# ENME 339 Final Project
# Spray Bottle

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Completed April 12 2021

## Abstract

The following report outlines the construction and assembly details of a spray bottle design. Spray bottles are commonly used for their ability to disperse a fluid of the user's choice evenly onto a surface. They consist of multiple parts and vary based on the specific product type, but they all generally have a trigger-pumping mechanism involved.

## Introduction

Many spray bottles are used to hold cleaning products- the most well-known brand being Windex. The spray bottle mechanism is simple in design and effectively transfers the contained liquid within the bottle up through a tube, and sprayed into the environment.

## Description of Project

For this project, I completed the task of designing a spray bottle, having the main container, straw, cap, nozzle, trigger, and hinge. Once fully assembled, the user pushes down on the trigger which activates a pump system to suck up the liquid through the straw. The user may also unscrew the cap attached to the bottle and fill the main container with whichever liquid they choose, and then can easily tighten the cap back on to ensure no leakage.

To design this project, I had to spend time planning the overall finished design prior to breaking it down component by component. As a mechanical engineer, it is necessary to possess strong visualization and planning skills in order to efficiently execute an idea. I referenced a spray bottle I had in my house for basic reference dimensions but decided to put my own innovative twist on the product by altering the nozzle shape.

To complete the overall assembly of the bottle, I decided to implement a mechanical hinge mate for the trigger, hinge, and nozzle connection. Mechanical mates are useful to communicate how the parts work and move together.

# Description of Major Parts

## Container:

The container is a cylindrical structure with a tapered bottleneck at the top for the cap to screw on. It was hollowed out in order for the straw to fit inside for assembly. When constructing, I had to consider the screw on top and how thick I wanted to create the ridges. Additionally, I had to ensure that the bottle was hollowed out to a certain thickness so that liquid volume could be maximized, but the overall structural integrity was not compromised.

## Nozzle:

This component was the most complicated to design. I wanted to implement my own creative design within this part but still wanted to mimic the pumping system design of a standard spray bottle. This piece has hollowed-out sections to allow for the straw to connect and for the liquid to pass through the ridged opening at the top. I had to also consider the hinge-trigger connection and make sure that the small circular opening passing through matched the 0.20cm diameter of the hinged piece.

## Trigger:

The trigger is the part that the user pushes on to activate the entire system. It has two curvatures on the outer portion for an efficient and visually desirable look. I had to consider the rotation of this piece once it was assembled with the nozzle, and had to go back and alter the dimensions to ensure the piece fits within. Within my initial design proposal, I had decided to create the trigger and pumping system pieces separately- I then had to make adjustments along the way and ultimately decided to combine both of these under the one label of a trigger.

## Straw:

A hollowed-out cylindrical structure. This piece wraps around the cap connection and thus the inner diameter had to be larger than that on the cap. I dimensioned the straw to be

long enough so that it reached far down inside the container but did not collide with other components. Referring to my own spray bottle found at home, I noticed that the straw was not exactly the height of the container and believe this is so that the liquid can be extracted.

### Cap:

This component was created using the sphere feature in SOLIDWORKS. The intent behind this part was to connect the nozzle piece and container together. I decided to create another component to accomplish this goal, instead of directly connecting the two together, because I wanted the bottle to have a neck portion that lengthened the overall look of the final product. Referencing my at-home spray bottle, I noticed that this also had a connection cap piece that could be taken on and off at the user's desire.

### Hinge:

Within my initial design proposal, this piece had not been considered. I decided to create a small hinge piece in order to implement the mechanical hinge mate for the trigger-nozzle connection. This piece is a small cylindrical part that runs the length of the nozzle's thickness and fits exactly within the space.

