**Mason Elliott, Evan Gill,**
**Jesse Orris, Christian Tello**
**[Bagel Guillo-Team]**


**MEGN 381 | Manufacturing Processes**
**Final Project Phase V: New Product Design and Manufacturing Analysis**
**Prof. Oyvind Nilsen**

## Phase V: New Product Design and Manufacturing Analysis

1. **New CAD Drawings [Full Sized Files Attached at the End]**

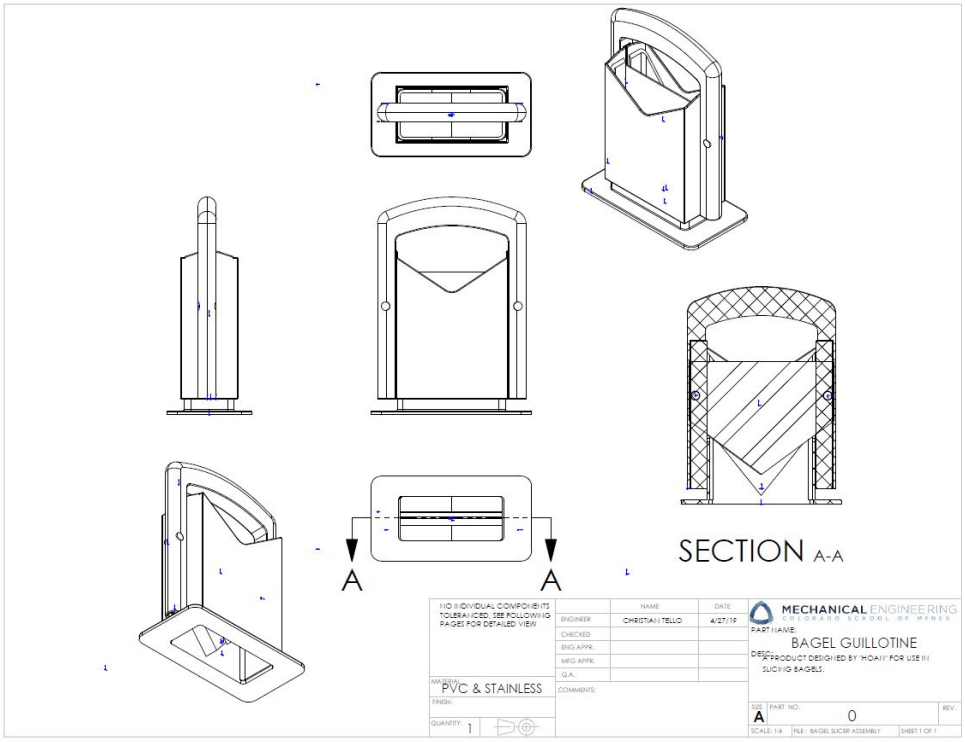



