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# VEGETABLE PEELER

## MECH 4250 OPERATIONAL READINESS REVIEW

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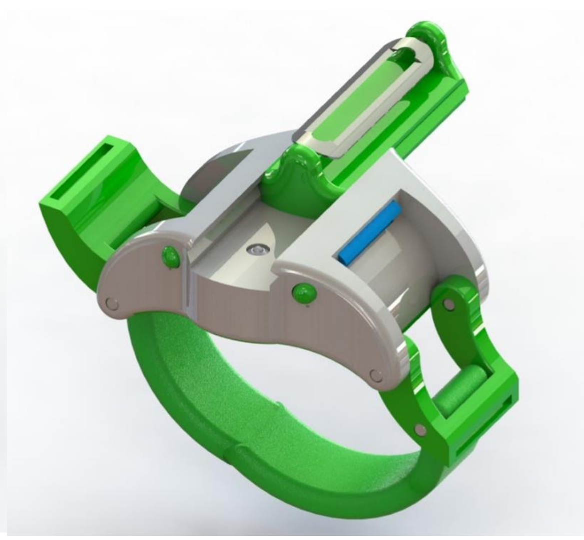
## SUMMARY:

In today's market, vegetable peeler designs focus solely on users who have full functionality of both hands. There are over three million people in the United States that have a limited functionality in one arm or hand. The primary objective of this project is to design a universal solution to peel vegetables with a focus on amputees and those with limited functionality in one arm or hand.

Keeping aesthetics and functionality in mind, the group has developed and analyzed several concept designs for the vegetable peeler. Through evaluations, the group and sponsor agreed upon a concept to move forward with. A proof-of-concept prototype has been built to determine the feasibility of the chosen design. The concept has been modified and re-engineered to allow the prototype to be 3-D printed using Acrylonitrile Butadiene Styrene (ABS).

The prototype performance succeeded in providing a proof-of-concept and being able to successfully peel various vegetables. Given the uniqueness of the product, we aimed our testing to focus on three parameters: comfort, ease, and preparation for use. Comfort and ease are two factors that are particularly important for the success of the prototype. The comfort and ease of the product for the user was evaluated on a scale from 1-10 where 10 is the best and 1 is the worst. The average comfort level and ease of use was 8.5 and 9.1, respectively. The preparation for use test outlines how long it takes for the user to attach the product to the appendage to be ready for use in a non-rushed fashion. Two time trials were taken averaging 6.27 seconds for trial 1 and 5.36 seconds for trial 2. The proof-of-concept prototyping process is further discussed in detail in the report.

**Isometric 1: Closed View**



**Isometric 2: Opened View**

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## INTRODUCTION

The primary objective of this project is to design a universal solution to peel vegetables with a focus of amputees and those with limited functionality in an arm or hand. There are over three million people in the United States that have a disability in their hand or forearm. Among amputees and people with other disabilities comes a challenge that is presented in the form of peeling vegetables, due to the need for full functionality in both hands. Through research of devices available in today's market, vegetable peeler designs only take users with functionality of both hands into consideration.

In the Concept Design Review (CDR), a systems engineering approach was used to systematically continue final development of the chosen design. The optimal re-design of band cuts cost and weight by transforming to a lighter, smaller, and sleeker overall design. Many parameters were implemented such as finite-element analysis and dimensioned drawings to validate the design. All materials and manufacturing processes for the product have also been verified.

The sponsor was pleased with the product presented at the CDR although their main concern was price. Although price is an important aspect of any design, price was not included in the requirements; therefore, we have decided to move forward with our design presented at the CDR at this time. Redesign to make the product more lean and cost efficient will come from upcoming groups.

This semester has been spent of Phase D of the Systems Engineering approach. Phase D encompasses system assembly, integration, and test and launch. The prototype is a proof of concept and has been assembled from ABS 3-D printed parts. The prototype is able to attach to the user and peel vegetables, but is not intended for kitchen use. Further parameters for the prototype are seen in the Manager's Project Contract of Deliverables (MPCOD).

## MISSION OBJECTIVE

The mission objective is to provide a vegetable peeling solution for individuals with limited functionality in one hand. Although the project targets specific users, it is meant to be a universal design. The solution will need to aesthetically pleasing assimilate into any kitchen environment.

## ARCHITECTURAL DESIGN DEVELOPMENT

The Adaptive Peeler Design is derived from the original adaptive band design of the peeler. In this design the chassis is made lighter, sleeker, and smaller while still preserving the necessary dimensions for proper functionality. The main feature provided by this design is the ease of discarding peelings as the vegetables are being peeled. The blade has been raised off of the blade assembly to prevent frequent peeling jams. Because there is less material used in this design than the previous designs, the costs due to materials are minimized slightly. The list below provides advantages and disadvantages of the Adaptive Peeler.

| ADVANTAGES | DISADVANTAGES |
|---|---|
| Easily/Safely Stored | Pinch Points |
| Manually Driven | |
| Dishwasher Safe | |
| Sleek and Attractive | |
| Universal | |
| Blade Oriented Parallel to Limb | |
| Detachable Blade | |
| User Friendly | |
| Minimal Rubbing Contact with Skin | |
| Double Edge, Swivel Blade | |

**Material Trade Studies:**

Surgical stainless steel was chosen for the blade, and other ordered parts of the design such as the pins. This material has excellent corrosion and oxidation resistance and also includes a variety of mechanical properties. It has a high creep and rupture strength, and it also has a maintainable attractive, shiny finish, and is also Food and Drug Administration (FDA) approved. The CES program was used in the determination of this material, which can be seen below.

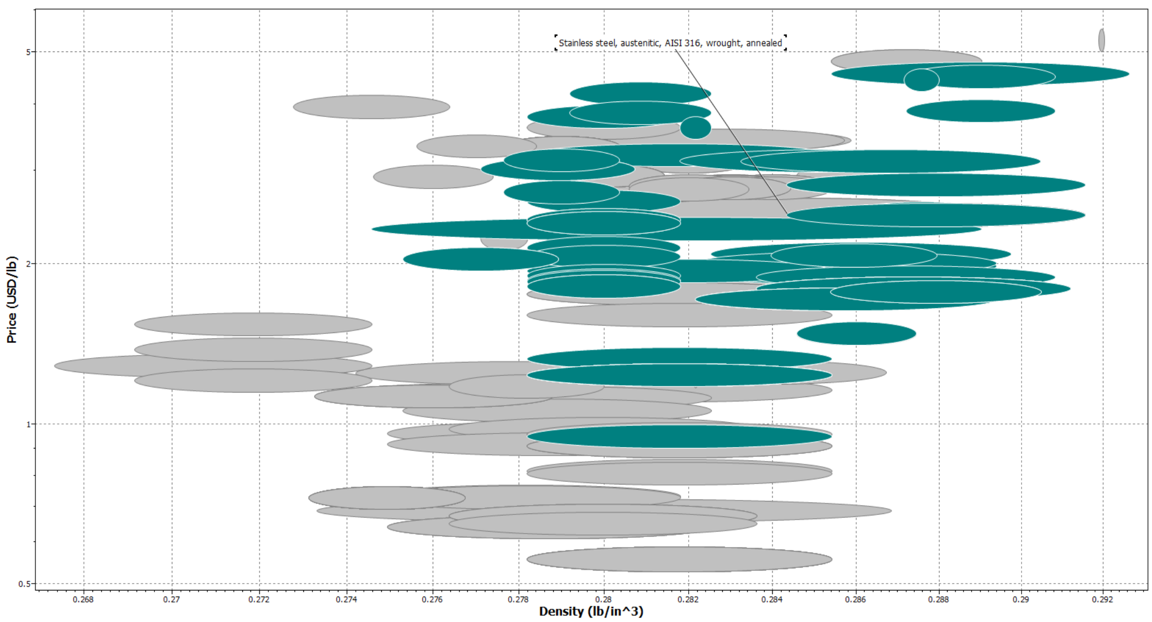



**Figure 1: Price vs. Density (Stainless Steel)**

As seen in **Figure 1**, CES is a very useful tool for appropriate material selection because multiple materials can be analyzed in a single plot. The grey shaded plots are the materials that did not pass the durability test that was set in CES.  The table below shows the durability ratings chosen to analyze the materials that were being considered.

**Table 1: Limits for Stainless Steel**

| Durability | Rating |
|---|---|
| Water (fresh) | Excellent |
| Water (salt) | Excellent |
| Weak acids | Excellent |
| Strong Acids | Acceptable |
| Weak alkalis | Excellent |
| Strong alkalis | Excellent |
| Organic solvents | Excellent |
| Oxidation at 500 C | Excellent |
| UV radiation (sunlight) | Excellent |
| Flammability | Non-flammable |

The resistance of a material in its unprotected conditions used in **Table 1** is categorized qualitatively on a four point scale: Unacceptable, Limited Use, Acceptable, and Excellent.  Only the stainless steel materials that are able to withstand the vegetable peeling and cleaning environment are colored to narrow down the material selection process.
After constricting the analysis of Stainless Steel to the most relevant materials, a detailed observation of each of the remaining material's properties and characteristics was done.  The best material to use for the blade and other ordered parts was determined to be Stainless steel, austenitic, AISI 316, wrought, annealed.  This material's typical uses include food-processing equipment and catering equipment, which is relevant because one or more of these parts will be in contact with the vegetable that will be peeled.  Below is a plot of this material's fatigue strength model.

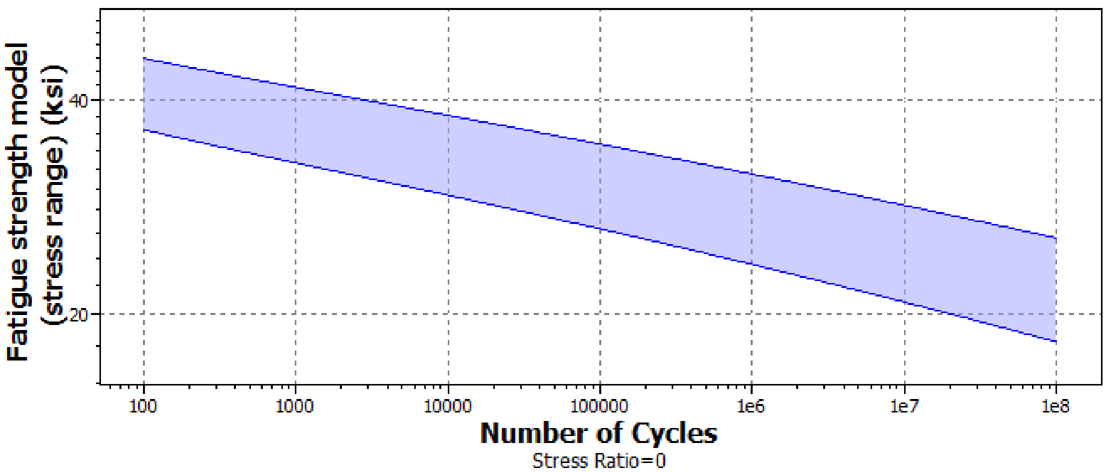



**Figure 2: Fatigue Strength Model**

A fatigue strength model is an estimate of the cyclic stress range that a material can survive given the number of cycles at a given stress ratio.  This model is for metals only and is a function of material properties such as Young's modulus, tensile strength, yield strength, and elongation.  As seen in **Figure 2** the stress ratio is equal to zero meaning that stress is applied and then relaxed each cycle, which is an accurate simulation of how the material will be used.

The CES program was also used to determine the material that is used for the chassis. Below is a CES plot of Young's Modulus relative to the price.

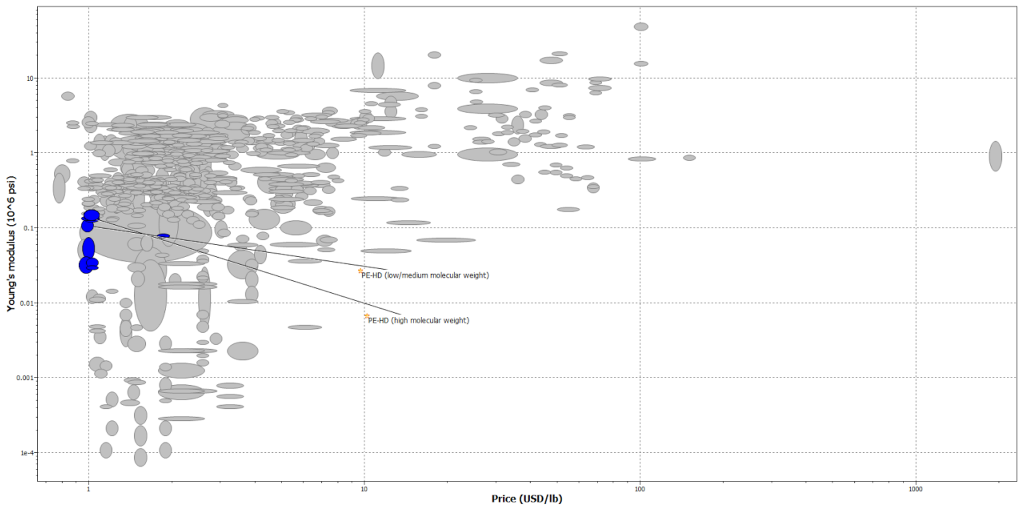



**Figure 3: Young's Modulus vs. Price (HDPE)**

As seen in **Figure 3** there is multiple gray plots of materials. The ability to injection mold this part is one of the main limitations used when analyzing materials for the chassis. Another useful CES plot is water absorption versus melting point.

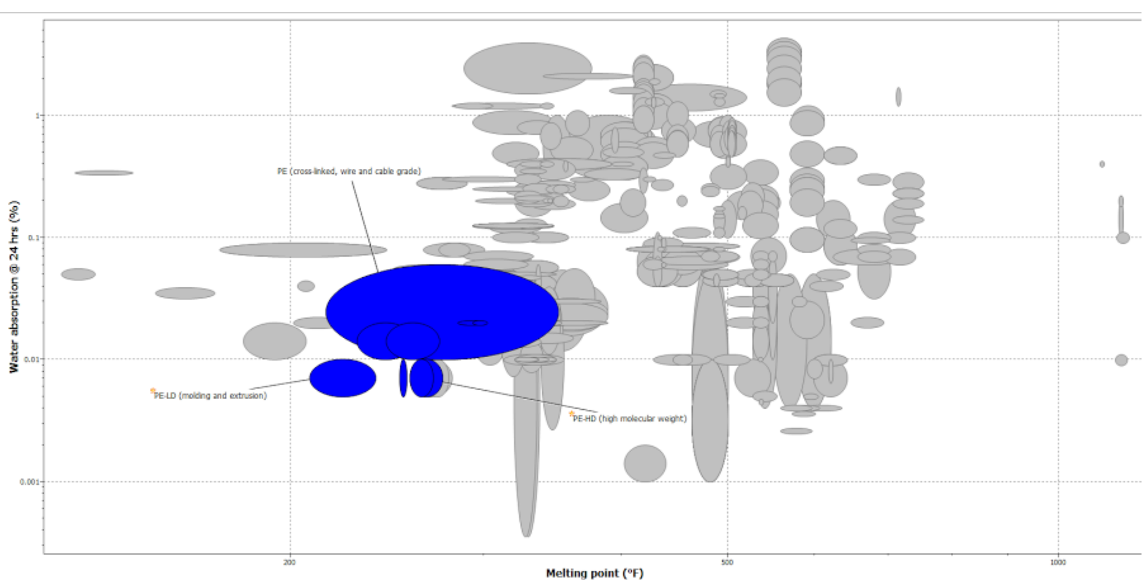



**Figure 4: Water Absorption vs. Melting Point**

As seen in **Figure 4** the remaining materials have a high enough melting point to withstand dishwasher conditions. This is important because many do not want to spend time hand washing dishes, and would much rather have dishwasher safe materials.

After closely observing the remaining materials' properties and characteristics, high density polyethylene (HDPE) was chosen as the material for the chassis. Its yield strength increases linearly with its density. It is a great selection for the peeler because of its low cost and good chemical resistance. It also has a high impact strength at low temperatures and a good friction and wear behavior. This material has a high tensile strength, better machinability, and a wide range of colors. It also has a pleasant finishing touch, which is important because parts of this material will come in contact with the user's wrist. To prove that HDPE is able to withstand forces that are applied when it is in use a finite element analysis focused on displacement.

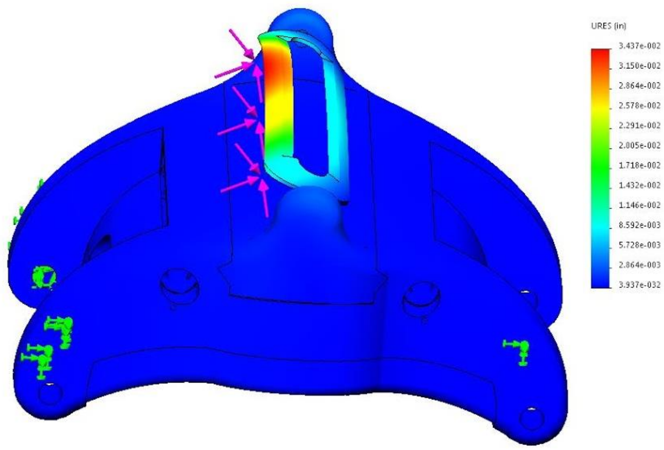



**Figure 5: Displacement**

To simulate the displacement analysis, an exaggerated force was applied to the blade as if the user were vigorously peeling a vegetable. As seen in Figure 5 the blade results in major displacement before any part of the chassis experiences any displacement.

CES was used to determine the most applicable material for the band. Ideally the properties of the desired material include a low Young's modulus, high yield strength and tensile strength, and an appealing hardness. Below is a plot from CES showing density vs. Young's Modulus and also a plot of tensile strength vs. yield strength.

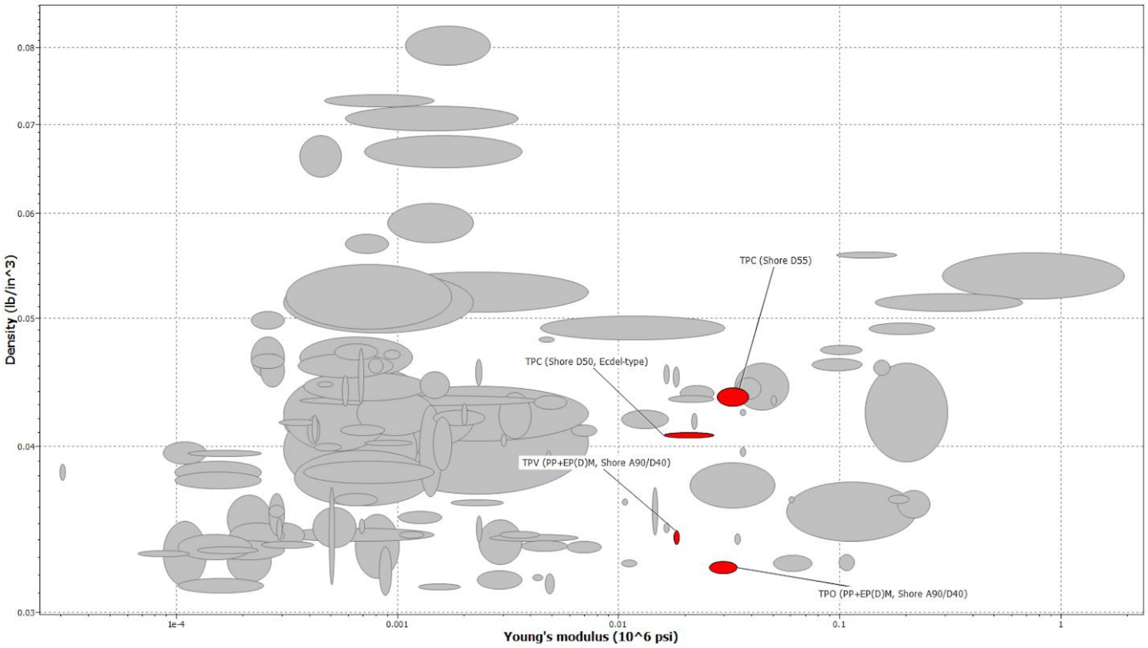



**Figure 6: Density vs. Young's Modulus (Polyurethane)**

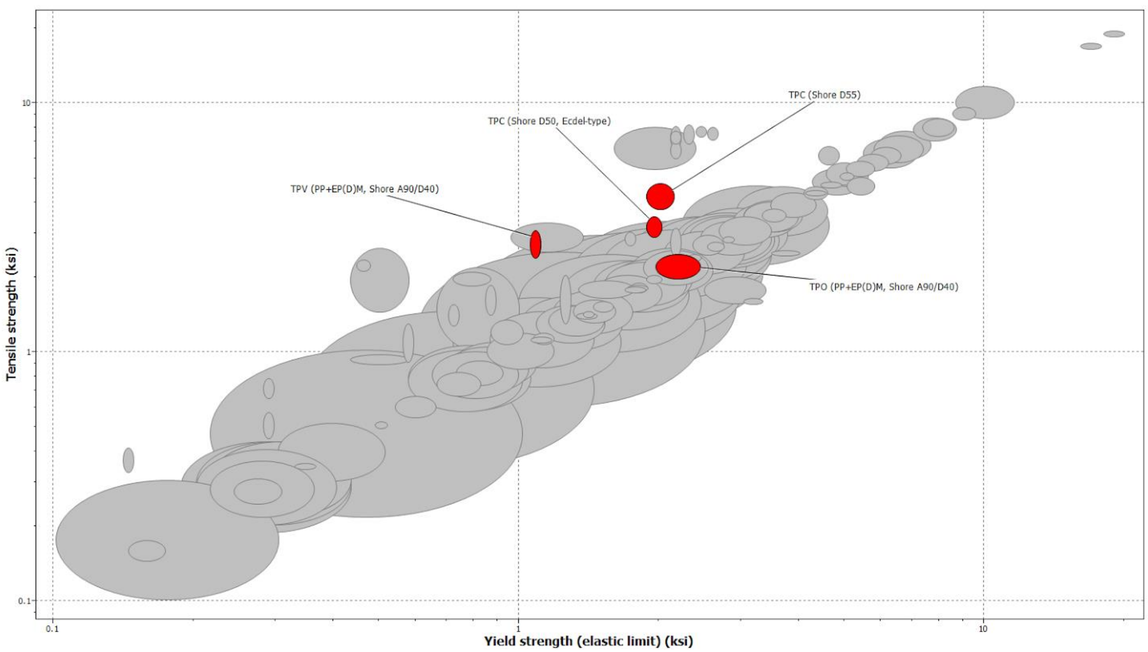



**Figure 7: Tensile Strength vs. Yield Strength (Polyurethene)**

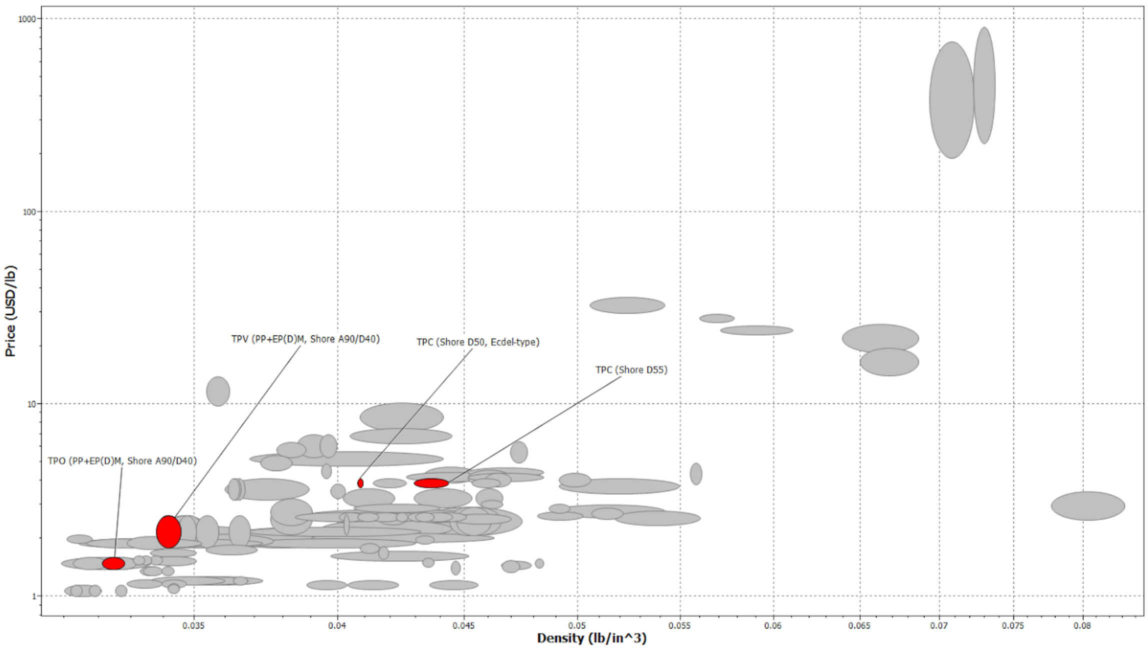


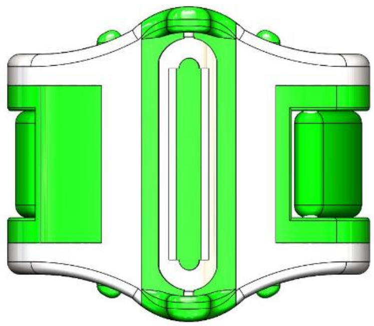

**Figure 8: Price vs. Density (Polyurethane)**

After analyzing multiple materials for the band, TPC (Shore D50) was concluded to be the best option for the band. This material has an elasticity, hardness, and density that can be defined in such a way that it meets all of the requirements. Other properties of this material include it durability and also its abrasion and oil resistance. This material is very light which is ideal for increasing productivity and minimizing user fatigue. These characteristics are crucial for products made for handling any food and/or products that incorporate contacts surfaces between the material and the user.

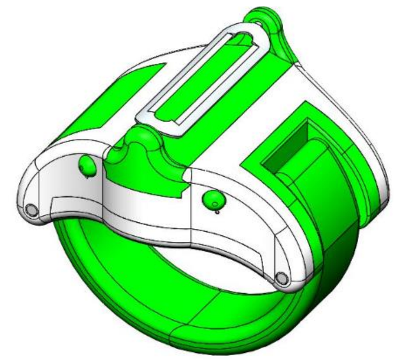
**Product Hierarchy:** Adaptive Peeler

- Adaptive Peeler
  - Chassis Sub-Assembly
    - Chassis
    - Chassis Base
    - Ergonomic Pad
  - Blade Sub-Assembly
    - Blade Housing
    - Blade
  - Band Sub-Assembly
    - Band
    - Retention Clasp
    - Tightening Clasp
  - Latch Sub-Assembly
    - Latch
    - Release Button

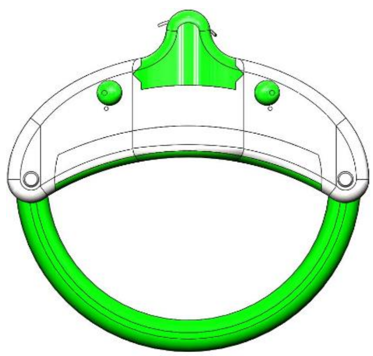
**Figure 9** below shows the isometric, top, side, and front view of the Adaptive Peeler.