## Discussion

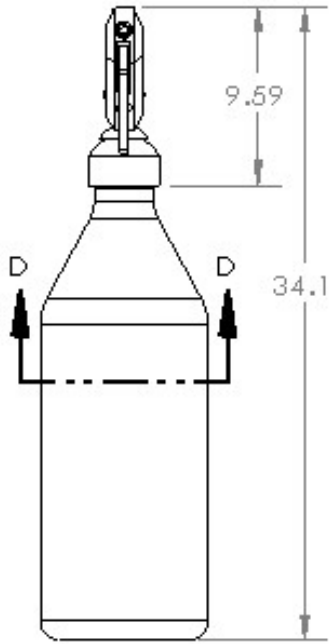
This project allowed me to gain an overall better understanding of the mechanical engineering design process using CAD software. Problem identification, ideation, refinement/analysis, and implementation/documentation are all key aspects of this process. While I was unable to carry out from start to finish the testing and manufacturing of my design, I did appreciate the modeling and critical thinking aspects.

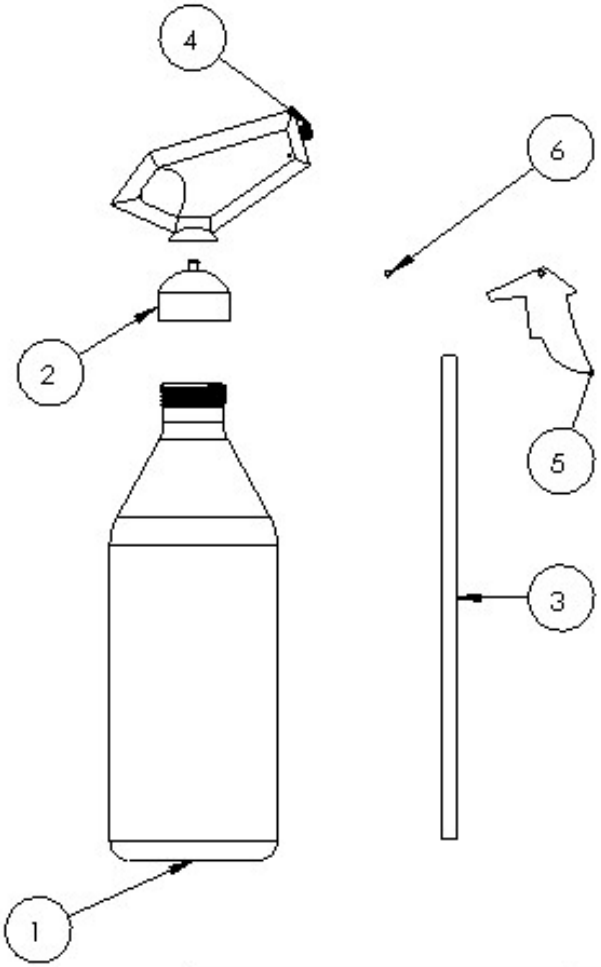
The largest challenge I faced throughout was making continuous refinements to each of my components. I did spend considerable time pre-planning out the end product and tried to envision what I wanted to look like all together, but if I were to use SOLIDWORKS again, I now understand the importance of planning out each of the components to guarantee they fit

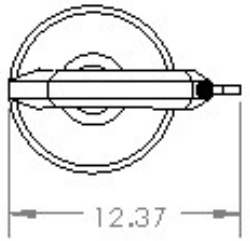
together accurately. With this being said, eliminating the constant refinements is not entirely possible and should be involved. The greatest task a mechanical engineer faces in the industry is creation, testing, and repeating until all requirements are satisfied. Overall, I now understand that this process can be a tedious one, and planning out ideas to the best of one's ability beforehand can significantly reduce time.