**Figure 1. CAD Drawing of the Full Assembly**

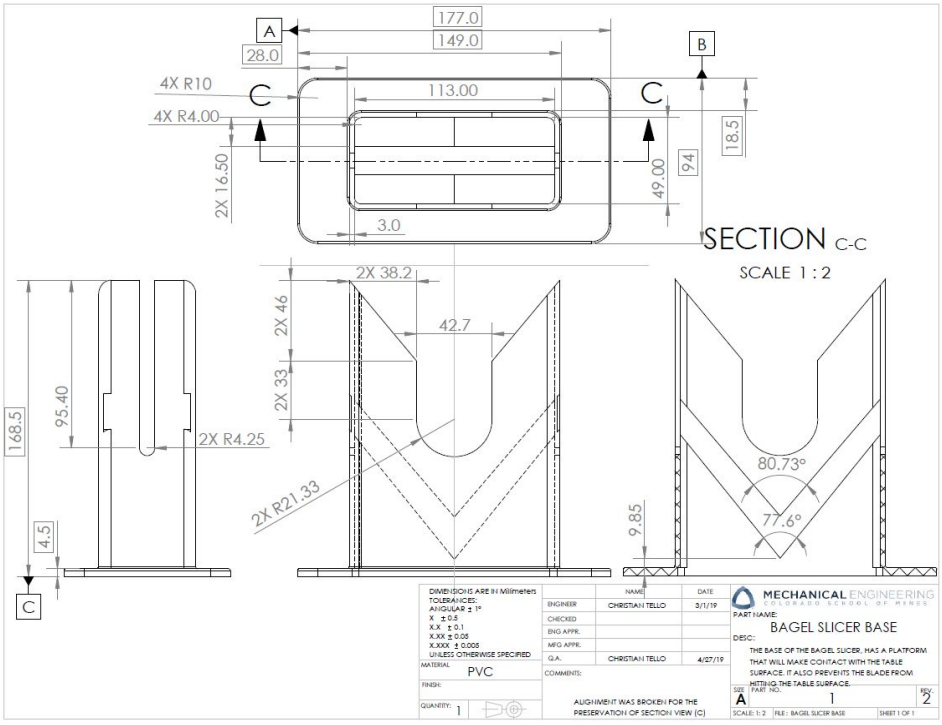



**Figure 2. CAD Drawing of the Bagel Slicer Base**

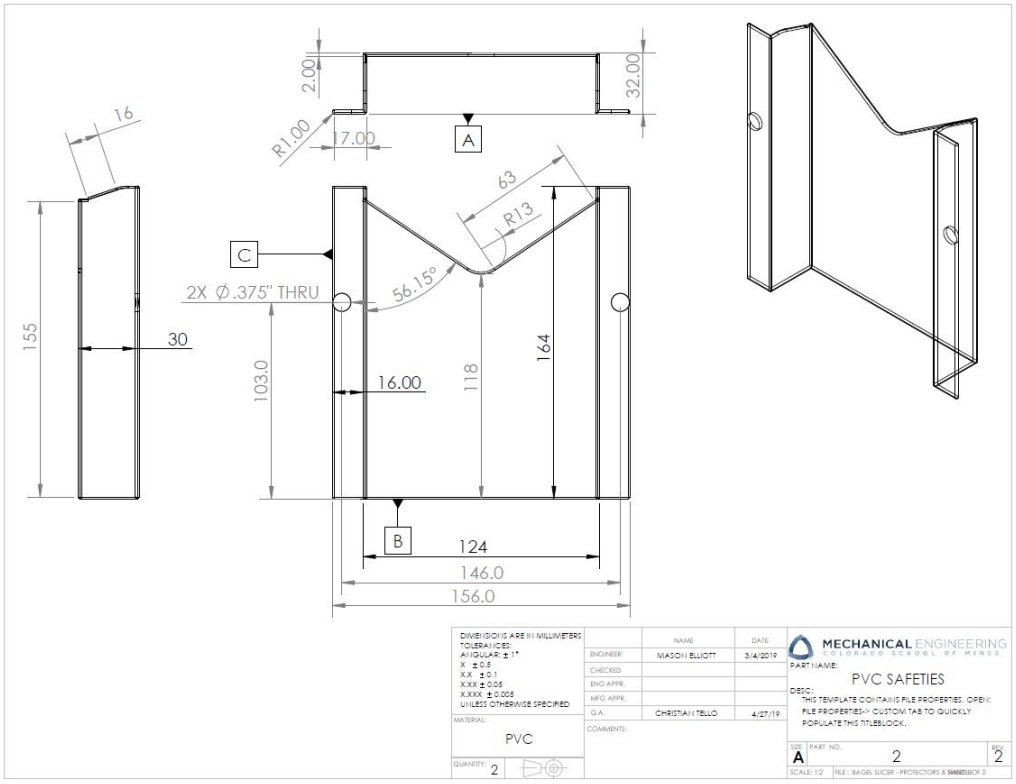



**Figure 3. CAD Drawing of the Safeties**

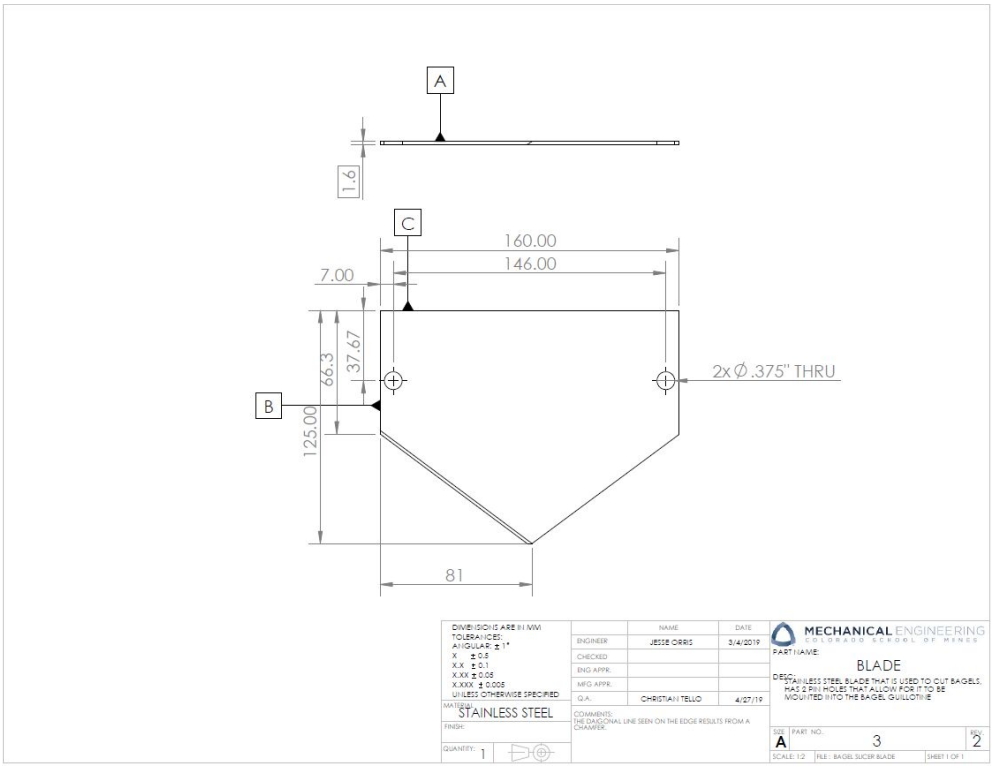



**Figure 4. CAD Drawing of the Bagel Guillotine Blade**

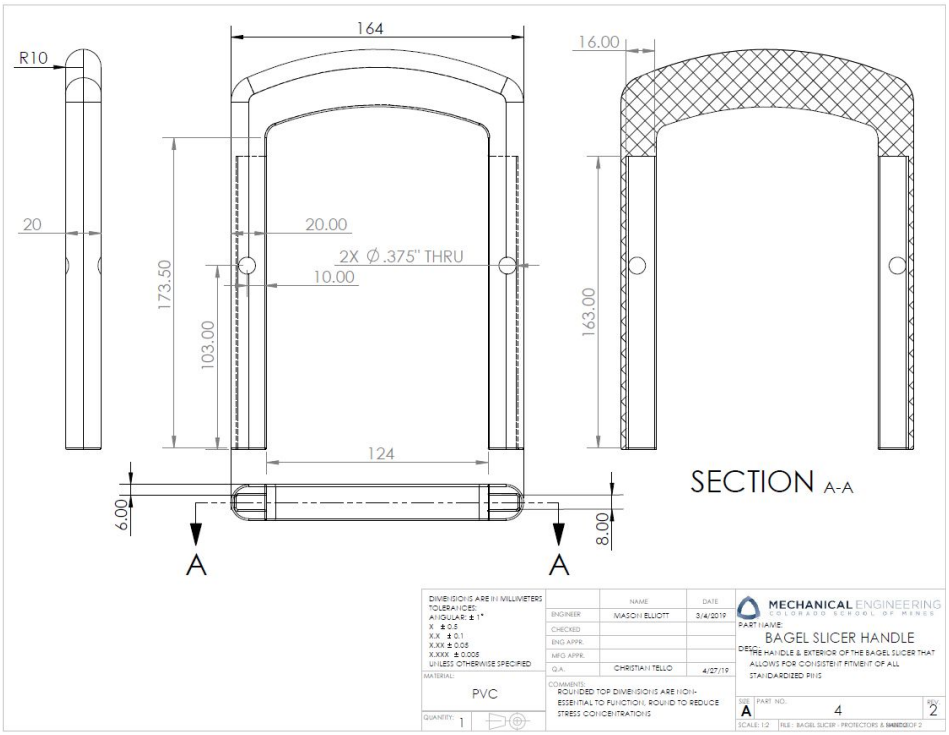



**Figure 5. CAD Drawing of the Bagel Guillotine Handle**

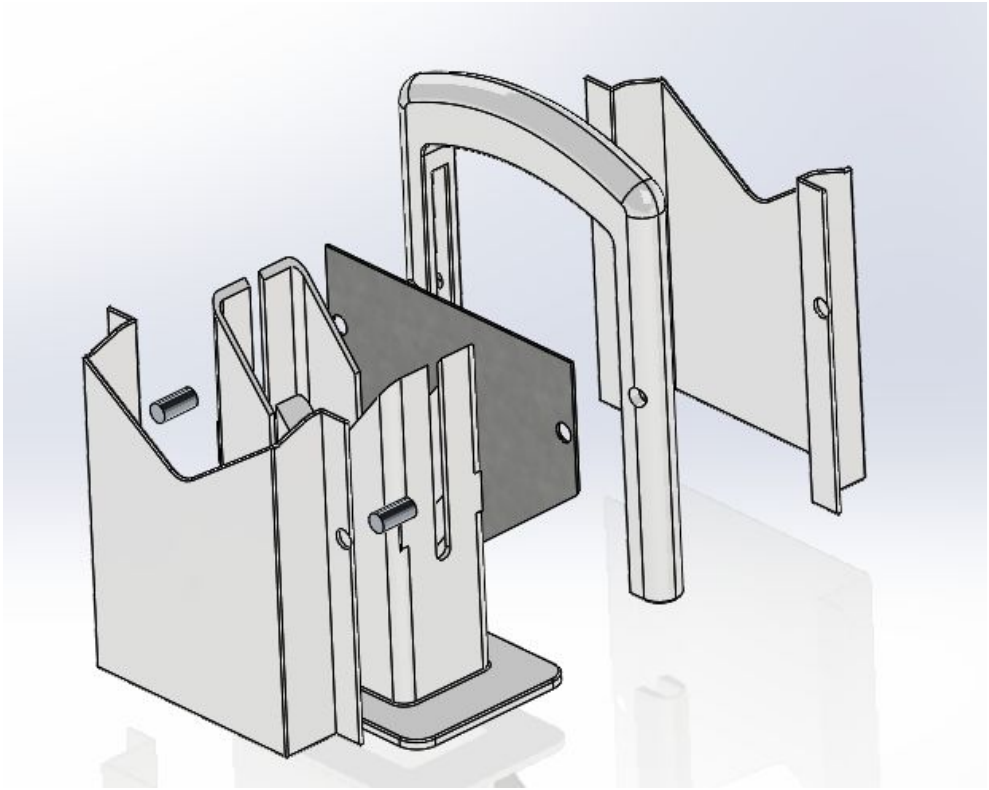