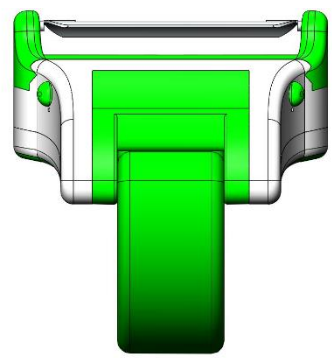
*(a) Top View*



*(b) Isometric View*



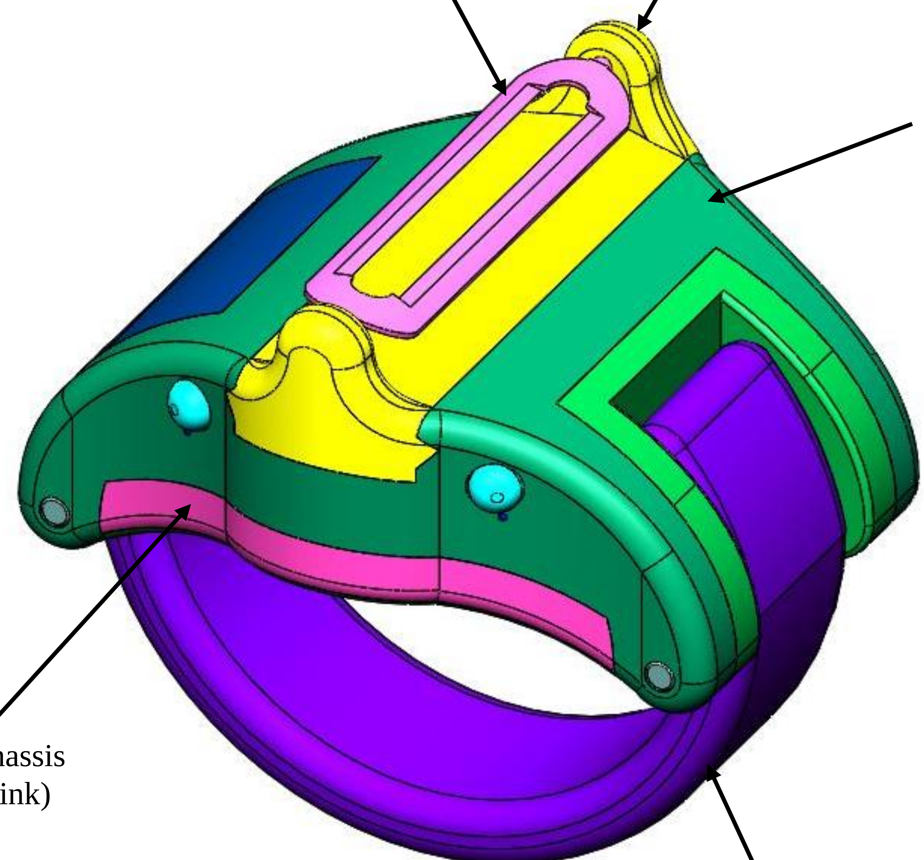
*(c) Front View*



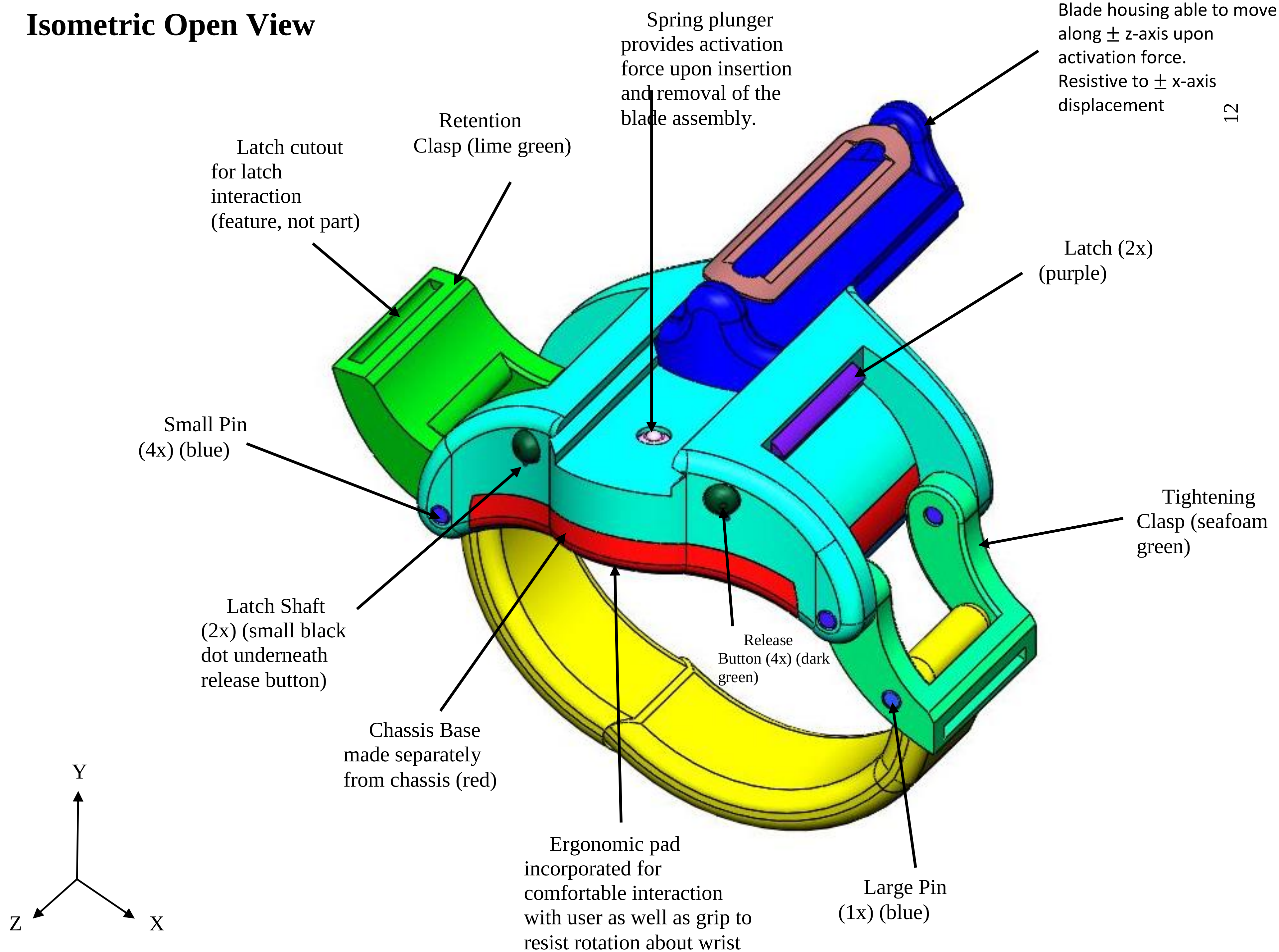
*(d) Side View*

**Figure 9: Adaptive Peeler**

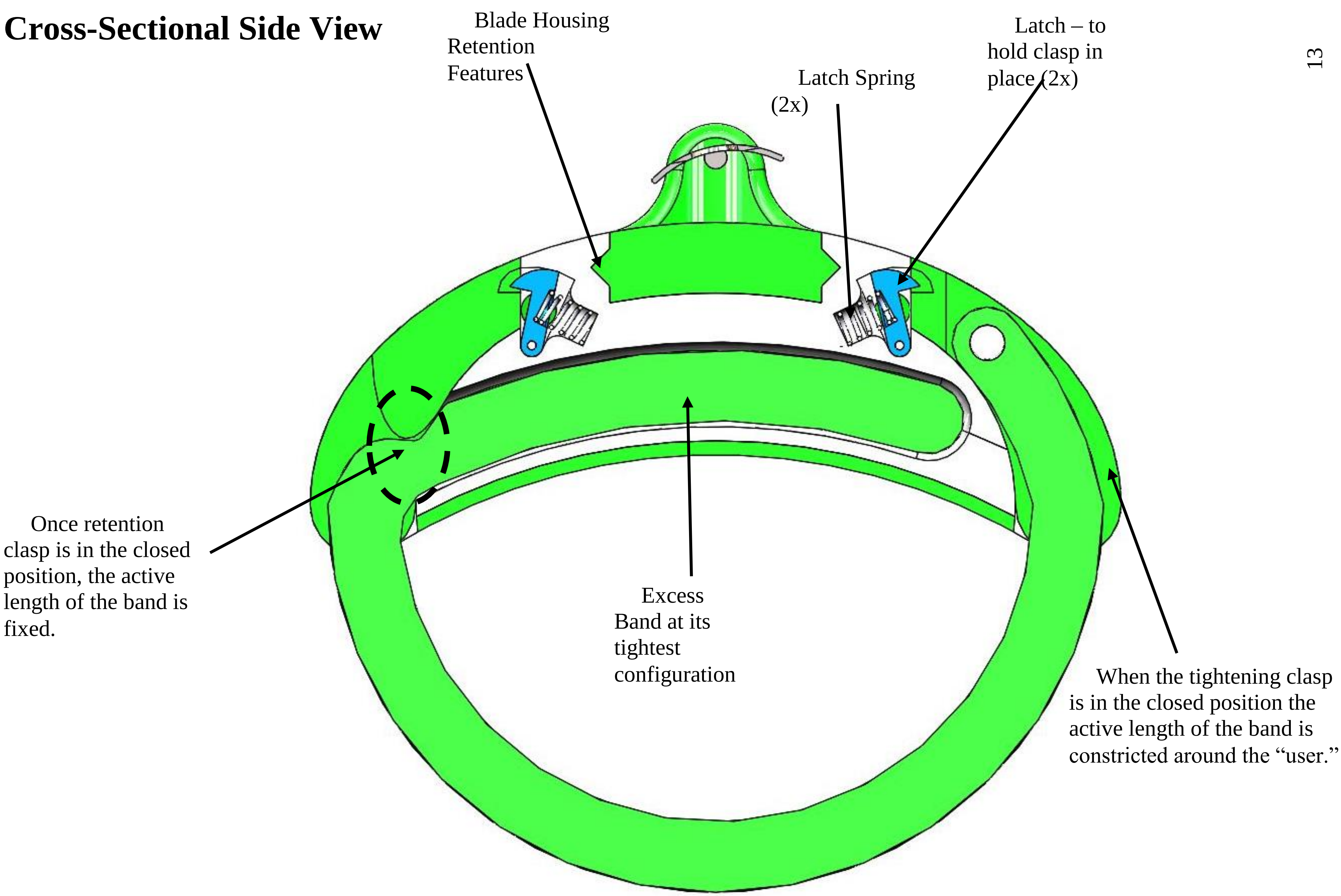
# Isometric View



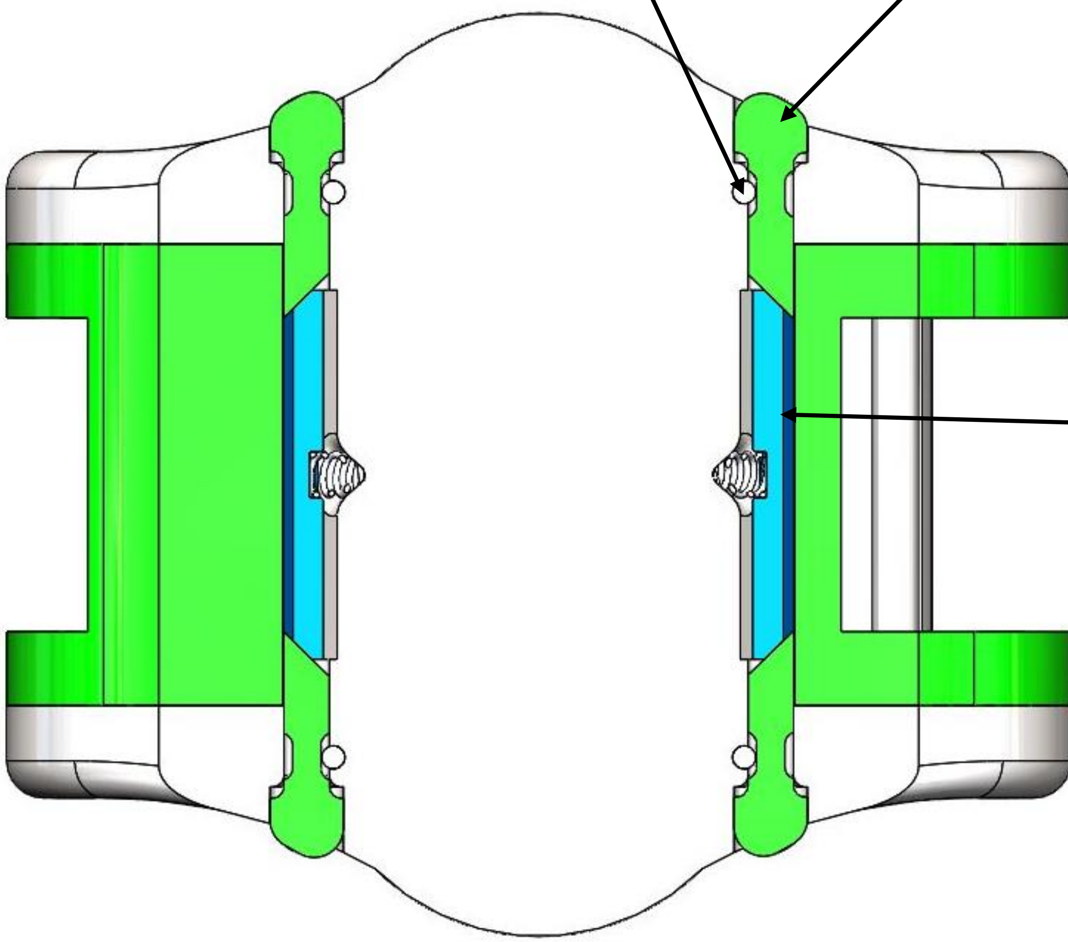
# Isometric Open View



# Cross-Sectional Side View



# Cross-Sectional Top View



**Bill of Materials:** Adaptive Peeler

**Cost to Manufacture One Peeler:**

| Manufacturer | Desired Product | Product Number | Quantity Per Product | Unit Price | Price Per Product |
|---|---|---|---|---|---|
| Amazon | Blade | N/A | 1 | $0.01 | $0.01 |
| McMaster-Carr | Small Pins | 9830A421 | 4 | $0.35 | $1.38 |
| | Large Pins | 98380A477 | 1 | $0.82 | $0.82 |
| | Latch Shaft | 8908K32 | 2 | $0.16 | $0.31 |
| | Latch Spring | 1986K43 | 2 | $0.84 | $1.67 |
| | Button Pin | 98380A421 | 8 | $0.41 | $3.27 |
| | Spring Plunger | 84895A31 | 2 | $4.58 | $9.16 |
| | | | | | **Total Cost Per Product = $16.63** |

## REQUIREMENTS

- Aesthetically appealing and blends in easily with other kitchen products
- Unique, Universal design that focuses on amputees and those with limited functionality in one arm or hand
- Blade assembly that has a double edge to allow peeling in both directions
- Ease of use for the user
- Features that will keep the user safe from incidental cuts
- Easily stored
- Able to be cleaned

Materials—Materials used in the construction of vegetable peelers shall comply with all Food and Drug Administration (FDA) specifications. Materials used shall be free from defects that would adversely affect the performance or maintainability of individual components of the overall assembly. Joints and seams in food zone shall be smooth and sealed.

Design and Manufacture—The vegetable peeler shall be complete so that when connected to the user the device can be used for its intended function. The vegetable peeler shall meet the then current applicable requirements of NSF/ANSI 8 and ANSI/UL 763.

## CONCEPT OF OPERATIONS

The implemented design will operate by being attached to the user's less functional appendage. Initially, the user will press the button on the retention clasp in order to adjust the active band length. The retention clasp is then locked, fixing the active band length. The tightening clasp is then released similar to the fashion of the retention clasp. The user will then place the band on his/her less dominant hand. The band is oriented such that the blade will be on the underside of the arm. The tightening clasp is then closed to its locked position. The blade sub-assembly is then inserted into its corresponding groove. The vegetable being peeled will be held stationary with the user's dominant hand with the intended peeling area facing upwards, towards the ceiling. The user's less dominant hand will then move the peeler, away from the body, across the area intended to be peeled. The user will then follow these steps in a backwards fashion to disassemble the band. This includes removing the blade housing and releasing the tightening clasp. At this point, the user is free to clean the peeler. The dishwasher is a safe method of cleaning. Lastly, the user will store the peeler. A schematic of the overall operation from user to storage can be seen in Figure 10.

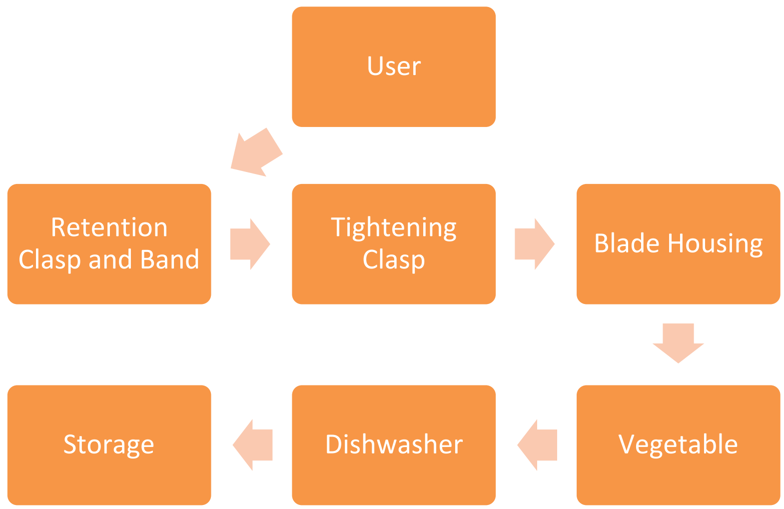



**Figure 10: Operations Schematic**

## VALIDATE AND VERIFY

At the beginning of the Summer 2016 semester, a prototype (**Figure 11**) was made by printing 3-D parts made out of ABS. The 3-D printed parts allowed the team to provide a proof-of-concept prototype. The prototype is fully functional but is not intended for kitchen use due to the band being made from a non-FDA approved material. After two failed 3D printing attempts, the design team changed the percent fill of the parts from 20%-30% to allow the parts to be stronger and more dense. In doing so, the parts proved to be through various test outlined below.

**Figure 11: Prototype Display**

**Prototype Testing:**

*Preparing for Use*

**Objective:** The objective of this experiment is to determine the average time that it takes the user to equip the vegetable peeler. It is also important to note any performance difficulties that may present themselves when conducting each test. The design is not adequate for the market that it is being sold for if the prototype does not uphold its simplicity throughout the entire peeling process, which including preparation.

**Analysis:** Each team member is timed while equipping the vegetable peeler twice. The fully assembled peeler is to be placed about waist height on a flat surface before beginning both timed portions of the experiment. This surface is used to simulate a kitchen counter. Individuals that are to be timed are recommended to place the prototype on their wrist in a non-rushed manor because kitchen preparation is not typically done in a racing fashion. For the first part, the time is to be started when the user touches the peeler and will be terminated once the user finishes adjusting the band to a desired fit. Once this test is complete have the user remove the prototype without making any band adjustments. For the second test, time the user putting the peeler on their wrist with the pre-adjusted band. The second test should be performed quicker than the previous test.

**Result:** The average time it takes for all users to properly equip the peeler on their wrists will be recorded, and the group will decide if this time is a pass or fail. The user's opinion is another factor in determining whether the prototype passes or fails the exam.

Desired Passing Time for Part 1:__7.00 s__________

Desired Passing Time for Part 2:__5.00 s__________

**Table 2: Preparing for Use Testing**

| | Time 1 [s] | Time 2 [s] | Appendage |
|---|---|---|---|
| *User 1:* | 7.00 | 3.43 | Hand |
| *User 2:* | 7.57 | 6.60 | Hand |
| *User 3:* | 4.30 | 3.98 | Wrist |
| *User 4:* | 5.73 | 3.73 | Hand |
| *User 5:* | 9.48 | 10.26 | Wrist |
| *User 6:* | 3.56 | 4.15 | Forearm |
| **Average:** | 6.27 | 5.36 | |

*Comfort of Use/Simplicity of Use*

**Objective:** The objective of this experiment is to rate the comfort and simplicity of the prototype as two separate ratings while it is in use. The product is designed to allow the user to perform the act of peeling vegetables with ease, so it is important to obtain feedback from the peeling process. Comfort is another consideration that was taken into account when designing the vegetable peeler, so testing the comfort level of the prototype is also essential.

**Analysis:** Each team member from Corp 7 is to peel a vegetable of choice at their own leisure. This is not a timed event, and like the previous test, it is not intended to be rushed. The experiment begins when the current user begins to peel the vegetable with the prototype already adjusted on their wrist of choice. The test ends once the user has peeled the entire vegetable or once the user has a good enough sense of how the prototype performs when in use. It is important to keep in mind how the prototype feels and how simple the prototype is when it is in use. Once each experiment is complete, the user is to rank the comfort and simplicity of the prototype separately on a scale of 1 to 10. Once all group members have completed the test and ranked the prototype's comfort and simplicity, the rankings of the comfort and the simplicity are to be averaged separately so that there is now only an average comfort ranking and an average simplicity ranking.

**Result:** Any scores ranging from 1 to 5 is a failing score. Rankings ranging from 6 to 10 are passing scores.

**Table 3: Comfort of Use/Simplicity of Use Testing**

| | **Comfort (1-10)** | **Ease (1-10)** | **Vegetable** | **Blade** | **Time (s)** |
|---|---|---|---|---|---|
| *User 1:* | 8 | 9 | Cucumber | Serrated | 29.10 |
| *User 2:* | 9 | 10 | Carrot | Serrated | 20.42 |
| *User 3:* | 9 | 9 | Carrot | Non-serrated | 30.20 |
| *User 4:* | 8.5 | 8.5 | Cucumber | Non-serrated | 26.34 |
| *User 5:* | 8 | 9 | Potato | Non-serrated | 40.05 |
| **Average:** | 8.5 | 9.1 | - | - | 29.22 |

The prototype proved to be successful due to the ease, comfort, and overall functionality for the user. The vegetables were peeled in a timely manner using the device on various vegetables and with different blades.

## INTERFACES

The main interfaces with the peeler are between the user and the peeler and also between the peeler and the vegetable. The risk of discomfort arises from the contact of the peeler and the user's wrist. There is also a risk of incidental cuts while operating the peeler, and would most likely occur between the blade and the vegetable that is being peal. An additional interface occurs between the band and the tightening clasp. Once the desired ideal fit has been selected for the user, there is an interface between the band and retention clasp. The two interfaces between the clasps affect the interface between the band and the user.

## MISSION ENVIRONMENT

The mission environment consists of exposure to microorganisms, extreme heat, and water. The vegetable peeler will have to overcome exposure to microorganisms it will come in contact with that are on the surface of the produce that will be peeled. Broken materials and particles from produce can remain behind in the peeler thus contaminating the next piece of produce the peeler will touch. Therefore, the vegetable peeler needs to be washed between every use. Along with the exposure to microorganisms on produce, the vegetable peeler will have to be able to withstand the intense conditions in a dishwasher. Unlike manual dishwashing, which relies largely on physical scrubbing to remove soiling, the mechanical dishwasher cleans by spraying hot water, typically between 55 and 75 °C (130 and 170 °F), at the dishes, with lower temperatures used for delicate items. The PH level in the dish detergent is another condition to be considered in the dishwasher. The vegetable peeler's material properties cannot be altered due to prolonged exposure to extreme heat, water conditions, and intense PH levels.

## TECHNICAL RESOURCE BUDGET TRACKING

The vegetable peeler must be a light yet rigid object to allow optimal peeling. To reduce user fatigue, the mechanism must be light weight. Although the peeler needs to be light it must also be rigid to resist rotational motion about the limb inflicted by the peeling motion. A breakdown of weight by component can be seen in Table 1 below. For perspective purposes, and iPhone 6 weighs 6.07 oz.

**Table 4: Technical Resource Budget Tracking**

| Subsystem | Component | Material | Volume (in^3) | Density (lb/in^3) | Mass (lb) | Mass (g) | Weight per (oz) | Qty | Weight (oz) |
|---|---|---|---|---|---|---|---|---|---|
| **Chassis** | Chassis | HDPE | 1.53 | 0.03 | 0.0459 | 20.8198 | 0.7344 | 1 | 0.7344 |
| | Chassis Base | Polyurethane | 0.68 | 0.03 | 0.0204 | 9.2532 | 0.3264 | 1 | 0.3264 |
| **Blade** | Blade Housing | HDPE | 0.51 | 0.03 | 0.0153 | 6.9399 | 0.2448 | 1 | 0.2448 |
| | Blade | Stainless Steel | 0.01 | 0.28 | 0.0028 | 1.2700 | 0.04480 | 1 | 0.0448 |
| **Latch** | Latch | HDPE | 0.03 | 0.04 | 0.0012 | 0.5443 | 0.0192 | 2 | 0.0384 |
| | Latch Shaft | HDPE | 0.00136 | 0.04 | 0.00005 | 0.0246 | 0.0008 | 2 | 0.0017 |
| | Latch Spring | Purchased | 0.00048 | 0.036 | 0.00001 | 0.0078 | 0.0003 | 2 | 0.0005 |
| **Other** | Small Pins | Purchased | 0.00584 | 0.04 | 0.00023 | 0.1059 | 0.0037 | 4 | 0.0149 |
| | Release Button | HDPE | 0.01 | 0.03 | 0.0003 | 0.1360 | 0.0048 | 4 | 0.0192 |
| | Button Pin | | 0.00178 | 0.04 | 0.00007 | 0.0323 | 0.0011 | 4 | 0.0045 |
| | Tightening Clasp | HDPE | 0.16 | 0.03 | 0.0048 | 2.1772 | 0.0768 | 1 | 0.0768 |
| | Retention Clasp | HDPE | 0.28 | 0.03 | 0.0084 | 3.8101 | 0.1344 | 1 | 0.1344 |
| | Large Pin | Purchased | 0.01659 | 0.04 | 0.0007 | 0.3010 | 0.0106 | 1 | 0.0106 |
| | Band | TPC Shore (D50) | 1.38 | 0.04 | 0.0552 | 25.0383 | 0.8832 | 1 | 0.8832 |
| | | | | | | | Total Weight (oz) | | 2.5348 |

## RISK MANAGEMENT

There are many risks and safety hazards associated with using any vegetable peeler. The blade assembly could possibly inflict severe cuts to the user if used improperly. To counteract this risk, safety measures have been considered such as the blade safety cover. The blade safety cover fully covers the exposed blade when it is not in use, thus minimizing incidental cuts. There are two precautions that should be taken into account when interacting with the peeler. The two precautions are that the user should cut away from their body and that children should be supervised when using the device. Discomfort is also a potential risk. Discomfort can occur between the chassis and the wrist of the user. This discomfort has been counteracted with a pad to provide a more comfortable and stable experience when peeling vegetables. A higher risk of discomfort is present if the band is not tightened enough. The looseness of band is counteracted by the latching mechanism. Another risk that arises when using the peeler is pinch points that may cause discomfort and potentially harm the user. These pinch points come from the slim adaptive band. These pinch points can be avoided by securing the band with caution and care. In the event of excessive force to the band, the band itself could break. Material optimization is of the utmost importance to ensure this safety parameter doesn’t occur. All materials the peeler are made of have been closely analyzed to ensure there is no harm done to the food and to the skin that it comes in contact with. Each material has been compared to a wide range of materials and limited to the best option for its specific purpose. The main limitation for material selections used for the peeler is that each material must be able to withstand corrosion caused by certain chemicals in foods that will be handled by the product.

## CONFIGURATION MANAGEMENT AND DOCUMENTATION

The team utilizes the Google Drive to update documents, drawings, and excel spreadsheets in real time. At all times the documents are as up to date as possible causing minimal confusion between team members. To document major tasks amongst team members, a contract of deliverables (COD) is drafted by the assignee to ensure the manager and assignee are clear on the task at hand. Once the COD is drafted, the manager and assignee sit down with document in hand to review the task and determine a suitable due date which is then reflected in the working schedule (Appendix).

