

EASY TIP

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Nayeli Yanez, Brady Quintard





Problem Statement

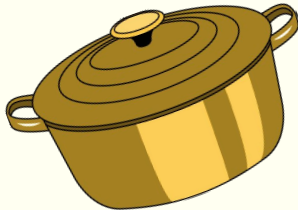
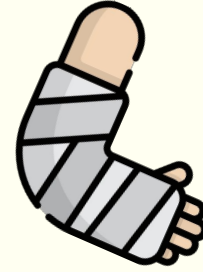


In America Today There Are...

57 million elderly people (over the age of 65)

39 million people with physical limitations

57% of household accidents occurring in the kitchen





Wrist Strength

- Endurance time for max wrist exertion is ~2-3 seconds
- Wrist strength diminishes ~30% into old age
- Wrist injuries are one of the most common injuries among the elderly






Testimonials



“Cooking gives me freedom that I don’t have in many areas of life... lifting and tipping is really hard. **I’m always afraid I’ll hurt myself** with my bad joints.”

- Susan, 76





Users with decreased physical capacity struggle to maneuver heavy items in the kitchen, reducing their autonomy and impairing their safety.

POV Statement



Elderly people and those with physical limitations need a **simple and safe** way to handle heavy pots in order to **prevent injuries** from hot surfaces in the kitchen and make cooking more **accessible**.





Potential User & Purchaser



Potential User & Purchaser



User: elderly or physically disabled people with weakened strength and joint mobility

Purchaser: users themselves, caretakers, and assisted living communities (such as Kendal)





State of the Art



Current Solution



State of the Art



Lightweight Cookware

- Doesn't address ergonomics
- Most of weight in the liquid



Brew Kettle

- Too large for everyday use
- Users need to replace pots



State of the Art Cont.

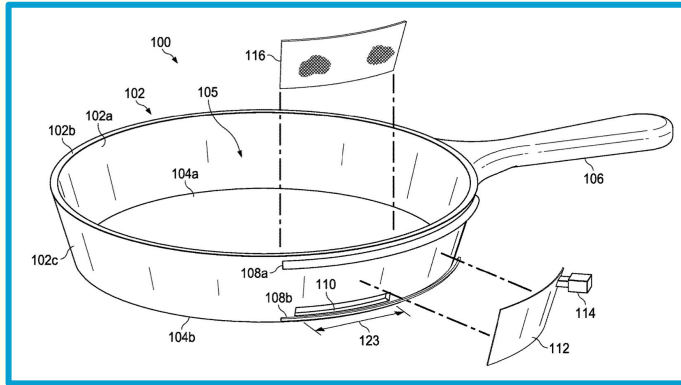


Water Siphon

- Hard to clean
- Potentially dangerous

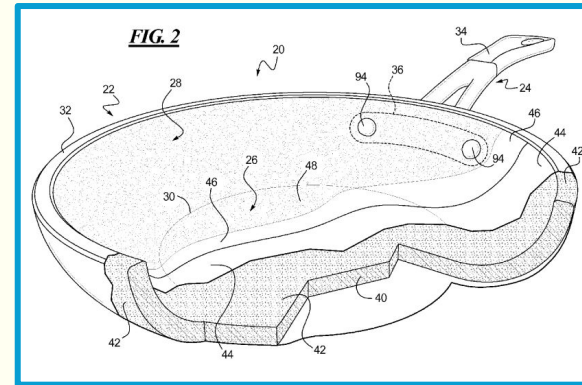


Patent Search



US20200337500A1

- Challenging to make a watertight, easy to use seal



US20110073602

- Don't address the ergonomic challenge of pouring out the pot





Ideation





Specifications

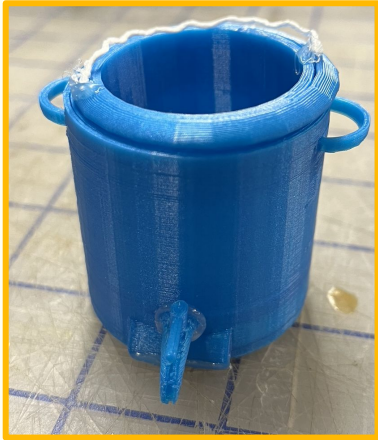
Specification	Temperature Regulation	Stability	Ease of Use	Performance	Size	Weight	Strength	Precision
Justification	Safety sub-spec, essential for protection of users	Important stand holds the weight of pot on a flat surface	Critical to cater to the needs of our potential users: elderly people	It should help fully empty the pot rather than making it more difficult to empty	Hold average sized pots already used in the kitchen	User should be able to lift and carry the product with minimal effort	Device should stand without shifting	Product should pour out contents in a controlled and accurate fashion
Weighting	0.8	0.8	0.8	0.7	0.8	0.8	0.9	0.8
Quantification	Contact material stays below 120°F	Pot lays flat when placed in device	Test with users and ask for feedback, 1-5 scale of how easy it was to use	Measuring angle the mechanism can rotate 90 degrees	Hold pots with diameter between 20-25 cm	Under 3 kg	Can hold 15 kg pot without moving	Measure amount of liquid is collected at different levels of precision



Alternatives Matrix

	Specifications	Strength	Stability	Ease of Use	Precision	Size	Weight	Temp Regulation	Performance	Safe	Legal	Ethical	TOTAL
Solutions	Weighting	9	8	8	8	8	8	8	7	10	10	10	
Pot with drainage spigot & lever on side		5	5	4	5	4	4	4	5	5	5	5	438
Pot with drainage holes & plugs		5	2	5	4	5	4	3	4	5	5	5	407
Pump mechanism to remove water		3	5	3	3	2	3	5	2	5	5	5	359
Track & cart to bring pot to sink		3	3	5	2	1	2	5	4	5	5	5	299
Trigger on handle that drops bottom out		3	2	3	3	4	3	4	5	4	5	5	354
Pivot mechanism to tilt pot		4	5	5	5	4	4	5	5	5	5	5	445
Pot with curved bottom for easy tilting		3	3	4	3	4	4	4	4	5	5	5	381
Siphoning metal tube & stopper, with mesh		5	5	4	4	4	5	3	3	5	5	5	416
Pot with a built-in, removable colander		5	4	5	5	5	4	4	5	5	5	5	446
Heat-safe pot cover		3	4	5	3	5	5	4	3	5	5	5	406

Idea Pivot



Original Idea

Straining pot with a built-in colander



Idea Shift

Pot tipping device inspired by the portagarrafón from Mexico



Factors Contributing to The Pivot



Feedback from Polly: “It’s the **pour**, the **twist**, and the **aiming** that’s challenging.”