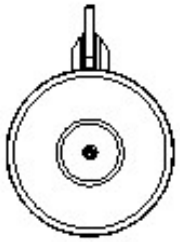
# Appendices

| ITEM NO. | PART NUMBER | manual explode/QTY. | COST (CAD $) |
|---|---|---|---|
| 1 | proj_container | 1 | 10.50 |
| 2 | proj_cap | 1 | 1.50 |
| 3 | proj_straw | 1 | 0.25 |
| 4 | proj_nozzle | 1 | 0.75 |
| 5 | proj_trigger | 1 | 2.50 |
| 6 | proj_hinge | 1 | 0.05 |



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DRAFTED BY: KIRSTEN KORSRUD 04/10/2021

ENGINEERED: 30089435

ADDITIONAL APPROVAL: NAME DATE

ADDITIONAL APPROVAL: NAME DATE

NAME: ENME339 Ltd., University Dr. 2500, Calgary, AB T2N 1N4

DRAWING TITLE:

Spray Bottle Assembly

SIZE A | CAGE CODE: | DWG NO.

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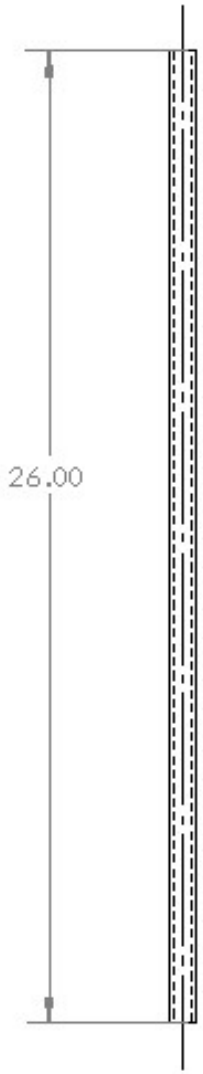


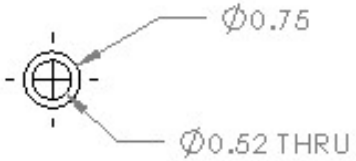


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| DRAFTED BY: CIRSTEN CORSTJOB 04/12/2021 | | | |
| ENGINEERED: 30089435 | | SIZE A | CAGE CODE: / DWG NO. |
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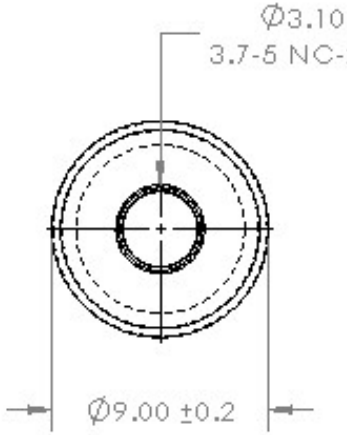