## SUBSYSTEMS DESIGN ENGINEERING

The first subsystem is the chassis sub-assembly seen in Figure 5. It is the main body of the adaptive peeler. It consists of the chassis, chassis base, ergonomic pad, and two spring plungers. All of these parts are unique with the exception of the spring plunger which can be purchased from McMaster-Carr. This subsystem supports the attachment and function of all of the other sub-assemblies. Some of those include the band cavity, attachment features for components of the latch and band sub-assembly, and retention features for the blade sub-assembly.

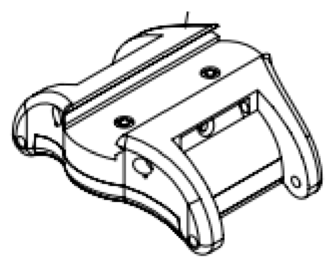


**Figure 12: Chassis Sub-Assembly**

The second subsystem is the blade sub-assembly seen in Figure 6. It includes the blade and the blade housing. This slides into the chassis with a satisfying click. The whole device is designed for machine washing, however, the blade detaches for easier cleaning. The blade will be purchased and the blade housing is designed to withstand all forces applied to the blade. The sliding motion is also orthogonal to the peeling motion, therefore the peeling will not cause the sub-assembly to slide free. In addition to that, it take a certain activation force (provided by the spring plungers) to insert or remove the blade sub-assembly.

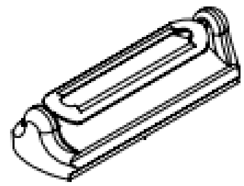


**Figure 13: Blade Sub-Assembly**

The third subsystem is the band sub-assembly seen in Figure 7. This includes the band, retention clasp, tightening clasp, a large pin, and four small pins. It is an original design that can be easily adjusted with infinite resolution to a wide range of diameters, while also being durable and flexible. There is a pinch point against the chassis sub-assembly on the side of the retention clasp that fixes the active band length when the retention clasp is closed. The portion of the band that is not active is stored inside of the band cavity (in the chassis sub-assembly). The tightening clasp cinches the active band length around the user. Both clasp are held closed by the latch sub-assemblies.

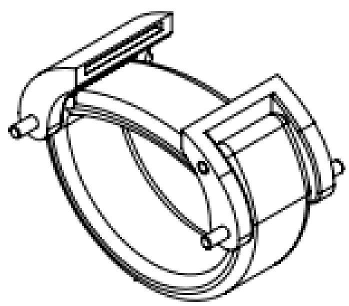


**Figure 14: Band Sub-Assembly**

The last subsystem is the latch assembly, seen in the figure below. The adaptive peeler requires two of these sub-assemblies, one for each clasp. The latch assembly consists of a latch, a latch spring, a latch pin, two release buttons and two button pins. The pins and springs are purchased parts from McMaster, the others are unique. It is designed so that pressing a button on either side will move the latch and release the corresponding clasp.

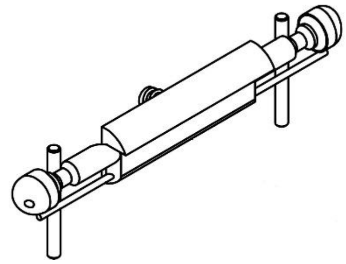


**Figure 15: Latch Assembly**

Dimension drawings sufficient so that parts can be made and detailed drawings can be found in the Appendix.

## PROJECT MANAGEMENT

Project management is a key aspect to ensure an exceptional product. By incorporating various measures, such as time management and communication, the team excels and little to no time is wasted. To drive communication and offer the most up to date documents the team has utilized applications such as Google Drive and Group Me. Each individual is assigned a specific role from the contract of deliverables (Appendix) to complete by the deadline. These roles are assigned to capitalize off each individual's various skills.
Many milestones have been completed since the Final Review including:

1. 3-D File Creation
2. 3-D Printed Parts Completion
3. Completed Provisional Patent
4. Molding Quote Completion for Mass Production
5. Completed Prototype Assembly
6. Completed Testing of Prototype
7. Design Notebook Completion

A completed schedule for the semester can be seen in the Appendix.

Prototyping cost can be seen in the **Table 5**: Expendituresbelow. All parts were ordered from McMasterr-Carr.

**Table 5: Expenditures**

| **Part #** | **Description** | **Quantity** | **Price** |
|---|---|---|---|
| 30585A85 | #68 Drill Bit | 1 | $1.31 |
| 30585A44 | #31 Drill Bit | 1 | $1.16 |
| 30585A68 | #53 Drill Bit | 1 | $1.16 |
| 8870A18 | ⅛ Drill Bit | 1 | $1.20 |
| 30585A44 | 1/32   Drill Bit | 1 | $1.48 |
| - | Watch Band | 1 | $8.00 |
| - | Vegetable Peeler | 1 | $3.97 |
| 98380A421 | Button Pin | 1 | $10.22 |
| 98380A477 | Large Pin | 1 | $8.23 |
| 1162K850 | Latch Shaft | 2 | $43.78 |
| 1986K430 | Latch Spring | 1 | $5.01 |
| 98380A481 | Small Pin | 1 | $8.64 |
| 84895A310 | Spring Plunger | 2 | $9.16 |
| 84895A61 | Spring Plunger | 2 | $8.36 |
| 86375K122 | Polurethane Foam Sheet | 1 | $10.17 |
| 8716K64 | Polurethane Rubber Sheet | 1 | $59.52 |
| | | | $181.37 |

The cost to mass produce the adaptive peeler has many different factors to take into consideration. The first cost would be the cost of the molds, which is also the upfront cost. The upfront cost varies depending on the company chosen. In this cost analysis three companies were looked ProtoLabs, ICOMold, and Xcentric. A quote was acquired for the less and most complex part, then linear regression was used to estimate the mold cost and the cost per part of all the parts in between. Next, the total cost of the product was summed up using these values and the cost of our McMaster Carr parts. Now that the total price for one product is known, a selling price can be decided upon. To find the breakeven point factors such as labor cost, assembly time, percent sold, product cost/sell price were all considered. There is an infinite number of scenarios that can be looked at, but only a few were evaluated. The time to breakeven ranged from less than a year to 5 years and could easily be more depending on different situations. This information is demonstrated in the tables and figures below.

**Table 6: Linear Regression**

| Linear Regression | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| For 7 Unique Parts | | ProtoLabs Mold | ProtoLabs Cost Per Parts | | ICO Mold | ICO Cost Per Parts | | Xcentric Mold | Xcentric Cost Per Parts (1) |
| (Latch) | 1 | $ 5,098.00 | $ 1.42 | | $ 2,030.00 | $ 0.38 | | $ 4,194.00 | $ 4.33 |
| . | 2 | $ 5,443.33 | $ 1.50 | | $ 2,403.33 | $ 0.57 | | $ 6,741.50 | $ 4.83 |
| . | 3 | $ 5,788.67 | $ 1.57 | | $ 2,776.67 | $ 0.76 | | $ 9,289.00 | $ 5.34 |
| . | 4 | $ 6,134.00 | $ 1.65 | | $ 3,150.00 | $ 0.96 | | $ 11,836.50 | $ 5.84 |
| . | 5 | $ 6,479.33 | $ 1.73 | | $ 3,523.33 | $ 1.15 | | $ 14,384.00 | $ 6.34 |
| . | 6 | $ 6,824.67 | $ 1.80 | | $ 3,896.67 | $ 1.34 | | $ 16,931.50 | $ 6.85 |
| (Chassis) | 7 | $ 7,170.00 | $ 1.88 | | $ 4,270.00 | $ 1.53 | | $ 19,479.00 | $ 7.35 |
| | **Total** | $ 42,938.00 | $ 11.55 | | $ 22,050.00 | $ 6.69 | | $ 82,855.50 | $ 40.88 |

**Table 7: Cost Comparison**

| | ProtoLabs Mold | ICO Mold | Xcentric Mold |
|---|---|---|---|
| Cost of 1 Product | $ 28.18 | $ 23.31 | $ 57.51 |
| McMaster Carr Price % | 59% | 71% | 29% |
| Casting Price % | 41% | 29% | 71% |

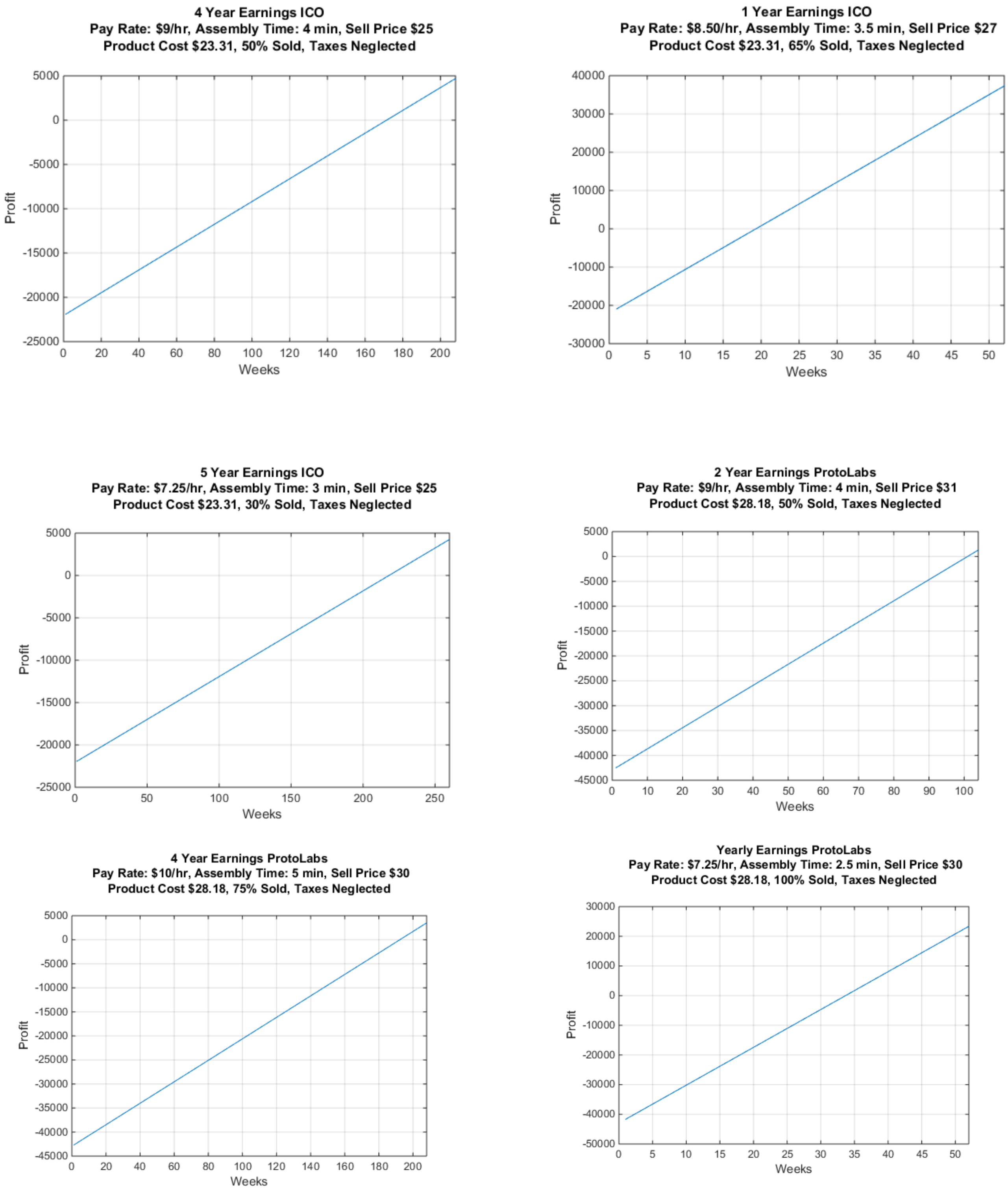



**Figure 16: Breakeven Projections**

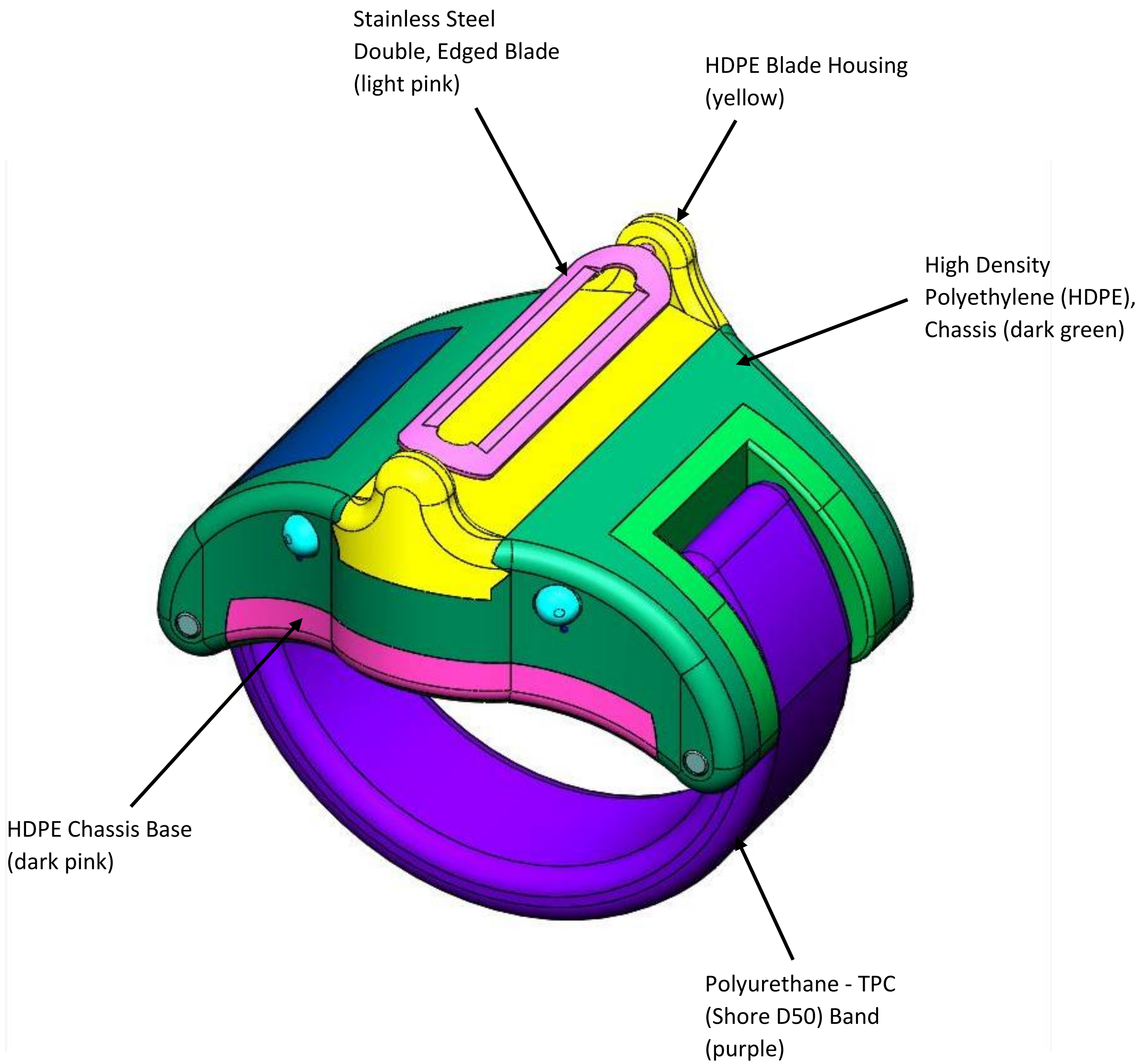
## **CONCLUSIONS**

Over the course of this project, many things were learned and ideas developed. Some of the most notable include user preferences, details of orchestrating mass production, and the FDA regulations on materials and surface finishes. When we first imagined solutions for our project we thought mechanization and automation was going to be desired, but as we discussed and evaluated concepts with our technical advisors we learned that the users would like to be very involved in the peeling process and for it to be as similar as possible to the normal peeling process. That is what lead us to develop the concept that attaches in a similar fashion to a watch. When evaluating different methods for production, many criteria have to be considered at once. Materials have to be chosen that are cost effective, have desired properties, FDA approved, and can be manufactured using the desired method. Injection molding quickly became the best choice for the non-metal components, as it will result in a FDA approved surface finish, can quickly, repeatability, and efficiently produce the complex, ergonomic shapes. It is also a compatible manufacturing method for HDPE which is our recommended material for rigid non-metal components. We also learned that the most effective ways to reduce the cost per peeler would be to reduce the number of parts and to use all the off-the-shelf parts possible. Finally, we would encourage anyone pursuing this project to thoroughly research the FDA regulations that are relevant to this product, because they are extensive and specific.

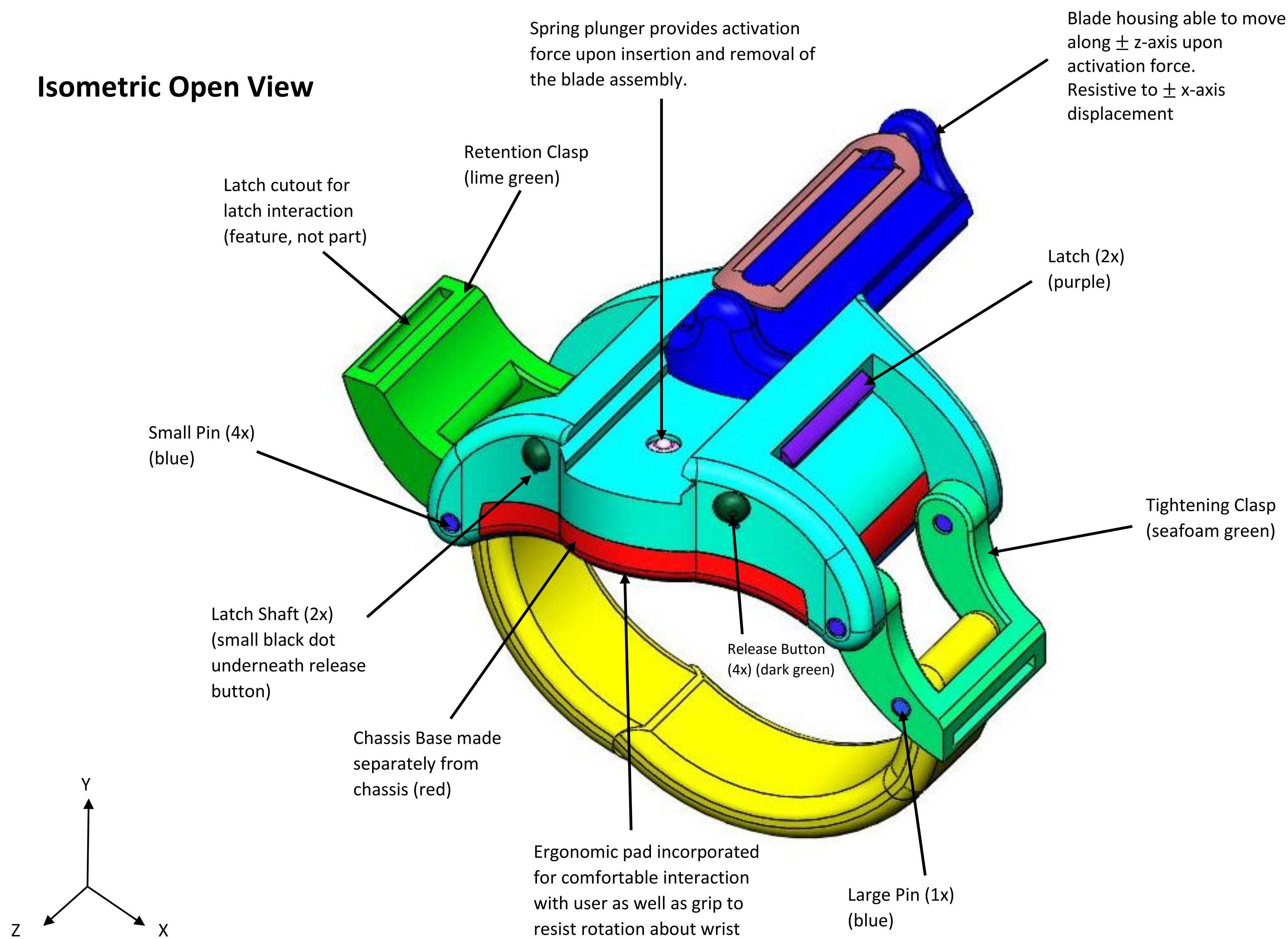
Our recommendations for continuing this project and to bring it to mass production include continued prototyping using the intended manufacturing techniques (or simulated manufacturing techniques) and then developing a plan for the complex process of launching production. We recommend additional prototyping using the intended manufacturing because virtually every product will have some amount of revision that optimizes it for mass production and user preferences. It also only stands to reason that one would want to validate not only the peeler but the manufacturing methods themselves. Furthermore, launching mass production can be significantly more complex than it may seem on first glance. That is why our group recommends another group of engineers continues this project in developing a detailed plan that when executed would successfully launch well-orchestrated mass production. This would include sources for raw materials, transportation of parts, assembly, and even packaging and marketing. So even though the product itself is pretty well developed at this point, we do not feel that it is ready for an immediate launch of mass production.

**APPENDIX**

## Isometric View

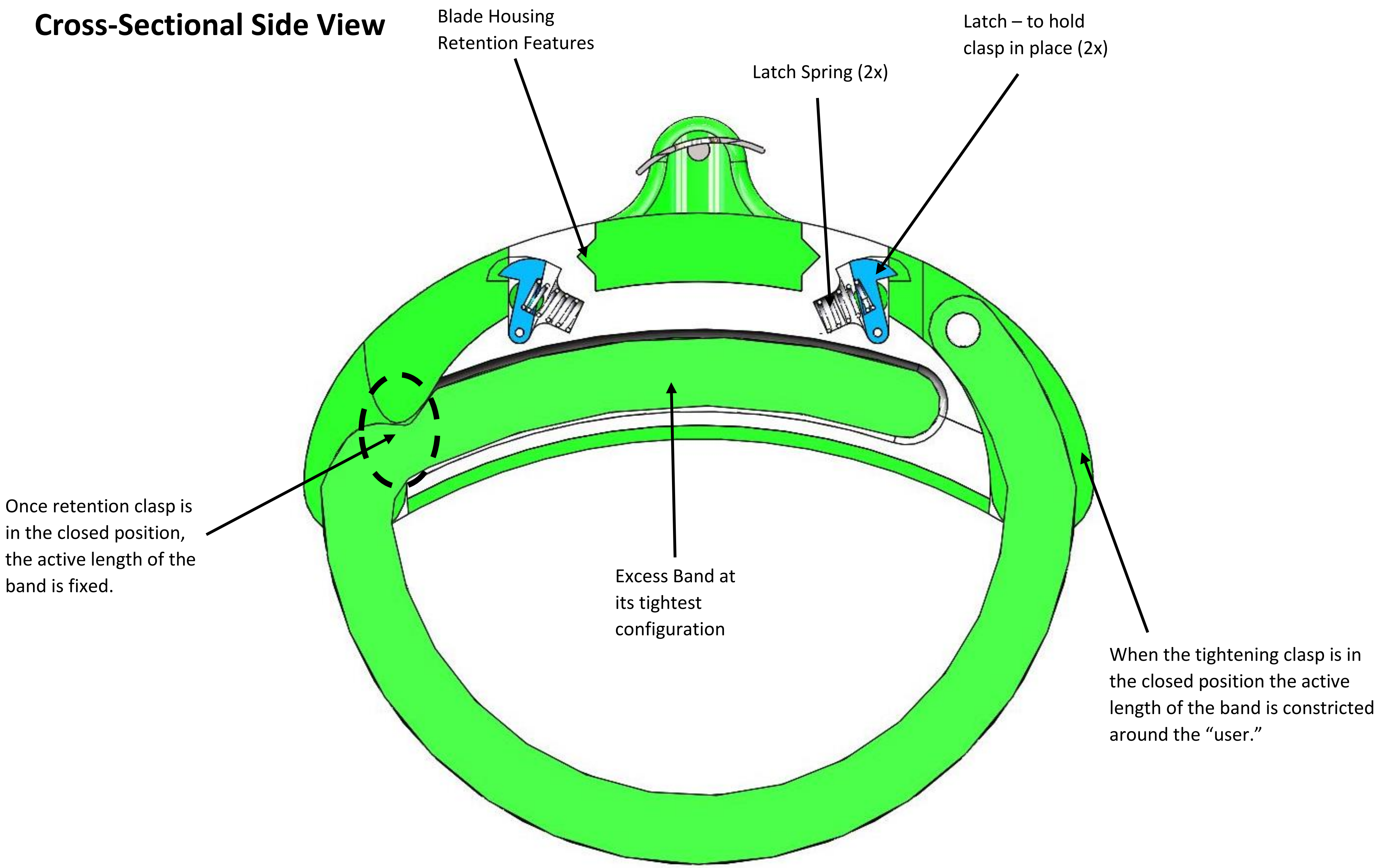


## Isometric Open View

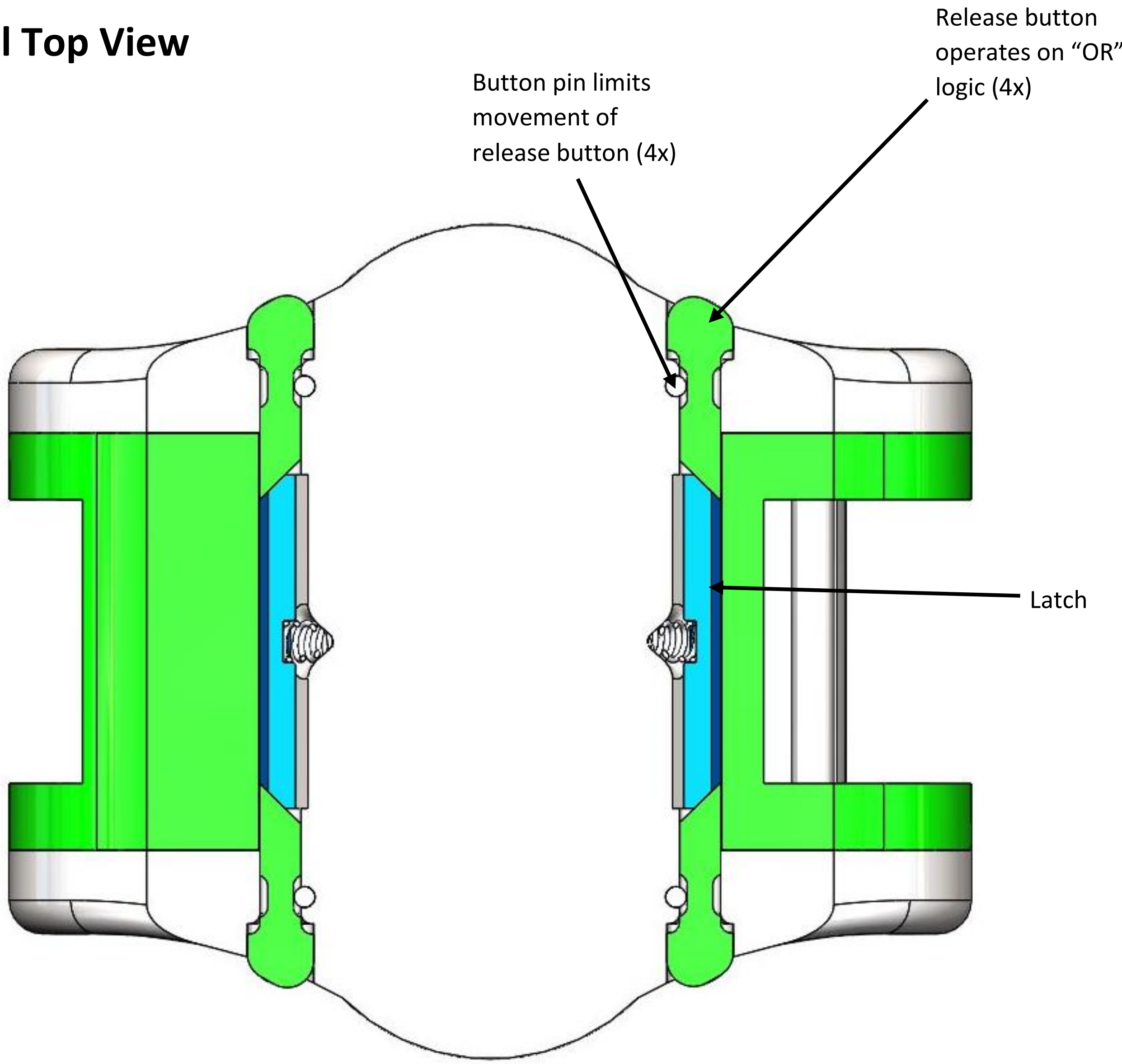



* **Note:** The band is a representation of a flexible body, meaning the hinge point is not included in reality.