Feedback from review board: “**overengineered, limited versatility**”

Inspiration from preexisting mechanisms

EASY TIP:
Mechanism that helps the user tilt pot





Alternatives Matrix with Updated Weightings

	Specifications	Temp Regulation	Stability	Ease of Use	Precision	Size	Performance	Strength	Weight	Safe	Legal	Ethical	TOTAL
Solutions	Weighting	10	10	9	9	8	8	8	7	10	10	10	
Pot with drainage spigot & lever on side		4	5	4	5	4	5	5	4	5	5	5	461
Pot with drainage holes & plugs		3	2	5	4	5	4	5	4	5	5	5	421
Pump mechanism to remove water		5	5	3	3	2	2	3	3	5	5	5	381
Track & cart to bring pot to sink		5	3	5	2	1	4	3	2	5	5	5	321
Trigger on handle that drops bottom out		4	2	3	3	4	5	3	3	4	5	5	371
Pivot mechanism to tilt pot		5	5	5	5	4	5	4	4	5	5	5	472
Pot with curved bottom for easy tilting		4	3	4	3	4	4	3	4	5	5	5	399
Siphoning metal tube & stopper, with mesh		3	5	4	4	4	3	5	5	5	5	5	433
Pot with a built-in, removable colander		4	4	5	5	5	5	5	4	5	5	5	468
Heat-safe pot cover		4	4	5	3	5	3	3	5	5	5	5	425

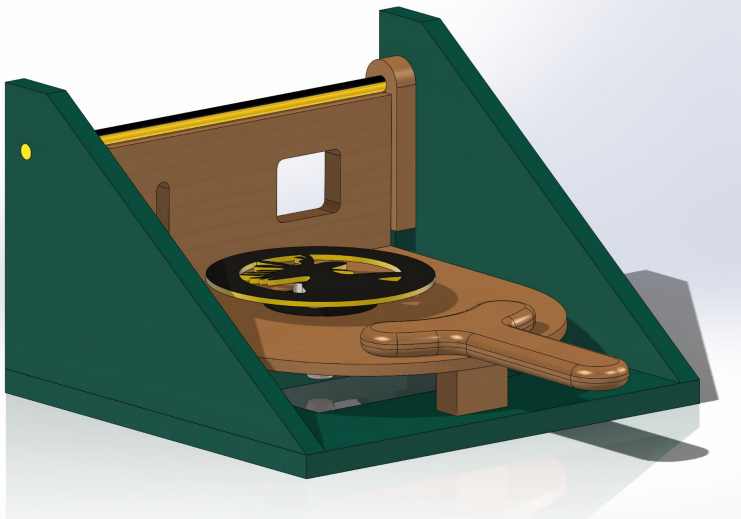




Our Solution



Our Solution



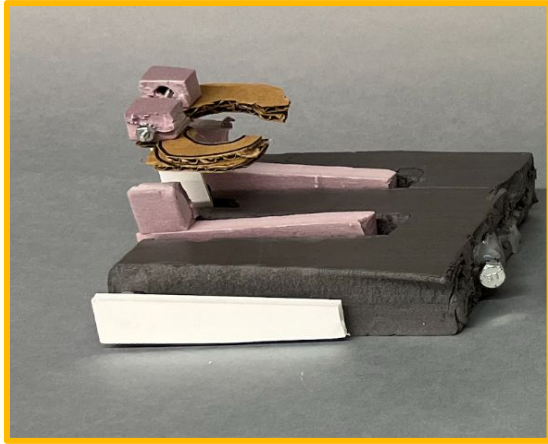


Iterative Prototyping





Feature #1 – The Stand



Flat Surface for pot

Too weak for this weight

Center of mass stays
above stand

Uneven surface for pot

Flat surface for pot

Center of mass stays above
stand





Feature #2 - The Lever



Wood

Lighter & easier to work with

Too weak for this weight

Brass

Much stronger

More rigid





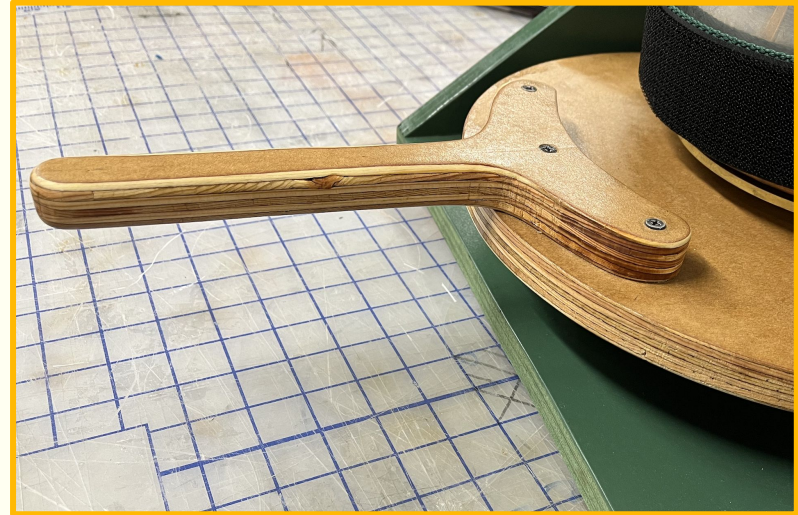
Feature #2 - The Lever



Side Lever

Visually pleasing, less space

Much harder to pull



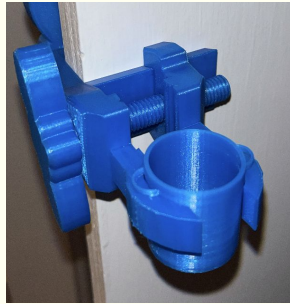
Handle

More force advantage

More ergonomic grip, 96% preferred



Feature #3 - Straps



Vice

Buckle

Double D Ring

Velcro Cinch Strap

Secure but clunky

Secure but hard to use

Hard to use

Secure & easy!



