# GRIP GAINERS

## GET THE GAINS WITHOUT THE STRAINS

SOFIA GARCES-VASQUEZ


Sof
INDUSTRIAL DESIGN

# TABLE OF CONTENTS

# OPENING STATEMENT

I Have been involved in the fitness industry for over 10 years and have been a personal trainer for the past 3 years. In my years of experience and involvement in the industry. I have seen and first handedly experience pain and discomfort using the handlebars on machines, cable attachments, dumbells, and barbells. This has affected the quality of my workouts several times, making me give up on exercises from grip pain rather than muscle fatigue.

The grips that are currently used to cushion these handles are made of materials that are not long-lasting or sustainable. They must be replaced every few years which creates a lot of waste as they just pile up in landfills over the years. This ongoing issue inspired me to redesign the handle grips found at the gym to improve the user's hand-to-object interaction during physical exercise. The goal is to find an alternative that better attains comfort, safety, and durability while working toward a more sustainable future.

# DEFINITION & BACKGROUND

Handles are found on hundreds of thousands of everyday items, they are used as an attachment to grip or manipulate an object. Every time you reach for something you are having a hand-to-item interaction, whether it is to grab your kitchen utensils, go for a bike ride, mow your lawn, or go for a workout.

Handle grips are used to improve the user's experience when interacting with a handle, creating a safer, more stable, and more comfortable handlebar (Why Are Hand Grips so Important? | Sinclair & Rush UK, n.d.). They can be made from a variety of materials depending on the intended use and application. They are meant to make these interactions more efficient by helping grip things firmly, with better control, and for longer periods of time without experiencing pain. They play a huge role in safety, performance, and the overall experience when manipulating fixtures, machinery, equipment, or executing a task. For my thesis project, I will be focusing specifically on the handle grips that are used at the gym, found on machines, barbells, dumbbells, and cable attachments

# PROBLEM

Due to the daily use of these handles, their grips must be replaced every one to two years (Why Are Hand Grips so Important? | Sinclair & Rush UK, n.d.). Unfortunately, the materials that are often used to make these grips are not biodegradable and they end up piling up on a landfill causing harm to the environment.

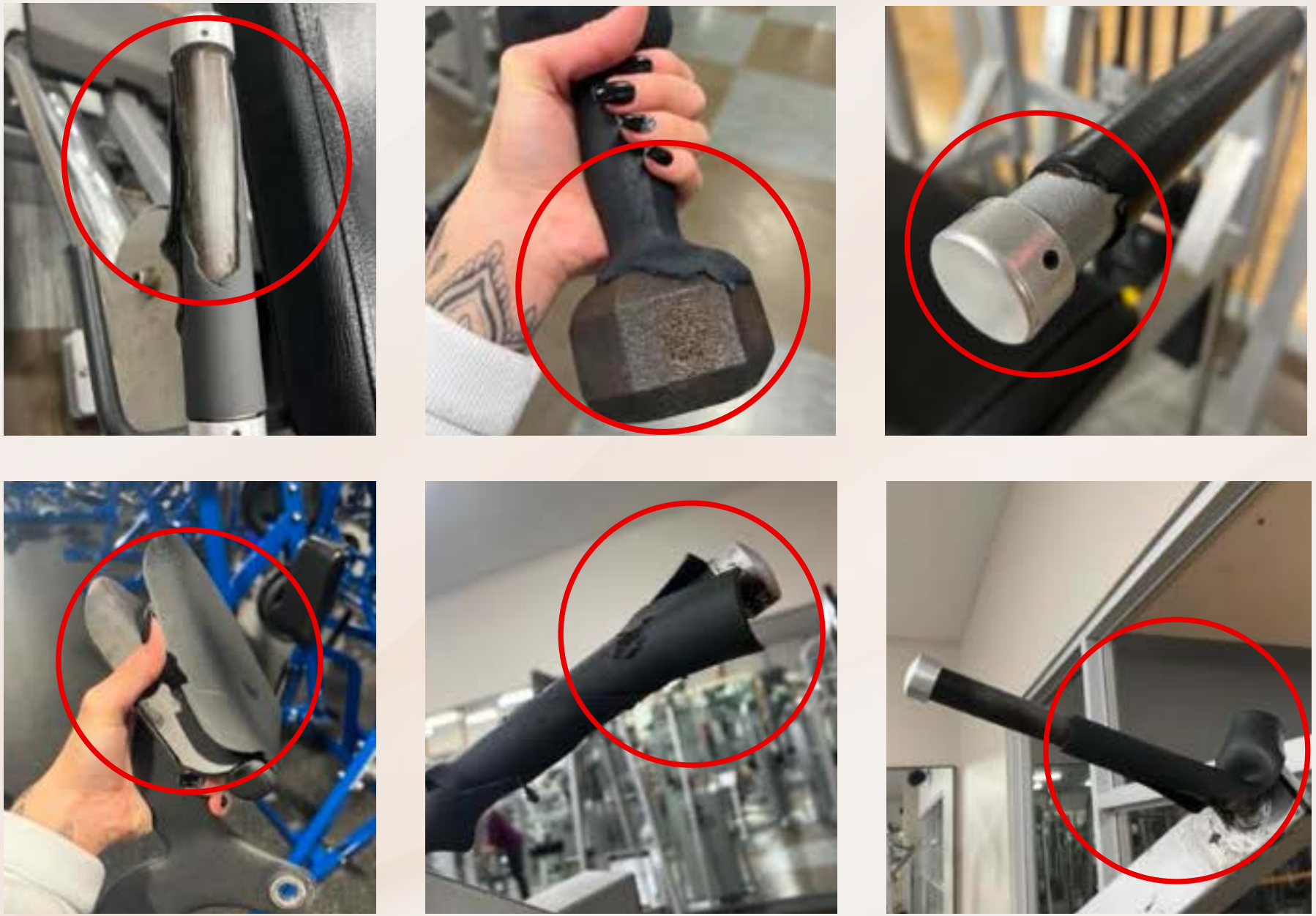


Figure 1: Examples of Material Wear and Tear (Photos: Sofia Garces)

# DESIGN OBJECTIVE

My capstone project aims to redesign the handle grips found at the gym to improve the user's hand-to-object interaction during physical exercise. Handle grips are currently made from materials that are not durable or biodegradable therefore they create a lot of waste and harm to the environment. My goal was to find an alternative that better attains comfort, safety, and durability while working toward a more sustainable future.

# RESEARCH & METHODOLOGY

My research summary consists of the exploration of different materials that are currently used to create handle grips. I focused on understanding the nature of the user's world, their environmental context, daily life routines, needs, challenges, interactions, and preferences.

I conducted Research on different handle grip designs and specific market research on the variety of workout accessories and attachments currently available to provide more support and stability on the hands during exercise. Finally, I conducted surveys and one on one interviews with gym owners, handle grip manufacturers, and everyday gym goers to gain insight into their overall experience with handles and grips on exercise equipment.

# INTERVIEWS

**SAJU** - Manufacturer of eyewear frames out of recycled plastic through injection molding - Colombia.

The goal with this interview was to learn more about the manufacturing process that they use to create their products. Since water bottles, bottle caps, and supplement tubs are the most common items disposed of at the gym, I'm considering this process for the manufacturing of my grips.

**1. What type of plastic do you use to create the glasses frames? What products/items is this type of plastic usually found in?**

- Our glasses are made of polypropylene which is a type of plastic that is commonly used to make bottles, packaging jars, yogurt containers, caps, drink cups, tampon casings, straws, tape, condiment bottles, and more.

**2. How do you break down the plastic to sort and melt it to then turn it into glasses?**

- We collect and sort these items by colour, and we put them in a machine that breaks them into tiny pellets. Once they are broken down, we put the pellets in an injection molding machine where the plastic is melted and injected into our custom molds.

**3. What machines do you use for this process?**

- We use a granule pelletizing machine to break down the recycled Polypropylene. The pellets are poured into a reactor and melted into a thick liquid to cast into a mold. The liquid cools down to harden into a solid plastic and produce the finished product

**4. Can users bring their recycled plastic to use for this experience?**

- Yes, we encourage our customers to bring their recycled plastics from home so they can be more involved in the experience and to encourage them to take recycling more seriously. We also have our recycled plastics in store that can be used for the experience, we offer 12 different colours that can be mixed to create fun and unique designs.

## RODRIGO - Regular gym goer

This interview helped me gain insight into the individual grip preferences of everyday gymgoers.

**1. What type of grip do you usually choose to use at the gym and why?**

- I like to use the etched metal grips because I feel like they have the perfect diameter, and they are comfortable to hold. I personally hate grips that are squishy because they feel awkward, they can slip and rotate in axis, and I feel like I'm putting much more of my energy and focus on gripping rather than on doing the actual exercise.

**2. Do you find your grip gives out before you are done with the exercise?**

- Yes, usually when I'm doing deadlifts or bent over back rows. After holding the bar for a while, I start to feel like my callouses are being worn down a lot more and they get painful, sometimes they peel off after these exercises. I can only hold a certain amount of weight for a certain amount of time before my grip starts to slip and I have to drop the bar.

**3. How do you counter that?**

- I usually put the bar on the floor to rearrange my grip and then I resume the exercise, sometimes I will do more sets and fewer reps to still be able to achieve muscle fatigue.

**4. Have you ever come across a machine that had a broken/damaged handle grip?**

- Yes, mostly on the plate-loading machines or the cable attachments.

**5. Do you bring your own grips or any attachments, and why?**

- I use what's available at the gym, and sometimes I'll use my friends' accessories.

## ATLANTIS FITNESS - Gym accessories manufacturer - Texas

The goal with this interview was to learn more about the different types, sizes, and material options available for grips, and to gain a better understanding of their installation process, and disposal guidelines.

**1. What materials do you usually use for the grips that you sell?**

- We have closed-end and open-end foam grips in a wide variety of bar sizes and lengths. Our end grips are typically made from soft foam, high-density rubber, sponge rubber, or molded PVC.

**2. Are any of them biodegradable?**

- No, they are not.

**3. How do you dispose of handle grips at the end of their lifecycle? Do gyms return worn-off grips to your company for disposal?**

- Each gym would dispose of them at the end of their lifecycle according to the city's garbage regulations.

**4. Are these grips of universal size for every machine? What are the different sizes that you provide?**

- We provide a variety of sizes and materials depending on their intended use and application.

**5. Are there certain grips that customers prefer? Is there a more popular grip?**

- Most gyms will go for molded PVC as they are the most durable due to their rougher yet cushioned texture. These are also great because they grip well to the handle, and they don't easily slip off the machine over time.

**6. Can they be easily installed?**

- Depends on the material you choose. We include installation services with the purchase.

## HAMMER STRENGTH FITNESS – Gym equipment manufacturer – Canada

The goal with this interview was to get a second opinion and gain more insight into the different types, sizes, and material options available for grips. To gain a better understanding of their installation process, and disposal guidelines to compare their methods with the previous manufacturer.

**1. What materials do you usually use for the grips that you sell?**

- We have closed-end and open-end grips in a wide variety of bar sizes and lengths. They are made of rubber, foam, or silicone.

**2. Are any of them biodegradable?**

- No, they are not biodegradable.

**3. How do you dispose of handle grips at the end of their lifecycle? Do gyms return worn-off grips to your company for disposal?**

No, each gym disposes of its used grips locally depending on the city's specifications.

**4. Are these grips of universal size for every machine? What are the different sizes that you provide?**

- We have a variety of bar sizes and lengths, but they are usually universal between gyms.

**5. Are there certain grips that customers prefer? Is there a more popular grip?**

- No, they usually buy what's available or I guess depending on the material preferences.

**6. Can they be easily installed?**

- The customer can install them themselves, but we also offer installation services for an extra cost.

I interviewed four gym owners with different member capacities. Commercial gyms have hundreds of members using their machines every day. Private studio gyms and home gyms on the other hand usually have fewer members, they tend to be more exclusive and used only for one on one training sessions with a coach, or for individual use for clients only. The goal with these interviews was to see and compare the difference in the wear and tear resistance of the handle grips based on their daily use.

**NENO** – Commercial gym owner – Sky Fitness, Mississauga, ON

1. **Where do you purchase the grips for the machines when they need replacement?**

- I purchased them from Hammer Strength Fitness, and I got someone to come to install them.