# Cross-Sectional Side View



# Cross-Sectional Top View



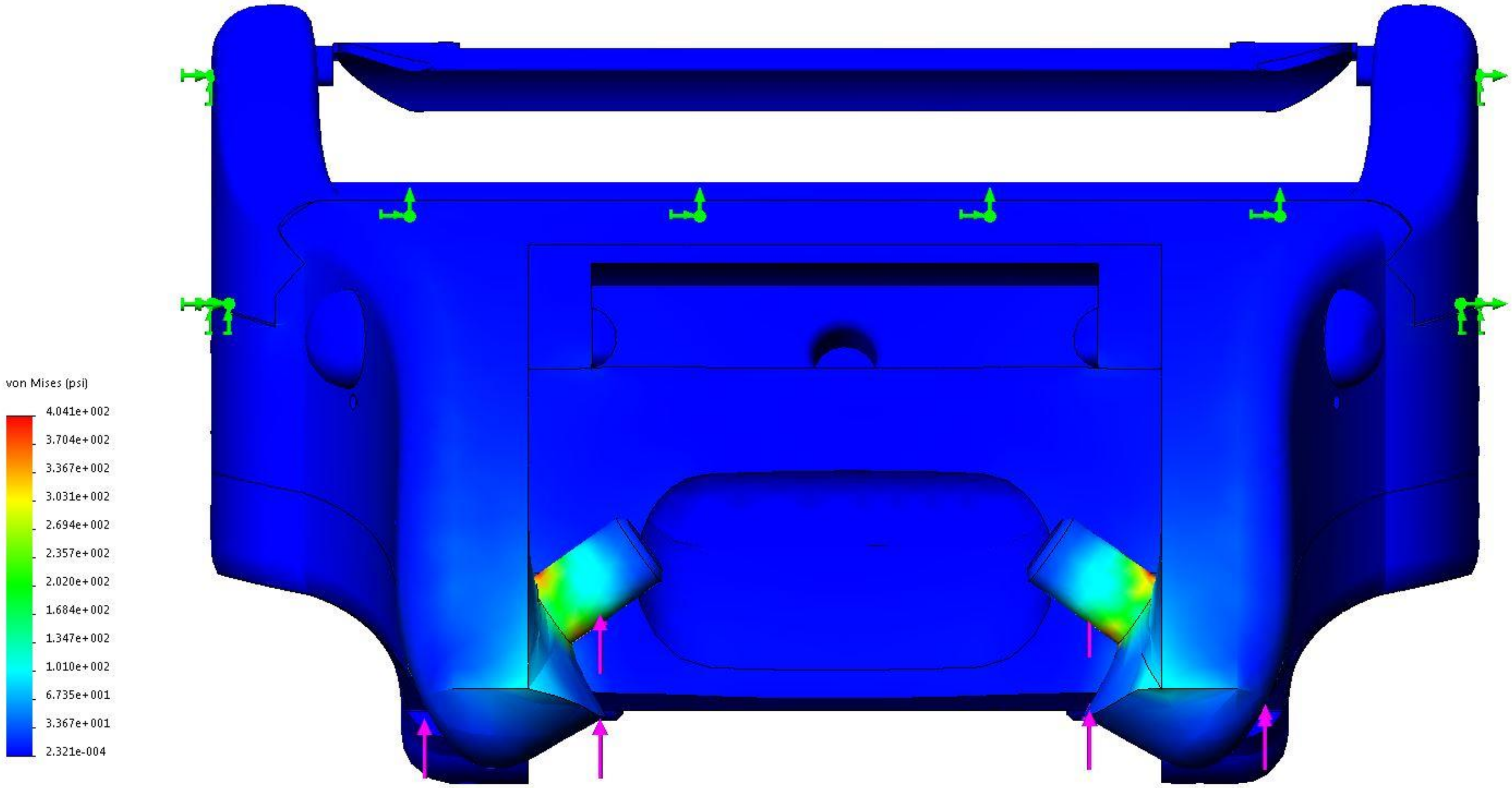



*Figure 1: Von Mises Stress*

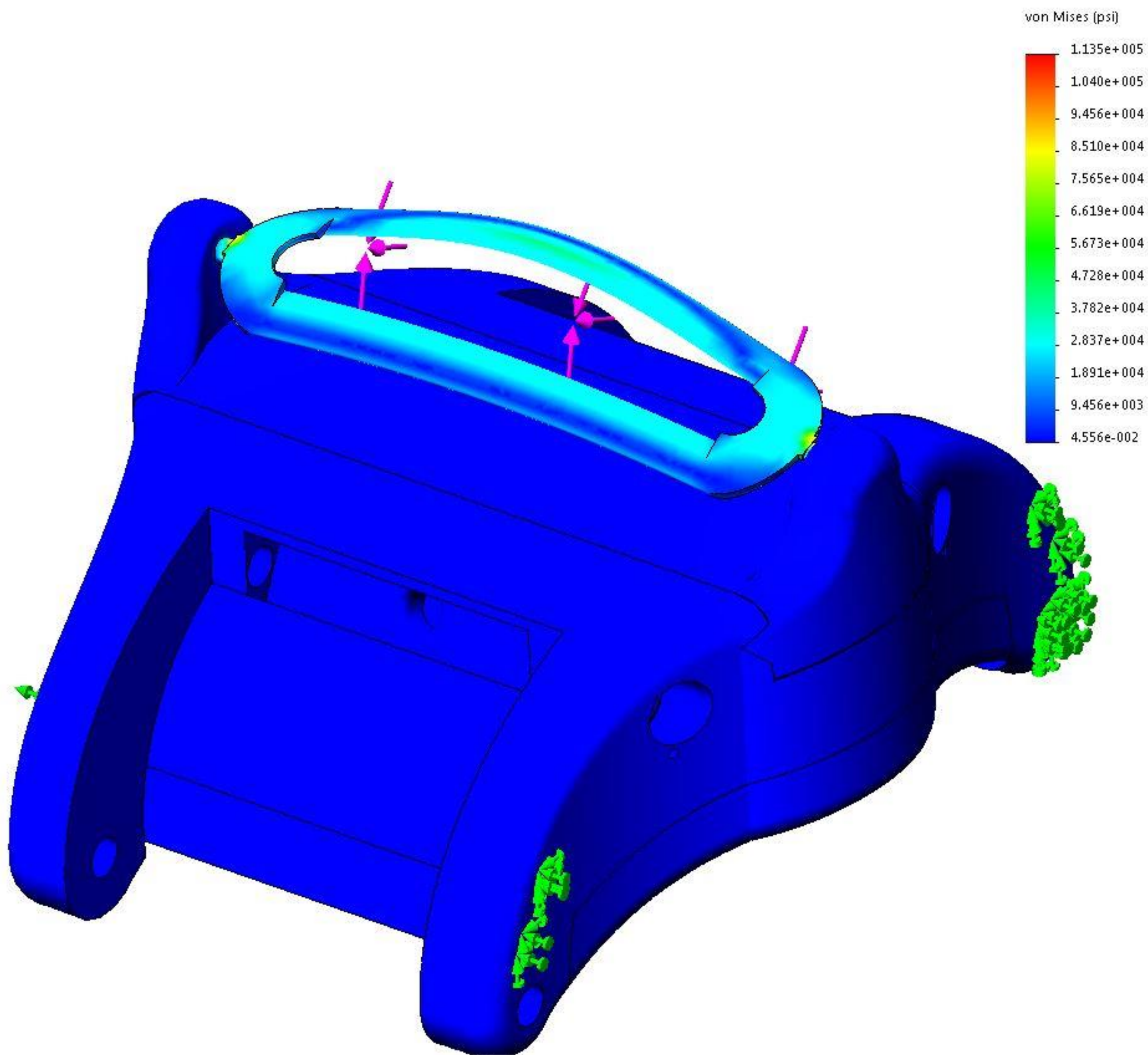



*Figure 2: Von Mises Stress (English)*

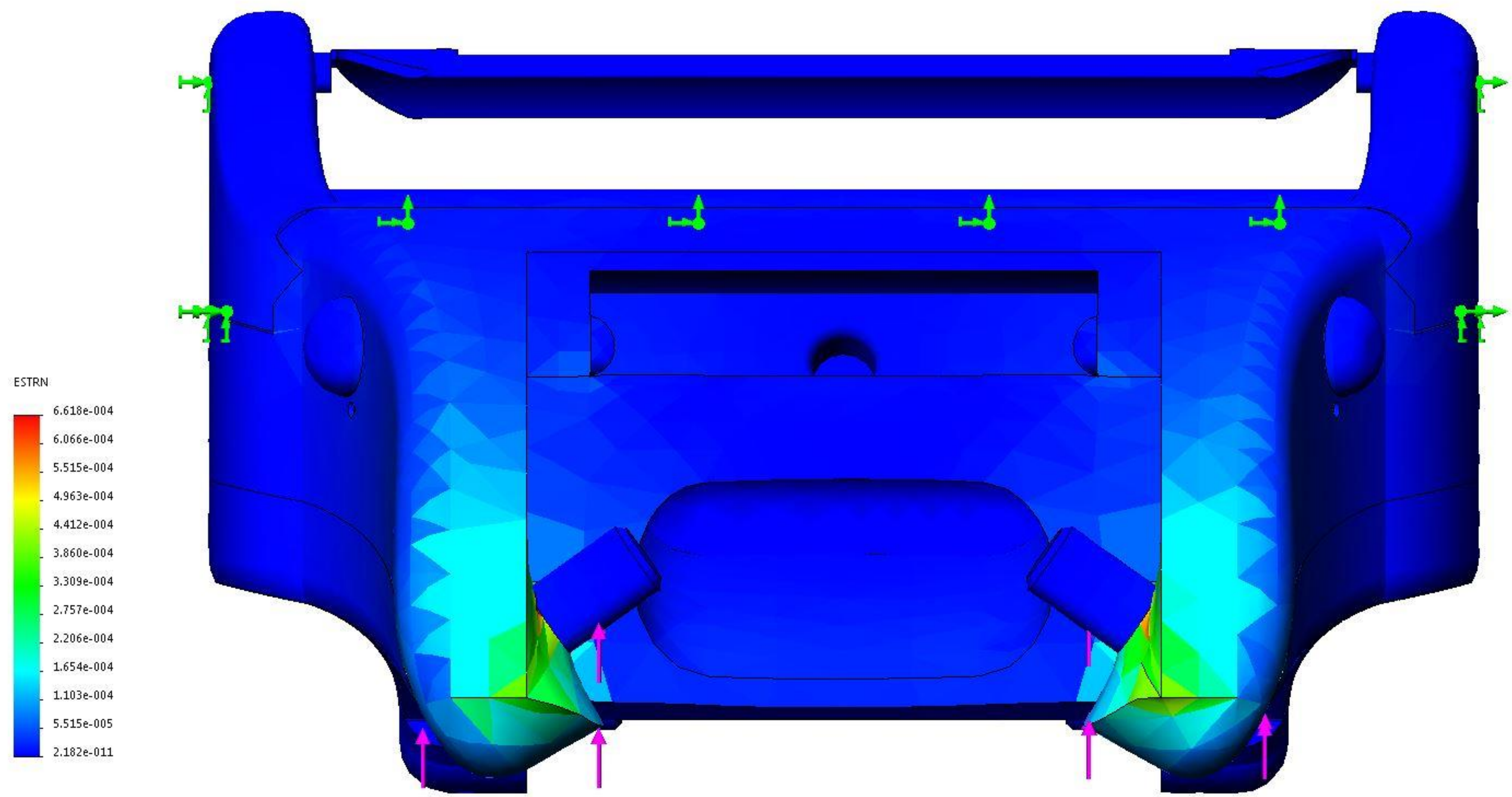



*Figure 3:Strain*

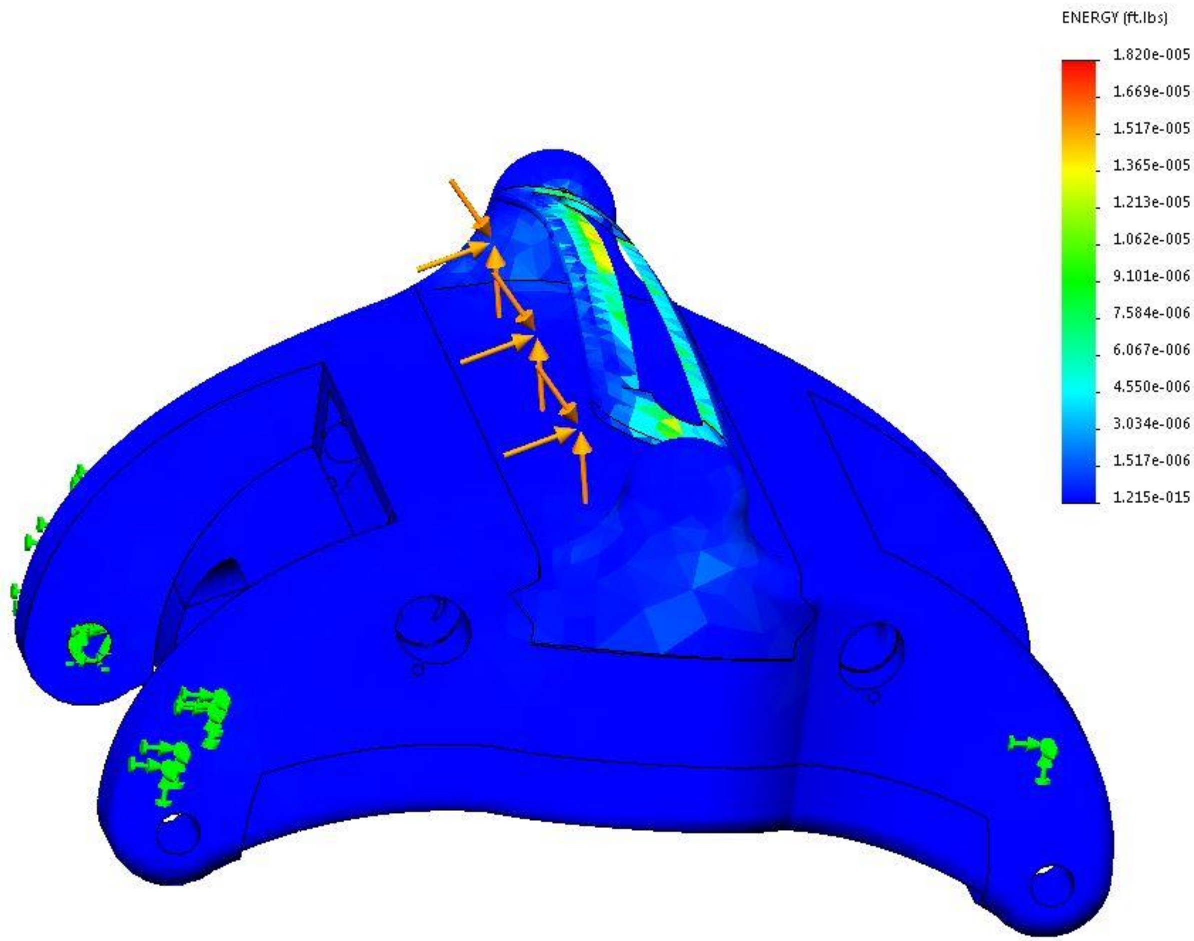



*Figure 4: Strain Energy*

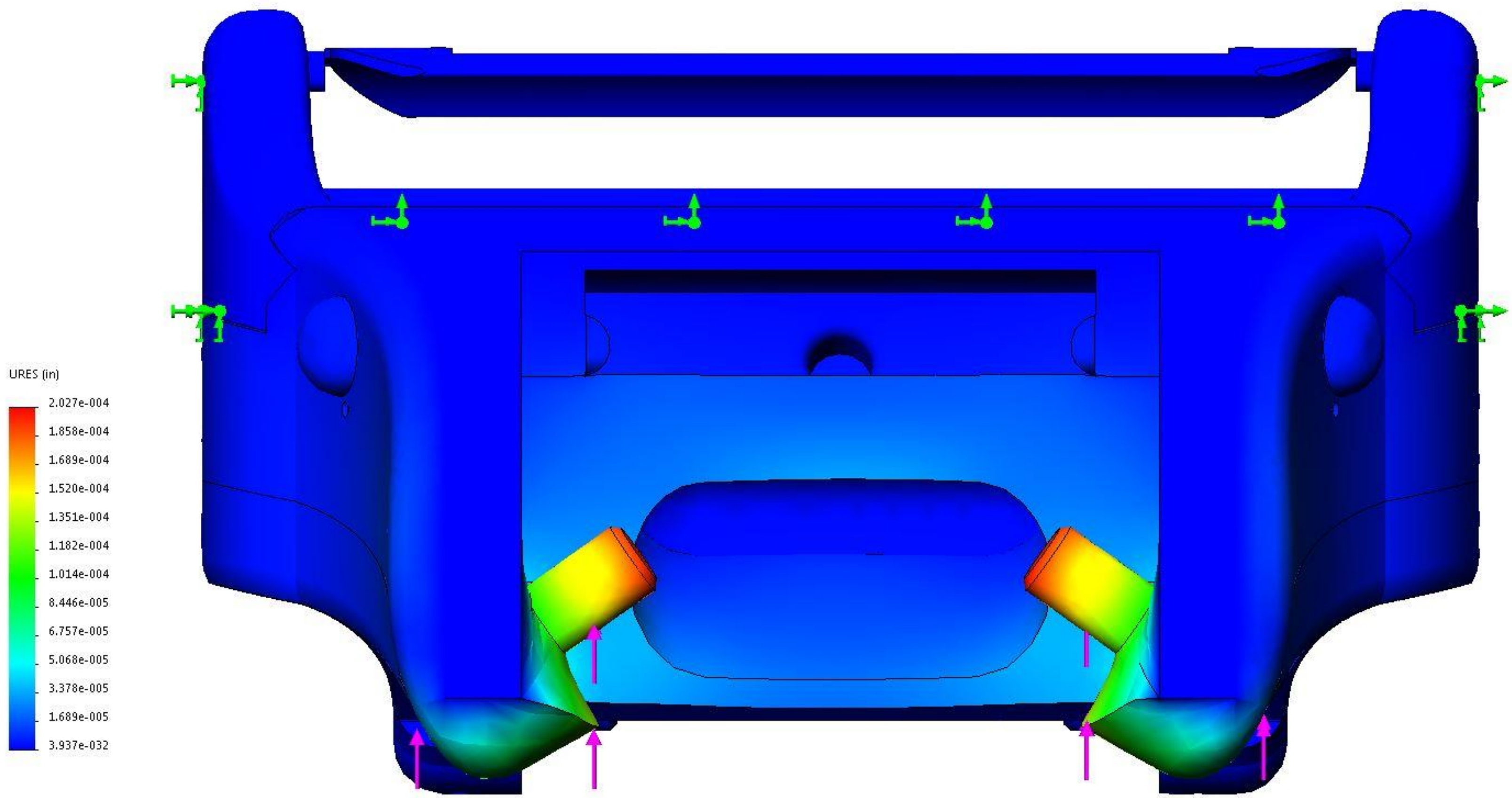



*Figure 5: Displacement*

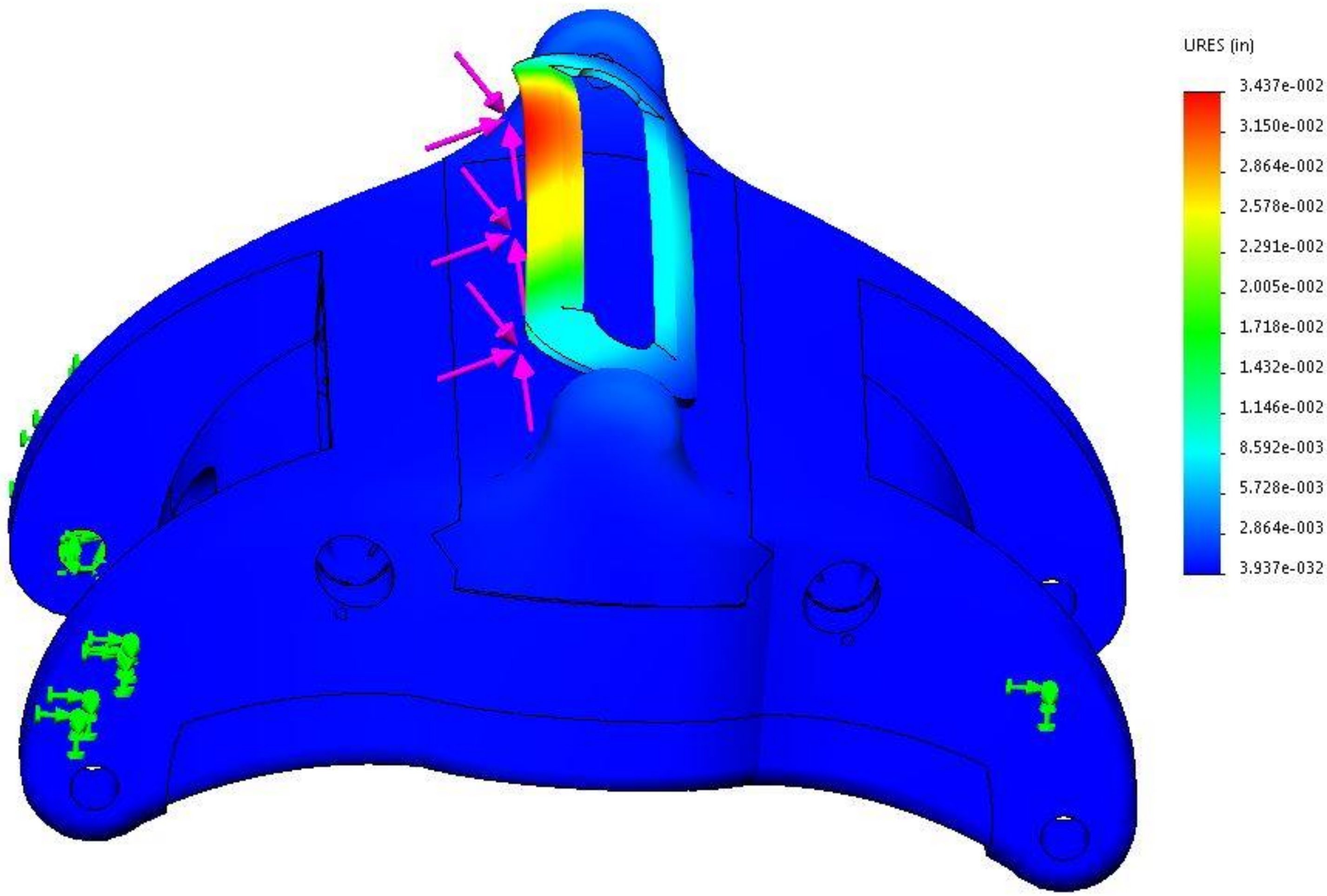
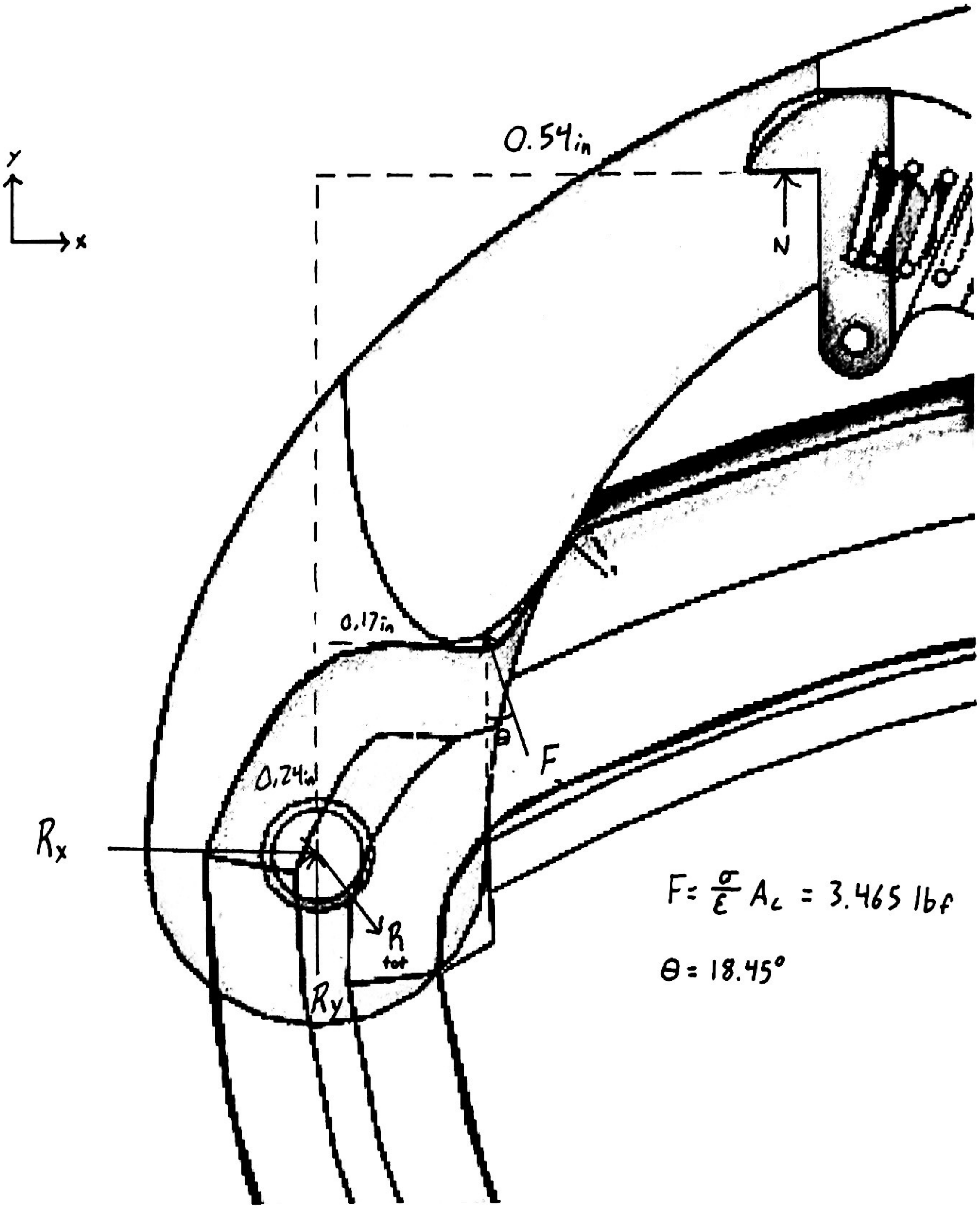



