MINI-PROJECT 5

3-D PRINTING

ME 270: *Design for Manufacturability*
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AB5_3

PRODUCT

The product we have chosen to disassemble for this mini project is a water bottle. None of the parts that we had used for previous projects had multiple components with both plastic and metal except for the Beats Headphones, but they were deemed too valuable to disassemble and use for a project. As an alternative, we decided to use an insulated water bottle. We chose this product because it has five main components, four of which are made of some plastic and the last piece being made of stainless steel. An image of this product has been displayed on the cover sheet with individual parts being displayed further on in the report.

DISASSEMBLED PRODUCT

Bill of materials of individual parts with function, rough dimensions, mass, material, and likely manufacturing process.

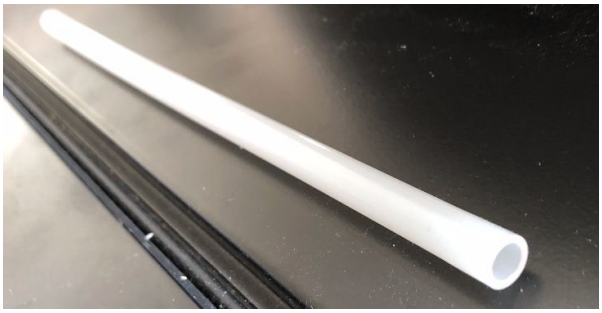
Mass was found using scale in Innovation Studio and Dimensions are of what sized box the part would fit in.

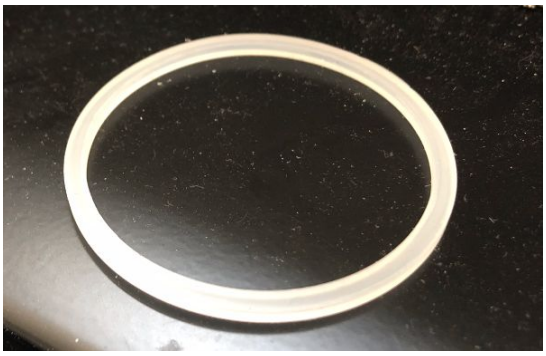
BILL OF MATERIALS

PART	FUNCTION	DIMENSIONS *	MASS	MATERIAL	LIKELY MANUFACTURING PROCESS
STRAW	Used to bring up water and is attached to cap.	8.5" x 0.25" x 0.25"	1.1 g	Polypropylene plastic	*Extrusion Molder* made for compounded plastic pellets made primarily of polypropylene resin with stabilizers and fillers.
				Stainless-Steel	
BODY	Storage tank for water.	9.25" x 3" x 3"	93.8 g		Sheet metal forming using a *die press* to bend the body into the correct shape and orientation.
MOUTHPIECE	Where mouth is placed and is attached to cap.	1" x 0.5" x 0.25"	0.5 g	Rubber / Plastic	Injection molded into unorthodox shape
SILICON BAND	Provides seal between body and cap.	2.5" diameter x 0.1"	_____ g	Silicon	Silicone is first pressed and cut into strips and the ends are then melted together.
SCREW-ON CAP	Prevents water leakage and is connected to every other part.	4" x 1.5" x 2.5"	8.9 g	Plastic	Likely injection molded, but potentially using material jetting.
		*: Fits in ___ sized box			

Exploded view of product with individual part images.

Silicon band (i.e. image #3 not depicted in exploded view because it snapped during reassembly for use)





FABRICATION PROCESS

The two components from the bill of materials that we are choosing to compare are the mouthpiece and metal bottle. The mouthpiece is manufactured using injection molding while the bottle is most likely cast using aluminium. To determine the quality of the part, the set of criteria used are dimensional accuracy, bending stiffness, surface finish, tensile strength, and cost. Each criteria was given a number out of 5, 1 being the least and 5 being the most.