**Figure 6. Isometric Exploded View of the Bagel Guillotine**

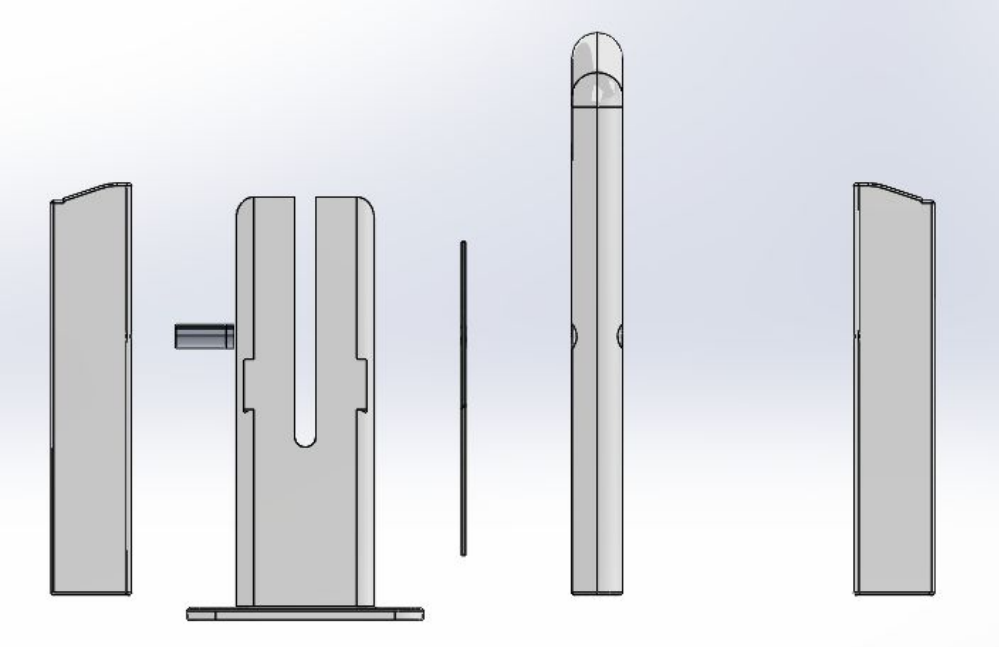


**Figure 7. Side Exploded View of the Bagel Guillotine**

## 2. Product Assembly

**DFA Analysis Worksheet**

**Assembly Name:** **Team:** Evan Gill, Jesse Orris, Christian Tello, Mas

If the answer is Yes to any of the metrics or questions enter a 1. If the answer is No then enter 0. Each cell must have a number.