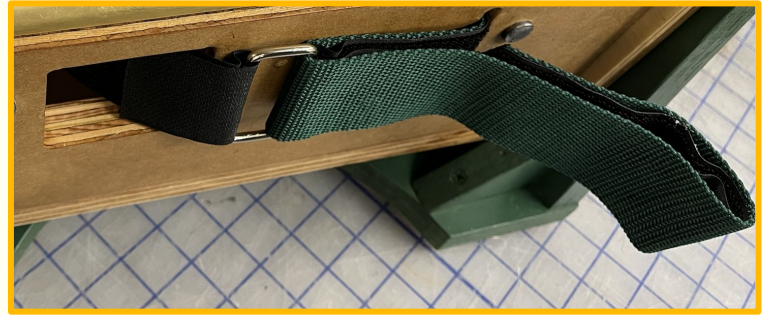
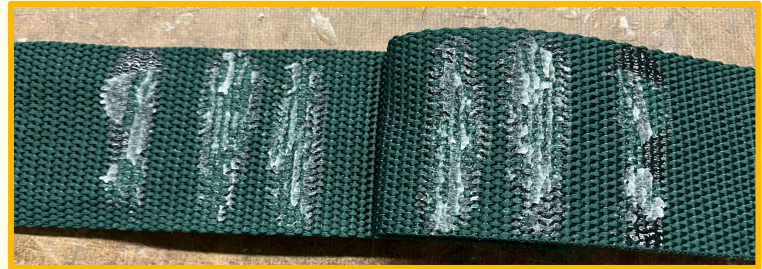
Feature #3 - Straps



Plain Velcro

Light/Cheap

Floppy



Epoxy Reinforced Nylon

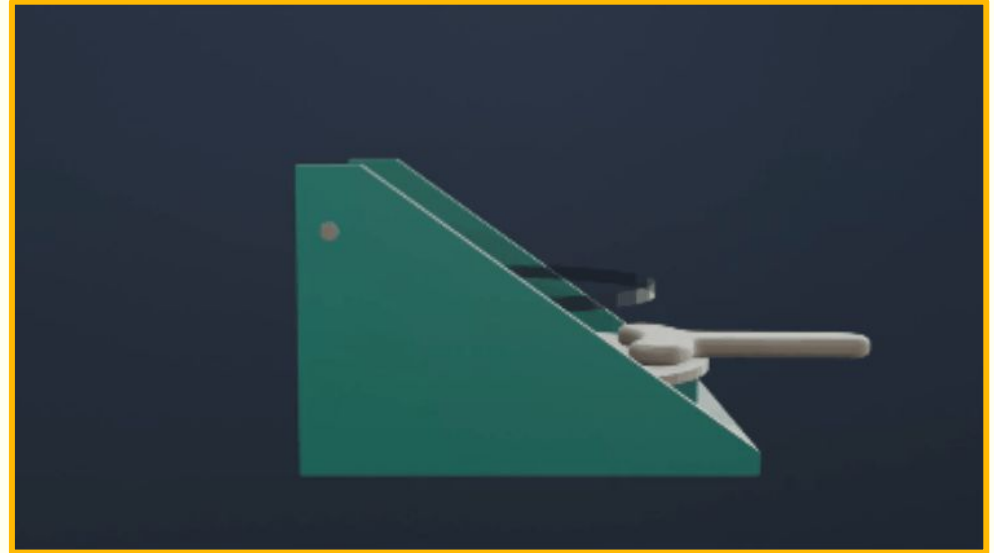
Cloth dissipates heat

Adds rigidity





Feature #4 – Height Adjustment



Spinning Plate

Easy to use, adjustable, increased precision

Slightly heavier



Final Product





Calculations



Total Area (3/4" plywood)

Piece	Quantity	Area (in ²)	Total (in ²)
Side	2	74.25	148.5
Gusset	2	3.125	6.25
Bottom	1	→	157.9
Base	1	→	157.4
Handle	1	→	~29
Back	1	→	56.25
Rod attachments	2	7.57	15.14

Total: 570.44

★ Excluding rod, screws, & plates:

$$\text{Volume} = \frac{3}{4}(\text{total}) + \text{Block with block} = 3 \text{ in}^3 \\ = 430.83 \text{ in}^3$$

$$\text{Plywood} \left\{ \begin{array}{l} \rightarrow \times (110 \text{ g}) / (21.75 \text{ in}^3) = \boxed{2.18 \text{ kg}} \text{ of wooden pieces} \\ \rightarrow \text{Measured density for plywood} \\ = 4.81 \text{ lbs} \end{array} \right.$$

Aluminum:

- Reducing sides to 3 bars in a triangle
- Reducing block to 0.5 in³ (small stopper)
- Reducing bottom to 4 bar frame
- Reducing handle to 1 bar
- All other pieces thin aluminum estimate

$$\text{New estimate: Bars + Plates (0.08" thick)} \\ 0.93 \text{ kg} + 0.83 \text{ kg} = \boxed{1.76 \text{ kg}} \\ 3.88 \text{ lbs}$$

★ Lighter & more durable than plywood

Materials Analysis

Conclusion: aluminum and polycarbonate would be lighter for the future, and polycarbonate would be more sustainable, but wood meets our specifications

Polycarbonate: Sustainability

$$\text{Using a thickness of } 0.1'' \\ \& \text{ density } 19.7 \text{ g/in}^3 \\ \rightarrow \text{New weight} = \boxed{1.17 \text{ kg}} \\ = 2.47 \text{ lbs}$$

★ Lighter than plywood
AND more sustainable

Force Analysis

**Tipping by hand
places lots of strain
on the wrist**

&

**Endurance time for
this exertion poses a
risk**

The diagram illustrates a hand tipping a pot. The pot is shown as a square with a dashed line indicating the axis of rotation at the top edge. The height of the pot is labeled as 8 in. (~0.2 m). The mass of the pot is labeled as M = 7 kg (~15 lbs). The center of mass is marked with a dot. The distance from the axis of rotation to the center of mass is 0.1 m. The angular acceleration is given as 10 m/s². The torque is calculated as $\tau = (7 \text{ kg})(0.1 \text{ m})(10 \text{ m/s}^2) = 7 \text{ N}\cdot\text{m}$ From pot.

Below the pot, a hand is shown tipping the pot. The wrist axis is indicated with an upward arrow. The palm size is estimated as 4 in. → 0.1 m. The torque is equated to the force applied at the palm: $7 \text{ N}\cdot\text{m} = (F)(0.1 \text{ m})$. The force needed to apply is calculated as $F = 70 \text{ N}$ needed to apply.