**2. How often do they need to be replaced?**

The gym has only been open for 2 years, unfortunately right after we opened, we had to close due to the pandemic so we have not had to replace them yet, however, some of them are coming to the end of their life cycle and will need to be replaced very soon.

**3. How many times have you replaced them since the gym opened?**

- We have not had to replace them yet; they usually last up to 2 years or less in commercial gyms because of the daily use by our members.

**4. When you first purchased the machines did, they come with grips? Or did you have to purchase them separately?**

- When I purchased the machines, they did not come with grips, I had to purchase them separately.

**TAYLOR** – Private studio gym owner – Vitality Fitness, Guelph, ON

**1. Where do you purchase the grips for the machines when they need replacement?**

- I mostly have molded PVC grips, etched metal, and some foam. I have never replaced them, the foam ones that are getting old or ripped I wrap them with hockey tape.

**2. How often do they need to be replaced?**

- The hockey tape must be re-wrap every 6 months or so. I've probably done it 7-10 times.

**3. When you first purchased the machines did, they come with grips? Or did you have to purchase them separately?**

- They came with the machines, but I got my machines used from a clearance gym.

**4. Do you use anything to reinforce your grip while working out?**

- I use something called "fat grips" they add thickness to the bar making exercises more challenging and increasing your grip strength. They increase muscle fibers' recruitment.

**TALLYSON** – Home gym owner – Coached by Six, Etobicoke, ON

**1. Where do you purchase the grips for the machines when they need replacement?**

- I purchase them from Hammer Strength. When I first got them, they came with rubber grips on the handles already.

**2. How often do they need to be replaced?**

- My gym is a home studio, I have between 5-10 people coming to train for one-on-one sessions every day, so the wear and tear is not a lot. A commercial gym would be different as they have hundreds of people a day using the machines. I have had to replace them once in the 3 years that the gym has been open.

**3. When you first purchased the machines did, they come with grips? Or did you have to purchase them separately?**

- Yes, the machines came with rubber handle grips, however the cable attachments I purchased separately. I choose to get the etched metal kind because I prefer the rougher grip. I do not mind having calluses I think they are just part of the sport and I kind of like them.
- My clients (mostly the girls) usually choose to bring gloves or wrist wraps so their hands don't hurt.

**1. Where do you purchase the grips for the machines when they need replacement?**

- They come with them, we get them from Hammer Strength, Cybex, or Atlantis Fitness.

**2. How often do they need to be replaced?**

- Some have lasted 20-plus years; others have to be replaced every six months. It depends on the make and the material.

**3. How many times have you replaced them since the gym opened?**

- 20 plus times, some pieces only once in 5-year spam.

**4. When you first purchased the machines did, they come with grips? Or did you have to purchase them separately?**

- They come with grips

**5. Do you install the grips yourself?**

- Most of them are self-installed but it depends. Some machines have to be dissembled to insert the grips. We also have so many machines, if we are replacing multiple at once it's faster if we pay for installation.

**SAMIR** – Personal trainer – Sky Fitness

The goal with this interview was to understand and gain insight into why Samir chooses to bring his own handles to the gym, for his personal use as well as for his clients.

**1. Why do you choose to bring your own cable handles?**

- It allows a better degree of freedom for your joints

**2. What function/benefits do they provide that the handles at the gym do not?**

- A lot of individuals don't have good rotation or mobility of the wrist and elbows. When you are using a fixed handle, it can cause pain. The free moving handles I bring spin on their axis, and it allows them to do movements pain-free.
- The unique swivel design of these handles yields a drastic increase in output potential. Their ergonomic grip reduces grip fatigue allowing for optimal exercise efficiency.

**3. Can you use them for multiple exercises or just one specific one?**

- You can use them for a variety of exercises, even off cables if you get creative.

**4. Do you use them on machines too? How do you attach them to the existing machine handles?**

- They are meant for cables, but I like to loop them around the handles of the machines, barbells, and dumbbell bars.

**5. Do the handles spin on their axis?**

- Yes.

**6. Do these handles have other attachments/accessories?**

- They come with a bar that can be used for wide grip movements like triceps extensions, bicep curls, and cable rows. They also come with cone grip attachments.

**7. Do they have a padded grip? Do you know what kind?**

- Yes, they have rubber padding

# SURVEY

I sent out a survey to 27 different people, each individual has different preferences, needs, and performance levels. The general key findings were:

**1. What workout accessories do you usually bring with you to the gym? (Kickback attachments, hip thrust pads, barbell clips, resistance bands, ankle weights, Etc.)**

- 74% of participants choose to bring their own accessories to the gym.
- Out of the 74%, the most common are accessories to cushion or support their grip during their workout: Wrist wraps (37%), gloves (10%), and personal cable attachments (15%).

**2. Why do you choose to bring these accessories?**

- Their reasons to bring these items to the gym are: To protect their hands, and minimize calluses (50%), to have a firmer grip, and attain better performance (50%).

**3. Do you find dumbbell/barbell grips painful or uncomfortable on your hands?**

- 9 out of 27 people (33.3%) said that they do find dumbbells and barbells painful and uncomfortable to hold.
- 18 out of 27 people (66.7%) said that they do NOT find dumbbells and barbells painful and uncomfortable to hold.
- Most who stated they find these handles painful and uncomfortable were women.
- Most who stated that they do not find them painful and uncomfortable were men.

**4. Do you wear gym gloves or wrist wraps to grab dumbbells/barbells**

- 10 out of 27 people (37%) said that they choose to wear either gloves or wrist wraps to improve their grip, a few stated that it would depend on the exercise and weight but yes, nonetheless.
- 17 out of 27 people (63%) said that they do not wear any hand or wrist support when lifting weights.

**5. Do your wrists feel secure when grabbing equipment in the gym?**

- Most participants affirmed that their wrists feel secure when lifting weights to a certain extent. As the weight gets heavier their hands start to hurt and sometimes, they will give up on an exercise from grip ache rather than muscle fatigue.

**6. Is there a specific exercise where gripping is challenging? why? please explain**

- Most individuals indicated that gripping is challenging during compound lifts like deadlifts, bench press, and squats as these tend to be of heavier load. A few said that gripping is challenging when using kettlebells, or on exercises that require wrist rotation.

**7. What makes a handle comfortable in your opinion?**

- Most participants mentioned that a handle is most comfortable when it is ergonomic and has some sort of cushioning or soft texture to grab onto but is not too squishy that it forces them to press it harder. however, a few people prefer the harder metal grip because the rough texture provides a better grasp.

**8. What makes a handle uncomfortable in your opinion?**

- Most people said that a handle is uncomfortable either when it's too bulky and it has etched metal or when it's too smooth and it easily slips out of your hands.

**9. Have you come across a handle that was too big or too small for your hands?**

67% of people answered no to this question.

**10. Do you grab handles with your thumb around the bar securing your fingers, or with your thumb behind the bar like a hook?**

- 78% of individuals said that they grab the bar with their thumb over it to secure their fingers, however, some also stated that this varies depending on the exercise.

**11. Are there any other handles that you use outside of the gym that are comfortable? (i.e., bike, cooking supplies, lawn mower, suitcase, gas pump, etc.)**

- Most participants mentioned biking, cooking, tennis, and suitcase handles, as well as gaming controllers and steering wheels.

**12. what do you like about these handles? what makes them comfortable?**

- Most participants stated that they like the softness and cushioning of these handles.

**13. Is there anything that you'd like to add as insight into this issue?**

- Some participants stated that their grip has a big impact on how much they can lift during their workout, others mentioned that handle grips tear too fast, peal or slip, and a few mentioned that most equipment is not catered to people with smaller hands, and it makes it difficult to do certain exercises.

# KEY FINDINGS & ANALYSIS

Through the numerous interviews, observations, and surveys that I conducted, I discovered that these grips are typically made of molded PVC, rubber, silicone, gel, foam, or metal (Types of Handlebar Grips, 2021). I plan on diving further into each one of these materials and their application to see their pros and cons, as well as their environmental effects when they are disposed of. With respect to participants' personal experiences and preferences when it comes to handles and grips, most of them stated that gym handles are uncomfortable and painful to hold, depending on the grip material, the shape of the handle, the weight load, and the exercise (Types of Handlebar Grips, 2021). Some even said that they tend to give up on the exercise not from muscle fatigue but grip weariness and that they have developed chronic wrist pain over time. Some of these individuals stated that they choose to wear grip-supporting accessories to improve their performance, and others choose to wear gloves, but they find that their palms get too sweaty as they don't have the proper ventilation. Wearing gloves also tends to get in the way of properly lifting the dumbbell or barbell as the gloves add some thickness to the bar, which makes gripping it firmly during an exercise more difficult.

# MATERIAL OBSERVATION

When choosing a grip, one of the most important things to consider is functionality. Grips come in different shapes, sizes, and textures. Some materials feel smooth on the hands but can be too slippery and tear easily, and others are more durable and sturdier but tend to cause blisters if they are held for too long without gloves.

The most common materials used for grips are...

# MOLDED PVC GRIPS



Figure 2: Moulded PVC Handle Grips (Photos: Sofia Garces)

Molded PVC is made from thermoplastics, this material can be manufactured to be rigid or flexible depending on the intended use and application; it is very resistant, and it has a lot of tensile strength (Losek, 2021b).

# RUBBER GRIPS

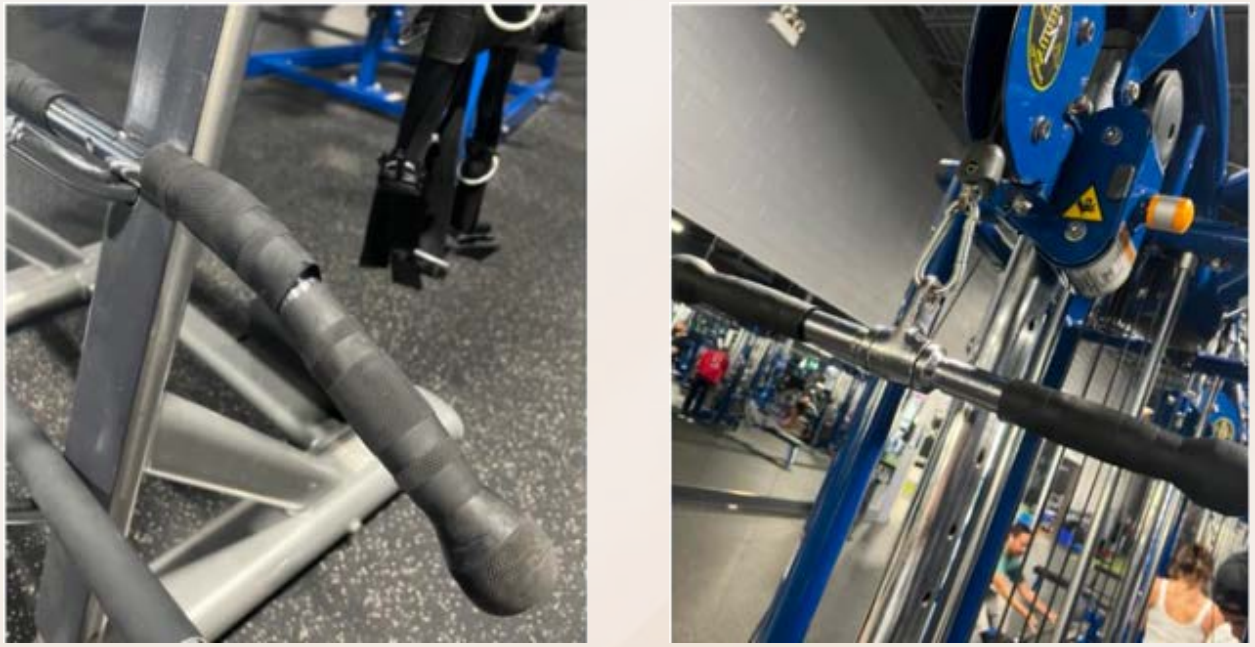


Figure 3: Rubber Handle Grips (Photos: Sofia Garces)

Rubber grips are cheap, long-lasting, and low maintenance. This material can absorb a great amount of shock and vibration; however, its main disadvantage is that it is not breathable. Sweat can quickly pool around the handle making it slippery and dangerous to use when handling heavy weights (Types of Handlebar Grips, 2021).