Criteria	Goal Number for Mouthpiece	Goal Number for Bottle
Dimensional accuracy	2	4
Bending stiffness	3	5
Surface finish	4	5
Tensile strength	2	4
cost	2	4

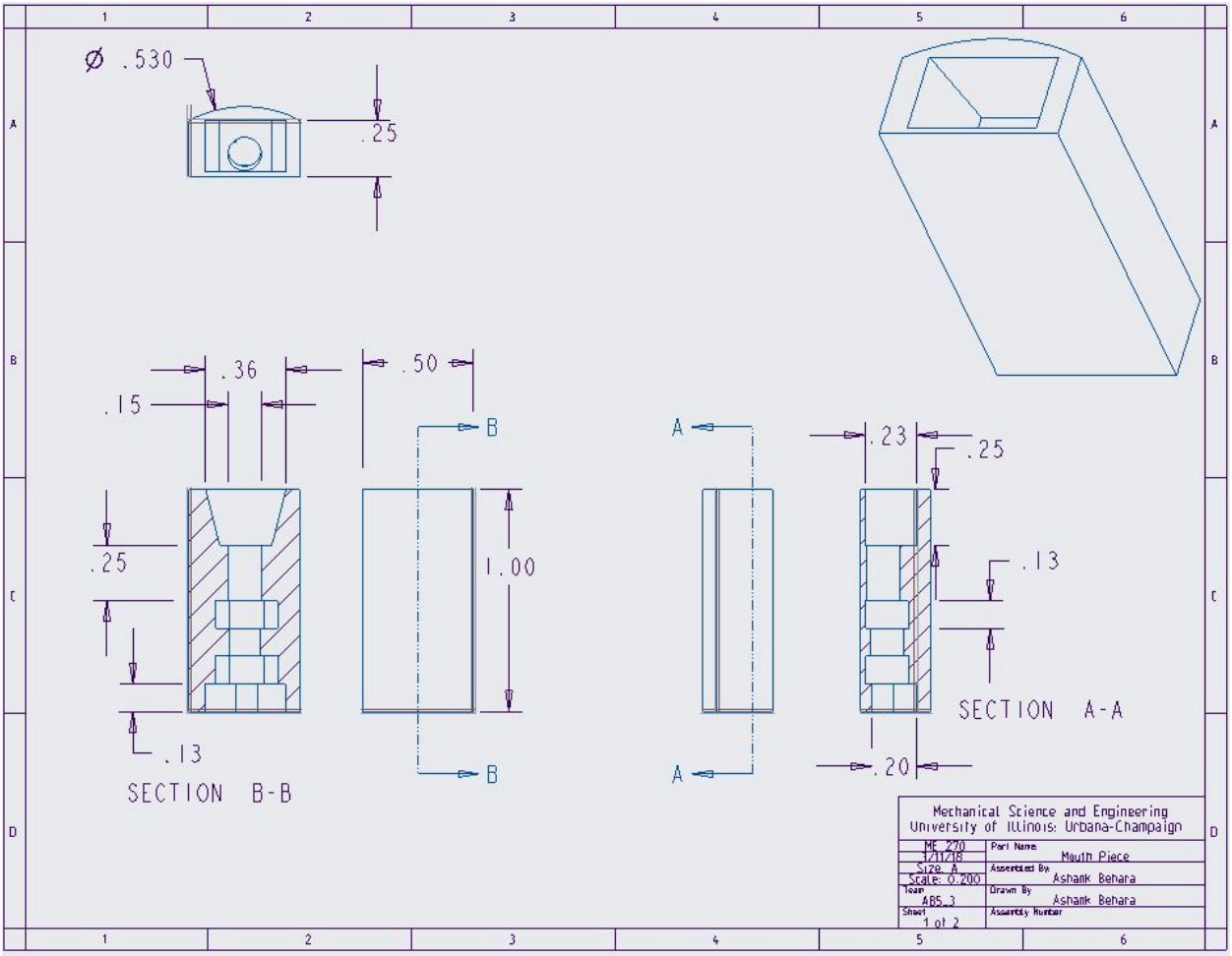
PUGH MATRIX

Criteria	**Mouthpiece** (original)	**Mouthpiece** (PET)	**Bottle** (original)	**Bottle** (PET)
Tensile Strength	2	+	4	-
Density	4	-	3	+
Young's Modulus	2	+	4	-
Operating Temperature	3	+	5	-
Surface Finish	4	-	5	-
Safety	4	-	5	-
Total		3- 3+		5- 1+
	Out of 5		Out of 5	
	5 is the ideal level.		5 is the ideal level.	

We choose PET to do the fused deposition modeling because our product is a water bottle and therefore needs food safe material. PET also has good impact resistance which makes it an ideal material candidate for this product. The bottle body, if manufactured using FDM, is not safe as the original material and manufacturing process because of its porous structure and frequent contact with water. The mouthpiece is better to produce by fused deposition modeling.