| Part Number | Part Name | Part | DFA Complexity: Number of Parts (Np) | DFA Complexity: Number of Interfaces (Ni) | Functional Analysis / Redesign Opportunity: Theoretical Minimum Part | Part Can Be Standardized (if not already standard) | Cost (Low/Medium/High) | Practical Minimum Part | Error Proofing: Assemble Wrong Part/ Omit Part | Error Proofing: Assemble Part Wrong Way Around | Handling: Tangle, Nest, or Stick Together | Handling: Flexible, Fragile, Sharp or Slippery | Handling: Pliers, Tweezers, or Magnifying Glass Needed | Insertion: Difficult to Align/ Locate | Insertion: Holding Down Required | Insertion: Resistance to Insertion | Insertion: Obstructed Access/ Visibility | Secondary Operations: Re-orient Workpiece | Secondary Operations: Screw, Drill, Twist, Rivet, Bend, or Crimp | Secondary Operations: Weld, Solder, or Glue | Secondary Operations: Paint, Lube, Heat, Apply Liquid or Gas | Secondary Operations: Test, Measure or Adjust |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Sub-Assembly No. 1 | | | | | | | | | | | | | | | | | | | | | | |
| 5 | Pins | | 2 | 8 | 2 | 1 | L | 2 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2 | PVC plastic sides | | 2 | 6 | 0 | 1 | L | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 3 | Blade | | 1 | 2 | 1 | 1 | L | 1 | 0 | 1 | 0 | 1 | 0 | 1 | 0 | 0 | 0 | 0 | 1 | 0 | 1 | 0 | 0 |
| 4 | Handle | | 1 | 2 | 1 | 1 | L | 1 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Sub-Assembly No. 2 | | | | | | | | | | | | | | | | | | | | | | |
| 1 | Bagel Slicer Base | | 1 | 1 | 0 | 1 | L | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 |
| | | | | | | | | | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | | | | | | | |
| | Sub-Assembly No. 3 | | | | | | | | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | | | | | | | |
| | Totals | | 7 | 19 | 4 | 5 | 0 | 5 | 0 | 1 | 0 | 1 | 0 | 4 | 1 | 0 | 0 | 1 | 1 | 0 | 1 | 0 | |
| | Design for Assembly Metrics | | 11.53 | | 57.1% | ←Theor. Effy. Pract. Effy.→ | | 71.4% | 0.25 | | 0.25 | | | 1.25 | | | | 0.75 | | | | | |

**Assembly Instructions:**

1. Unpackage Product
2. Set base aside (Figure 2), and locate safety covers (x2) (Figure 3), .375” pins (x2) (Standard Part), blade (Figure 4), and handle (Figure 5).
3. Slide blade into handle while sandwiched between the two properly oriented safety covers
4. Place handle upright and seat it flush to line up the pin holes.
    a. If everything is lined up correctly, holes should be unobstructed on each side of handle assembly
5. Press pins into holes, and ensure a tight fit such that the handle is a single unit
6. Slide handle onto base, and your bagel guillotine is ready to use!
    - Bagel Guillotine should now look identical to Figure 1.

**Changes From Original System:**

- With the new product modifications, there are less pins to be assembled, and therefore less room for error in the manufacturing process. As far as ease of assembly, there is slightly less work done, as only 2 pins are pressed in. We also changed the material of the safety guard from a clear acrylic to a PVC, because in doing this we are able to decrease the cost of the material, and also decrease the cost of production because we are eliminating a manufacturing process. Aside from that nothing changes. As the assembly process was already very simple, there is not much more simplification to be done.

3. **Cost Analysis**

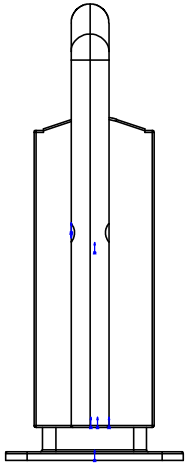
| Part Type | Quantity Needed Per Slicer | Cost Total Assuming a run of 10 Slicers | Cost Total Assuming a run of 100 Slicers | Cost Total Assuming a run of 1,000 Slicers | Cost/Slicer |
|---|---|---|---|---|---|
| **Pins** | **2** | **$5.12** | **$51.20** | **$512** | **$0.512** |
| **Handle** | **1** | **$5.60** | **$56.00** | **$560.00** | **$0.56** |
| **Blade** | **1** | **$6.73** | **$67.30** | **$673.00** | **$0.673** |
| **Base** | **1** | **$7.58** | **$75.80** | **$758.00** | **$.758** |
| **Safety Guard** | **2** | **$3.75** | **$37.50** | **$375.00** | **$0.375** |
| | | | | | |
| **Injection Molding Machine** | **1** | **10,000-100,000 (assumed $30,000)** | **10,000-100,000 (assumed $30,000)** | **10,000-100,000 (assumed $30,000)** | **$0.40** |
| | **Total:** | **~$30,028.78** | **~$30,287.80** | **~$32,875** | |
| | **Cost/Slicer (Total)** | **~$3002.88** | **~$302.88** | **~$32.88** | |

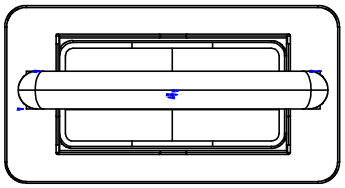
**NOTE:** These prices per slicer are not ideal when looking at producing small scale, with the cost of the injection molding machine this product is intended for mass production, and attempting to produce smaller amounts while still purchasing all needed equipment will result in unreasonably high production costs. With just material cost, the price per part is much more reasonable.

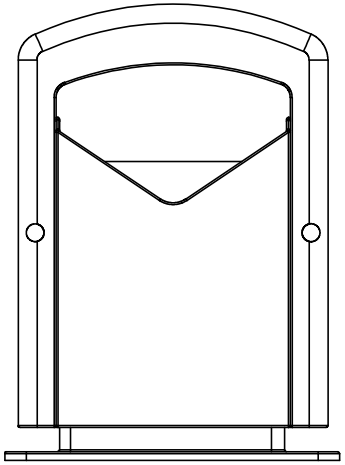
From the original system to our current system we found saving in decreasing the number of pins and changing the material of the safety guard to PVC. Decreasing the number of pins decreases the pin cost by half, and also decreases the amount of holes needed to be pressed, as well as decreases the amount of pins that need to be pressed into place. With all these factors the price per slicer for pins decreases just under a dollar, and when looking at producing thousands of slicers, that is a good savings. Also changing the material to PVC cuts out the process of having to make the acrylic safety guard and changes the process to injection molding which can be done cheaper, and the material is cheaper.