## SILICONE GRIPS

Figure 4: Silicone Handle Grips (Photos: Sofia Garces)

Silicone grips are comfortable, lightweight, and have great impact absorption properties. Their drawback is that this material is quite fragile, and it tears easily. Grips made of silicone usually require maintenance and replacement every couple of months (Types of Handlebar Grips, 2021).

# GEL GRIPS

Figure 5: Gel Handle Grips (Photos: Sofia Garces)

Handle grips can also be made of gel, which is often combined with rubber to enhance its durability, these types of grips are cheap and one of the most comfortable options in the market but just like the plain rubber grips mentioned above, they are not breathable nor sweat absorbent, this can easily cause safety issues and blistering in the hands from the constant friction (Types of Handlebar Grips, 2021).

# FOAM GRIPS

Figure 6: Foam Handle Grips (Photos: Sofia Garces)

Another material that is commonly used for grips is foam, this material is very lightweight, affordable, and sweat-absorbent. The main disadvantage of grips made from this material is that it easily wears down from overuse and from being exposed to heat or UV light. this material was the most used for handle grips until silicone grips emerged (Types of Handlebar Grips, 2021).

# METAL GRIPS

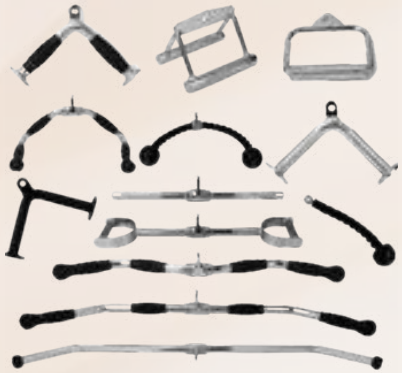
Figure 7: Metal Handle Grips (Photos: Sofia Garces)

Lastly, we have metal grips that are usually made from stainless steel. They provide maximum strength and durability, as they are anticorrosion, antirust, and very aesthetic. Their main detriment is that they are much heavier and more expensive than other handles, they also do not have padded grips to protect and cushion your hands (OneMonroe, 2021).

# EQUIPMENT TYPES

## CABLE SYSTEM

This equipment consists of a vertical steel frame about three meters wide and two meters tall, with a weight stack attached via cables to a height-adjustable pulley. The end of the cables can be attached to various handles, which allows for a variety of exercises to be performed on the apparatus (An Introduction to the Cable Machine / Fitness / Equipment, n.d.-b).



**Cable System**

From: Cable Machines. (n.d.-b). Fitness Avenue. https://www.fitnessavenue.ca/collections/cable-machines

**Cable Attachments**

From: Cable Machines. (n.d.-b). Fitness Avenue. https://www.fitnessavenue.ca/collections/cable-machines

# FREE WEIGHTS



These training loads are not connected to a specific machine or piece of equipment, they allow you to do a variety of exercises for any muscle group. Free weights are designed with a narrow bar in the middle and two preloaded plates at each end that determine their weight. The three types of free weights in the gym are dumbbells, barbells, and kettlebells (Dumbbells, Definition, Purpose, History, Description, n.d.).

From: Free weights. (n.d.). Shutterstock. https://www.shutterstock.com/image-illustration/barbell-kettlebells-dumbbells-black-plates-on-1967109910

# STATIONARY MACHINES

These machines usually have a preloaded weight stack that can be adjusted with a pin mechanism. They use gravity as the primary source of resistance and they can only be used to train a specific muscle by performing a specific movement.


From: O-001 Converging Chest Press. (n.d.). PowerMax. https://www.powermaxfitness.net/selectorized/o-series-c-54.html

# MATERIAL EXPLORATION

I paid a visit to the Material ConneXion Library located at the Sheridan College, HMC campus to learn and explore new materials that I could possibly use or incorporate into my final concept. I looked at different types of polymers which are elements that are composed of large molecules called macromolecules. These molecules are a compilation of simpler chemical units called monomers which are arranged in repeating patterns (curious, 2019). When the molecular structure of polymers changes, it results in the creation of elements or materials with different strengths, flexibilities, temperature resistances, and recyclability properties (curious, 2019).

There are two types of polymers: Synthetic, which are man-made and produced by chemical reactions that consist of adding monomers in a growing chain. Natural polymers on the other hand are extracted from nature. They can be found in plants, animals, and microorganisms, they are biodegradable, and they can be used in a variety of applications (curious, 2019).

Koroyd SARL is a synthetic polymer that is a structural fabric reinforcement, made from a combination of welded plastic tubes and a variety of fabrics. This material provides superior load-spreading and breathability without compromising its flexibility. A heat-activated web adhesive is used to laminate the fabric to the edges of the tubes, which provides stiffness to the overall structure while maintaining minimal thickness (Material ConneXion Library, 2022).

Figure 8: Koroyd SARL - From Material ConneXion Library (Photo: Sofia Garces)

This polymer is designed to maintain its shape after repeated use and to provide extreme impact protection. Not only is it durable, flexible, and thin but it also has moisture-absorbing air channels for added comfort. This material is made of open-cell polyurethane foam molded between a TPU (thermoplastic polyurethane) film with a polyester fabric backing (Material ConneXion Library, 2022).

Figure 9: Poron XRD X-Pad - From Material ConneXion Library (Photo: Sofia Garces)

Shape-memory silicone is a synthetic polymer that allows for a custom fit as it can mold to a new shape and then return to its original state when released. It has great impact absorption, shape recovery, and tear strength that can be customized depending on its intended application (Material ConneXion Library, 2022).

Figure 10: Shape-Memory Silicone - From Material ConneXion Library (Photo: Sofia Garces)

Ariaprene is a closed-cell synthetic rubber foam polymer that is hypoallergenic, waterproof, and recyclable. This material provides good insulation and impact resistance. it has great stretch and compression properties, hot and cold temperature resistance, and it is latex, and solvent-free (Material ConneXion Library, 2022).

Figure 11: Ariaprene - From Material ConneXion Library (Photo: Sofia Garces)

Goat leather is a natural material sourced from animals that have died naturally, or that were raised for consumption. It has great strength, durability, and resistance to impact and tears (Material ConneXion Library, 2022).

Figure 12: Goat Leather - From Material ConneXion Library (Photo: Sofia Garces)

These are 100% Natural rubber sheets; They have high flexibility and elasticity which makes them perfect for wrapping around stainless-steel frames. They have great tensile strength for load-bearing uses (Material ConneXion Library, 2022).

Figure 13: Natural Rubber - From Material ConneXion Library (Photo: Sofia Garces)

# NATURAL MATERIALS

Cork is 100% natural, recyclable, and reusable and it is harvested from nature every 9-10 years. This material has excellent thermal insulation, impact resistance, and endurance to high temperatures. It has Excellent elasticity, compressibility, high friction resistance, and impermeability. It is extremely light and hypoallergenic (Portugal, n.d.).

From: Cork. (n.d.). Shutterstock. https://www.shutterstock.com/search/corck

High-density polyethylene (HDPE) is a thermoplastic polymer produced from the monomer ethylene. HDPE is used in the production of plastic bottles, corrosion-resistant piping, and plastic lumber. HDPE is commonly recycled and can reprocess. I'm interested in this material because water bottles and supplement tubs are the most common materials found on the garbage
(Material ConneXion Library, 2022).

From: 7 Types of Thermoplastic Elastomers (TPEs). (2022, June 27). Xometry. https://www.xometry.com/resources/materials/types-of-thermoplastic-elastomers/

Silicone is a synthetic polymer that allows for a custom fit as it can mold to a new shape, and then return to its original state when released. It has great impact absorption, shape recovery and tear strength that can be customized depending on its intended application (Material ConneXion Library, 2022).

From: 7 Types of Thermoplastic Elastomers (TPEs). (2022, June 27). Xometry. https://www.xometry.com/resources/materials/types-of-thermoplastic-elastomers/

This metal has a high level of corrosion resistance and self-cleaning properties which makes it a great choice for a long-term solution that is also cost-efficient (Material ConneXion Library, 2022).

From: Copper Casting. (n.d.). U.S.B.F.&M.I. https://usbfmi.com/copper/

White Iron is known for its excellent wear resistance. Some white irons have high levels of chromium or other alloys for increased performance of high-temperature service, or for corrosion resistance (Material ConneXion Library, 2022).

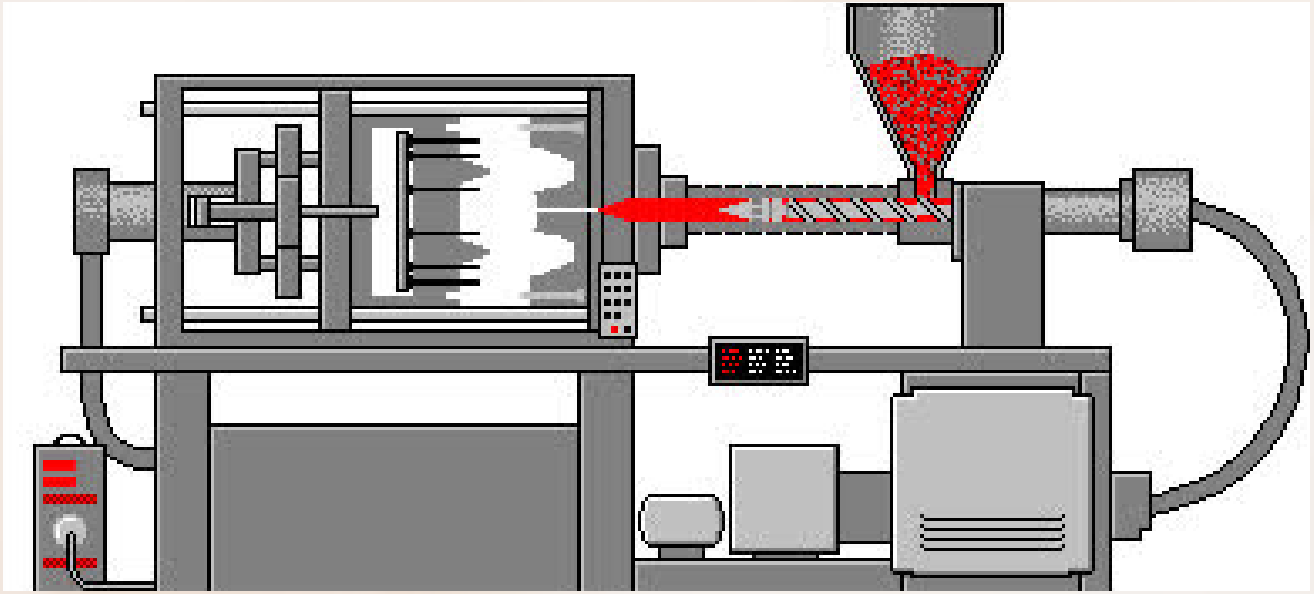
From: Cast iron profile BC04 series. (n.d.). Direct Industry.
https://www.directindustry.com/prod/leave-industrial/product-84285-1864263.html

# PROCESSES



## INJECTION MOULDING

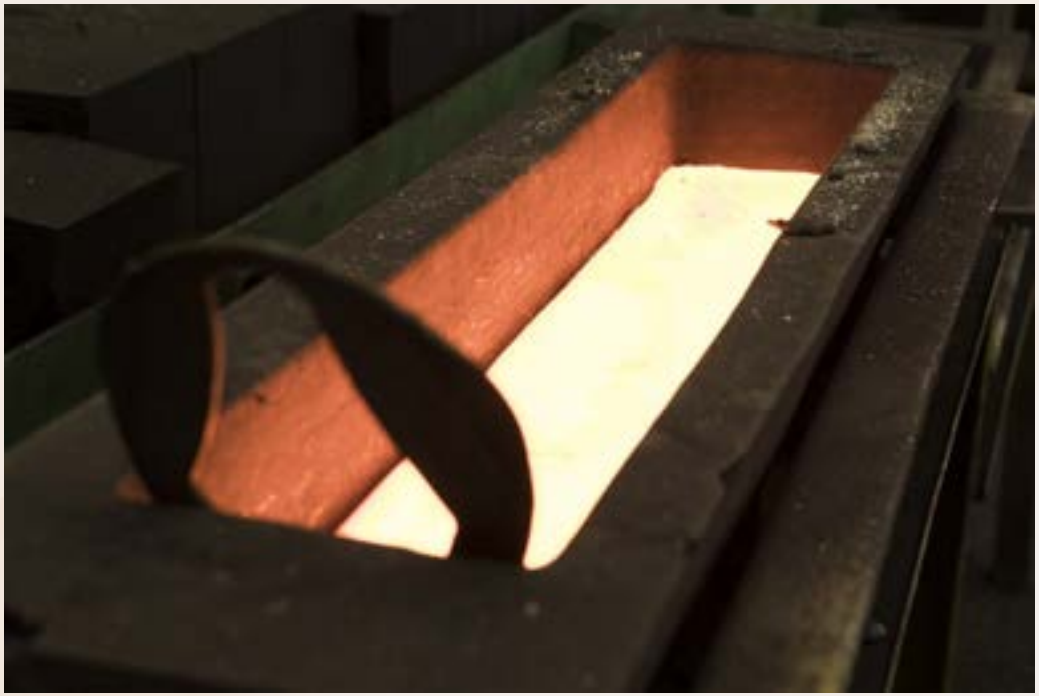
Injection molding is one of the most common processes used to mass-produce thermoplastics as it is cheap (depending on scale) and does not usually require any finishes. During this process, the plastic material is heated until it becomes a viscous melt. It is then injected into a closed mold that defines its shape, then the material is cooled until it reverts to a solid, and finally, the mold is opened and the finished part is extracted (Robotics in Injection Moulding, 2022).