Average wrist flexor exertion for a healthy person: 70 N

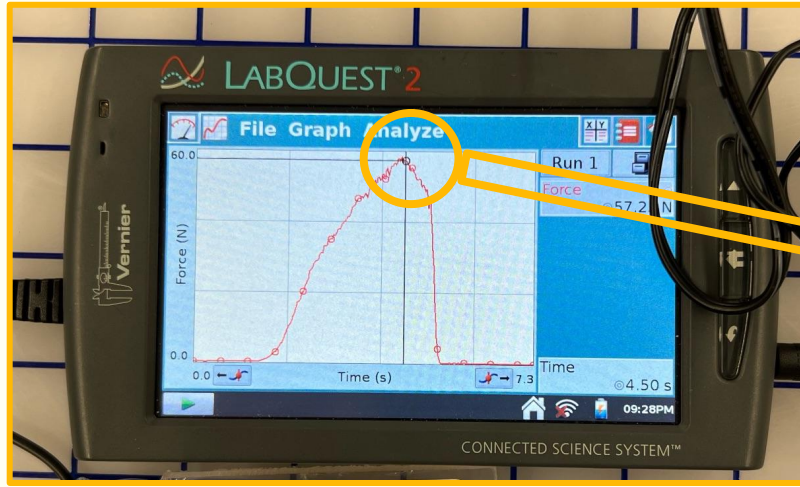


Benchmark Testing



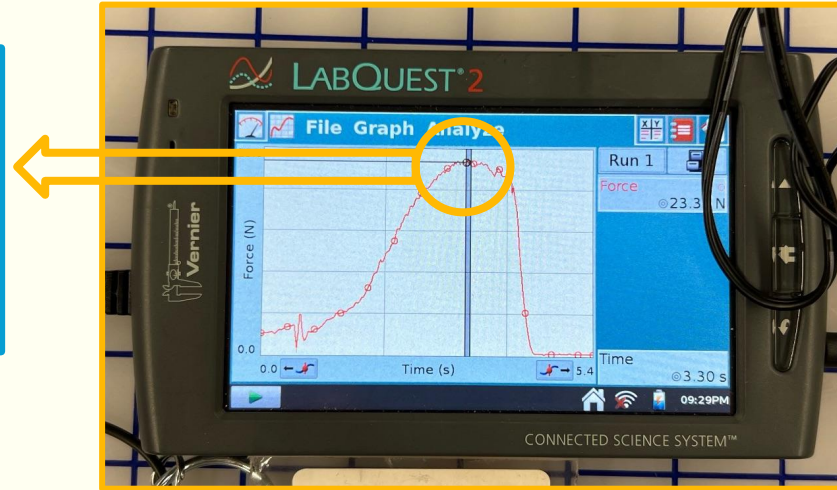
Strength Tests

LabQuest-compatible
force sensor



Using the side
lever, 57.2 N to
lift

Using the handle
on the end of the
base, 23.3 N to
lift!



Strength

Spec:

- Hold at least 15 kg

Model:

- Fits pots up to 27 cm in diameter



Weight

Spec:

- Weighs under 3 kg

Model:

- Weighs 5.5 kg



Size

Spec:

- Fits pots 20-25 cm in diameter

Model:

- Fits pots up to 27 cm in diameter





Performance – Tipping Stop



AT REST	2.15°
AT MAXIMUM	99.15°

- Demonstrated **97°** of free rotation
- Stopped within **10°** of vertical

Stability



Spec:

- Stability

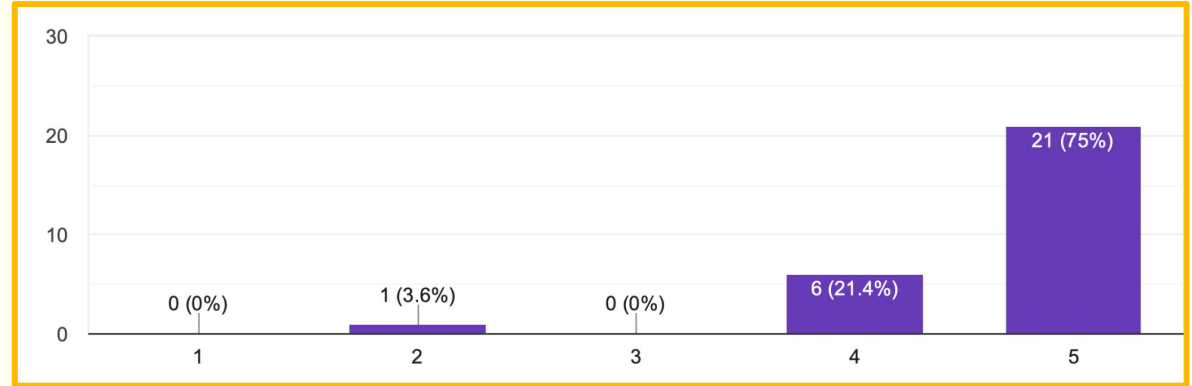
Test:

- User feedback (28 users)
- Check for wobble

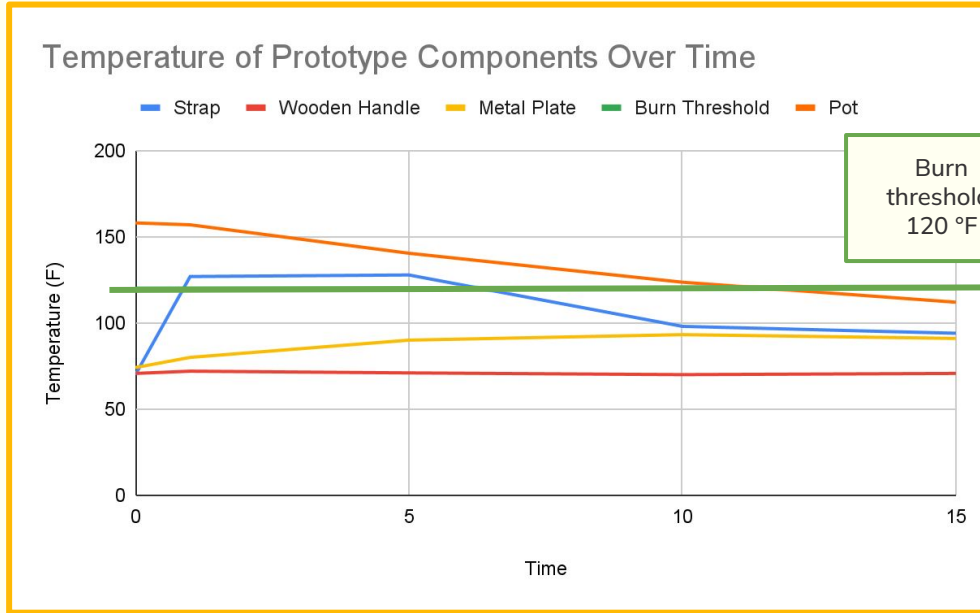
Results:

- Very little wobble
- Users largely said it felt very stable

Rank the stability of the product on a scale of 1 to 5.



