E29 Final Project Report

Dish Dazzle

Group 1018

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PROJECT REPORT

A.

Doing dishes by hand is inefficient, frustrating, and wasteful. It can get very tedious to put soap on each and every dish by hand, all the while your water is running, leading to waste. Using a sponge or another tool can lead to excess soap use on each dish. Finding the right balance of soap for each dish is time-consuming, and not everyone has a dishwasher. Over 30 percent of the U.S. population, or over 90 million people, lacks one. Our device could benefit this significant portion of the population.

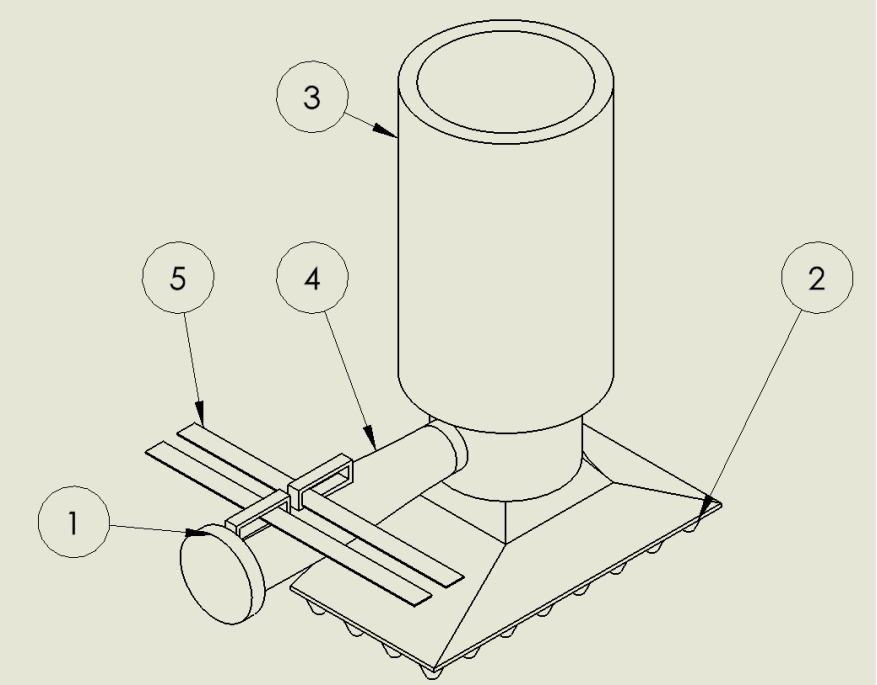
B.

The technology we're developing is both useful and user-friendly. Traditional dish cleaning with soap and a sponge is time-consuming, especially when applying soap to each dish separately. Our product simplifies this process by using a mixing chamber and soap dispenser situated around the sink, streamlining the cleaning of dishes. Squeezing the detachable soap bottle and turning on the sink mixes soap and water in our product's mixing chamber, dispensing a foaming mixture in one go, eliminating the need to apply soap to each dish manually.

C.

Most people use dishwashers to clean their dishes or use a sponge and dish soap to wash by hand. The problem with dishwashers is that many people do not possess one or cannot afford them. There are existing tools that help reduce the tedium of hand-washing, but none of them aid in water and soap efficiency like our product. Our product is also nearly hands-free, only requiring the occasional squeeze on the soap dispenser, leaving both hands free to scrub and move around dishes as needed.

D.



E.

Fit #	Component A fits to Component B	Function of fit	Fit Class	Component A critical dimension and tolerance	Component B critical dimension and tolerance
i	Soap Bottle (4) → Mixing Chamber (2)	Connect the soap bottle to the mixing chamber and allow soap to mix with water.	**Locational Clearance LC2** These pieces need to fit together snugly but be able to be disassembled.	.250 in +0.0006 -0.000	0.250 in 0.000 -0.0004
ii	Cap (1)→Soap Bottle (4)	Close off the soap reservoir and allow for refilling.	**Sliding Fit LC11** *Locational Clearance Fit* The cap needs to fit over the soap reservoir but be able to be disassembled easily.	0.700 in +0.01 in -0.000 in	0.700 in -0.008 in -0.018 in
iii	Mixing Chamber	Create a water-tight	We will clamp a rubber coupler (3)		

	(2)→Sink	connection between sink and chamber	over the two pieces for a water-tight seal, no fit needed.		
iv	Soap Bottle (4)→Sink	Further secure soap reservoir to sink head	Velcro Straps (5) will be used to tighten this to the sink/coupler. There is no fit or tolerance needed.		