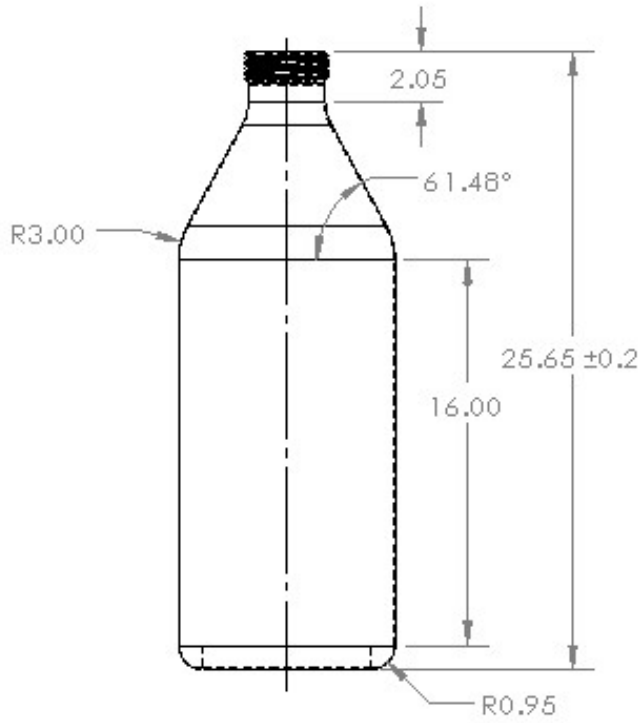


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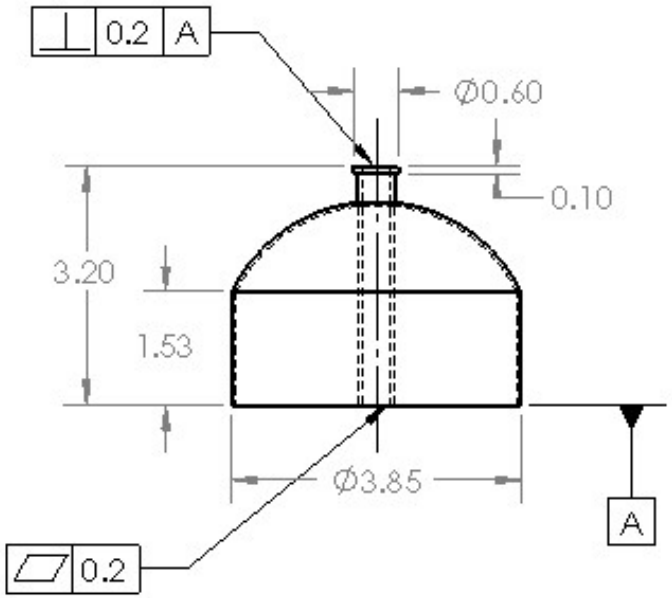


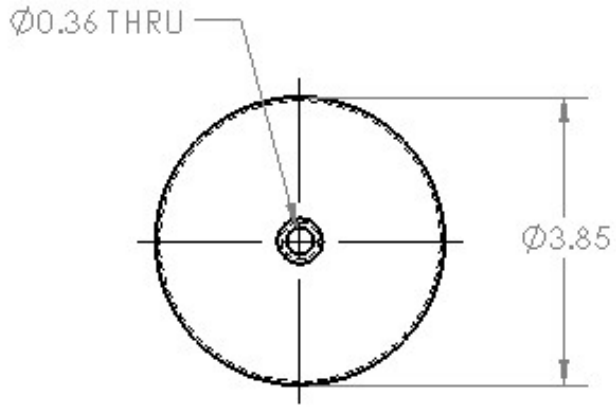


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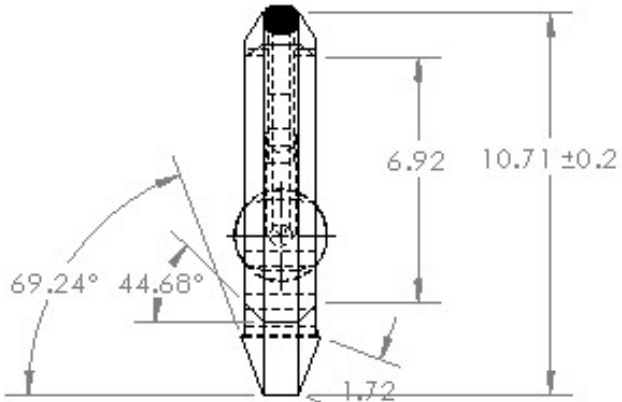