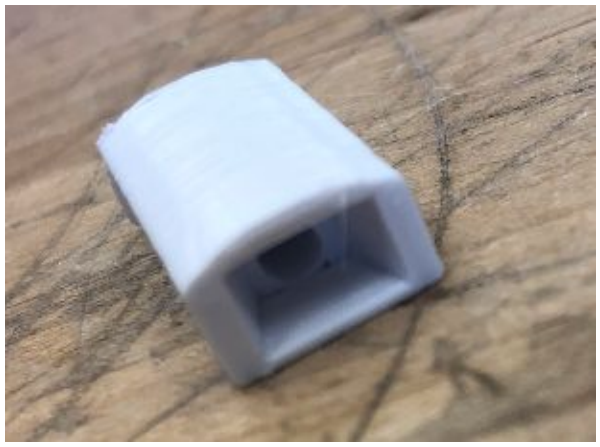
ENG. DRAWING FOR FDM *(Fused Deposition Modeling)*

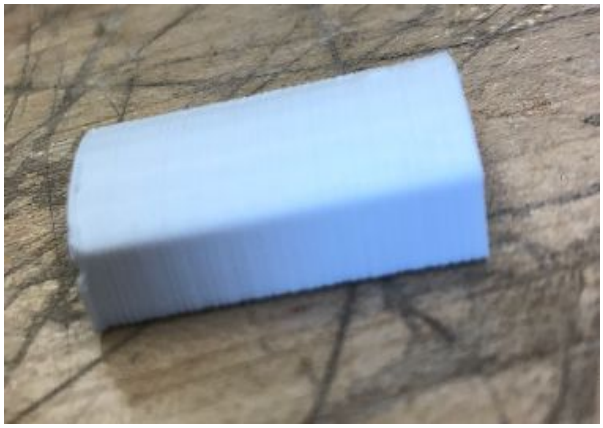
Displayed below is the engineering drawing for the mouthpiece that we will manufacture using fused deposition molding.

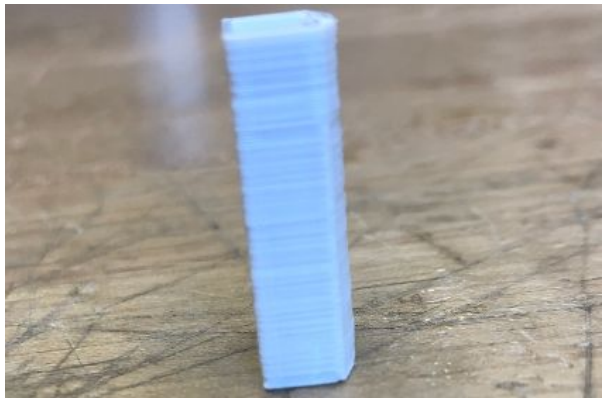


MANUFACTURED PIECE

Depicted below are four orientations of the fused deposition modeled mouthpiece.







Depicted below are four orientations of the original mouthpiece.




DIMENSIONAL ACCURACY

In terms of the criteria set before for mouthpiece recreated using FDM is as follows

- dimensional accuracy: 4
    - This is because the FDM model has a couple of flaws especially the bore in the middle of the piece. It does not have the same tolerance accuracy as injection molding.
- bending stiffness: 5
    - The FDM model has exceptional bending stiffness most likely because the way that it is printed, creates less of a chance for air bubbles and weaknesses.
- surface finish: 1
    - The surface finish is not shiny nor is it as smooth as the injection molded version of the mouthpiece. The stripey, ridged surface finish reduces the aesthetic and creates a rugged, unfinished look.
- tensile strength: 4

    - The tensile strength is roughly the same as the injection molded piece because the material is relatively the same. Also, the mouthpiece did not have any small, thin sections which is when the FDM would not perform as well as the injection mold.
- Cost: 5
    - The cost is significantly cheaper for the FDM because it only includes how much material is needed for one gram while the injection mold has to take into account the mold itself as well as the material used to create the part.

In regards of FDM for a small lot-size fabrication, we believe that this would be an effective and more cost efficient method to fabricate this part. However, despite the significant reduction in price, the dimensional accuracy and surface finish are significantly affected and reduced. The mouthpiece is the most used area of the water bottle so the user would most be affected by the roughness of the piece. The rough edges could hurt the user. The dimensional accuracy is also completely inaccurate. The main purpose of the mouthpiece is to flow water from the bottle to the mouth of the user. The FDM is not accurate enough to fabricate the piece without having extra material interfere with the bore in the middle of the part. The bore is the main purpose of the piece and the FDM does not deliver on that purpose.