*Figure 6: Displacement*

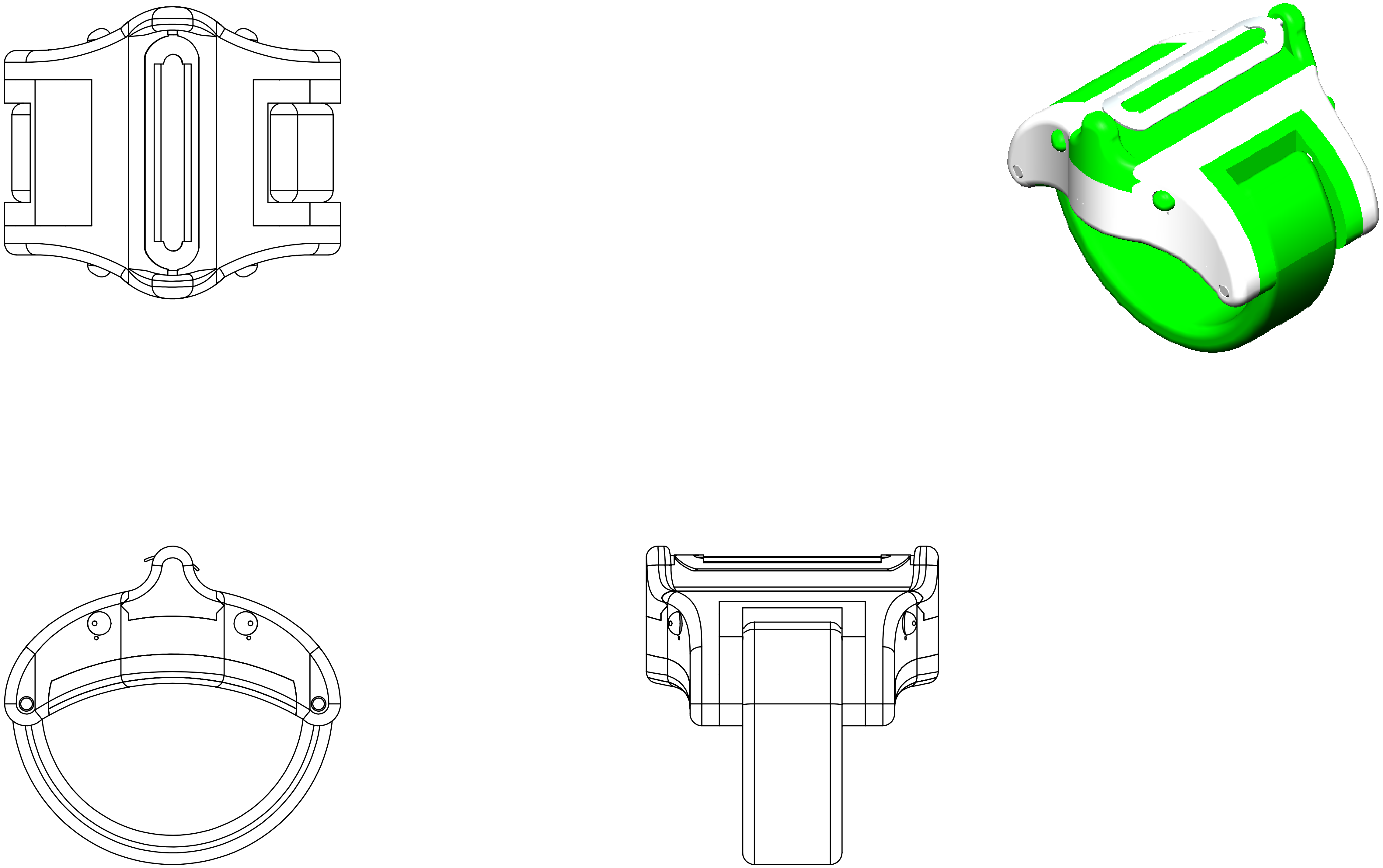



$$\circlearrowleft + \sum M = 0 = (F\cos\theta \cdot 0.17\,in) + (F\sin\theta \cdot 0.24) + (N \cdot 0.54) \Rightarrow N = \frac{-0.17F\cos\theta - 0.24F\sin\theta}{0.54} = -1.5 \text{ lbf}$$

$$+\uparrow \sum F_y = 0 = R_y + F\cos\theta + N \Rightarrow R_y = -F\cos\theta - N = -1.79 \text{ lbf}$$

$$\overset{+}{\rightarrow} \sum F_x = 0 = R_x - F\sin\theta \Rightarrow R_x = F\sin\theta = 1.1 \text{ lbf}$$

$$R_{tot} = \sqrt{R_x^2 + R_y^2} = 2.1 \text{ lbf}$$



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| APPV'D | | |

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WEIGHT: 0.19

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REVISION

# Corp 7: Vegetable Peeler

Including: Daniel Gullatte, Taylor Gutherie, Trevor Hauenstein, Megan Haywood, Trey Perkins, and Alex Poole

SUBSYSTEM:

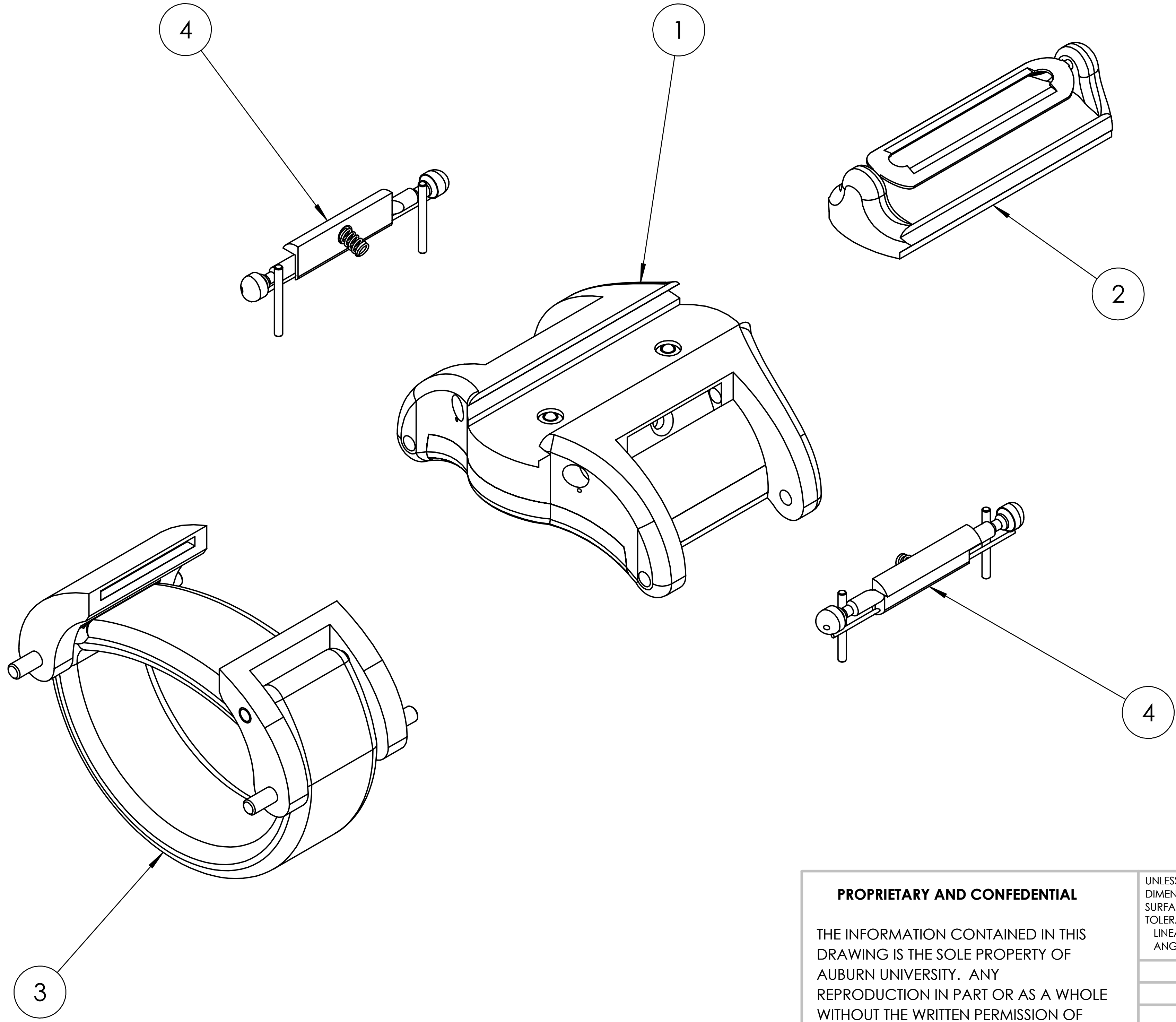
PART NAME: Adaptive Peeler

A3

SCALE:1:1

SHEET 1 OF 3

| ITEM NO. | Sub-Assembly | QTY. |
|---|---|---|
| 1 | Chassis Sub-Assembly | 1 |
| 2 | Blade Sub-Assembly | 1 |
| 3 | Band Sub-Assembly | 1 |
| 4 | Latch Sub-Assembly | 2 |

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MATERIAL:

WEIGHT: 0.19

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# Corp 7: Vegetable Peeler

Including: Daniel Gullatte, Taylor Gutherie, Trevor Hauenstein, Megan Haywood, Trey Perkins, and Alex Poole

SUBSYSTEM:

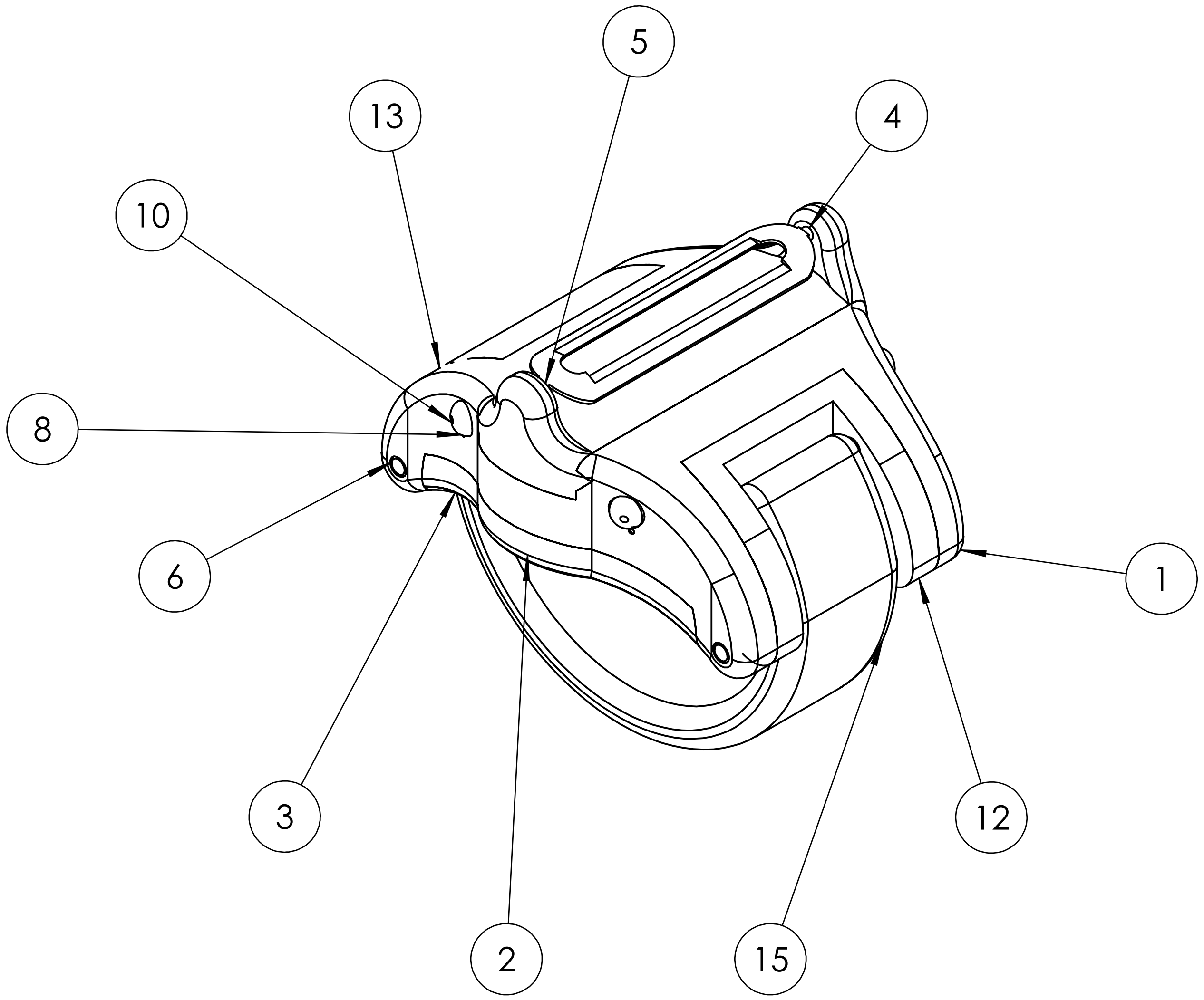
PART NAME: Adaptive Peeler

A3

SCALE:1:1

SHEET 2 OF 3

| ITEM NO. | Part Name | Source: (Purchased/Unique) | QTY. |
|---|---|---|---|
| 1 | Chassis | Unique | 1 |
| 2 | Chassis Base | Unique | 1 |
| 3 | Ergonomic Pad | Unique | 1 |
| 4 | Blade Housing | Unique | 1 |
| 5 | Blade | Purchased: TBD | 1 |
| 6 | Small Pin 98380A481 | McMaster-Carr | 4 |
| 7 | Latch | Unique | 2 |
| 8 | Latch Shaft 1162K850 | McMaster-Carr | 2 |
| 9 | Latch Spring 1986K430 | McMaster-Carr | 2 |
| 10 | Release Button | Unique | 4 |
| 11 | Button Pin 98380A421 | McMaster-Carr | 4 |
| 12 | Tightening Clasp | Unique | 1 |
| 13 | Retention Clasp | Unique | 1 |
| 14 | Large Pin 98380A477 | McMaster-Carr | 1 |
| 15 | Band | Unique | 1 |




Note: Not all components could be shown so they are not indicated on this page but will be on subsequent pages



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| CHK'D | | |
| APPV'D | | |

Including: Daniel Gullatte, Taylor Gutherie, Trevor Hauenstein, Megan Haywood, Trey Perkins, and Alex Poole

SUBSYSTEM:

MATERIAL:

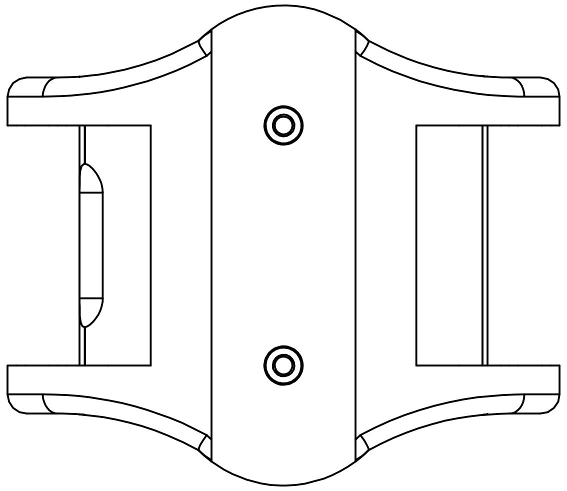
PART NAME: Adaptive Peeler

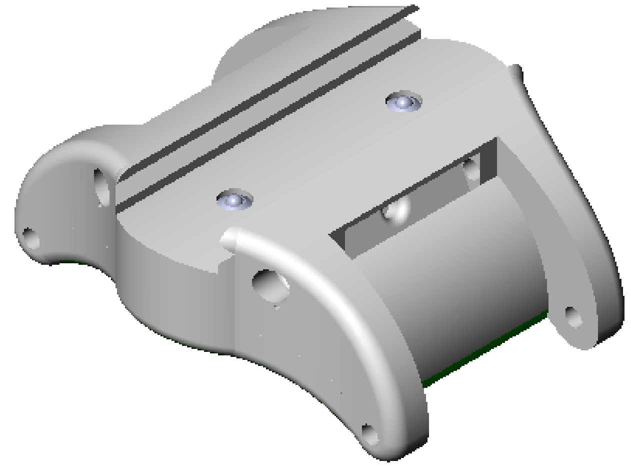
A3

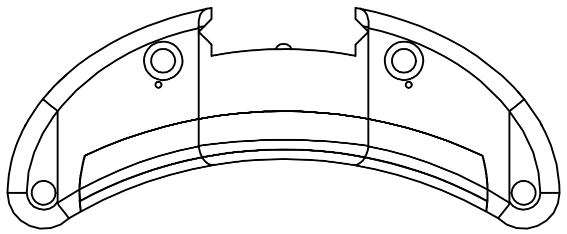
WEIGHT: 0.19

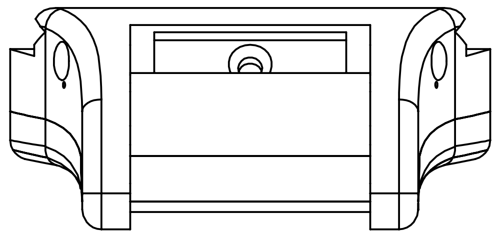
SCALE:1:1

SHEET 3 OF 3









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Including: Daniel Gullatte, Taylor Gutherie, Trevor Hauenstein, Megan Haywood, Trey Perkins, and Alex Poole

SUBSYSTEM:

PART NAME: Chassis Sub-Assembly

A3

SCALE:1:1

SHEET 1 OF 2

| ITEM NO. | Part Name | QTY. |
|---|---|---|
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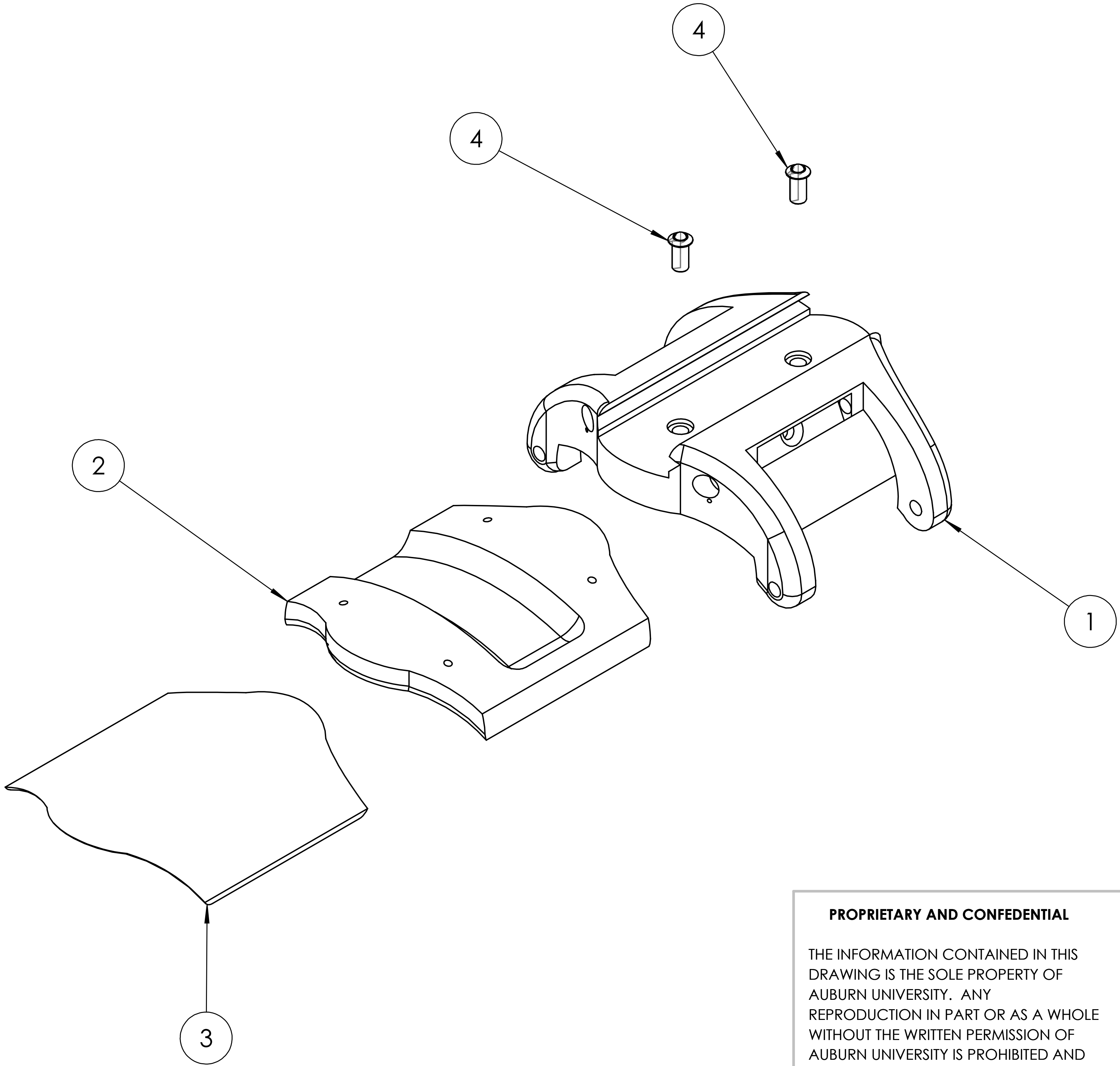
| 2 | Chassis Base | 1 |
| 3 | Ergonomic Pad | 1 |
| 4 | Spring Plunger 84895A310 | 2 |

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WEIGHT: 0.09

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Corp 7: Vegetable Peeler

Including: Daniel Gullatte, Taylor Gutherie, Trevor Hauenstein, Megan Haywood, Trey Perkins, and Alex Poole

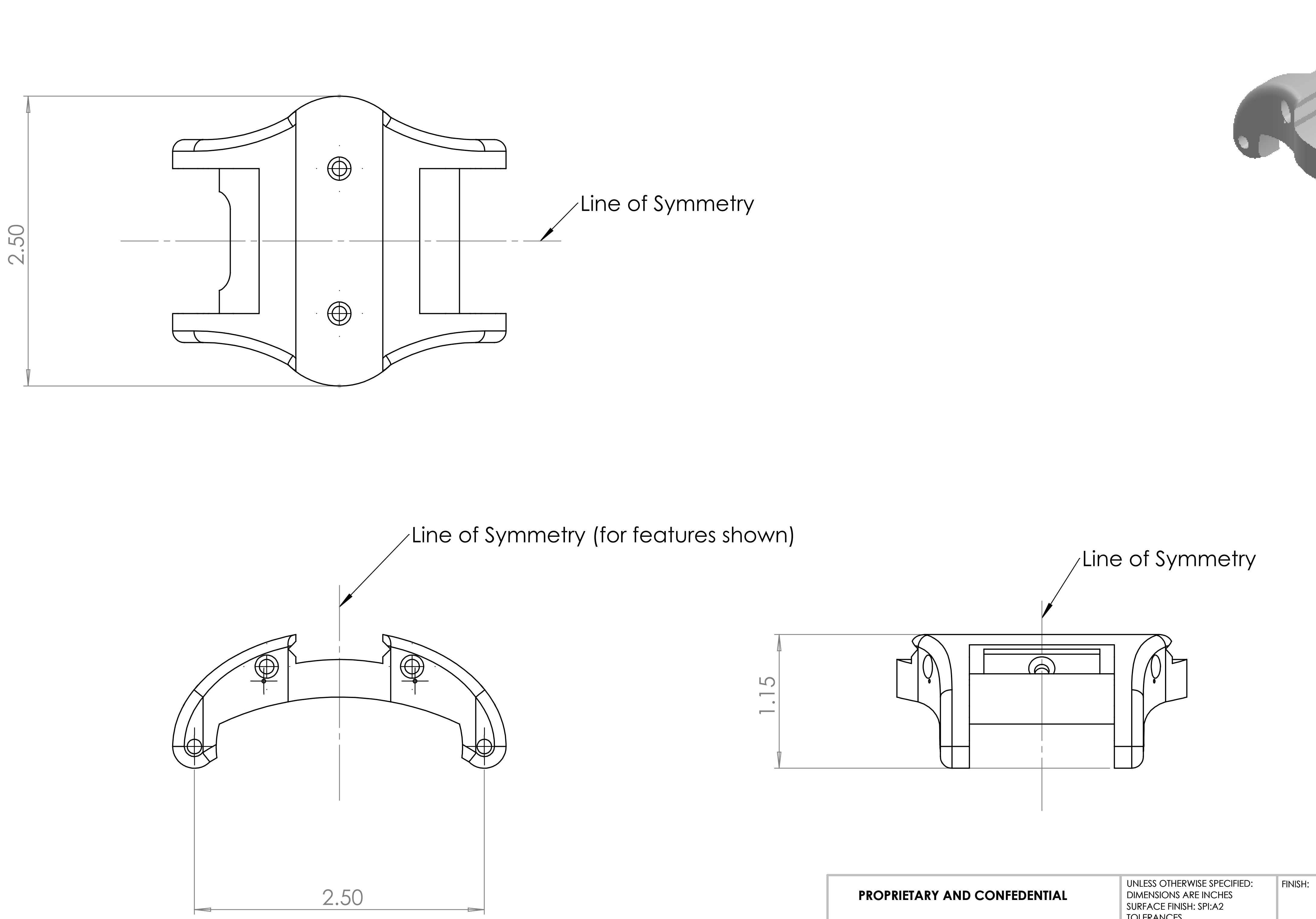
SUBSYSTEM:

PART NAME: Chassis Sub-Assembly

A3

SCALE:1:1

SHEET 2 OF 2

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|---|---|---|
| DRAWN | TMH | 4/23/16 |
| CHK'D | | |
| APPV'D | | |

MATERIAL: PE High Density

WEIGHT: 0.05

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Corp 7: Vegetable Peeler

Including: Daniel Gullatte, Taylor Gutherie, Trevor Hauenstein, Megan Haywood, Trey Perkins, and Alex Poole