Temperature Testing



Spec:

- Temperature regulation

Test:

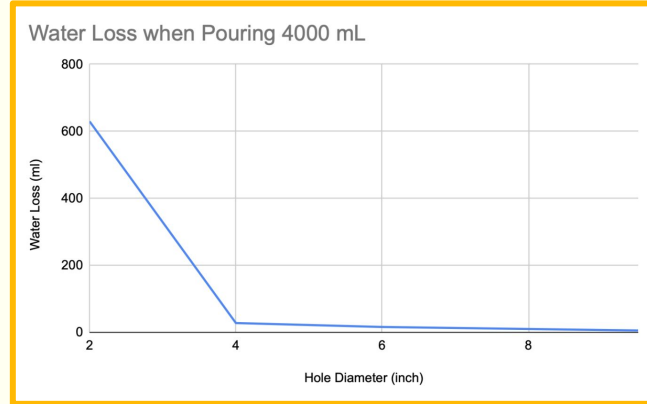
- Put materials in contact with a pot of boiling water
- Measure temperature over time

Results:

- Dual strap heated up significantly less than velcro
- Handle showed little to no increase in temperature



Precision Testing



Spec:

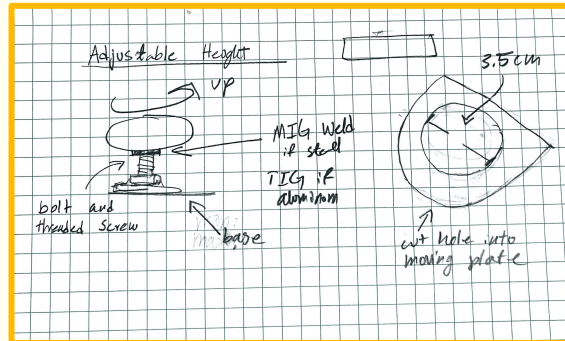
- Precision

Test:

- Pouring into targets of different size

Results:

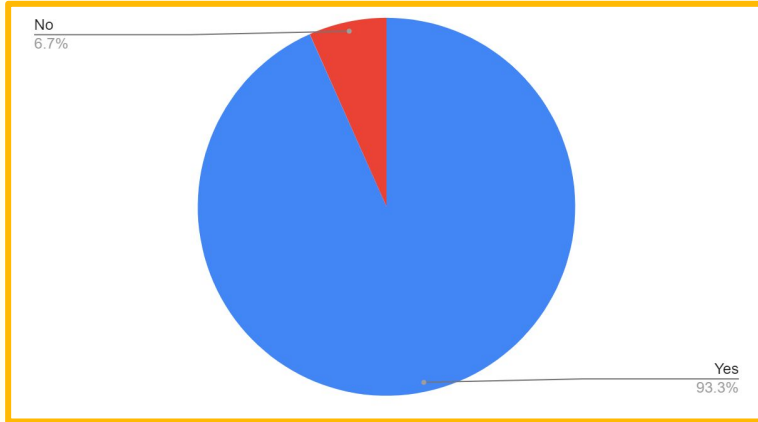
- The ability to adjust height contributed to the precision of pour





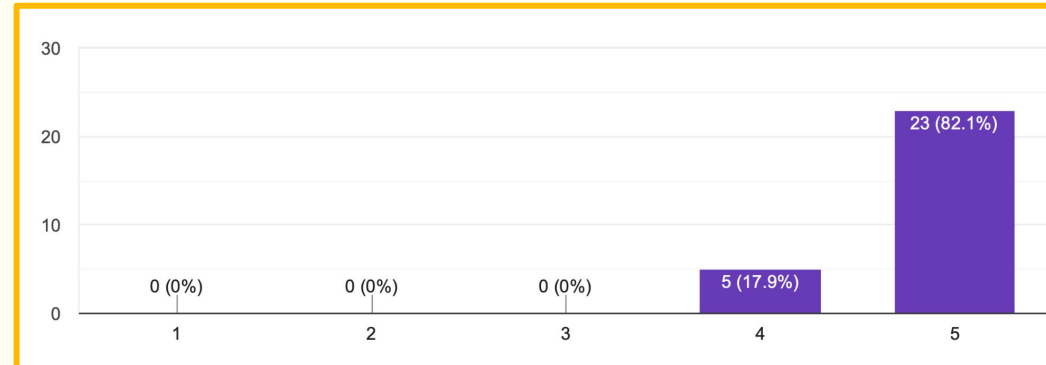
User Feedback – Ease of Use

Would you use this product?



93.3% of users above 75 stated that they would benefit from our product

Rank ease of use on a scale of 1 to 5.



82.1% of all users ranked 5/5 on ease of use specification





Ethics and Sustainability



Ethics and Risks



Accessibility

- Our product would allow people with limited mobility to perform tasks requiring hot water



Social Equity

- Ensuring fair treatment of employees

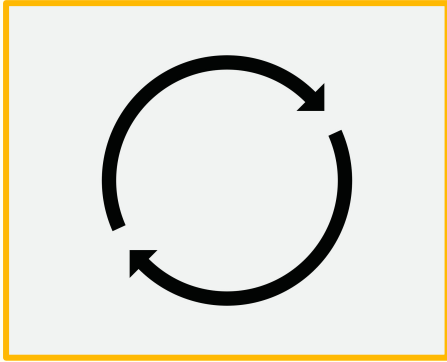


Risks

- Tipping too fast could cause the mechanism to fall
 - Mitigate by creating clear instructions and communicating risks to users

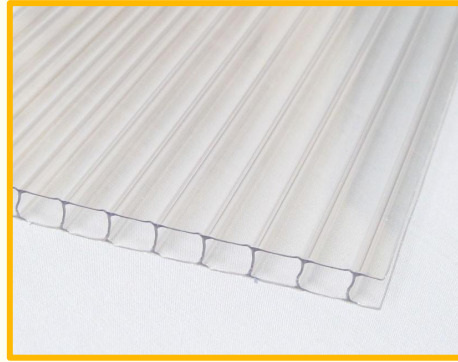


Sustainability



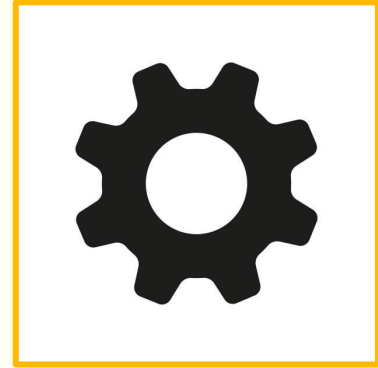
Lifetime Use

- Meant to only be purchased once per household
- Material allows for durable, long lasting product