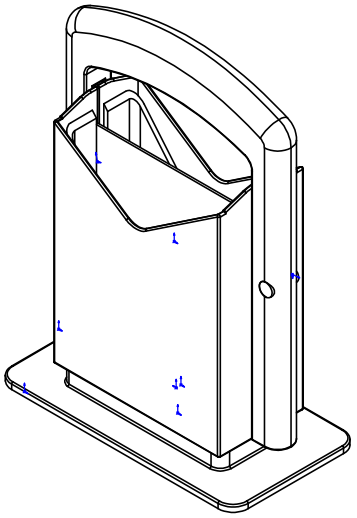
At the quantities of 10, 100, and 1000, there are different ways to do all these based on profits. At 10 and 100 units it is unreasonable to buy a injection molding machine and make all the parts because that exponentially increases the price if not using for mass production. As seen in the cost analysis the price per slicer for these quantities is unrealistic. If we were to

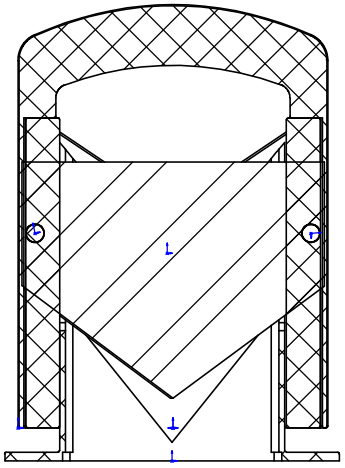
produce at these levels we would expedite all the processes in order to save money, and just do the assembly at our factory. When looking at 1000 units, the price is more reasonable to purchase the injection molding machine however even then still the possibility that it is worth it to expedite all the processes because there are even more considerations to manufacturing than the material cost and the machine cost, there is the employee cost, electricity, building space, and all that goes into the price of what the consumer pays so at 1000 units the injection molding isn't the best choice. We would produce on a mass scale of 10,000 units and up in order to properly justify purchasing all our own machinery and producing the system ourselfs.

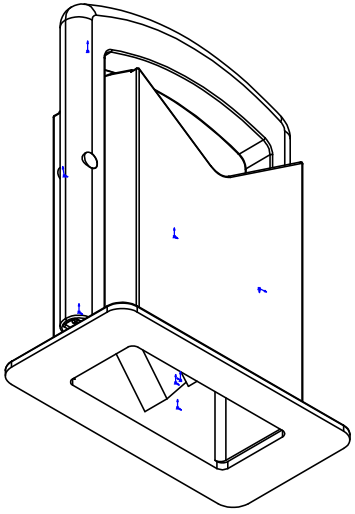


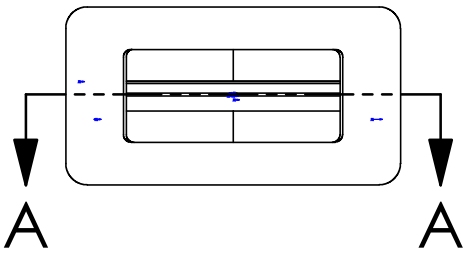













SECTION A-A

NO INDIVIDUAL COMPONENTS TOLERANCED, SEE FOLLOWING PAGES FOR DETAILED VIEW

MATERIAL: PVC & STAINLESS

FINISH:

QUANTITY: 1

| | NAME | DATE |
|---|---|---|
| ENGINEER | CHRISTIAN TELLO | 4/27/19 |
| CHECKED | | |
| ENG APPR. | | |
| MFG APPR. | | |
| Q.A. | | |

COMMENTS:

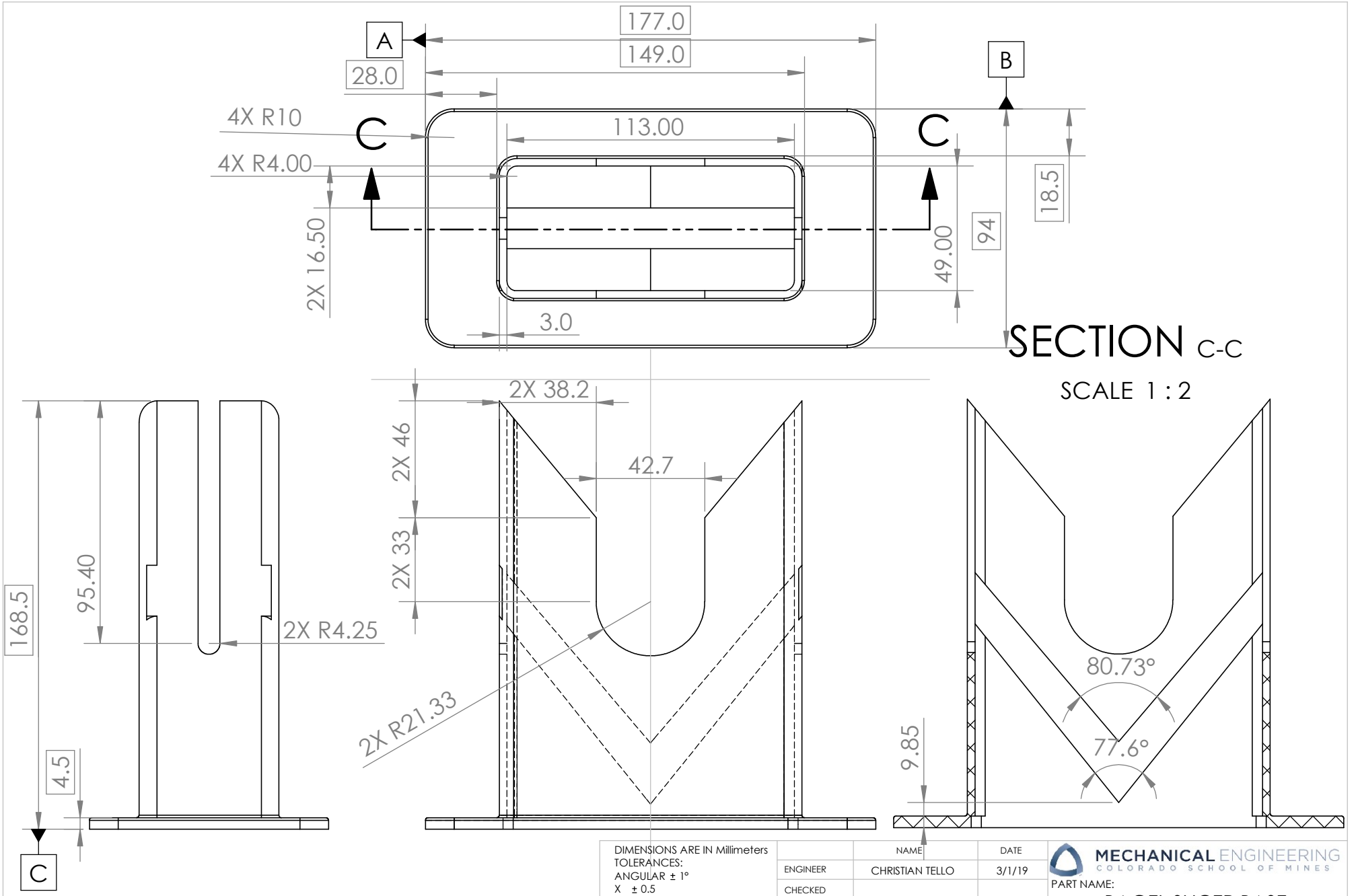
MECHANICAL ENGINEERING
COLORADO SCHOOL OF MINES

PART NAME: BAGEL GUILLOTINE

DESC: A PRODUCT DESIGNED BY "HOAN" FOR USE IN SLICING BAGELS.

| SIZE | PART NO. | REV. |
|---|---|---|
| A | 0 | |

SCALE: 1:4 | FILE : BAGEL SLICER ASSEMBLY | SHEET 1 OF 1




| | | |
|---|---|---|
| DIMENSIONS ARE IN Millimeters<br>TOLERANCES:<br>ANGULAR ± 1°<br>X ± 0.5<br>X.X ± 0.1<br>X.XX ± 0.05<br>X.XXX ± 0.005<br>UNLESS OTHERWISE SPECIFIED | | |
| MATERIAL: PVC | | |
| FINISH: | | |
| QUANTITY: 1 | | |

| | NAME | DATE |
|---|---|---|
| ENGINEER | CHRISTIAN TELLO | 3/1/19 |
| CHECKED | | |
| ENG APPR. | | |
| MFG APPR. | | |
| Q.A. | CHRISTIAN TELLO | 4/27/19 |

COMMENTS:

ALIGNMENT WAS BROKEN FOR THE PRESERVATION OF SECTION VIEW (C)

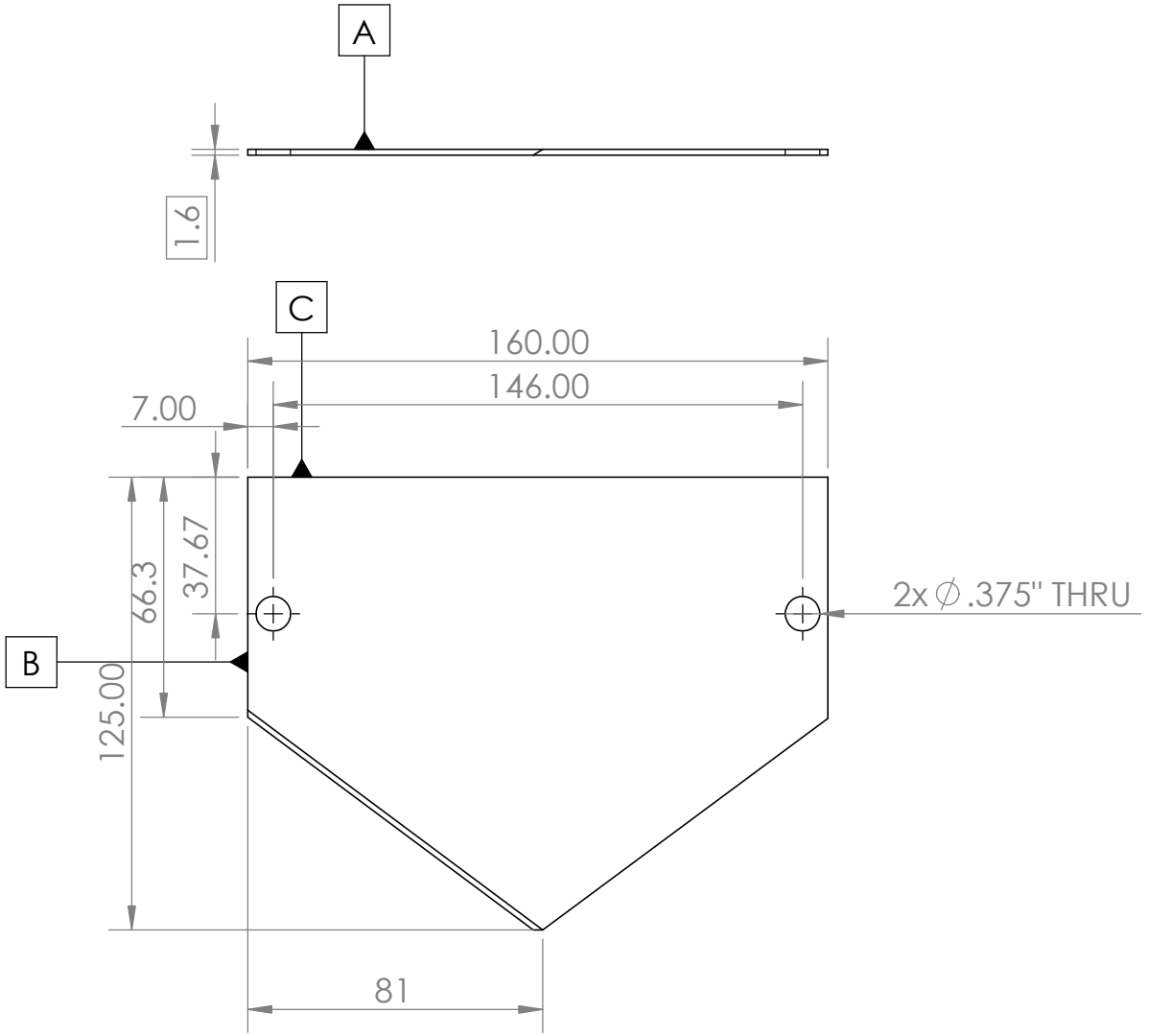
MECHANICAL ENGINEERING
COLORADO SCHOOL OF MINES

PART NAME:
BAGEL SLICER BASE

DESC:
THE BASE OF THE BAGEL SLICER, HAS A PLATFORM THAT WILL MAKE CONTACT WITH THE TABLE SURFACE. IT ALSO PREVENTS THE BLADE FROM HITTING THE TABLE SURFACE.