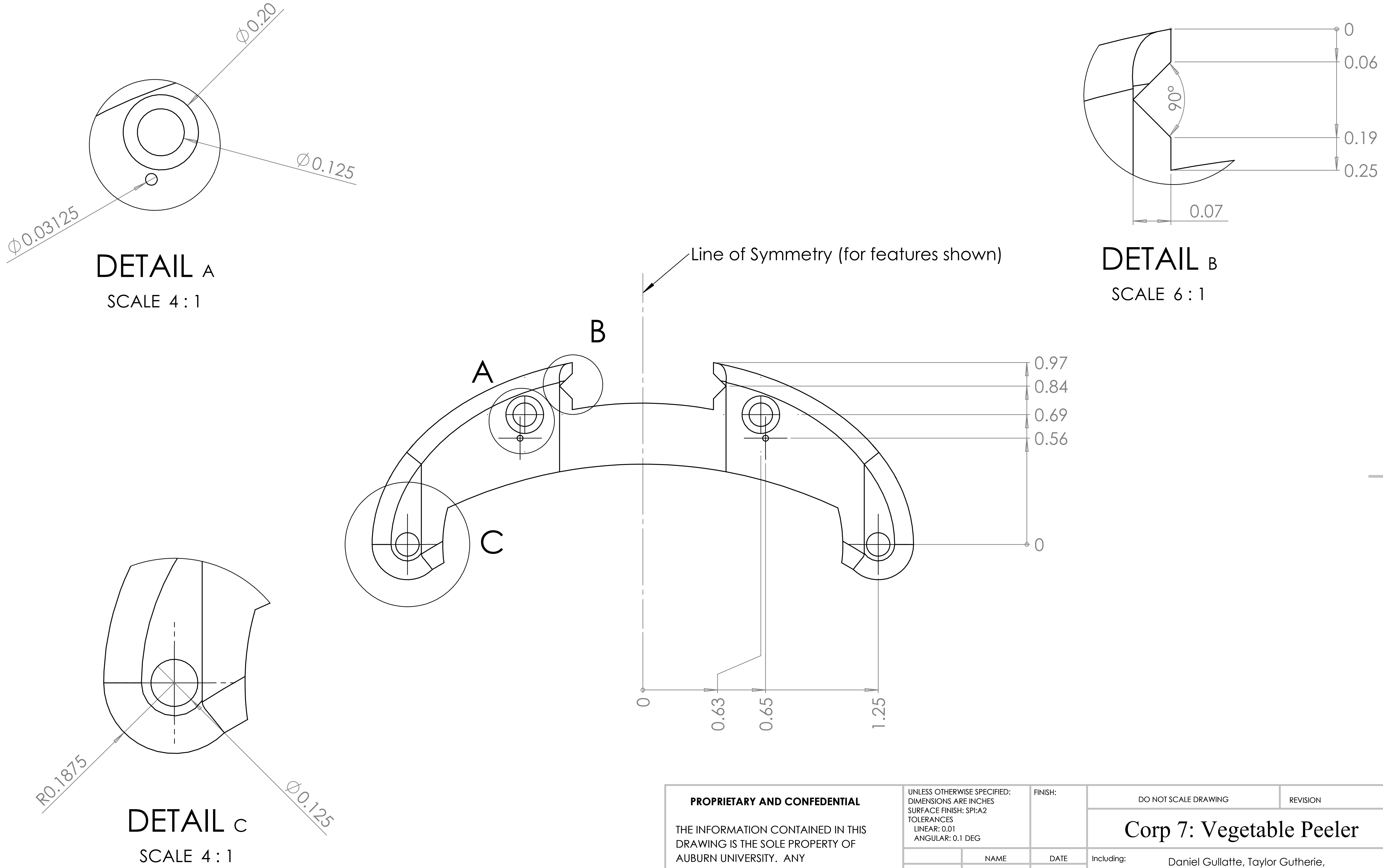
SUBSYSTEM: Chassis Sub-Assembly

PART NAME: Chassis

A3

SCALE:1:1

SHEET 1 OF 4

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TOLERANCES
LINEAR: 0.01
ANGULAR: 0.1 DEG

FINISH:

| | NAME | DATE |
|---|---|---|
| DRAWN | TMH | 4/23/16 |
| CHK'D | | |
| APPV'D | | |

MATERIAL: PE High Density

WEIGHT: 0.05

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# Corp 7: Vegetable Peeler


Including: Daniel Gullatte, Taylor Gutherie, Trevor Hauenstein, Megan Haywood, Trey Perkins, and Alex Poole

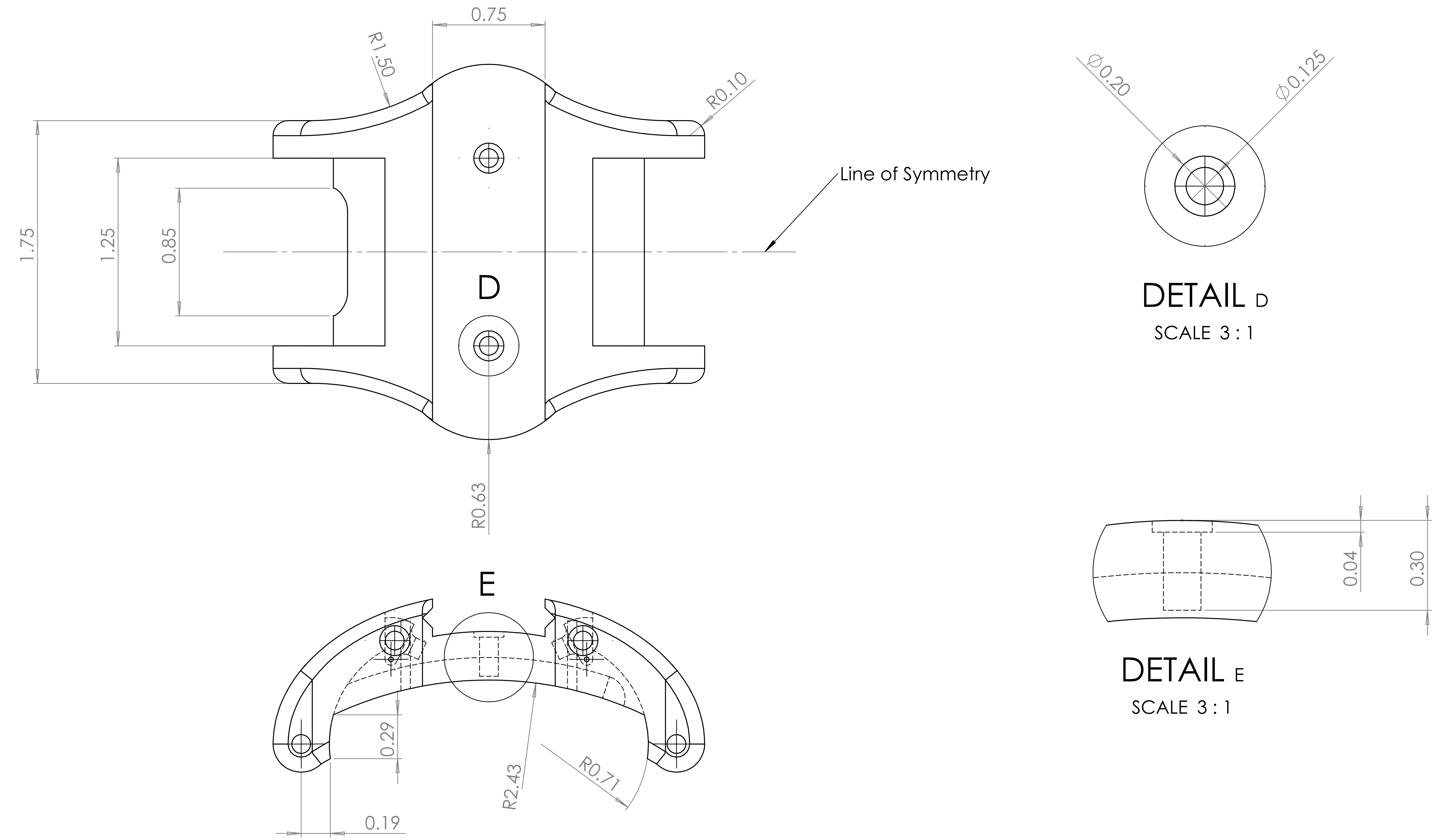

SUBSYSTEM: Chassis Sub-Assembly

PART NAME: Chassis

A3

SCALE:1:1

SHEET 2 OF 4

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SURFACE FINISH: SPI:A2
TOLERANCES
LINEAR: 0.01
ANGULAR: 0.1 DEG

FINISH:

| | NAME | DATE |
|---|---|---|
| DRAWN | TMH | 4/23/16 |
| CHK'D | | |
| APPV'D | | |

MATERIAL: PE High Density

WEIGHT: 0.05

DO NOT SCALE DRAWING — REVISION

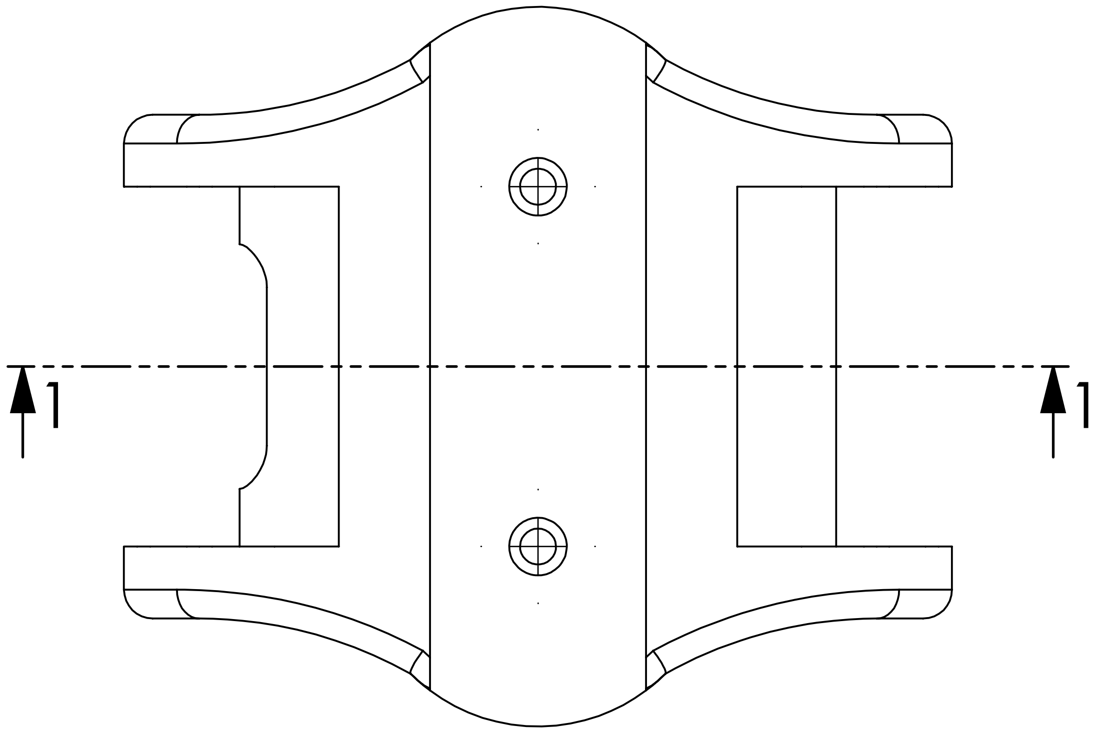
# Corp 7: Vegetable Peeler

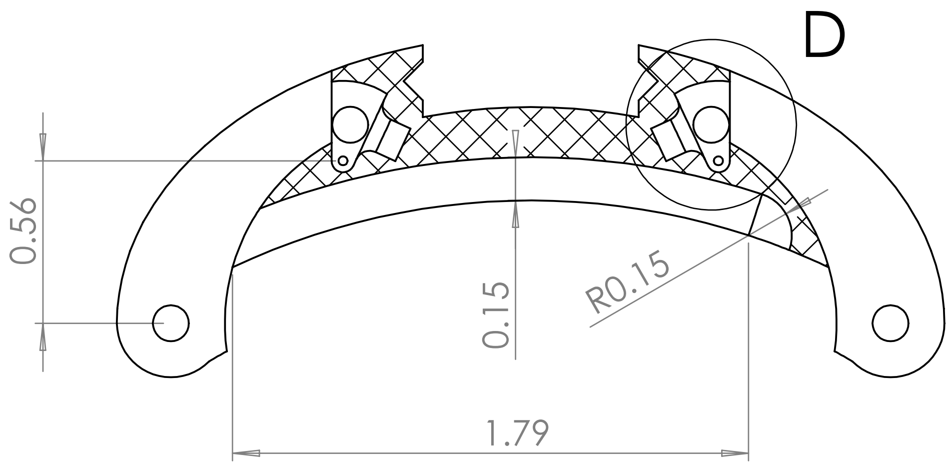
Including: Daniel Gullatte, Taylor Gutherie, Trevor Hauenstein, Megan Haywood, Trey Perkins, and Alex Poole

SUBSYSTEM: Chassis Sub-Assembly

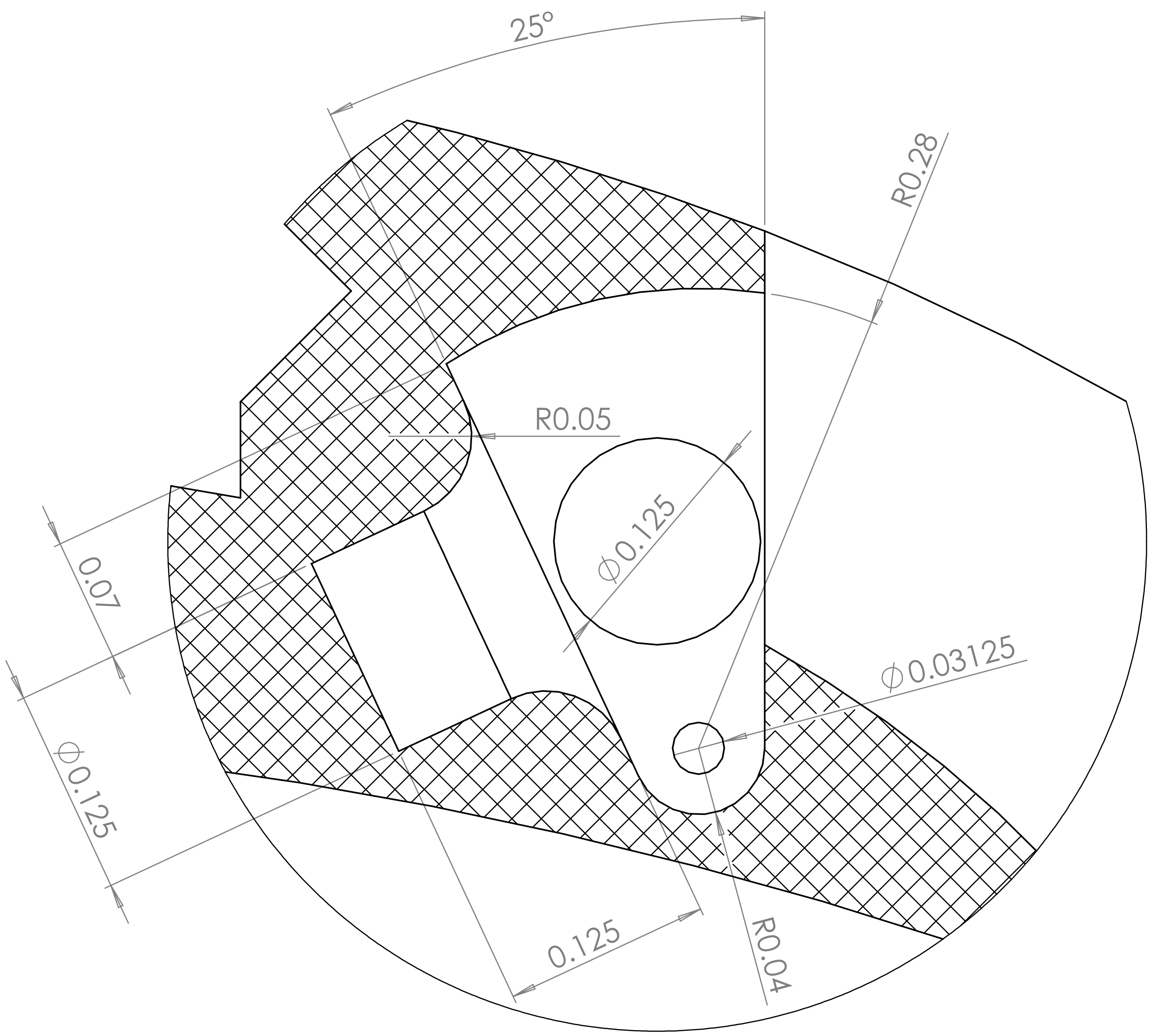
PART NAME: Chassis — A3

SCALE:3:2 — SHEET 3 OF 4




SECTION 1-1




DETAIL D

SCALE 10 : 1

**PROPRIETARY AND CONFIDENTIAL**



UNLESS OTHERWISE SPECIFIED:
DIMENSIONS ARE INCHES
SURFACE FINISH: SPI:A2
TOLERANCES
LINEAR: 0.01
ANGULAR: 0.1 DEG

FINISH:

| | NAME | DATE |
|---|---|---|
| DRAWN | TMH | 4/23/16 |
| CHK'D | | |
| APPV'D | | |

MATERIAL: PE High Density

WEIGHT: 0.05

DO NOT SCALE DRAWING

REVISION

# Corp 7: Vegetable Peeler

Including: Daniel Gullatte, Taylor Gutherie, Trevor Hauenstein, Megan Haywood, Trey Perkins, and Alex Poole

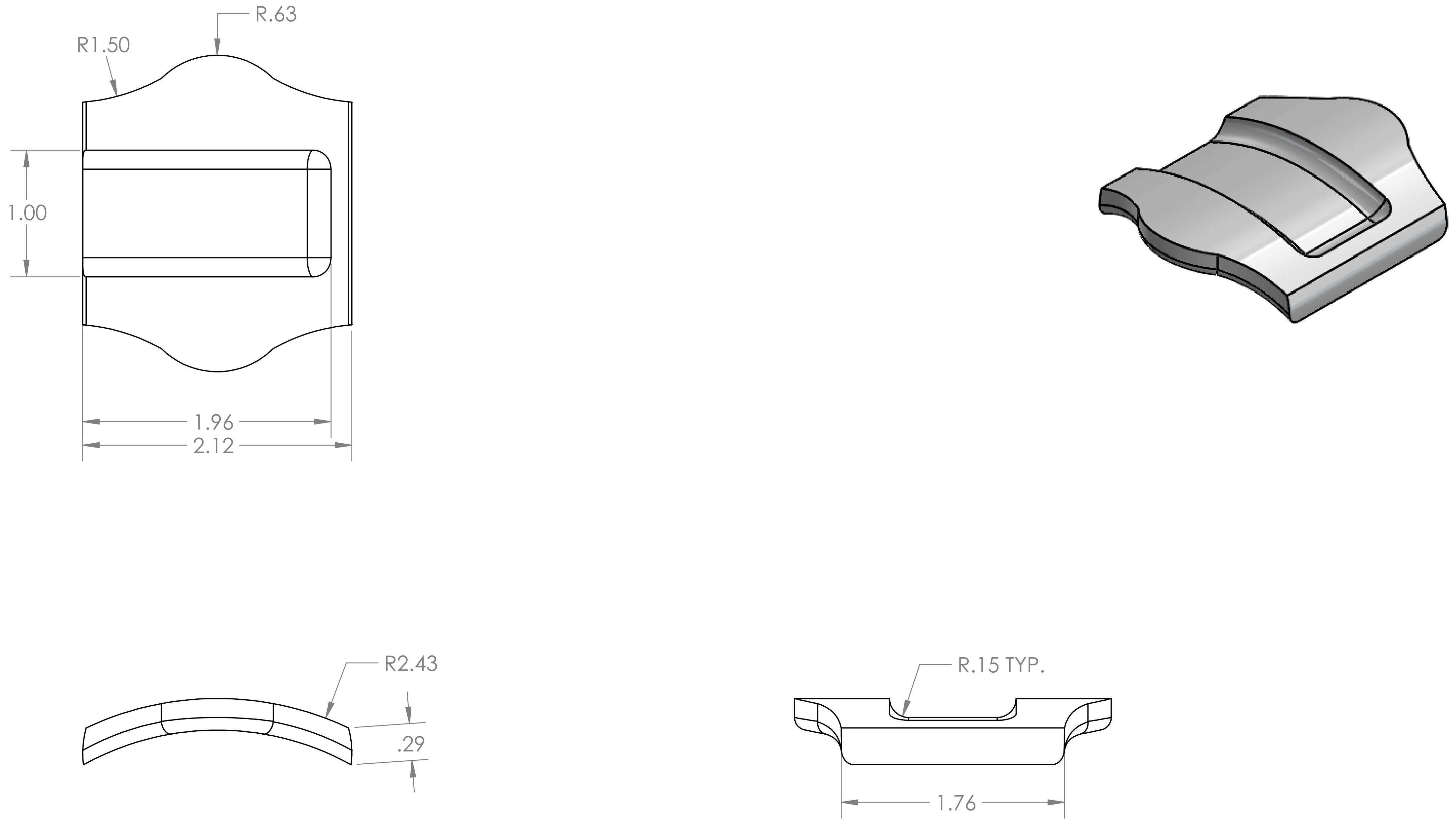
SUBSYSTEM: Chassis Sub-Assembly

PART NAME: Chassis

A3

SCALE:3:2

SHEET 4 OF 4




Note: This part effects the change of the chassis, and will have thergonomic pad molded onto the under side.

**PROPRIETARY AND CONFEDENTIAL**



UNLESS OTHERWISE SPECIFIED:
DIMENSIONS ARE INCHES
SURFACE FINISH: SPI:A2
TOLERANCES
LINEAR: 0.01
ANGULAR: 0.1 DEG

FINISH:

| | NAME | DATE |
|---|---|---|
| DRAWN | TWP | 4/21/2016 |
| CHK'D | | |
| APPV'D | | |

MATERIAL: HDPE

WEIGHT: 0.03

DO NOT SCALE DRAWING

REVISION

# Corp 7: Vegetable Peeler

Including: Daniel Gullatte, Taylor Gutherie, Trevor Hauenstein, Megan Haywood, Trey Perkins, and Alex Poole

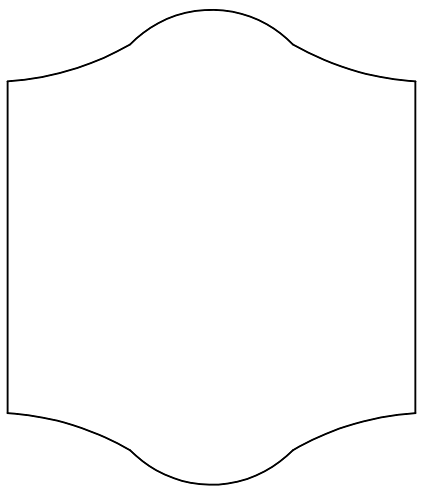
SUBSYSTEM: Chassis Subassembly

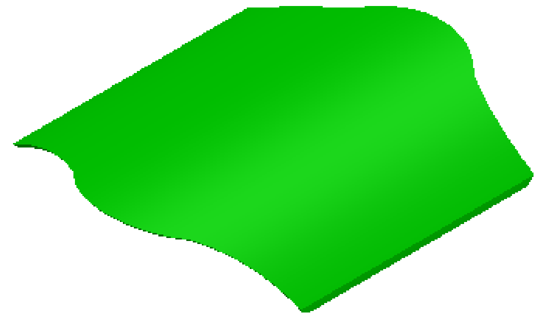
PART NAME: Chassis Base

A3

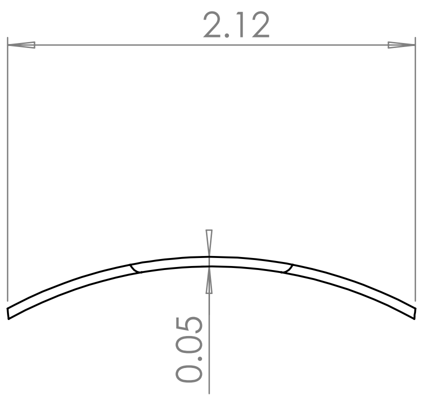
SCALE:1:1

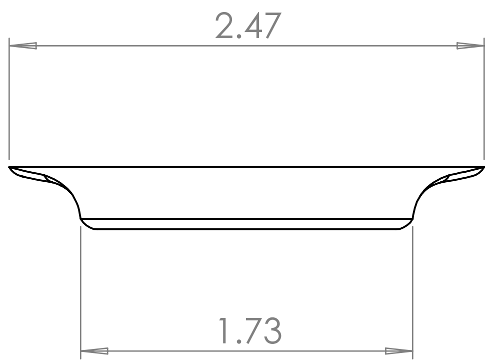
SHEET 1 OF 1





Note: This is just a very thin layer of Polyurethane that will be molded onto the Chassis Base(no adhesive need), so for any unspecified demensions refer to the Chassis Base Drawing.