Sustainable Materials

- Polycarbonate
- Aluminum




Production

- Meant for a smaller subset of the population
- Wouldn't be mass produced to the extent of creating unnecessary waste



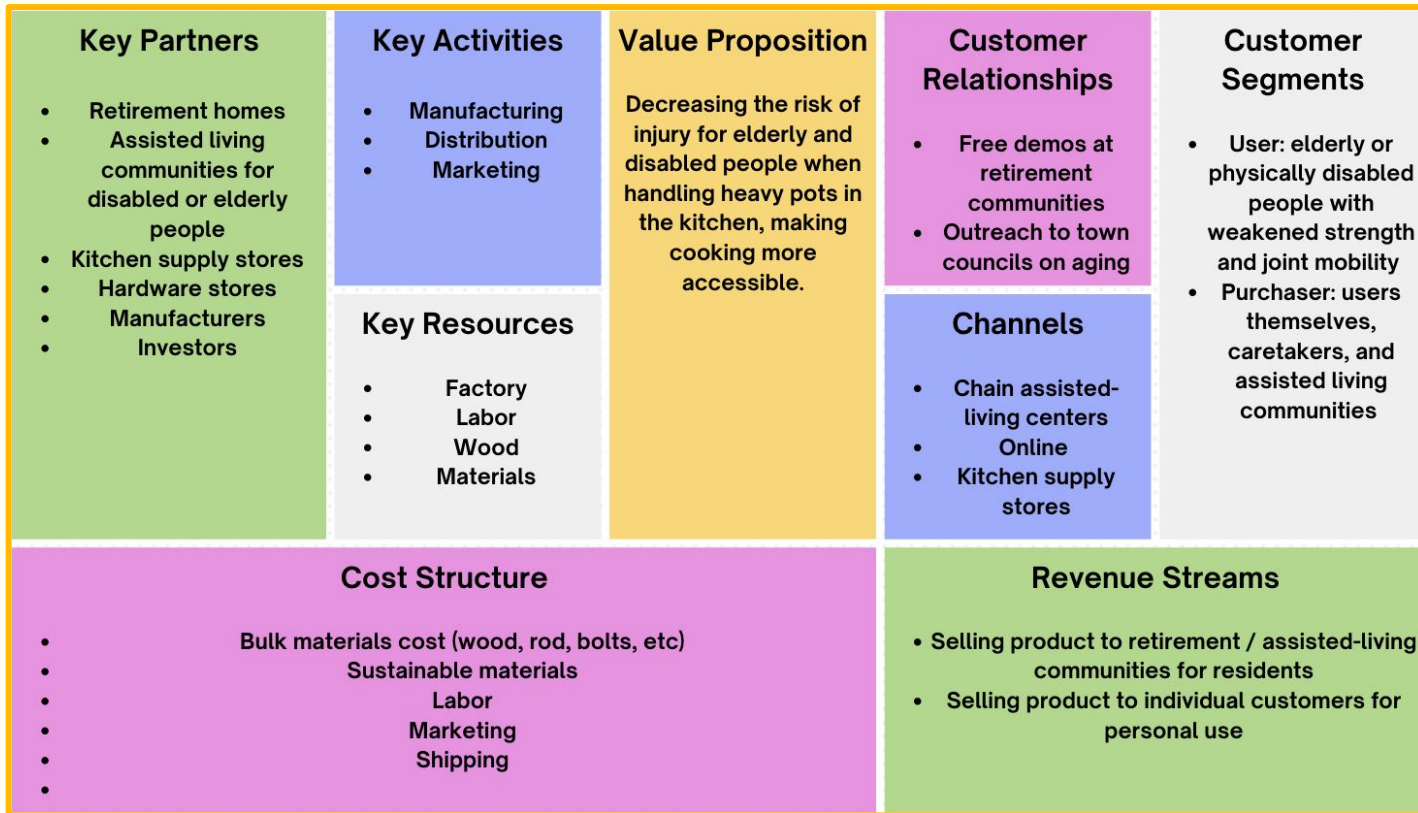


Economics and Business Plan





Business Plan





Cost Estimation: Variable Costs

- ¾" Plywood: \$1.25/ft² (4 ft²)
- Brass rod: \$3.50 per unit (1)
- Steel plate: \$5 per unit (1)
- Strap: \$2 per unit (1)
- Screws: \$0.15/unit (8)
- Watco Butcher Block Stain: \$17.28/pint (⅓)
- ¾ - 10 bolt: \$2.12 per unit (1)
- ¾ - 10 nut: \$0.82 (2)
- Spray paint \$6.98/can (⅓)
- Epoxy: \$1

Product Cost
\$29.60

Packaging Cost
\$2.50

Total Cost
\$32.10

Price
\$80

Profit
\$47.90





Cost Estimation: Fixed Costs

One-Time:

- Equipment - \$20,000

Monthly:

- Payroll - \$50,000
- Rent - \$4,000
- Utilities - \$1,000
- Insurance - \$300
- Marketing - \$2000