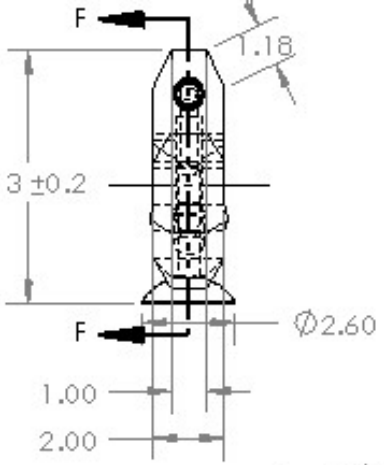


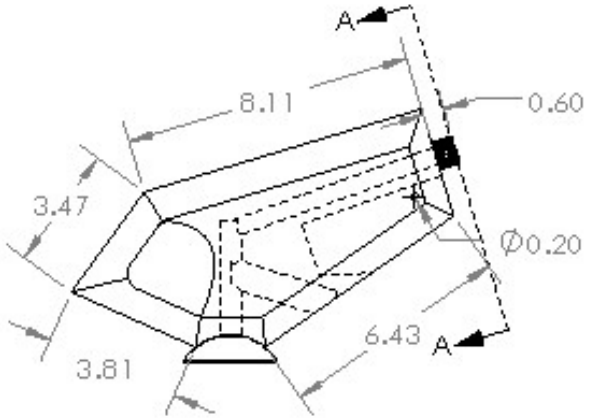


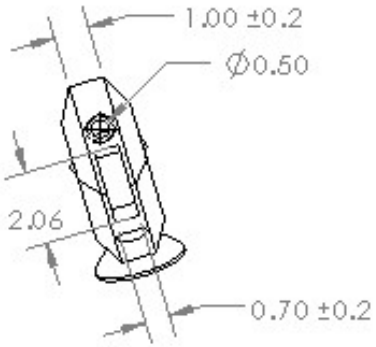


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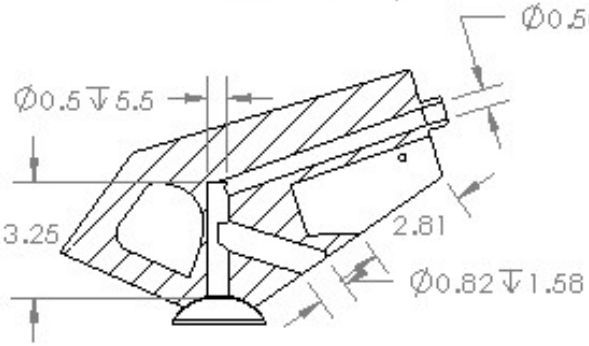


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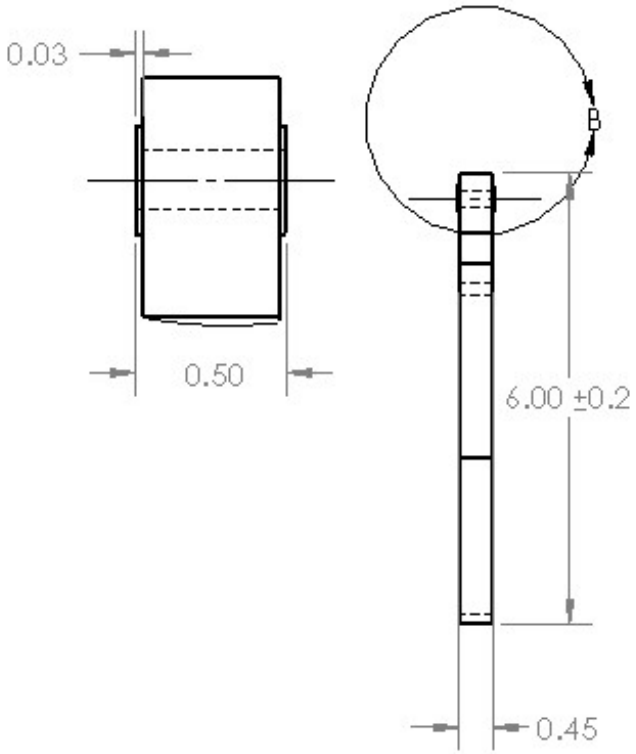