**PROPRIETARY AND CONFIDENTIAL**



UNLESS OTHERWISE SPECIFIED:
DIMENSIONS ARE INCHES
SURFACE FINISH: SPI:A2
TOLERANCES
LINEAR: 0.01
ANGULAR: 0.1 DEG

FINISH:

| | NAME | DATE |
|---|---|---|
| DRAWN | TMH | 4/23/16 |
| CHK'D | | |
| APPV'D | | |

MATERIAL:
POLYURETHANE (11671)

WEIGHT: 0.01

DO NOT SCALE DRAWING

REVISION

# Corp 7: Vegetable Peeler

Including:
Daniel Gullatte, Taylor Gutherie,
Trevor Hauenstein, Megan Haywood,
Trey Perkins, and Alex Poole

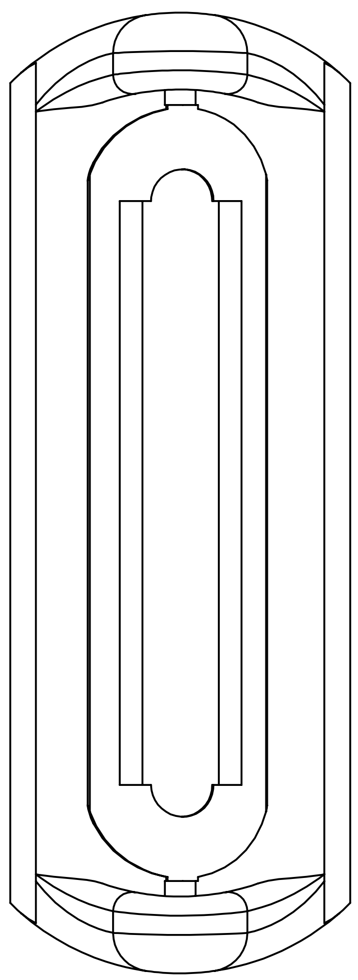
SUBSYSTEM:
Chassis Sub-Assembly

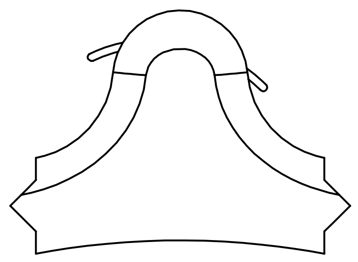
PART NAME:
Ergonomic Pad

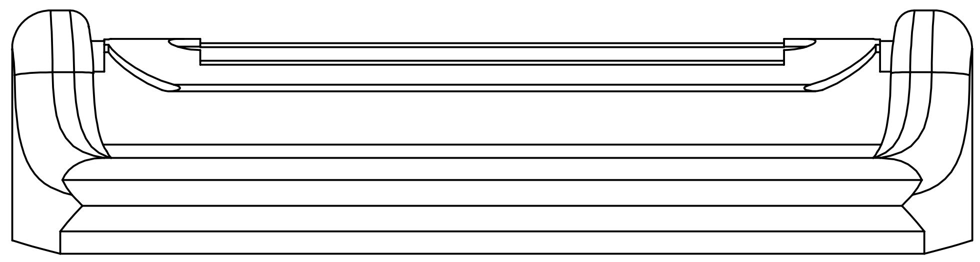
A3

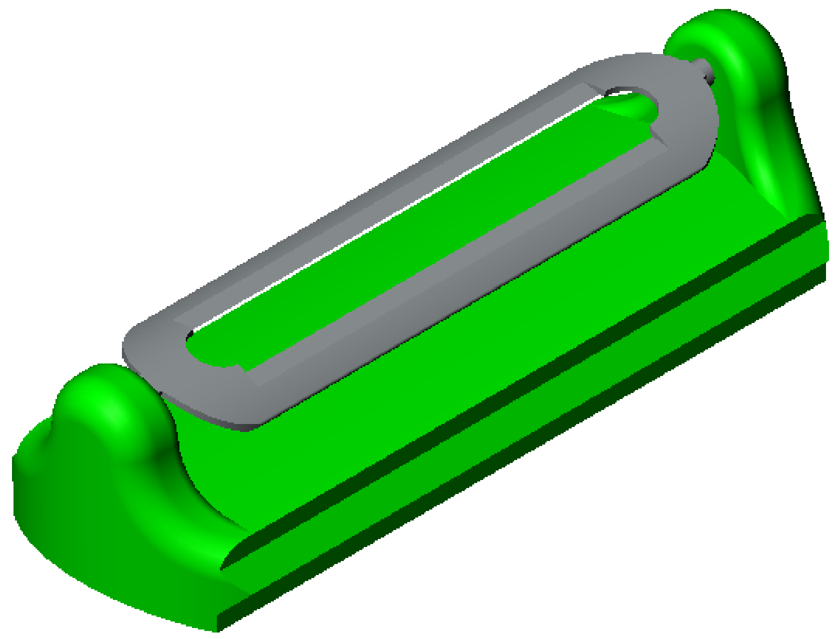
SCALE:1:1

SHEET 1 OF 1









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SURFACE FINISH: SPI:A2
TOLERANCES
LINEAR: 0.01
ANGULAR: 0.1 DEG

FINISH:

| | NAME | DATE |
|---|---|---|
| DRAWN | TMH | 4/23/16 |
| CHK'D | | |
| APPV'D | | |

MATERIAL:

WEIGHT: 0.02

DO NOT SCALE DRAWING

REVISION

# Corp 7: Vegetable Peeler

Including: Daniel Gullatte, Taylor Gutherie, Trevor Hauenstein, Megan Haywood, Trey Perkins, and Alex Poole

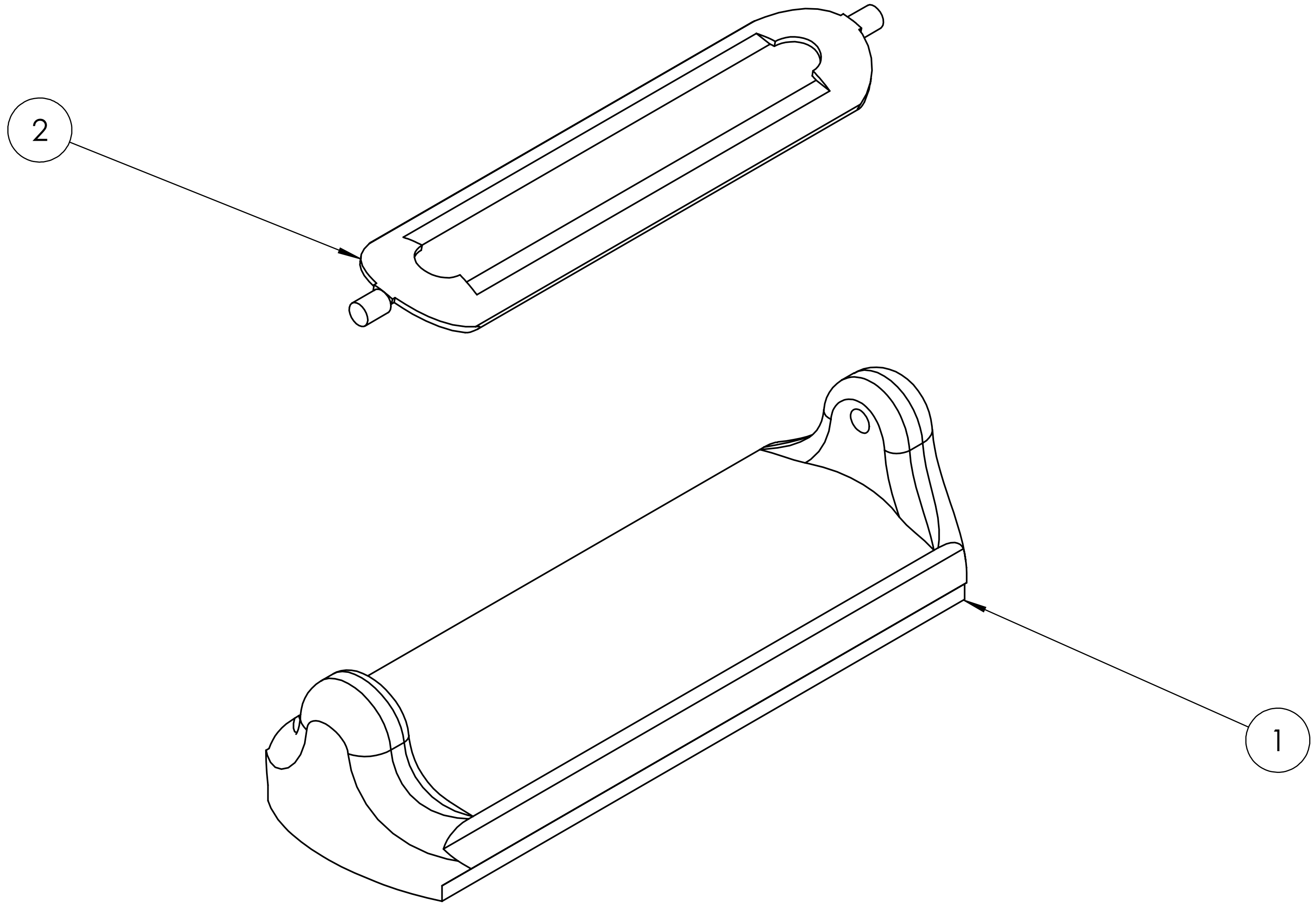
SUBSYSTEM:

PART NAME: Blade Sub-Assembly

A3

SCALE:2:1

SHEET 1 OF 2




| ITEM NO. | PART NUMBER | QTY. |
|---|---|---|
| 1 | Blade Housing | 1 |
| 2 | Blade | 1 |

**PROPRIETARY AND CONFIDENTIAL**



UNLESS OTHERWISE SPECIFIED:
DIMENSIONS ARE INCHES
SURFACE FINISH: SPI:A2
TOLERANCES
LINEAR: 0.01
ANGULAR: 0.1 DEG

FINISH:

| | NAME | DATE |
|---|---|---|
| DRAWN | TMH | 4/23/16 |
| CHK'D | | |
| APPV'D | | |

MATERIAL:

WEIGHT: 0.02

DO NOT SCALE DRAWING

REVISION

# Corp 7: Vegetable Peeler

Including: Daniel Gullatte, Taylor Gutherie, Trevor Hauenstein, Megan Haywood, Trey Perkins, and Alex Poole

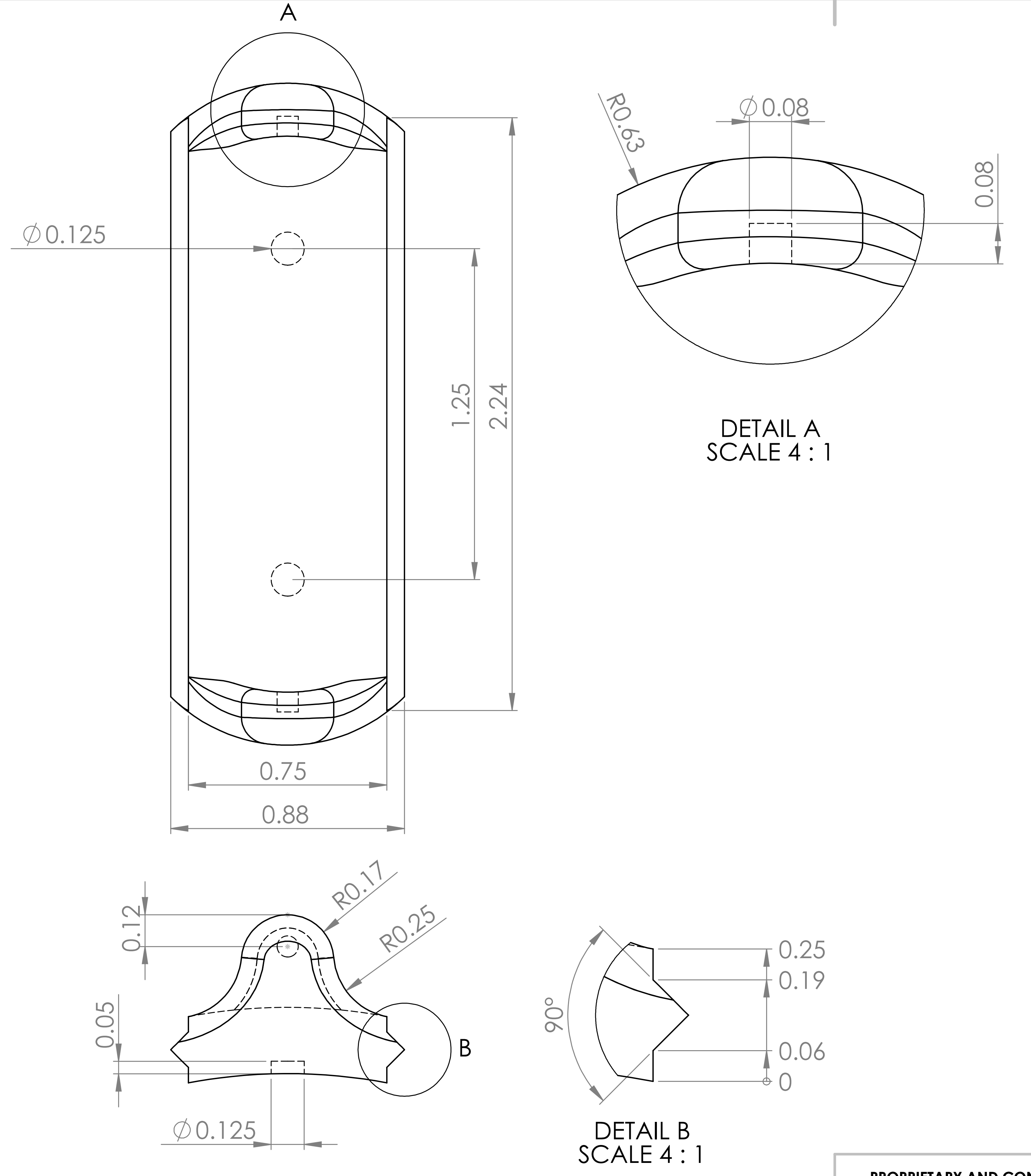
SUBSYSTEM:

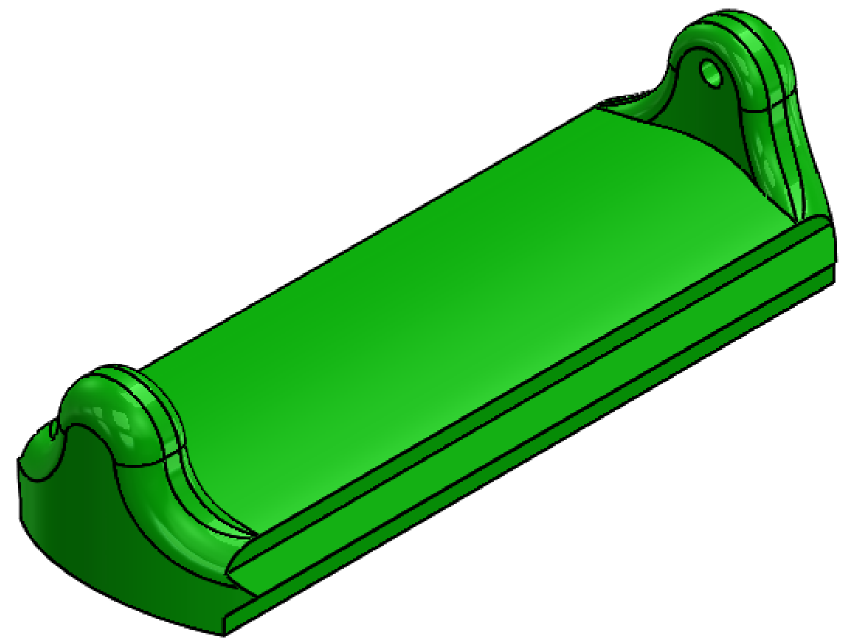
PART NAME: Blade Sub-Assembly

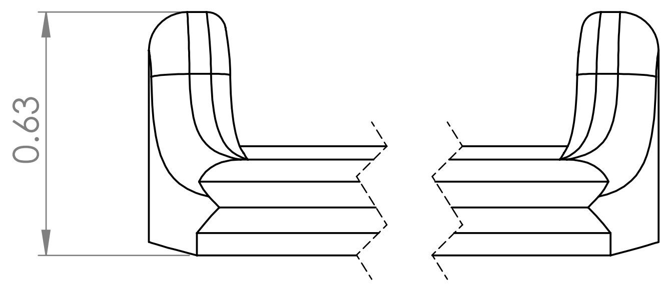
A3

SCALE:2:1

SHEET 2 OF 2






VIEW



UNLESS OTHERWISE SPECIFIED:
DIMENSIONS ARE INCHES
SURFACE FINISH: SPI:A2
TOLERANCES
LINEAR: 0.01
ANGULAR: 0.1 DEG

FINISH:

| | NAME | DATE |
|---|---|---|
| DRAWN | TWP | 4/21/2016 |
| CHK'D | | |
| APPV'D | | |

MATERIAL: HDPE

WEIGHT: 0.015 lb

DO NOT SCALE DRAWING

REVISION

# Corp 7: Vegetable Peeler

Including: Daniel Gullatte, Taylor Gutherie, Trevor Hauenstein, Megan Haywood, Trey Perkins, and Alex Poole

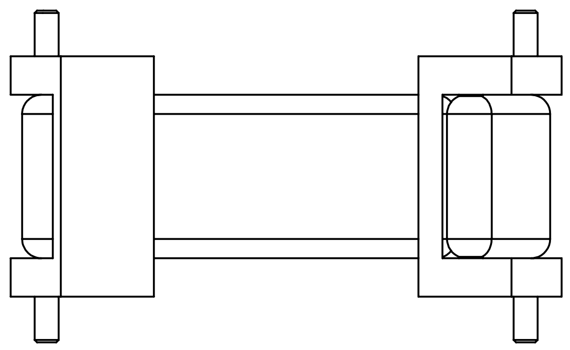
SUBSYSTEM: Blade Subassembly

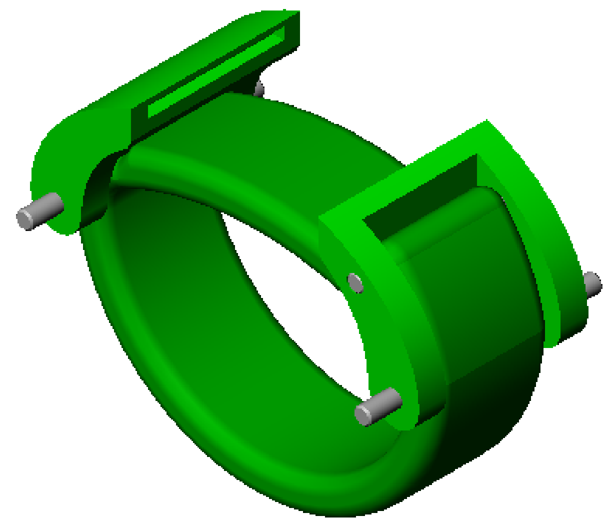
PART NAME: Blade Housing

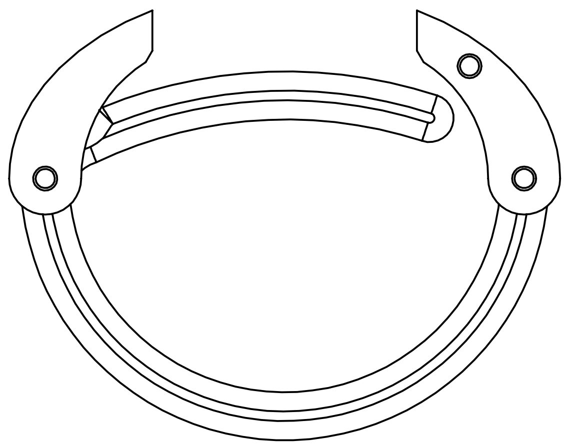
A3

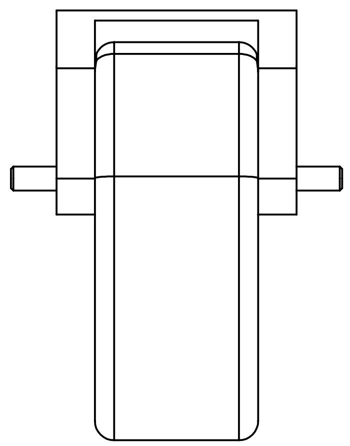
SCALE:2:1

SHEET 1 OF 1









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SURFACE FINISH: SPI:A2
TOLERANCES
LINEAR: 0.01
ANGULAR: 0.1 DEG

FINISH:

| | NAME | DATE |
|---|---|---|
| DRAWN | TMH | 4/23/16 |
| CHK'D | | |
| APPV'D | | |

MATERIAL:

WEIGHT: 0.08

DO NOT SCALE DRAWING

REVISION

# Corp 7: Vegetable Peeler

Including: Daniel Gullatte, Taylor Gutherie, Trevor Hauenstein, Megan Haywood, Trey Perkins, and Alex Poole

SUBSYSTEM:

PART NAME: Band Sub-Assembly

A3

SCALE:1:1

SHEET 1 OF 2

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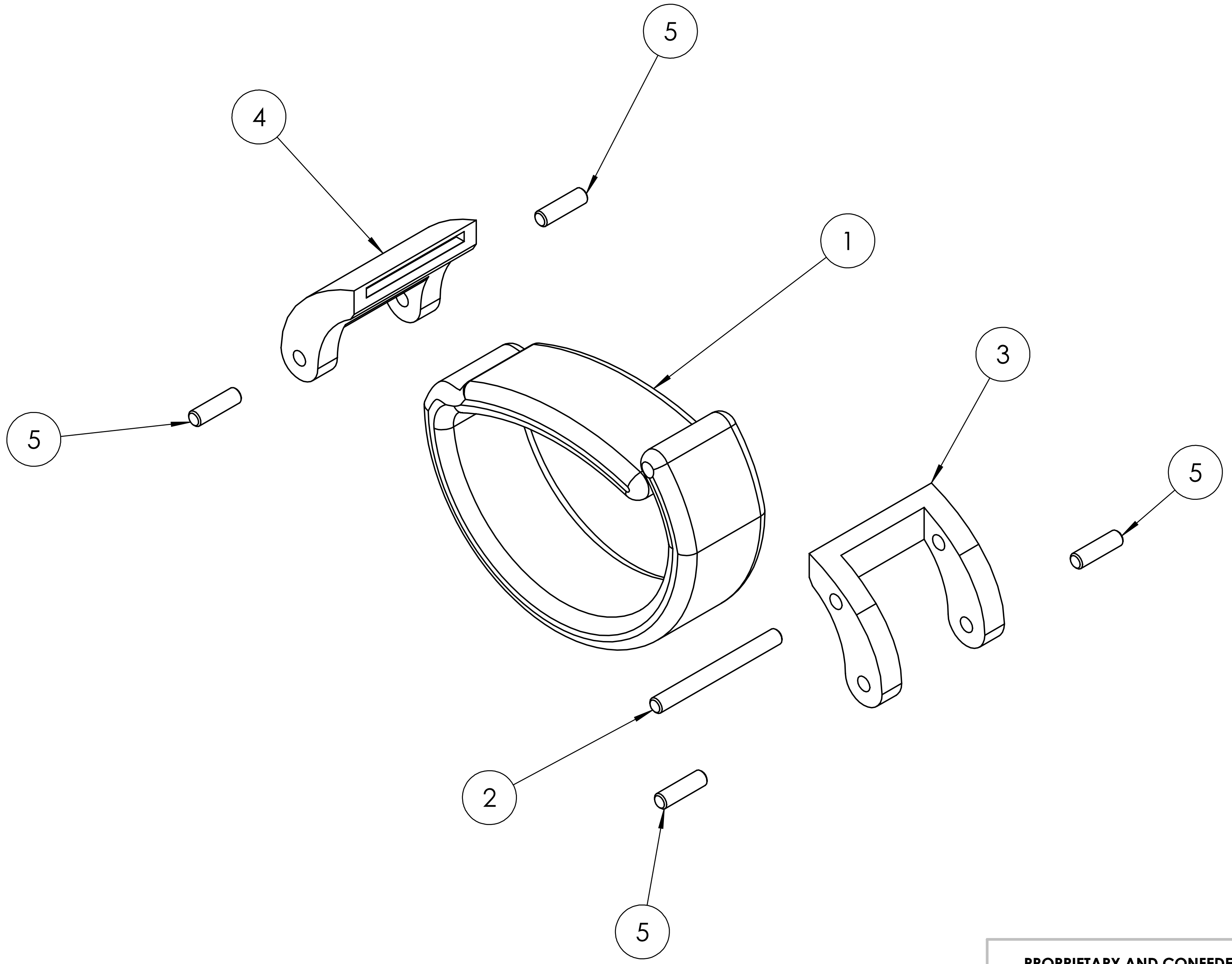
| ITEM NO. | Part Name | QTY. |
|---|---|---|
| 1 | Band | 1 |
| 2 | Large Pin 98380A477 | 1 |
| 3 | Tightening Clasp | 1 |
| 4 | Retension Clasp | 1 |
| 5 | Small Pins 98380A481 | 4 |








UNLESS OTHERWISE SPECIFIED:
DIMENSIONS ARE INCHES
SURFACE FINISH: SPI:A2
TOLERANCES
LINEAR: 0.01
ANGULAR: 0.1 DEG

FINISH:

| | NAME | DATE |
|---|---|---|
| DRAWN | TMH | 4/23/16 |
| CHK'D | | |
| APPV'D | | |

MATERIAL:

WEIGHT: 0.08

DO NOT SCALE DRAWING

REVISION

# Corp 7: Vegetable Peeler

Including: Daniel Gullatte, Taylor Gutherie, Trevor Hauenstein, Megan Haywood, Trey Perkins, and Alex Poole

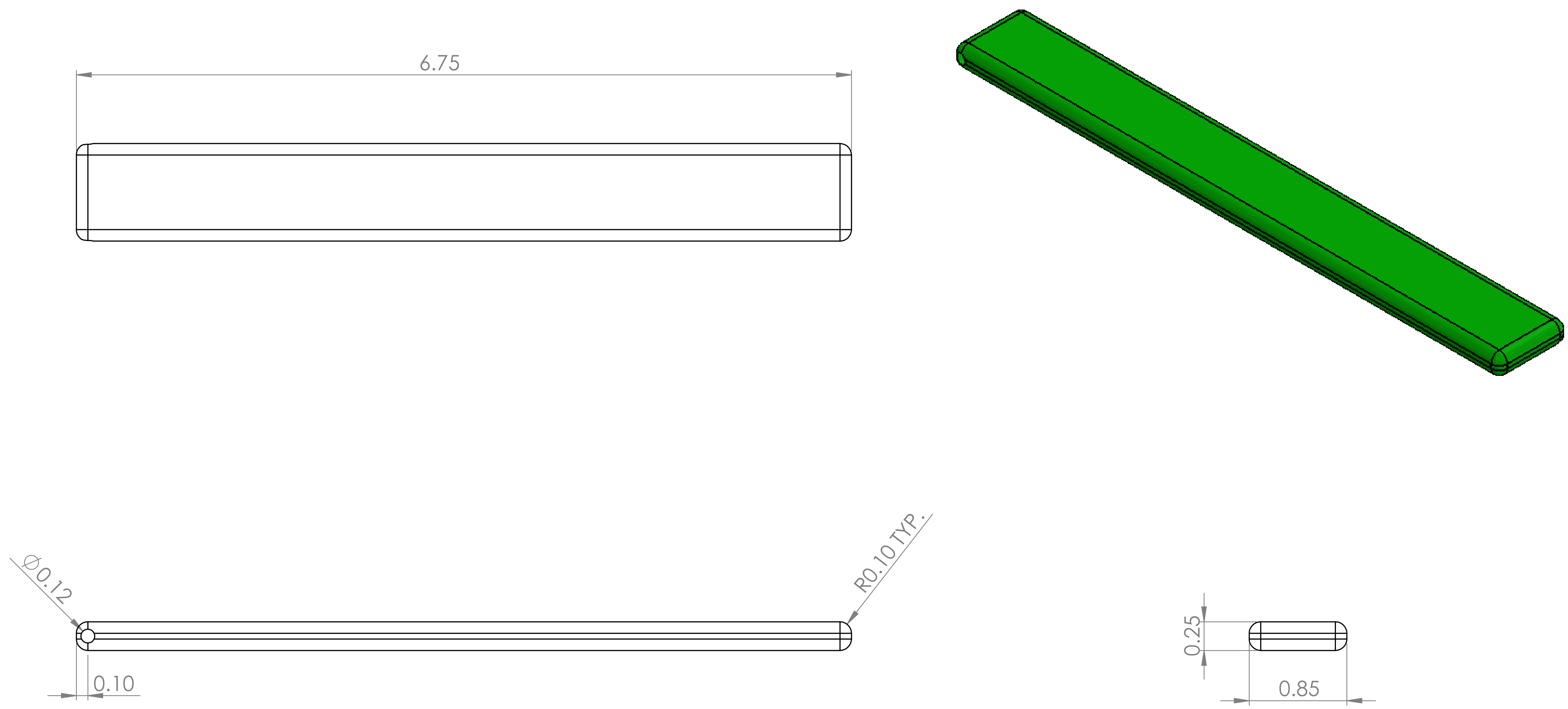
SUBSYSTEM:

PART NAME: Band Sub-Assembly

A3

SCALE:1:1

SHEET 2 OF 2

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SURFACE FINISH: SPI:A2
TOLERANCES
LINEAR: 0.01
ANGULAR: 0.1 DEG

FINISH:

| | NAME | DATE |
|---|---|---|
| DRAWN | TWP | 4/21/2016 |
| CHK'D | | |
| APPV'D | | |

MATERIAL:
TPC (Shore D50)

WEIGHT: 0.055lb

DO NOT SCALE DRAWING

REVISION

# Corp 7: Vegetable Peeler

Including: Daniel Gullatte, Taylor Gutherie, Trevor Hauenstein, Megan Haywood, Trey Perkins, and Alex Poole