- **Total - \$57,300**

Break Even Point - 1200 units

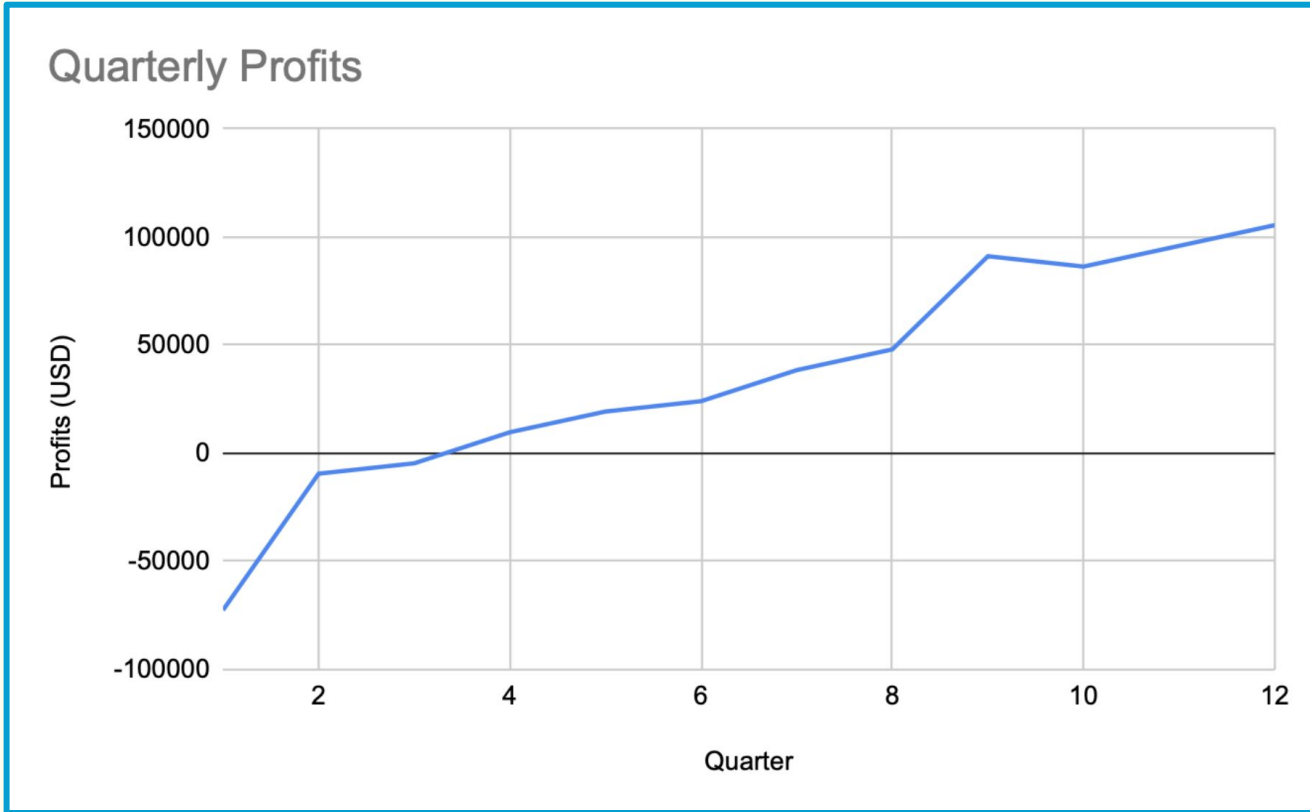
Total US Market Size - 2 million

Funding - ~\$100,000 to reach break even point





Projected 3-Year Cash Flow





Reflections and Next Steps



Business Team Roles

**Design
and
Layout**

Tommy

**User
Outreach**

Meghan

**Numerical
Analysis**

Brady

**Prototyping
and Refining**

Abbey

Machining

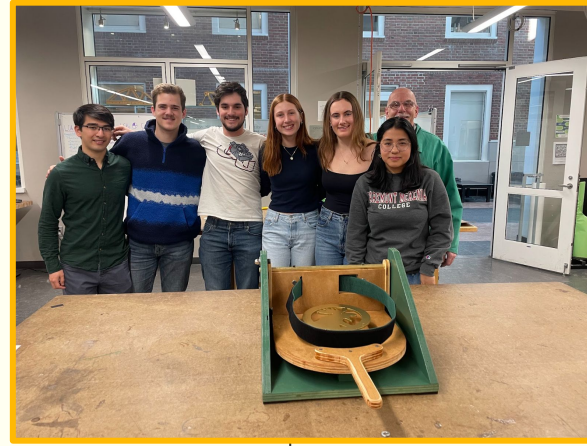
Nayeli



Teamwork and Project Management



Proved to be especially challenging with our pivot



Timeline



Communication

Successful with consistent team check-ins

Collaboration

Worked to our strengths, very collaborative in building our full-sized model



Conclusions

Specifications Analysis:

Stability	Size	Performance	Strength
Precision	Weight	Temperature	Ease of Use

Key:

Met/exceeds	
Room for improvement	
Not met	



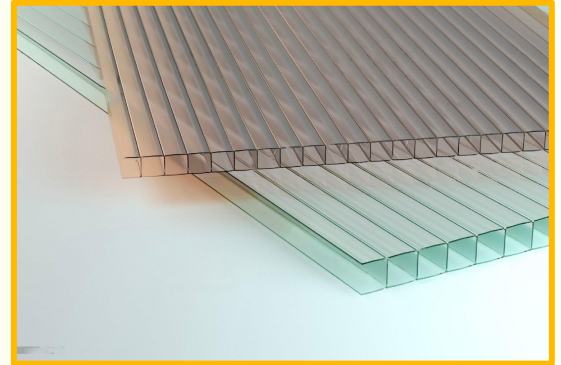
Improvements and Future Plans

Materials Consideration

- Balance stability, cost, and weight

Test and Prototype Improvements in Design

- Minimize contact with the strap
- Weight optimization
- Countertop space used





Thank you! Questions?