F.

Our main rationale for tolerances was to create watertight connections while keeping in mind how often each connection would need to be undone and redone. The GD&T tolerances in our drawings are to aid in functionality. The soap bottle's profile tolerance was to ensure the shape was easy to hold in your hand and to squeeze.The flatness tolerance on the cap was for user comfort and to ensure the piece was aesthetically pleasing. The perpendicularity tolerance on the connection to the soap chamber was to ensure that the bottle was oriented correctly for dispensing soap *only* when squeezed, not at any other time. The parallelism tolerance on the hooks to run the velcro straps through was to allow them to be used the most effectively.

G.

For manufacturing we used SLA 3D printing. The Form 3 printers were chosen due to their superiority in tolerance, finish, and their ability to print rubber materials as well as solid plastic. As we had complicated convex shapes and the need for a pliable soap container, Form 3 was a must-have. Jacobs provided the training on how to use these printers as they are sensitive machines that need to be handled with care. After the first prototype was created we had some issues with the integrity of the soap container as the flexible 80A resin with our original design was too floppy and did not hold its shape very well. Other things from our first prototype that we noticed were that the proportions of the mixing chamber shaft and stock rubber coupler were off. We also noticed a nonuniform mixing of the soap in the chamber as one side got all the soap and wasn't adequately dispersed to all nozzles. Going back to the drawing board we redesigned a smaller thicker soap container to try and increase the integrity and rigidity of the piece. We enlarged the size of the mixing chamber to make it more compatible with the coupler. We also moved the connection between the soap bottle and mixing chamber to the side to aid in mixing the soap and water more thoroughly. The final drafts as well as the prototype went through the same manufacturing process. Solidworks parts were downloaded as STLs, uploaded to Perform (a tweaking software) and tweaked to ensure optimal prints. Printing on Form 3 took approximately 7-8 hours in 2 different printers - one with solid resin and one with flexible 80a resin. The parts were then cleaned in an agitated alcohol bath for 20 min and cured in a UV & thermal oven for 10 min at 60 degrees Celsius.

H.

For a full-scale production we would use Injection Molding. This would keep the cost of the product down and produce a light yet strong part that could be used with water without being damaged. Injection

molding can create the geometry we need cheaply, quickly, and with a low amount of waste. For the soap container, silicone would be a good choice as it would give us rigidity while keeping the part flexible enough to be squeezed. ABS would be the material of choice for the mixing chamber due to its rigidity and ability to work with water. The off the shelf-parts would be sourced in bulk to cut costs.

I.

Acrylonitrile Butadiene Styrene (ABS) is an impact-resistant engineering thermoplastic. ABS offers a good balance of impact, heat, chemical and abrasion resistance, dimensional stability, tensile strength, surface hardness, and rigidity to make it the perfect candidate for the mixing chamber. This will help make the chamber immune to damage caused by soap and hot and cold water while also keeping the manufacturing process easy. ABS forms an excellent pair with injection molding and can take up any color easily, helping in making a wide range of products. Silicone has the ability to form water-tight bonds and repel water. It resists creasing which helps to make rubber sheets out of it. These sheets can then be used to form the soap bottle part because silicone is rigid enough to hold its own shape but can be squeezed when needed to dispense soap.

J.

The main reason we chose injection molding was so we could manufacture small features that are hard to create otherwise. The small holes on the mixing chamber that dispense the soapy water were unable to be 3D printed, and it would be expensive to machine them. Injection molding can accurately create these small features without significant errors, which is why we chose this manufacturing process.

K.

Our biggest takeaway from this is that tolerances matter! It’s easy to look at a drawing or SOLIDWORKS model and think a part may look perfect, but after it’s manufactured, something isn’t quite right. Making sure you allow for manufacturing errors is a tricky and imprecise process, but well worth it to avoid reprints and in some cases, full redesigns. We also learned that working with a team is great, but can come with challenges like scheduling and dividing tasks up evenly. Lastly, we learned that for a consumer product like this, simpler is better. If we can create a fully functional product in just a few parts, it’ll make our lives and the lives of our potential customers a whole lot easier than if we made a complicated product. This became more apparent during our lab where we assembled another team’s device. In the future, we’d have a bit better communication with our team members to ensure everyone was on the same page for the project.

L.

We’d like to thank the E29 staff for helping us along the way with this project and in providing constructive feedback to help improve our product. We also want to thank the Jacob's staff for their assistance and training in the printing processes we used.