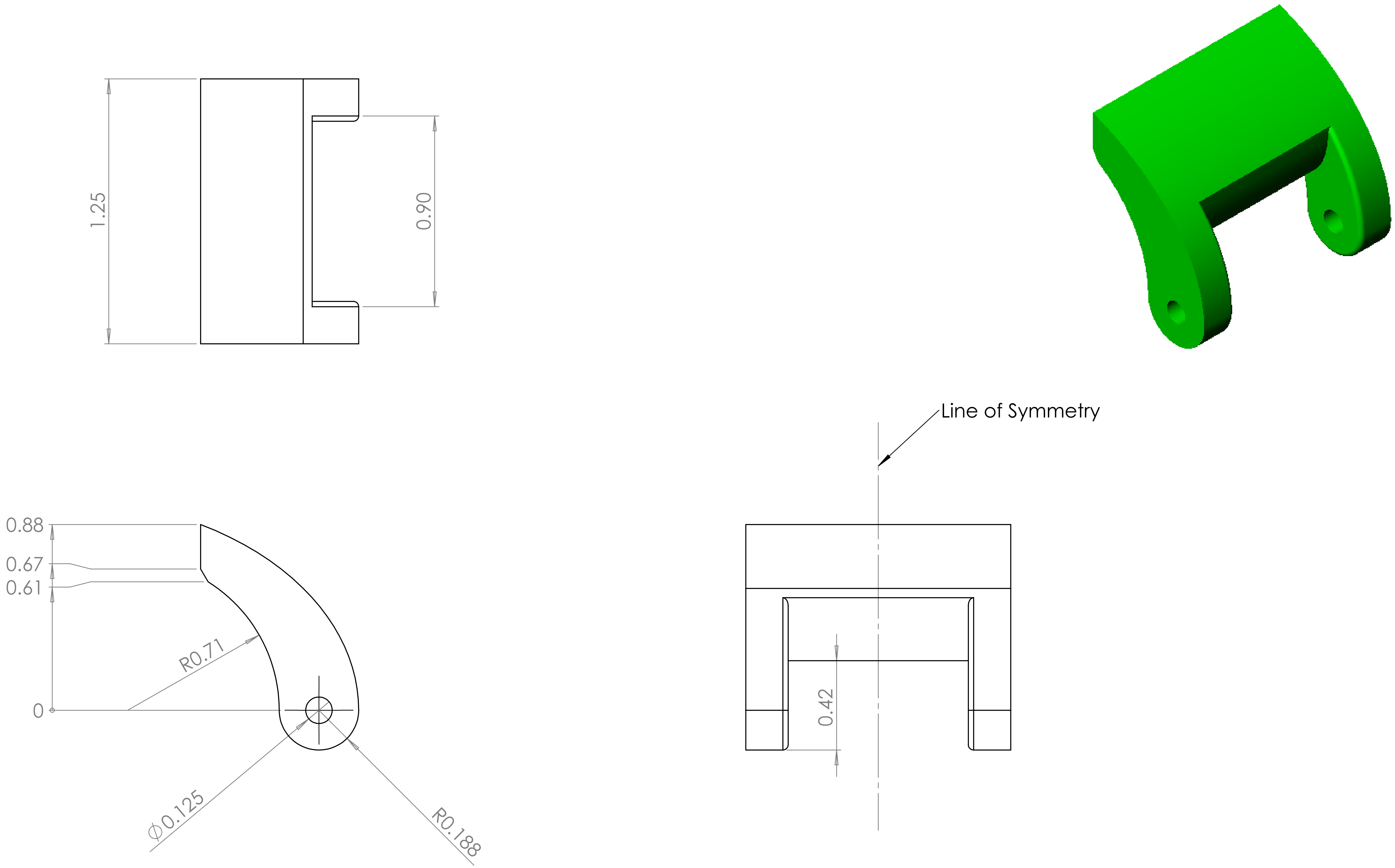
SUBSYSTEM: Band Subassembly

PART NAME: Straight Band

A3

SCALE:1:1

SHEET 1 OF 1

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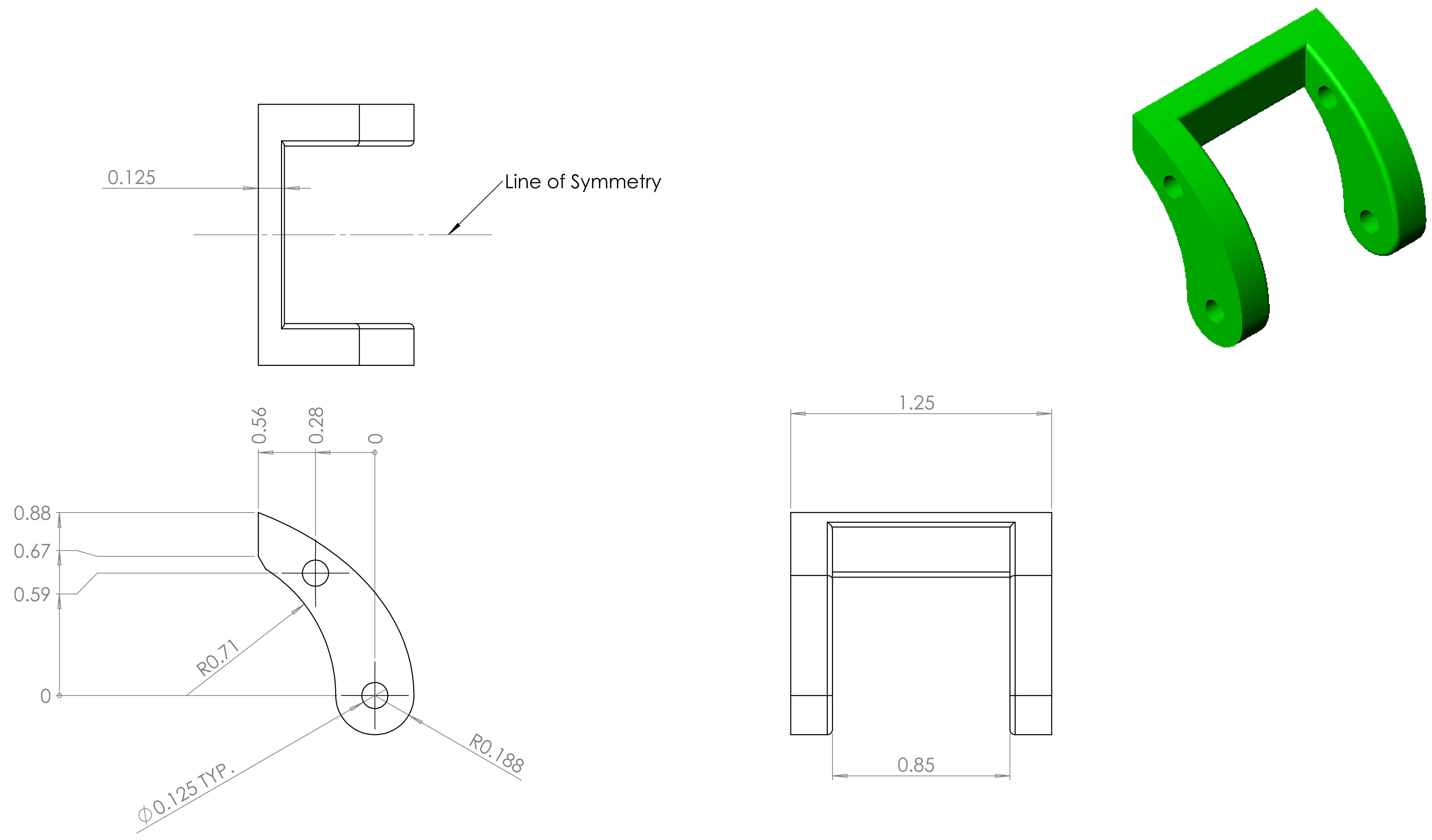
| | | | | |
|---|---|---|---|---|
| UNLESS OTHERWISE SPECIFIED: DIMENSIONS ARE INCHES SURFACE FINISH: SPI:A2 TOLERANCES LINEAR: 0.01 ANGULAR: 0.1 DEG | | FINISH: | DO NOT SCALE DRAWING | REVISION |
| | | | Corp 7: Vegetable Peeler | |
| | NAME | DATE | Including: Daniel Gullatte, Taylor Gutherie, Trevor Hauenstein, Megan Haywood, Trey Perkins, and Alex Poole | |
| DRAWN | TMH | 4/23/16 | | |
| CHK'D | | | | |
| APPV'D | | | SUBSYSTEM: Band Sub-Assembley | |
| MATERIAL: PE High Density | | | PART NAME: Retension Clasp | A3 |
| WEIGHT: 0.01 | | | SCALE:2:1 | SHEET 1 OF 1 |

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SURFACE FINISH: SPI:A2
TOLERANCES
LINEAR: 0.01
ANGULAR: 0.1 DEG

FINISH:

| | NAME | DATE |
|---|---|---|
| DRAWN | TMH | 4/23/16 |
| CHK'D | | |
| APPV'D | | |

MATERIAL: PE High Density

WEIGHT: 0.01

DO NOT SCALE DRAWING

REVISION

# Corp 7: Vegetable Peeler

Including: Daniel Gullatte, Taylor Gutherie, Trevor Hauenstein, Megan Haywood, Trey Perkins, and Alex Poole

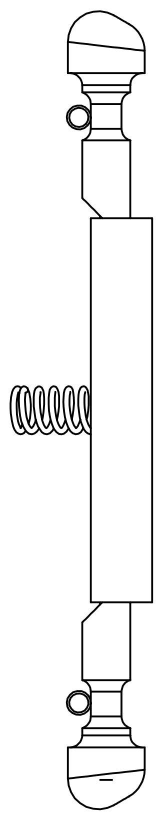
SUBSYSTEM: Band Sub-Assembly

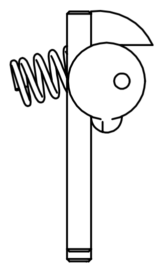
PART NAME: Tightening Clasp

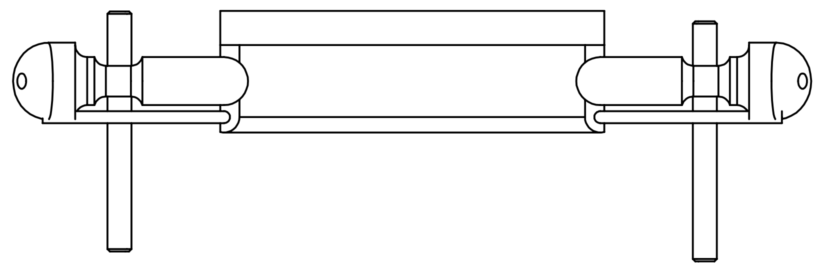
A3

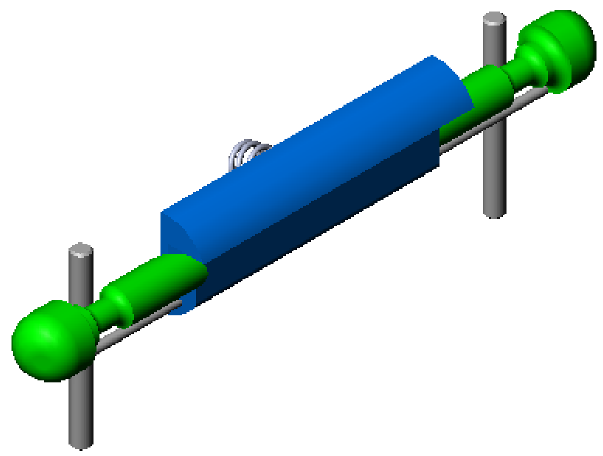
SCALE:2:1

SHEET 1 OF 1









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DIMENSIONS ARE INCHES
SURFACE FINISH: SPI:A2
TOLERANCES
LINEAR: 0.01
ANGULAR: 0.1 DEG

FINISH:

| | NAME | DATE |
|---|---|---|
| DRAWN | TMH | 4/23/16 |
| CHK'D | | |
| APPV'D | | |

MATERIAL:

WEIGHT: 0.00

DO NOT SCALE DRAWING

REVISION

Corp 7: Vegetable Peeler

Including: Daniel Gullatte, Taylor Gutherie, Trevor Hauenstein, Megan Haywood, Trey Perkins, and Alex Poole

SUBSYSTEM:

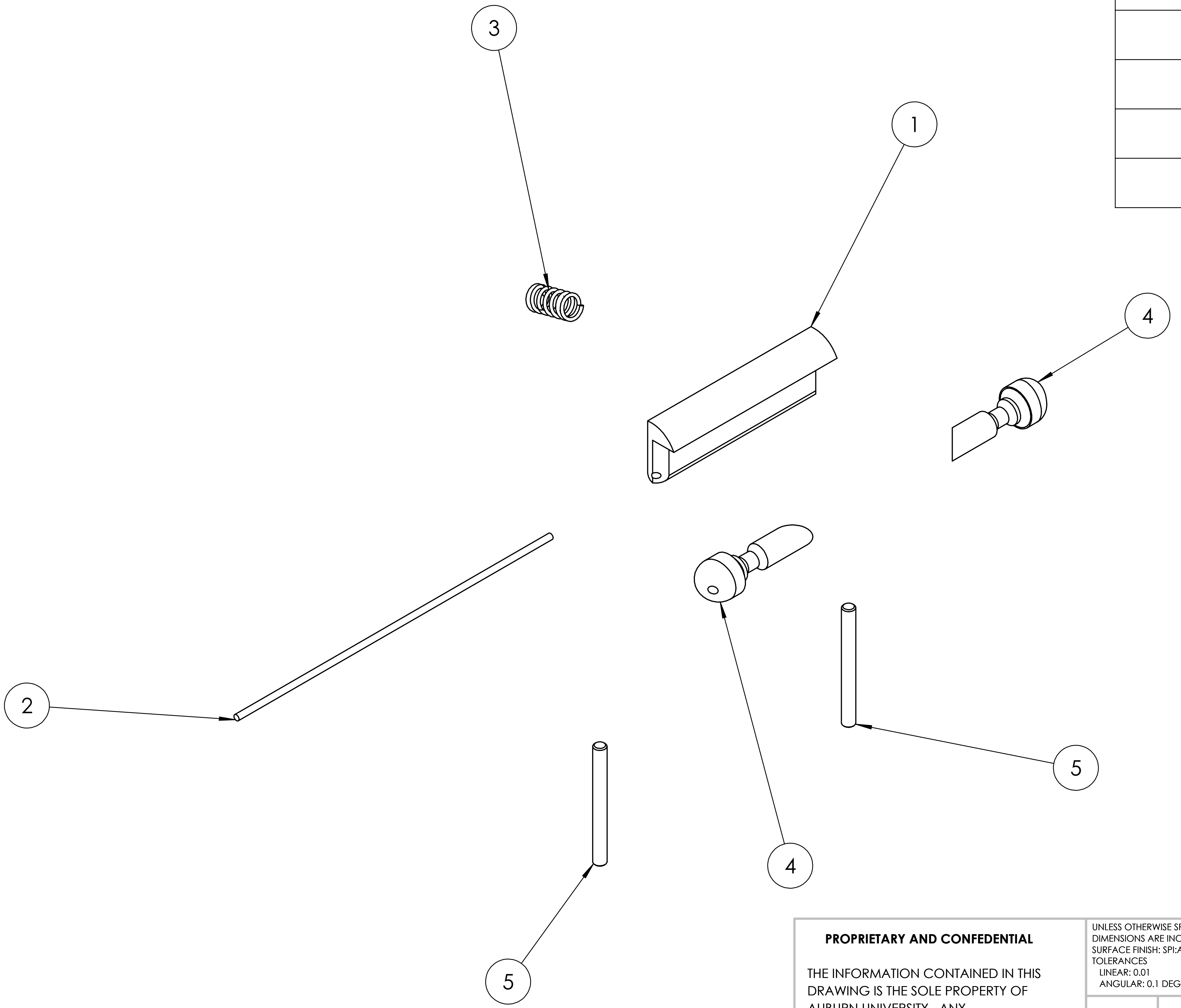
PART NAME: Latch Sub-Assembly

A3

SCALE:2:1

SHEET 1 OF 2

| ITEM NO. | Part Name | QTY. |
|---|---|---|
| 1 | Latch | 1 |
| 2 | Latch Shaft 1162K850 | 1 |
| 3 | Latch Spring 1986K430 | 1 |
| 4 | Release Button | 2 |
| 5 | Button Pin 98380A421 | 2 |

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SURFACE FINISH: SPI:A2
TOLERANCES
LINEAR: 0.01
ANGULAR: 0.1 DEG

FINISH:

| | NAME | DATE |
|---|---|---|
| DRAWN | TMH | 4/23/16 |
| CHK'D | | |
| APPV'D | | |

MATERIAL:

WEIGHT: 0.00

DO NOT SCALE DRAWING

REVISION

# Corp 7: Vegetable Peeler

Including: Daniel Gullatte, Taylor Gutherie, Trevor Hauenstein, Megan Haywood, Trey Perkins, and Alex Poole

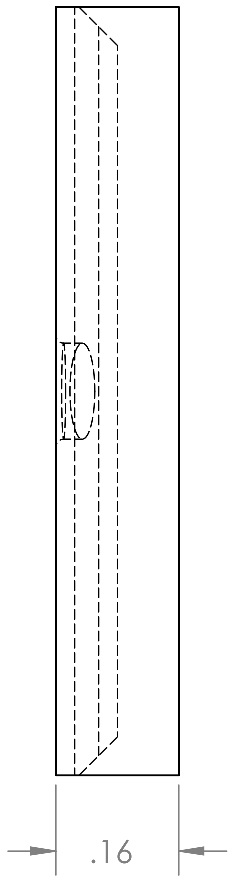
SUBSYSTEM:

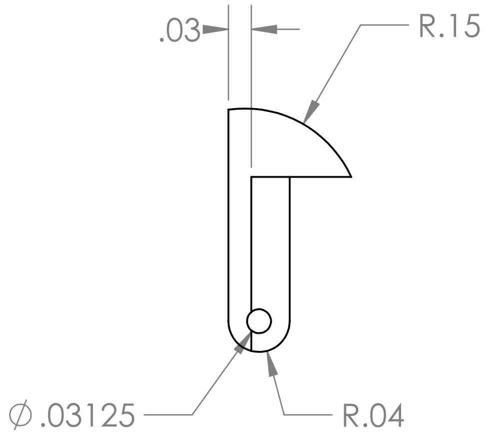
PART NAME: Latch Sub-Assembly

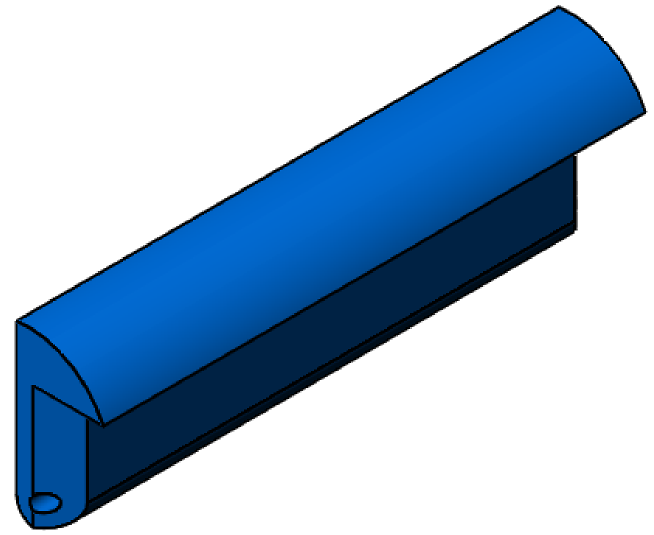
A3

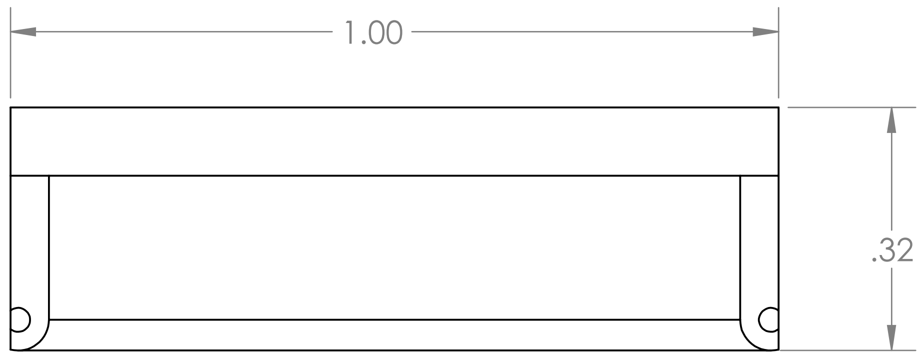
SCALE:2:1

SHEET 2 OF 2



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SURFACE FINISH: SPI:A2
TOLERANCES
LINEAR: 0.01
ANGULAR: 0.1 DEG

FINISH:

| | NAME | DATE |
|---|---|---|
| DRAWN | TWP | 4/21/2016 |
| CHK'D | | |
| APPV'D | | |

MATERIAL: HDPE

WEIGHT: 0.001 lb

DO NOT SCALE DRAWING

REVISION

# Corp 7: Vegetable Peeler

Including: Daniel Gullatte, Taylor Gutherie, Trevor Hauenstein, Megan Haywood, Trey Perkins, and Alex Poole

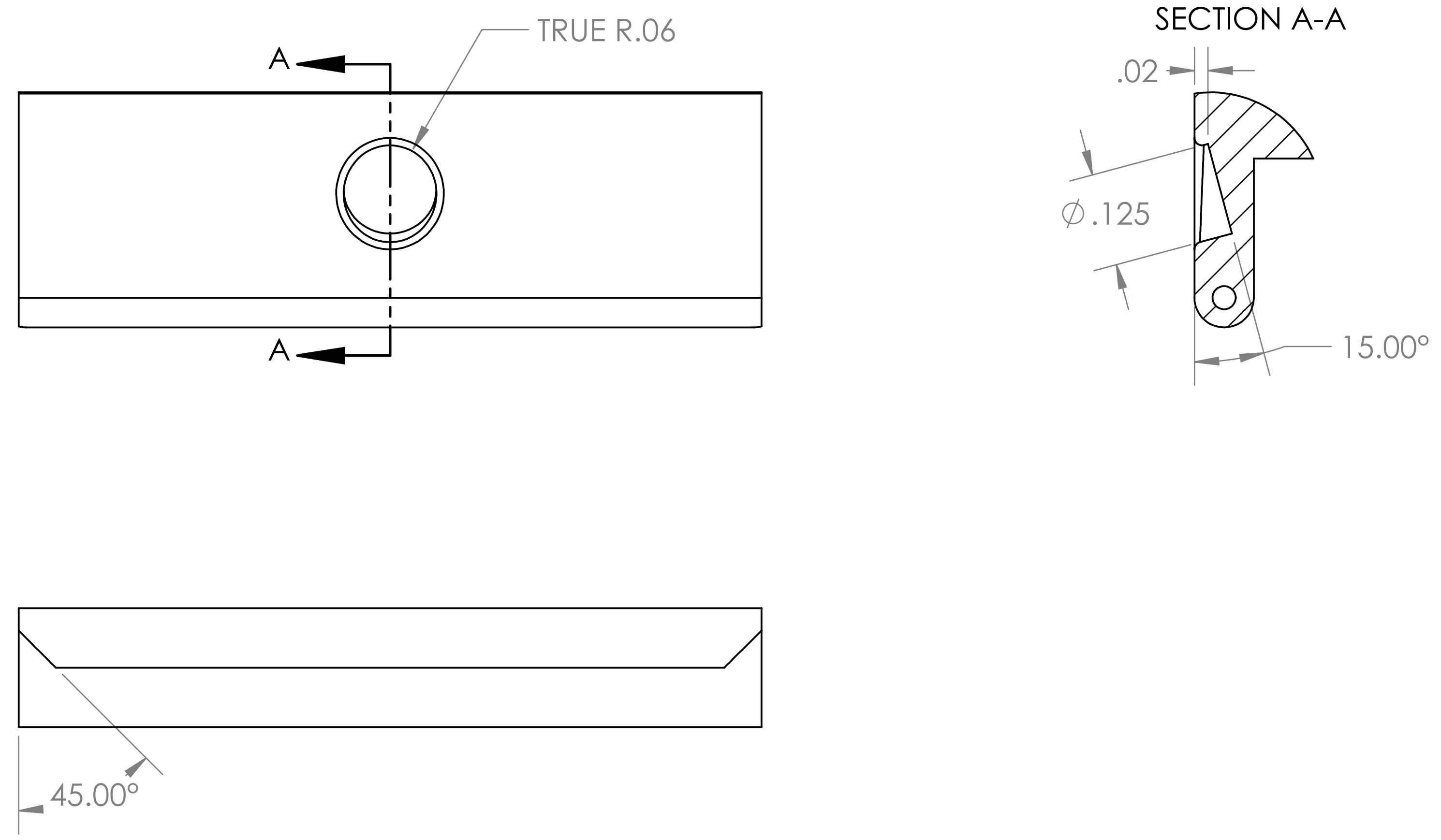
SUBSYSTEM: Latch Subassembly

PART NAME: Latch

A3

SCALE:4:1

SHEET 1 OF 2




**PROPRIETARY AND CONFIDENTIAL**



UNLESS OTHERWISE SPECIFIED:
DIMENSIONS ARE INCHES
SURFACE FINISH: SPI:A2
TOLERANCES
LINEAR: 0.01
ANGULAR: 0.1 DEG

FINISH:

DO NOT SCALE DRAWING

REVISION

# Corp 7: Vegetable Peeler

| | NAME | DATE |
|---|---|---|
| DRAWN | Trey | 4/21/2016 |
| CHK'D | | |
| APPV'D | | |

Including: Daniel Gullatte, Taylor Gutherie, Trevor Hauenstein, Megan Haywood, Trey Perkins, and Alex Poole

SUBSYSTEM:

MATERIAL:

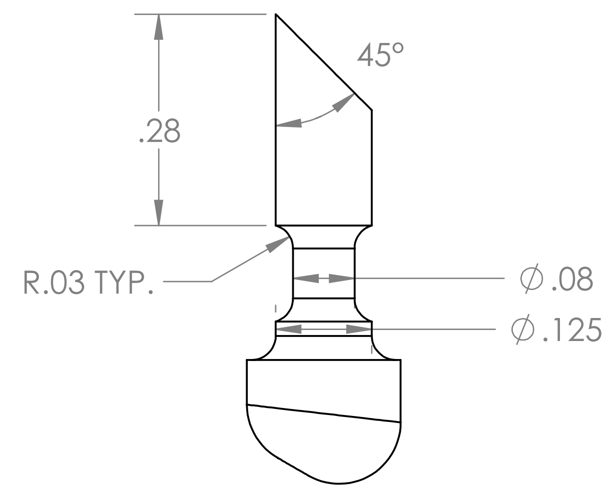
PART NAME: Latch

A3

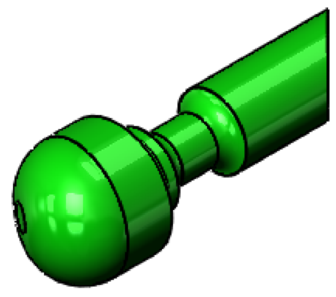
WEIGHT:

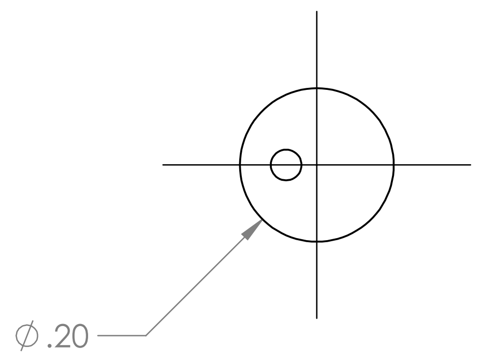
SCALE:4:1

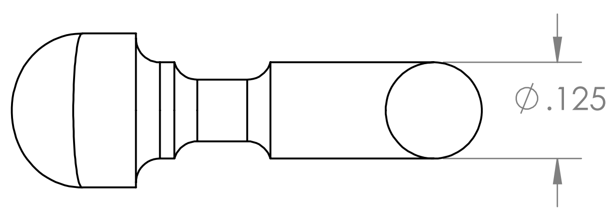
SHEET 2 OF 2




VIEW -



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UNLESS OTHERWISE SPECIFIED:
DIMENSIONS ARE INCHES
SURFACE FINISH: SPI:A2
TOLERANCES
LINEAR: 0.01
ANGULAR: 0.1 DEG

FINISH:

| | NAME | DATE |
|---|---|---|
| DRAWN | TWP | 4/21/2016 |
| CHK'D | | |
| APPV'D | | |

MATERIAL:
HDPE

WEIGHT: 0.0003 lb

DO NOT SCALE DRAWING

REVISION

# Corp 7: Vegetable Peeler

Including: Daniel Gullatte, Taylor Gutherie, Trevor Hauenstein, Megan Haywood, Trey Perkins, and Alex Poole

SUBSYSTEM: Latch Subassembly

PART NAME: Release Button

A3

SCALE:4:1

SHEET 1 OF 1