From: Plastic Injection Moulding Process. (n.d.). RNA.
https://www.rnaautomation.com/insight/robotics-in-injection-moulding/

# METAL CASTING

Metal casting is the process of making objects by pouring molten metal into an empty mold. The metal then cools and hardens into the form given to it by this cavity. I would use this method with copper or white iron to make my grips (11 Metal Casting Methods, n.d.).



From: 11 Metal Casting Methods. (n.d.). Reliance Foundry. https://www.reliance-foundry.com/blog/metal-casting-methods

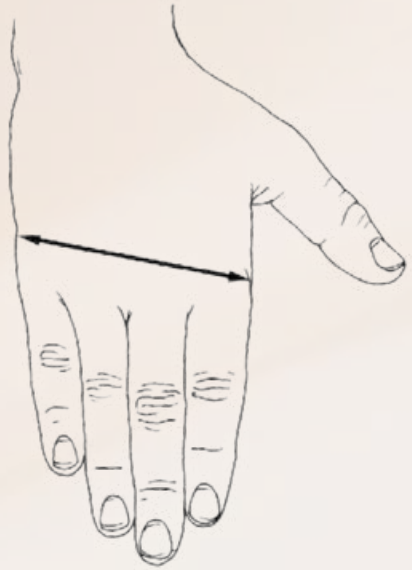
# ANTHROPOMETRICS



Anthropometrics are the average measurements of people, their body parts, and the body's range of movement. Anthropometric data is used to assess the size, proportions, and composition of the human body (Gordon, 1989).

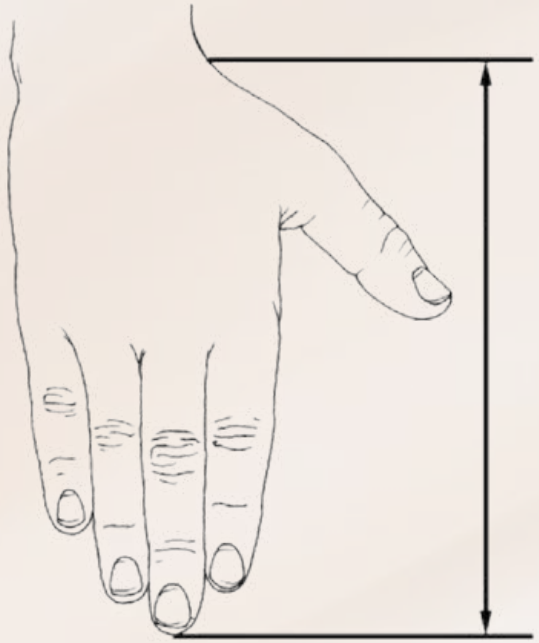
**Hand Breadth**

| FEMALE N = 2208 | | | MALE N = 1774 | | |
|---|---|---|---|---|---|
| Centimeters | | Inches | Centimeters | | Inches |
| 7.94 | Mean | 3.13 | 9.04 | Mean | 3.56 |
| .38 | Std Dev | .15 | .42 | Std Dev | .17 |
| 9.80 | Maximum | 3.86 | 10.60 | Maximum | 4.17 |
| 6.60 | Minimum | 2.60 | 7.70 | Minimum | 3.03 |
| | Percentiles | | | Percentiles | |
| 7.09 | 1st | 2.79 | 8.07 | 1st | 3.18 |
| 7.19 | 2nd | 2.83 | 8.19 | 2nd | 3.22 |
| 7.25 | 3rd | 2.86 | 8.27 | 3rd | 3.25 |
| 7.34 | 5th | 2.89 | 8.36 | 5th | 3.29 |
| 7.47 | 10th | 2.94 | 8.51 | 10th | 3.35 |
| 7.56 | 15th | 2.98 | 8.61 | 15th | 3.39 |
| 8.63 | 20th | 3.00 | 8.69 | 20th | 3.42 |
| 7.69 | 25th | 3.03 | 8.75 | 25th | 3.45 |
| 7.74 | 30th | 3.05 | 8.82 | 30th | 3.47 |
| 7.79 | 35th | 3.07 | 8.87 | 35th | 3.49 |
| 7.84 | 40th | 3.09 | 8.93 | 40th | 3.51 |
| 7.89 | 45th | 3.11 | 8.98 | 45th | 3.54 |
| 7.93 | 50th | 3.12 | 9.03 | 50th | 3.56 |
| 7.98 | 55th | 3.14 | 9.09 | 55th | 3.58 |
| 8.03 | 60th | 3.16 | 9.14 | 60th | 3.60 |
| 8.08 | 65th | 3.18 | 9.20 | 65th | 3.62 |
| 8.13 | 70th | 3.20 | 9.26 | 70th | 3.64 |
| 8.18 | 75th | 3.22 | 9.32 | 75th | 3.67 |
| 8.25 | 80th | 3.25 | 9.40 | 80th | 6.70 |
| 8.32 | 85th | 3.28 | 9.48 | 85th | 3.73 |
| 8.42 | 90th | 3.31 | 9.59 | 90th | 3.78 |
| 8.56 | 95th | 3.37 | 9.76 | 95th | 3.84 |
| 8.66 | 97th | 3.41 | 9.86 | 97th | 3.88 |
| 8.74 | 98th | 3.44 | 9.93 | 98th | 3.91 |
| 8.86 | 99th | 3.49 | 10.04 | 99th | 3.95 |