| SIZE | PART NO. | REV. |
|---|---|---|
| A | 1 | 2 |

SCALE: 1: 2 | FILE : BAGEL SLICER BASE | SHEET 1 OF 1




| | | |
|---|---|---|
| DIMENSIONS ARE IN MM<br>TOLERANCES:<br>ANGULAR: ± 1°<br>X ± 0.5<br>X.X ± 0.1<br>X.XX ± 0.05<br>X.XXX ± 0.005<br>UNLESS OTHERWISE SPECIFIED | | |
| MATERIAL: STAINLESS STEEL | | |
| FINISH: | | |
| QUANTITY: 1 | | |

| | NAME | DATE |
|---|---|---|
| ENGINEER | JESSE ORRIS | 3/4/2019 |
| CHECKED | | |
| ENG APPR. | | |
| MFG APPR. | | |
| Q.A. | CHRISTIAN TELLO | 4/27/19 |

COMMENTS:
THE DAIGONAL LINE SEEN ON THE EDGE RESULTS FROM A CHAMFER.

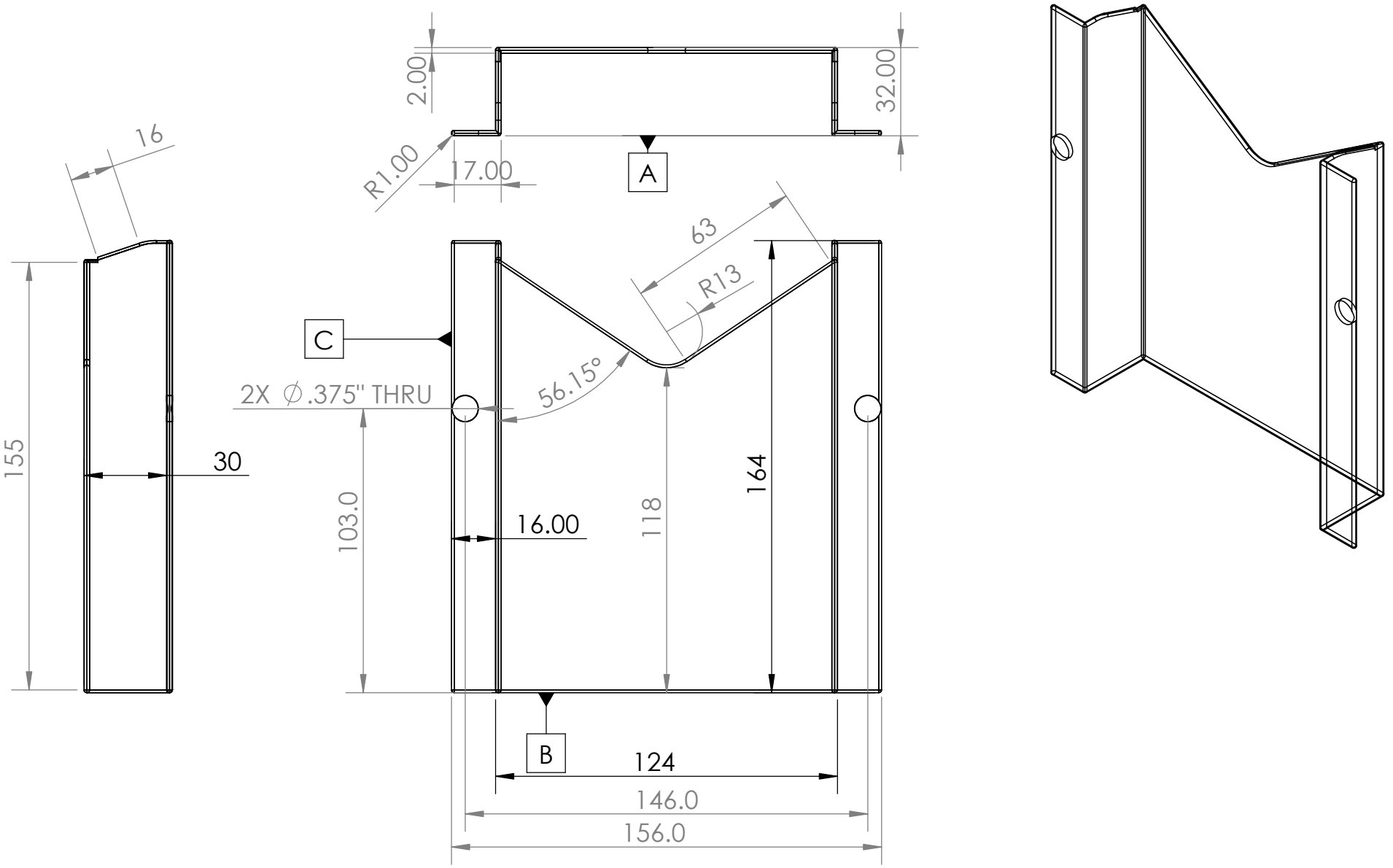
MECHANICAL ENGINEERING
COLORADO SCHOOL OF MINES

PART NAME:
BLADE

DESC:
STAINLESS STEEL BLADE THAT IS USED TO CUT BAGELS, HAS 2 PIN HOLES THAT ALLOW FOR IT TO BE MOUNTED INTO THE BAGEL GUILLOTINE

| SIZE | PART NO. | REV. |
|---|---|---|
| A | 3 | 2 |

SCALE: 1:2 | FILE : BAGEL SLICER BLADE | SHEET 1 OF 1






DIMENSIONS ARE IN MILLIMETERS
TOLERANCES:
ANGULAR: ± 1°
X ± 0.5
X.X ± 0.1
X.XX ± 0.05
X.XXX ± 0.005
UNLESS OTHERWISE SPECIFIED