Special thanks to Joe and Christian, our TI and TA



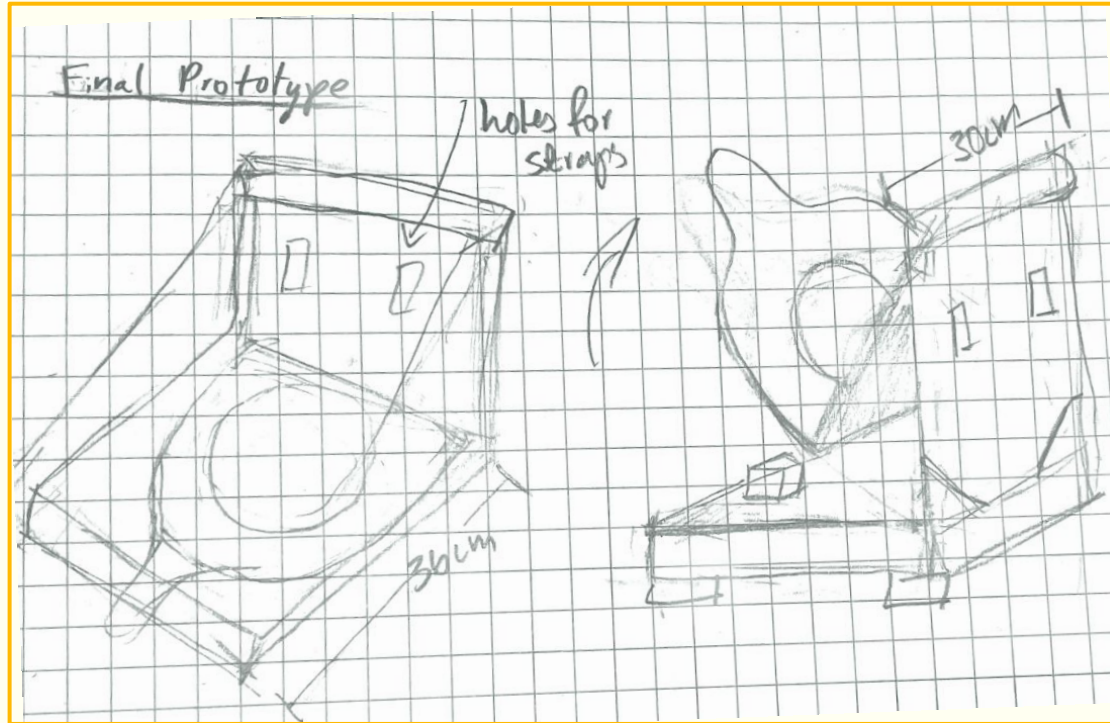


Appendix



Appendix # 1

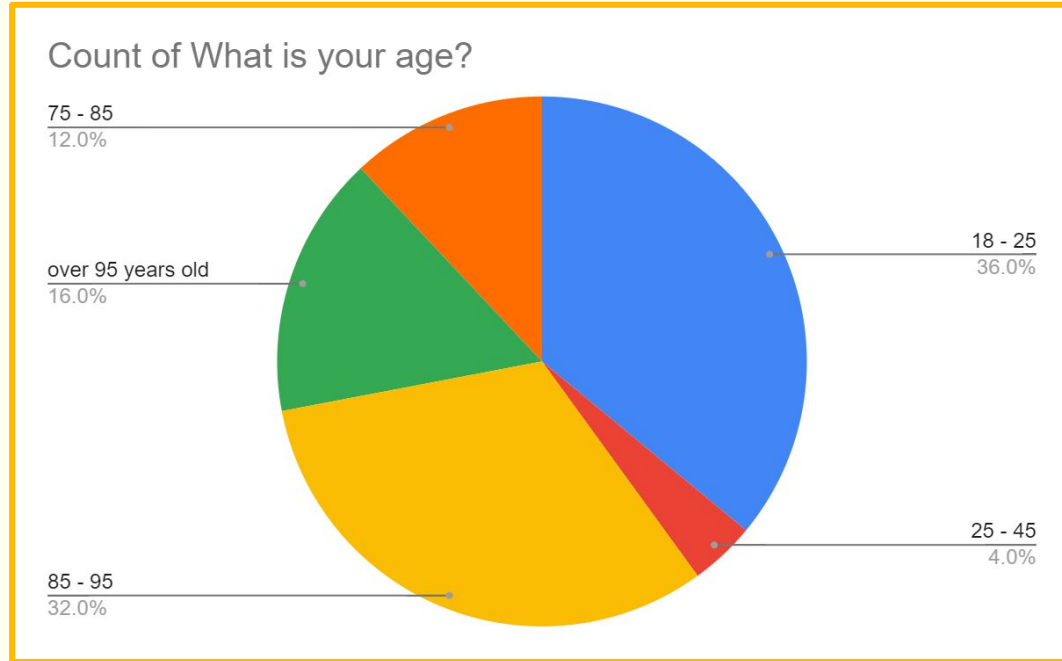
Final Prototype Sketch:



Appendix #2



Ages of participants in user-testing:



Appendix #3



**Cutting wood
pieces using the
bandsaw**

**Using the milling
machine to make
holes for screws**



Appendix #4



**Welding bolts and
plasma cutting plate
for the height
adjustable feature**





Appendix #5



Sustainability Research:

“One of the key ecological advantages of polycarbonate is its exceptional durability and longevity” - (The Eco-Friendly Nature of Polycarbonate: A Sustainable Solution)

“Aluminum is a sturdy material that can withstand heavy foot traffic and is less prone to damage from moisture or impact. Wood, on the other hand, is prone to scratches, dents, and warping over time, especially in high traffic areas.” - (Aluminum vs. Wood Thresholds)





Appendix #6



User Testimonials:

“I have a problem with the bones on both hands if I don't keep them straight, so I can't rotate my hands to tip pots. I'm trying not to do that sort of motion.”

-Betty, 85

“I do have trouble with that. This is great!”

-Jenny, 95

“It's the pour, the twist, and the aiming that's challenging.”

- Polly, 74

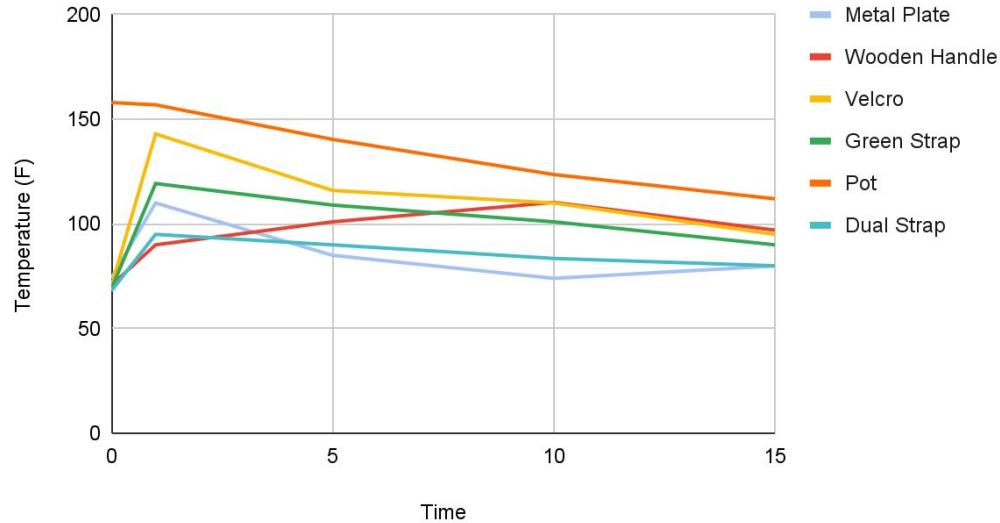




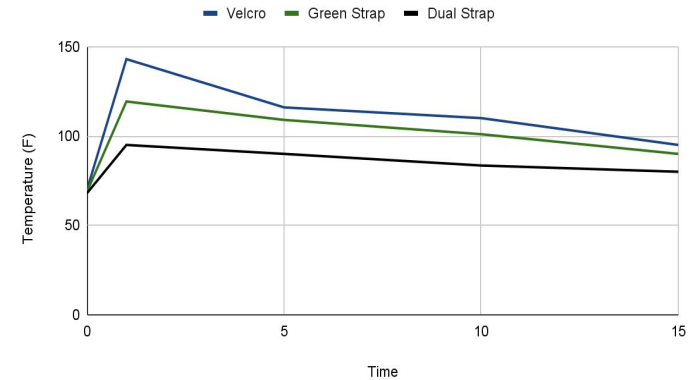
Appendix #7

Strap Temperature Testing

Temperature of Prototype Components Over Time



Temperature of Potential Straps Over Time





Appendix #8



Appendix #9



Manufacturing Process