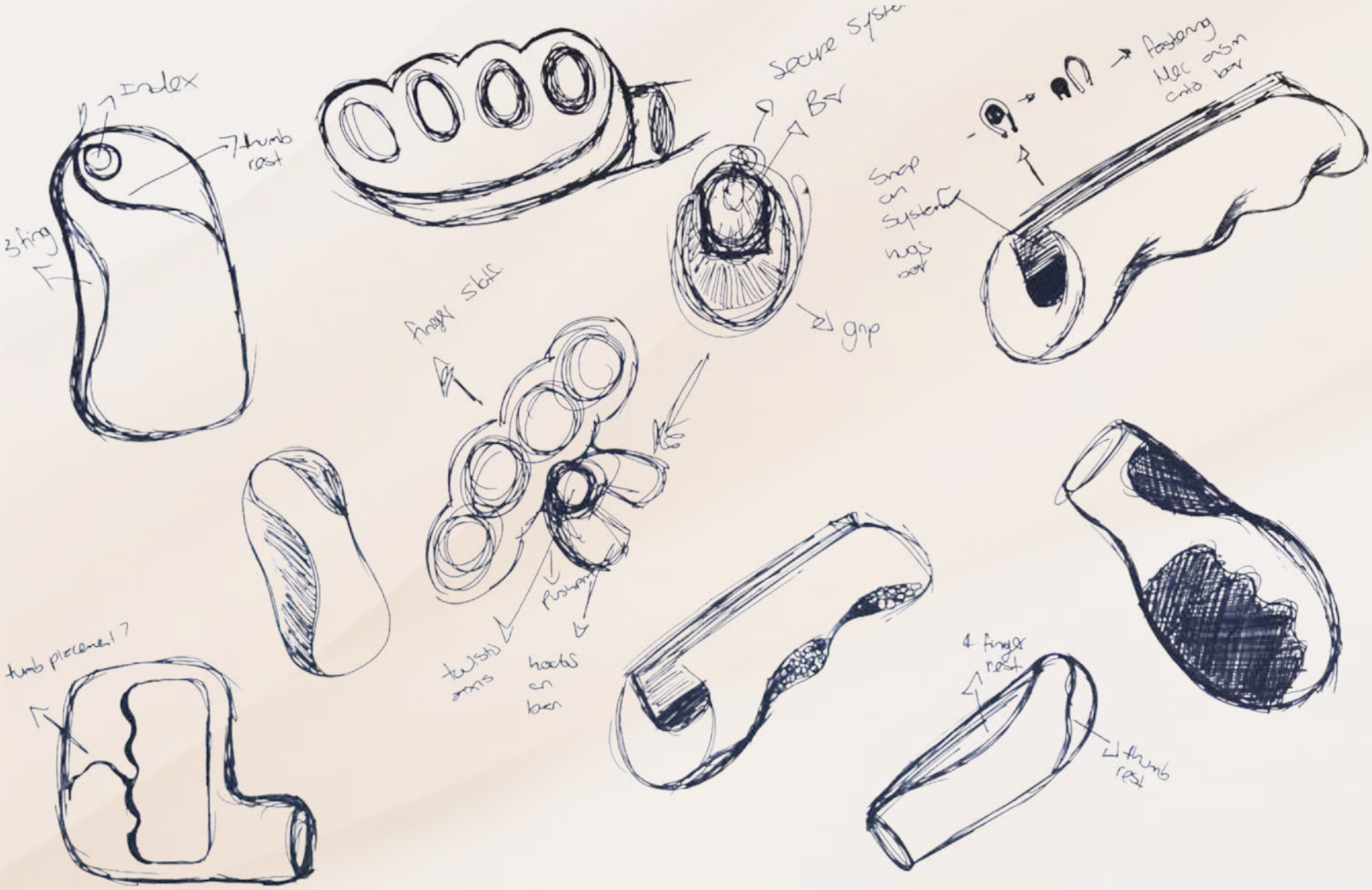
## Hand Length

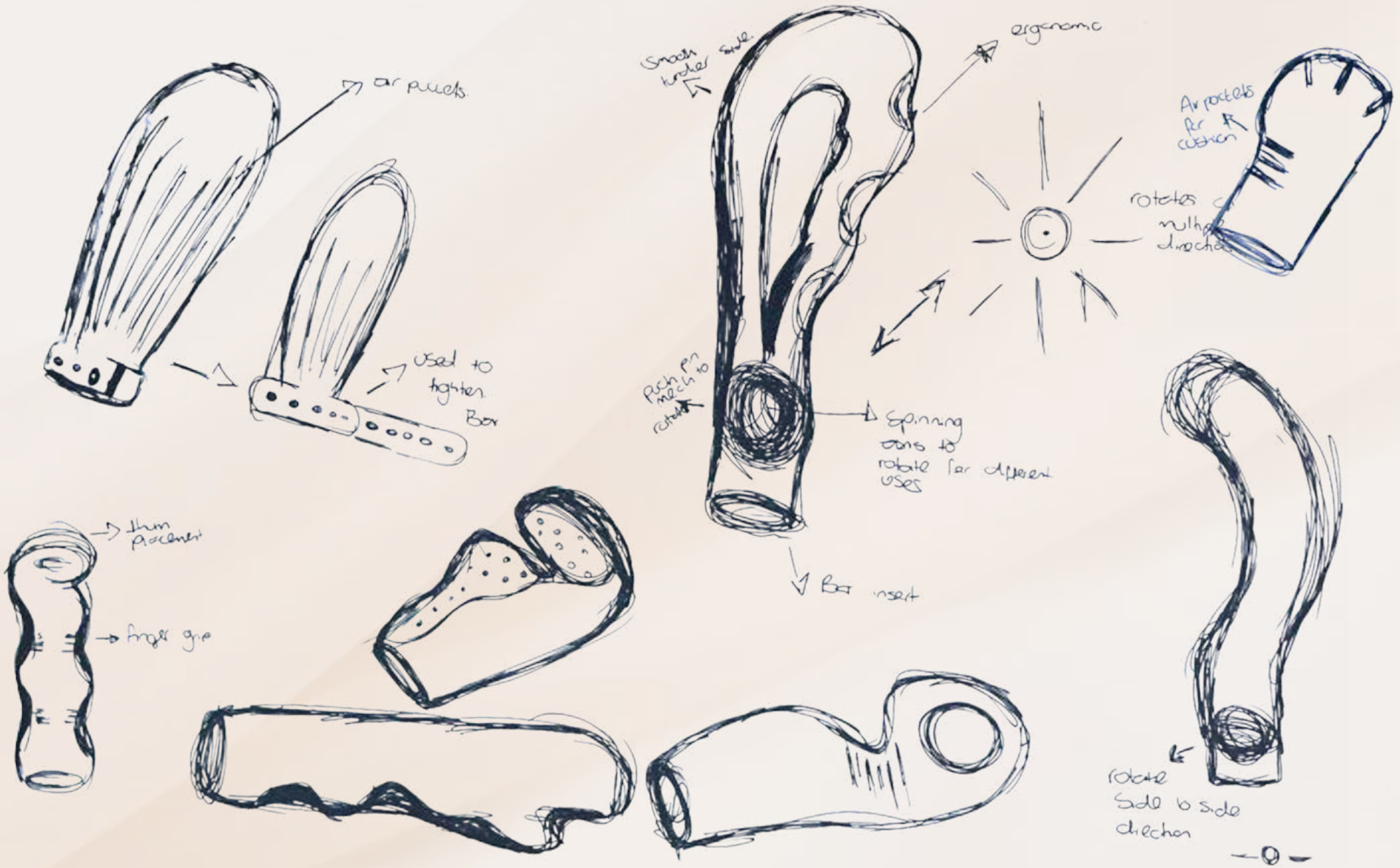
| FEMALE N = 2208 | | | MALE N = 1774 | | |
|---|---|---|---|---|---|
| Centimeters | | Inches | Centimeters | | Inches |
| **18.05** | **Mean** | 7.10 | 19.38 | **Mean** | 7.63 |
| .97 | **Std Dev** | .38 | .98 | **Std Dev** | .39 |
| 21.50 | **Maximum** | 8.46 | 23.30 | **Maximum** | 9.17 |
| 14.90 | **Minimum** | 5.87 | 16.00 | **Minimum** | 6.30 |
| | **Percentiles** | | | **Percentiles** | |
| 15.89 | 1st | 6.26 | 17.28 | 1st | 6.80 |
| 16.13 | 2nd | 6.35 | 17.52 | 2nd | 6.90 |
| 16.29 | 3rd | 6.41 | 17.67 | 3rd | 6.96 |
| 16.50 | 5th | 6.50 | 17.87 | 5th | 7.04 |
| 16.83 | 10th | 6.63 | 18.18 | 10th | 7.16 |
| 17.06 | 15th | 6.72 | 18.39 | 15th | 7.24 |
| 17.24 | 20th | 6.79 | 18.56 | 20th | 7.31 |
| 17.39 | 25th | 6.85 | 18.71 | 25th | 7.37 |
| 17.53 | 30th | 6.90 | 18.85 | 30th | 7.42 |
| 17.66 | 35th | 6.95 | 18.97 | 35th | 7.47 |
| 17.78 | 40th | 7.00 | 19.09 | 40th | 7.52 |
| 17.90 | 45th | 7.05 | 19.21 | 45th | 7.56 |
| 18.02 | 50th | 7.09 | 19.33 | 50th | 7.61 |
| 18.14 | 55th | 7.14 | 19.45 | 55th | 7.66 |
| 18.26 | 60th | 7.19 | 19.57 | 60th | 7.70 |
| 18.39 | 65th | 7.24 | 19.70 | 65th | 7.75 |
| 18.52 | 70th | 7.29 | 19.84 | 70th | 7.81 |
| 18.67 | 75th | 7.35 | 19.99 | 75th | 7.87 |
| 18.84 | 80th | 7.42 | 20.16 | 80th | 7.94 |
| 19.04 | 85th | 7.49 | 20.37 | 85th | 8.02 |
| 19.29 | 90th | 7.60 | 20.64 | 90th | 8.13 |
| 19.69 | 95th | 7.75 | 21.06 | 95th | 8.29 |
| 19.96 | 97th | 7.86 | 21.34 | 97th | 8.40 |
| 20.16 | 98th | 7.94 | 21.55 | 98th | 8.49 |
| 20.50 | 99th | 8.07 | 21.90 | 99th | 8.62 |

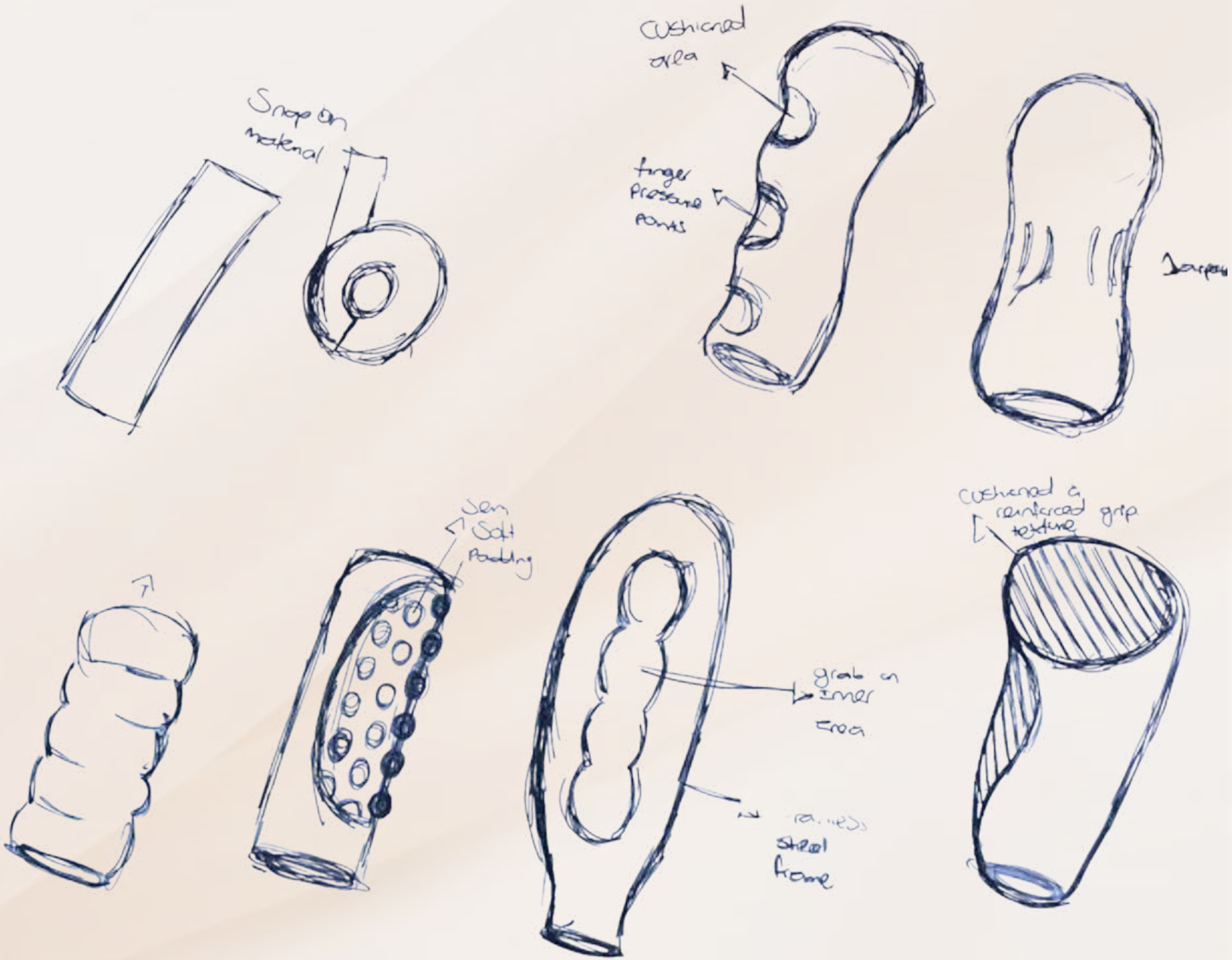


From: Gordon, Claire C. et. al 1988 Anthropometric Survey of U.S. Personnel: Summary Statistics Interim Report. March 1989.

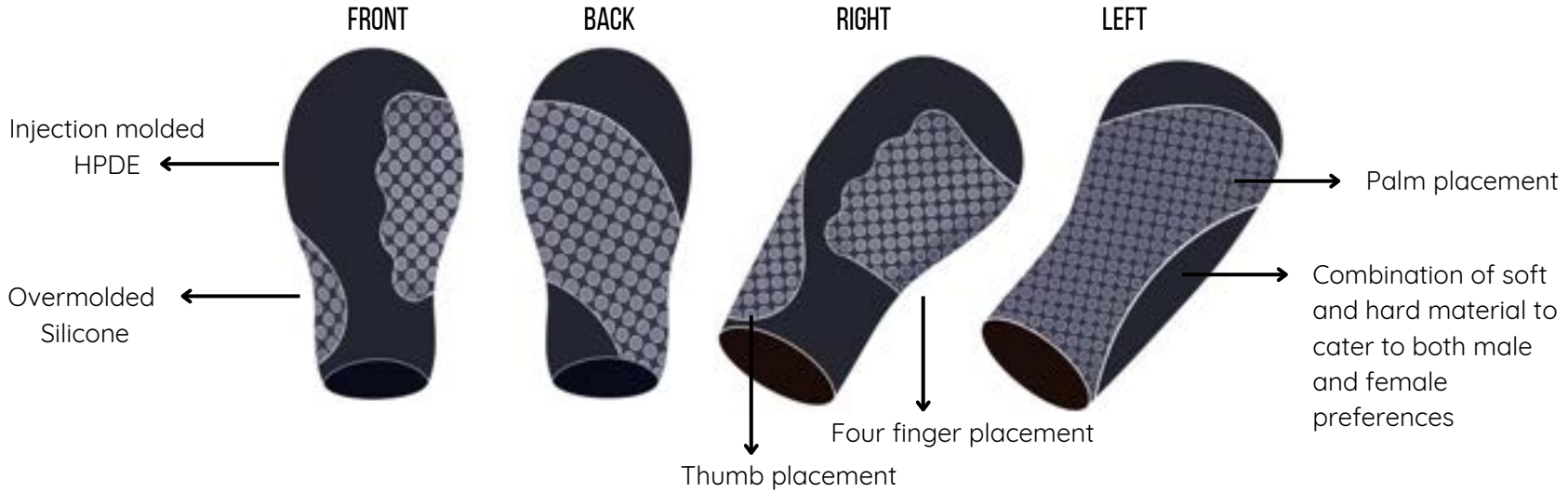
# IDEATION


Index
thumb rest
sling
Grip
thumb placement?
4 finger rest
thumb rest


air pockets
used to tighten Bar
Thumb Accelerator
finger grip
smooth surface
ergonomic
Air pockets for cushion
rotates
Push pin mech to ratchet
Spinning arms to rotate for different uses
Bar insert
rotate side to side clockwise


Snap on material
Cushioned area
finger pressure points
Soft Padding
grab on inner area
steel frame
Cushioned & reinforced grip texture

