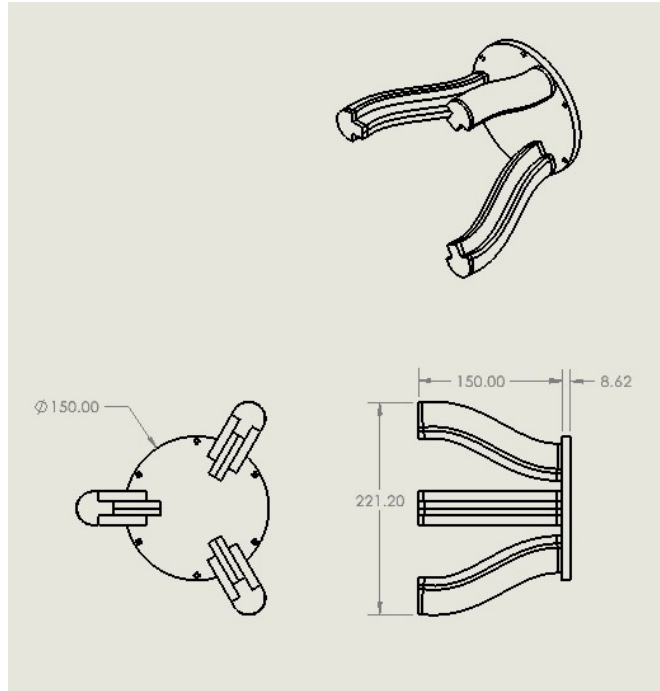


Figure 17: Legs