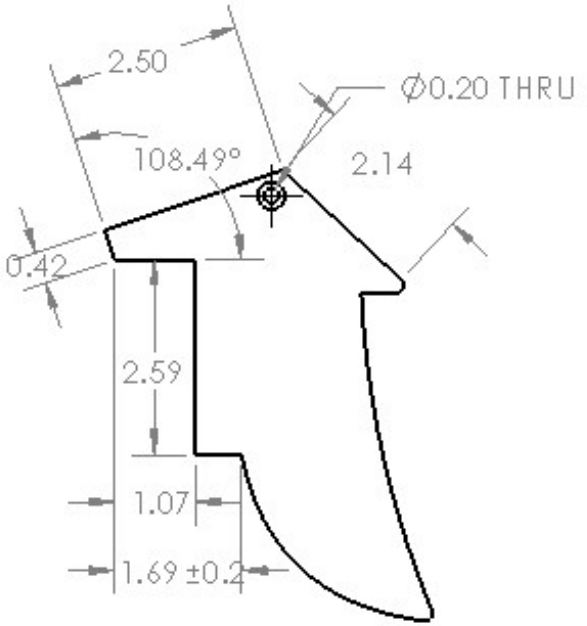


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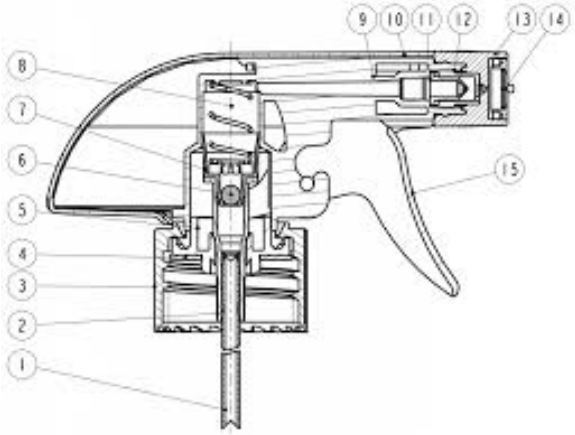
# ENME 339 CAD Design of Spray Bottle

Kirsten Korsrud
30089435




## Product Function:

The function of a spray bottle is to store liquid within the bottom compartment, to then disperse the liquid in an even, thin coating. This is done by pressing down on the trigger, which is connected to a small pump system that creates a pressure difference to 'squeeze' the liquid out through the nozzle. The liquid comes out in a mist-like spray because the tip is covered in many small holes. Spray bottle systems come in variety, but all have some form of simple pumping system which is started and stopped by the user.

## Bill of Materials:

| | Name | Function Description | Quantity | Price |
|---|---|---|---|---|
| 1. | Polystyrene Plastic Container | Stores the liquid in the bottom of the spray bottle. Has screw ridges on top so the cap can attach. | 0.480 ounces US = 13.6 grams CAD | $ 10.50 CAD |
| 2. | Trigger | When pressed, activates the pump and spray system. | 1 | $ 0.75 CAD |
| 3. | Screw-on Cap | Outer shell of top cap and nozzle part- contains the pumping system. | 1 | $ 1.50 CAD |
| 4. | Nozzle | Tip of spray bottom where liquid is released into the environment. | 1 | $ 0.75 CAD |

| | | | | |
|---|---|---|---|---|
| 5. | Pump System | Contains cylindrical pump column, spring, and hinge connected to trigger. | 3 | ~ $ 0.50 CAD / unit (total $ 1.50 CAD) |
| 6. | Tube | Used to suck up the liquid. | 1 | $ 0.25 CAD |

Total Number of Parts: 8

## Project Working Plan:

March 01 - 10: Research Possible Project Ideas

March 11: Project Proposal Writeup and Submission

March 12 - 19: Build Container and Screw-on cap in SolidWorks
- Create and finish Drawings of each as well

March 20 - 26: Build Pump System and Trigger in SolidWorks
- Create and finish Drawings of each as well

March 27 - April 02: Build Tube and Nozzle in SolidWorks, make any needed adjustments to other parts
- Create and finish Drawings of each as well

April 03 - April 06: Assemble Components and add Motion

April 09 - 12: Write and Submit Report

***** Final Project and Report Due April 12 at 6:00 pm *****