# CONCEPT 1.



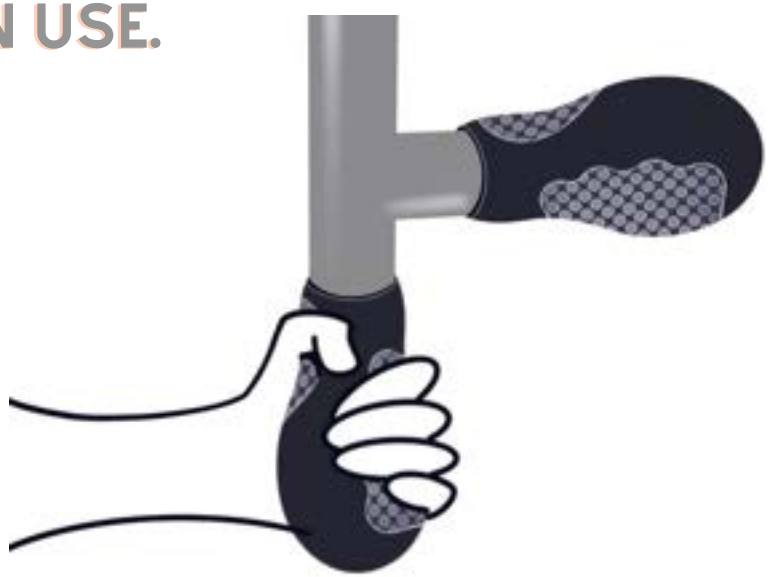

# MATERIALS CONSIDERED.

Injection molded HPDE using recycled plastics

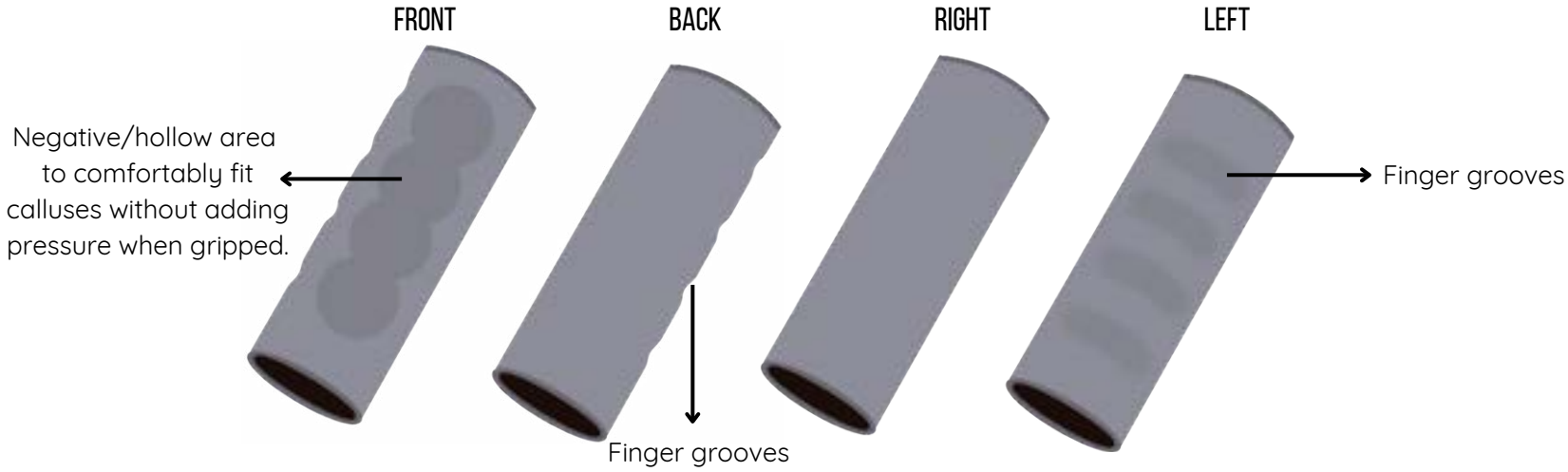
&

Overmolded Silicone

# IN USE.

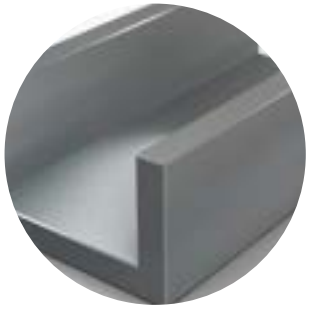


# CONCEPT 2.




# MATERIALS CONSIDERED.

OR



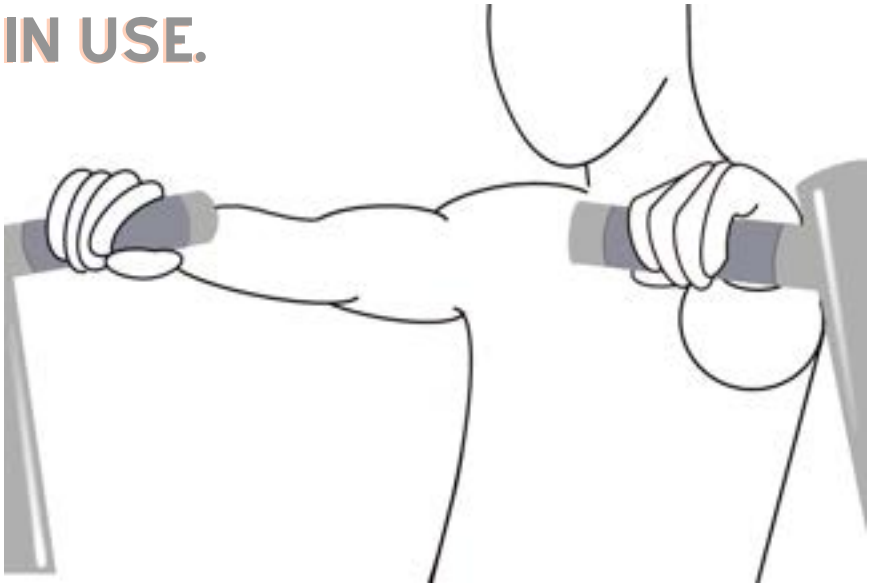
Casted Copper

- corrosion resistant
- Long-term cost efficienent

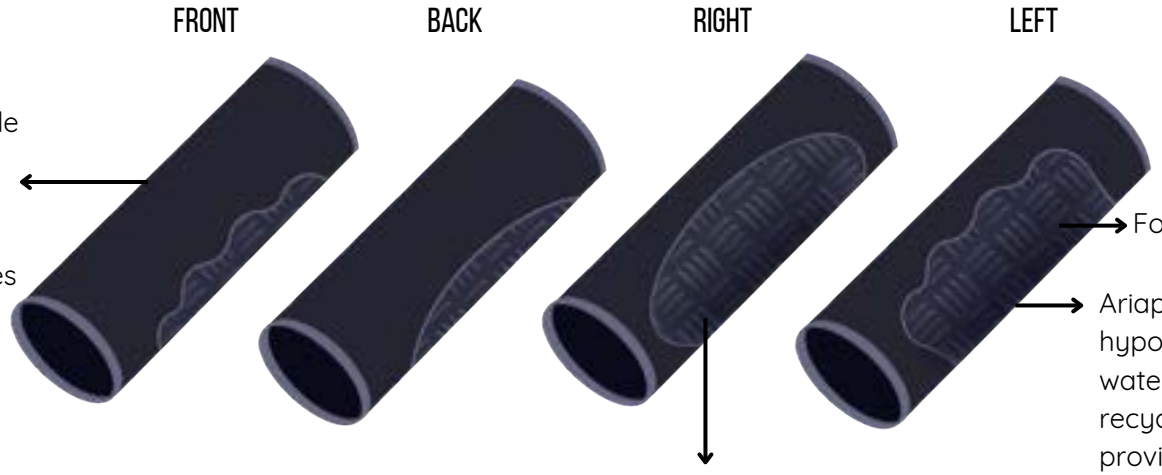
Casted Iron

- Excellent wear resistance
- High-temperature resitance
- Corrosion resistance

# IN USE.



# CONCEPT 3.

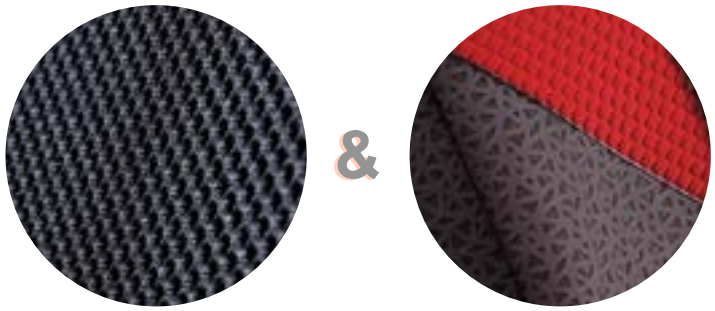



Koroyd fabric is made from a combination of welded plastic tubes and fabric. This material provides superior load-spreading and breathability without compromising its flexibility

Four finger placement

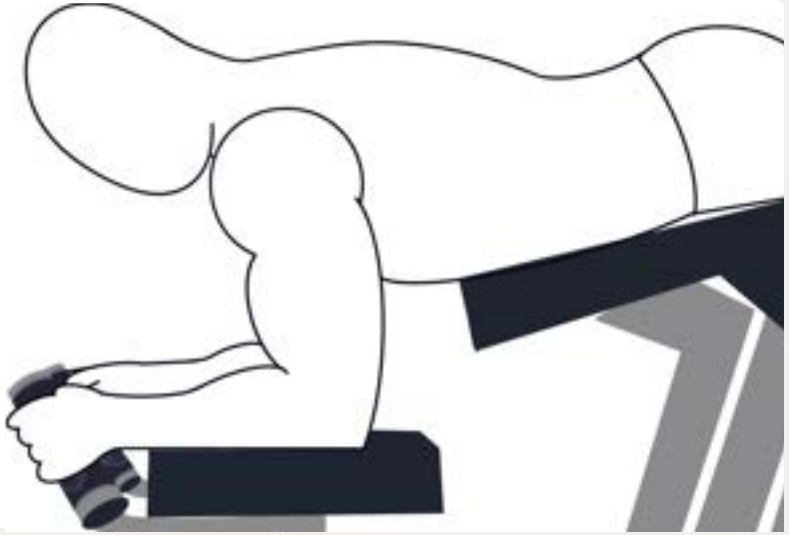
Ariaprene is hypoallergenic, waterproof, and recyclable. This material provides good insulation and impact resistance.

# MATERIALS CONSIDERED.



Koroyd structural fabric & Ariaprene

# IN USE.



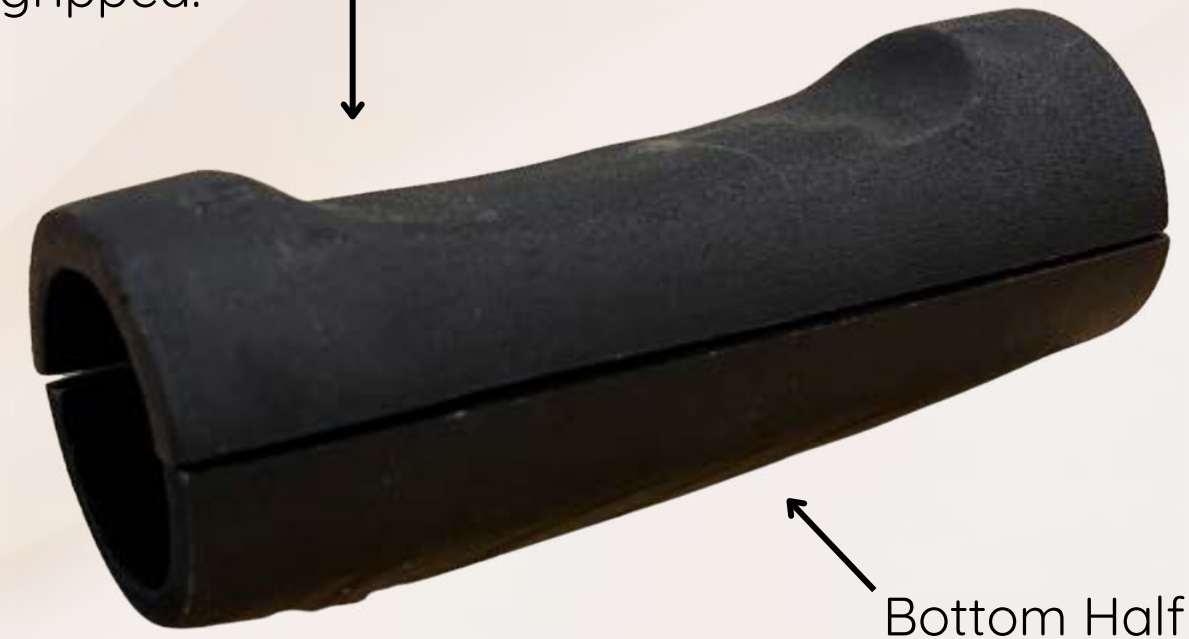
# LOW-FIDELITY

## MODEL 1

# LOW-FIDELITY

## MODEL 2

Negative/hollow area
to comfortably fit calluses
without adding pressure when
gripped.