MATERIAL: PVC

QUANTITY: 2

| | NAME | DATE |
|---|---|---|
| ENGINEER | MASON ELLIOTT | 3/4/2019 |
| CHECKED | | |
| ENG APPR. | | |
| MFG APPR. | | |
| Q.A. | CHRISTIAN TELLO | 4/27/19 |

COMMENTS:

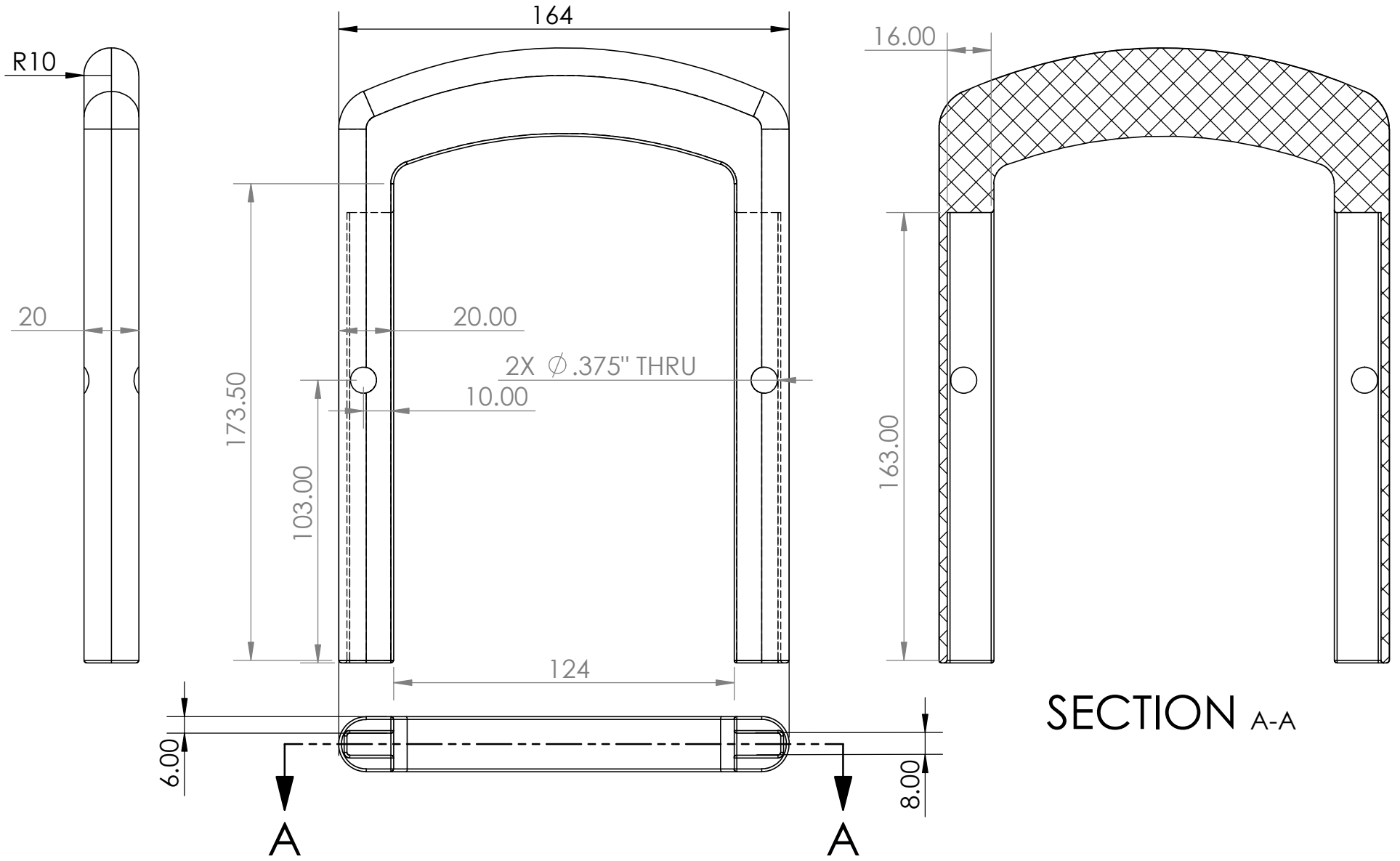
MECHANICAL ENGINEERING
COLORADO SCHOOL OF MINES

PART NAME: PVC SAFETIES

DESC: THIS TEMPLATE CONTAINS FILE PROPERTIES. OPEN: FILE PROPERTIES-> CUSTOM TAB TO QUICKLY POPULATE THIS TITLEBLOCK.

| SIZE | PART NO. | REV. |
|---|---|---|
| A | 2 | 2 |

SCALE: 1:2 | FILE : BAGEL SLICER - PROTECTORS & HANDLE | SHEET 1 OF 2




SECTION A-A

DIMENSIONS ARE IN MILLIMETERS
TOLERANCES:
ANGULAR: ± 1°
X ± 0.5
X.X ± 0.1
X.XX ± 0.05
X.XXX ± 0.005
UNLESS OTHERWISE SPECIFIED

MATERIAL: PVC

QUANTITY: 1

| | NAME | DATE |
|---|---|---|
| ENGINEER | MASON ELLIOTT | 3/4/2019 |
| CHECKED | | |
| ENG APPR. | | |
| MFG APPR. | | |
| Q.A. | CHRISTIAN TELLO | 4/27/19 |

COMMENTS:
ROUNDED TOP DIMENSIONS ARE NON-ESSENTIAL TO FUNCTION, ROUND TO REDUCE STRESS CONCENTRATIONS

MECHANICAL ENGINEERING
COLORADO SCHOOL OF MINES

PART NAME:
BAGEL SLICER HANDLE

DESC:
THE HANDLE & EXTERIOR OF THE BAGEL SLICER THAT ALLOWS FOR CONSISTENT FITMENT OF ALL STANDARDIZED PINS

| SIZE | PART NO. | REV. |
|---|---|---|
| A | 4 | 2 |

SCALE: 1:2 FILE : BAGEL SLICER - PROTECTORS & HANDLE SHEET 2 OF 2