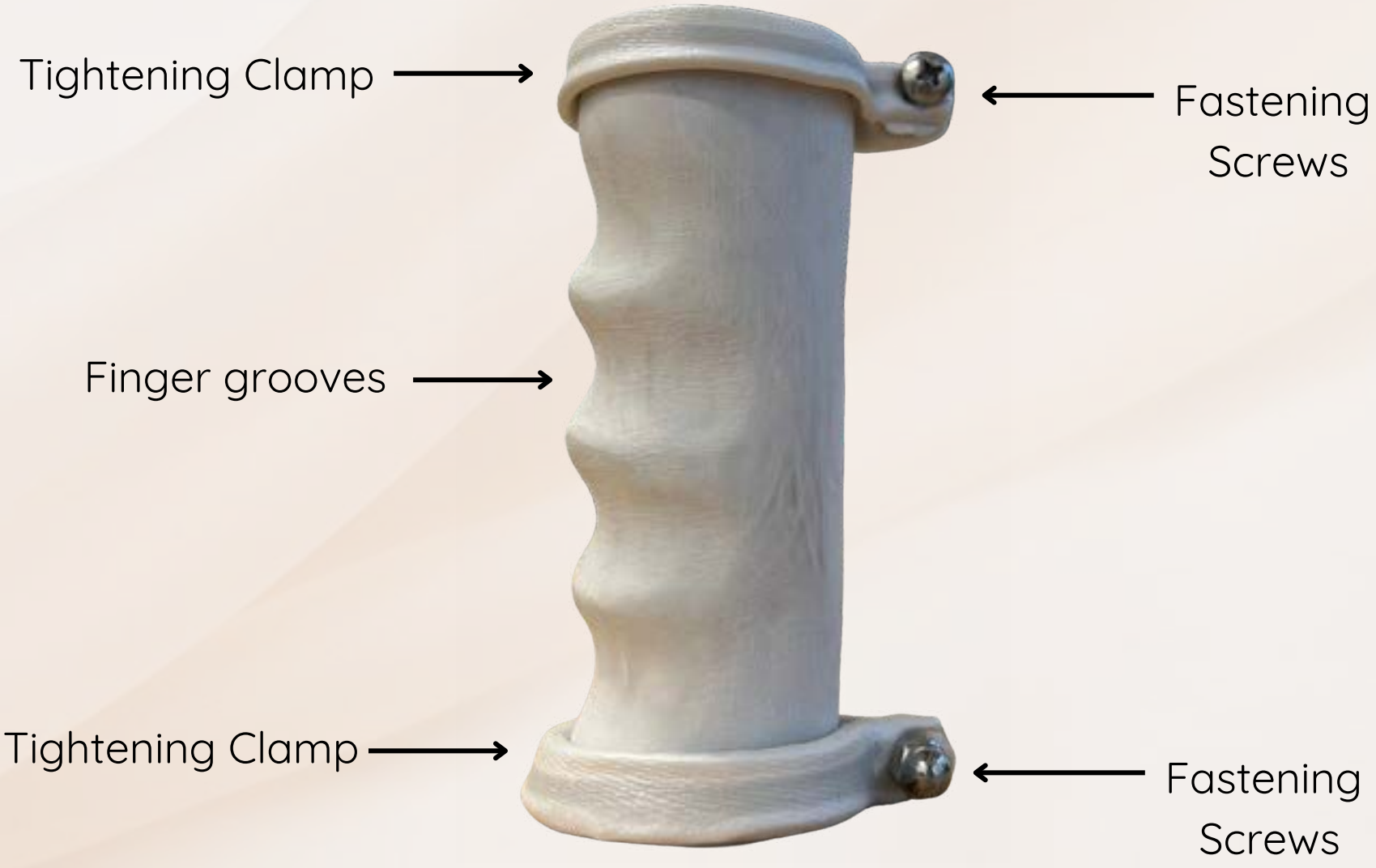


Bar Slot

Bottom Half

# LOW-FIDELITY

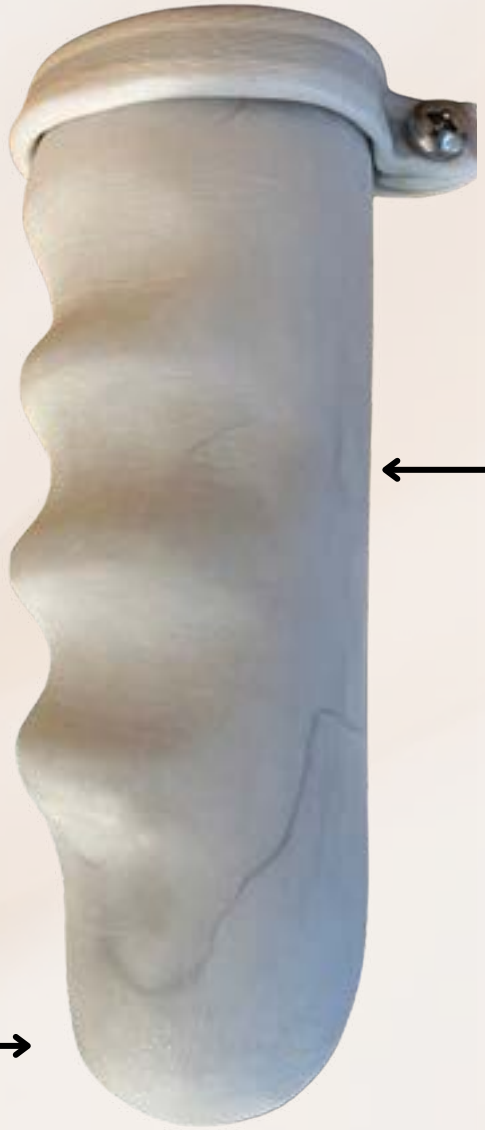
## MODEL 3



# LOW-FIDELITY



## MODEL 4



Tightening Clamp

Fastening Screws

Finger grooves

Negative/hollow area to comfortably fit calluses without adding pressure when gripped.

Rounded end to secure/cover bar

# TESTING

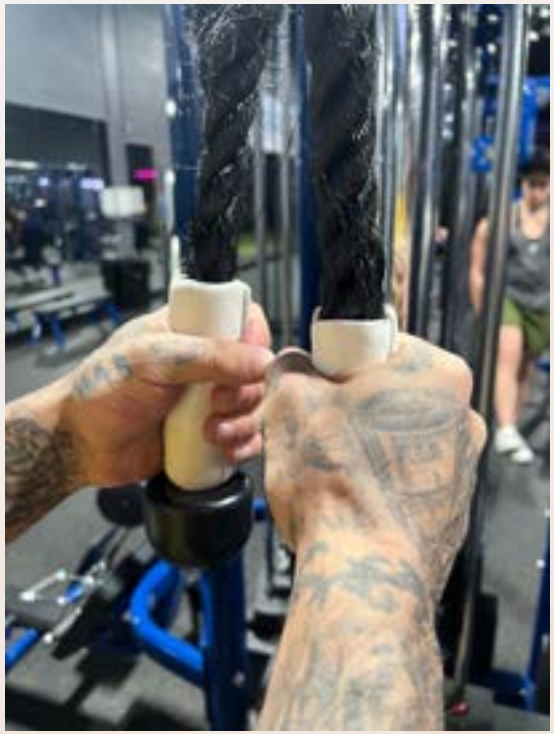


Figure 14: Prototype Testing (Photos: Sofia Garces)

The concept model/prototype was put to the test by putting it through a full workout. I made sure to test it on clients with different genders, backgrounds, age groups,  and strength levels to make sure it was suitable for different users.

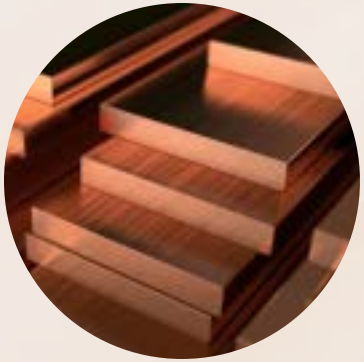
# REFINED



## MODEL 5

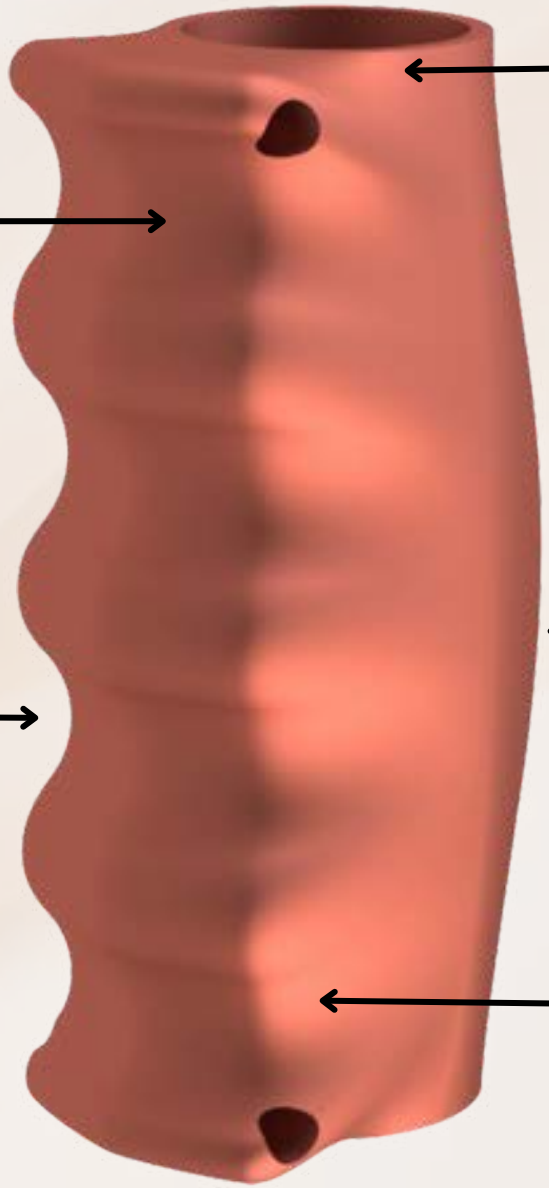
Negative/hollow area to comfortably fit calluses without adding pressure when gripped.

Built in securing clamp



Casted Copper

- corrosion resistant
- Long-term cost efficienent

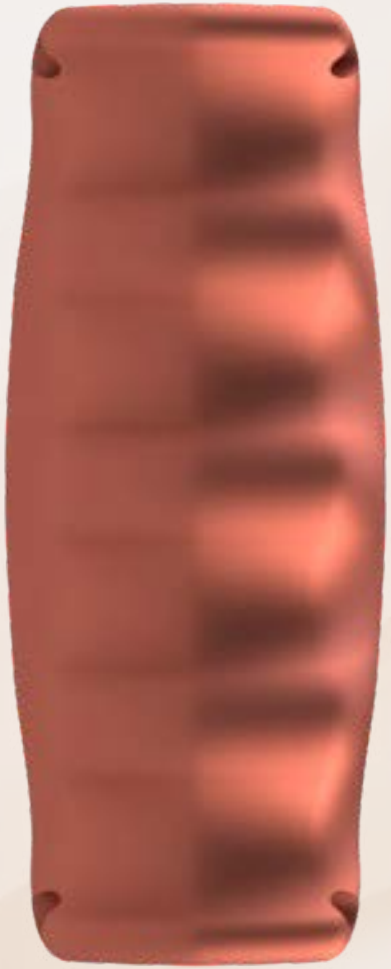


Palm Placement

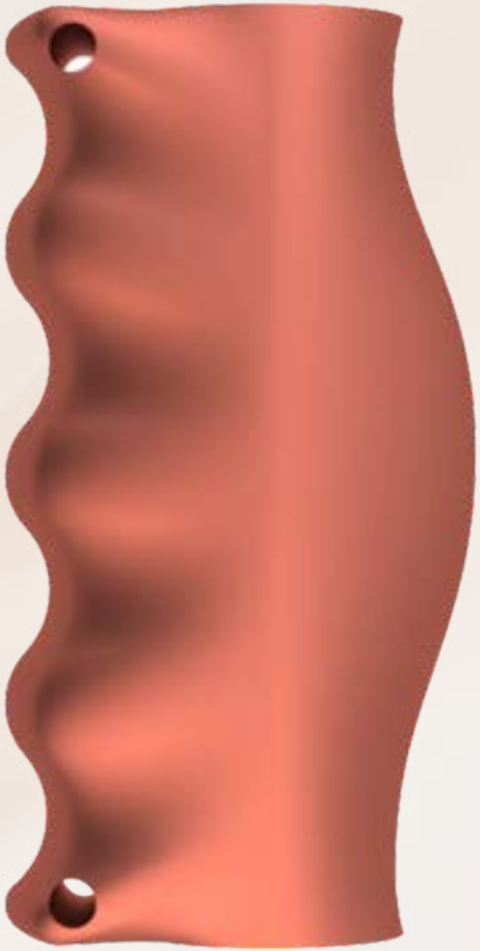
Finger grooves

# VIEWS

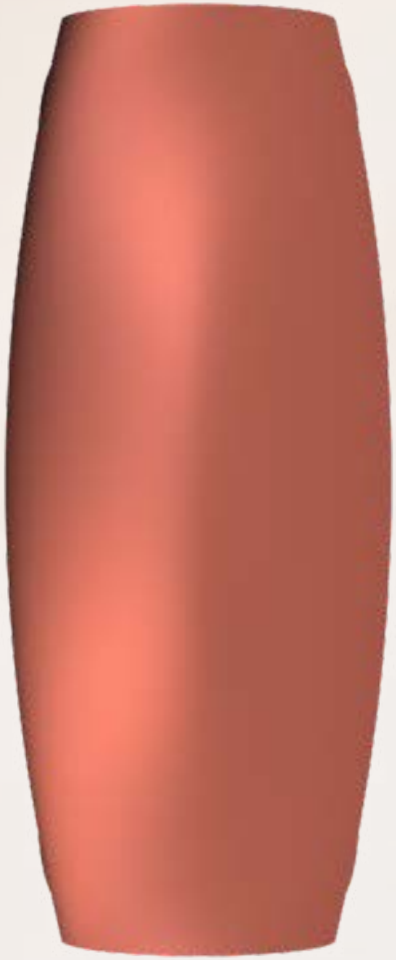
FRONT



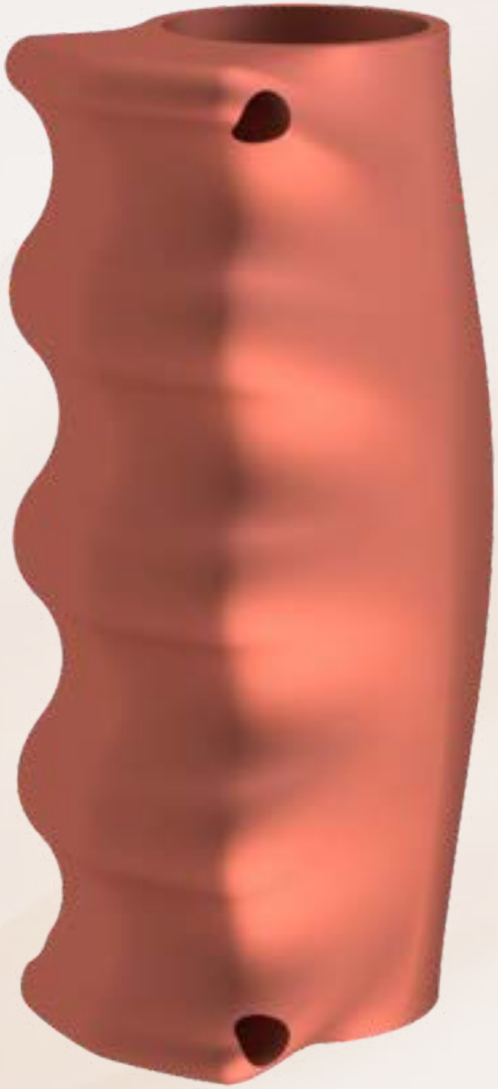
SIDE



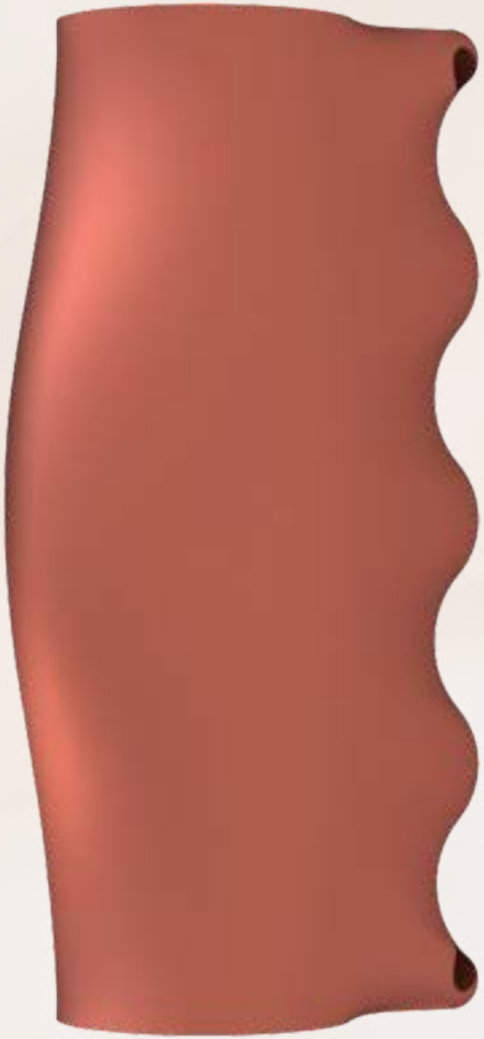
BACK



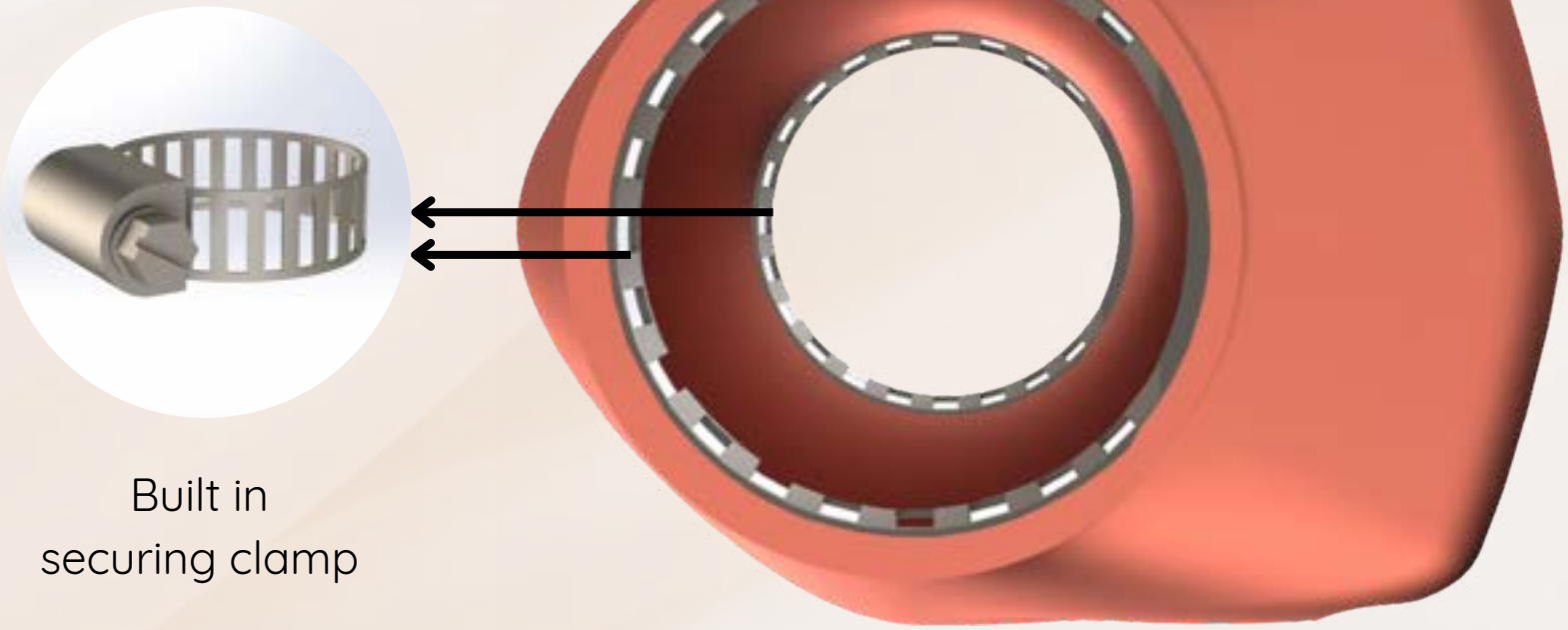
## 3/4



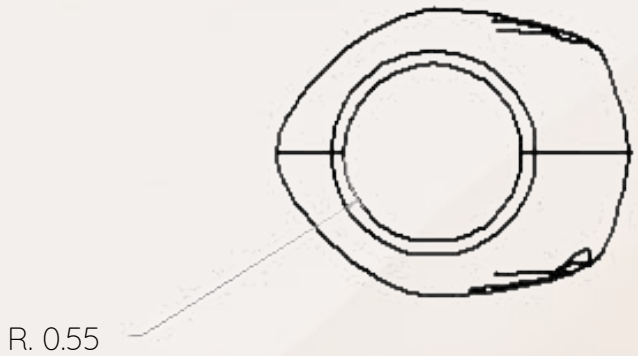
## 3/4 BACK

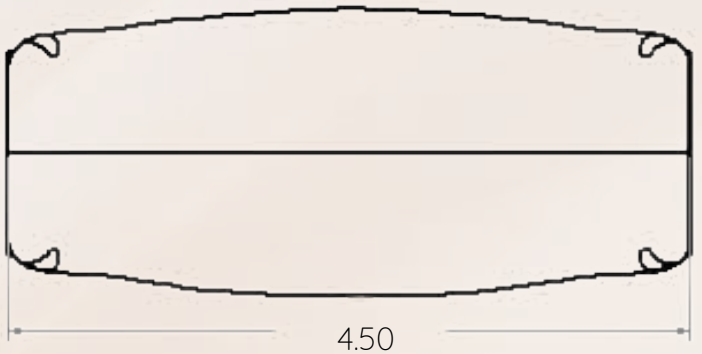


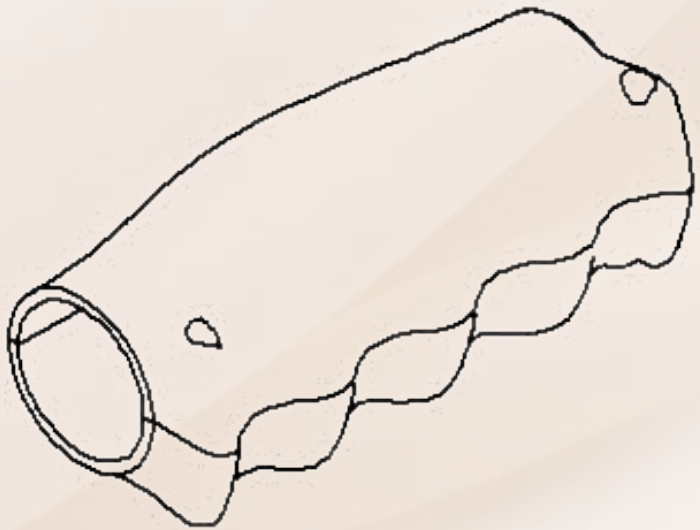
# TOP



Built in
securing clamp


R. 0.55

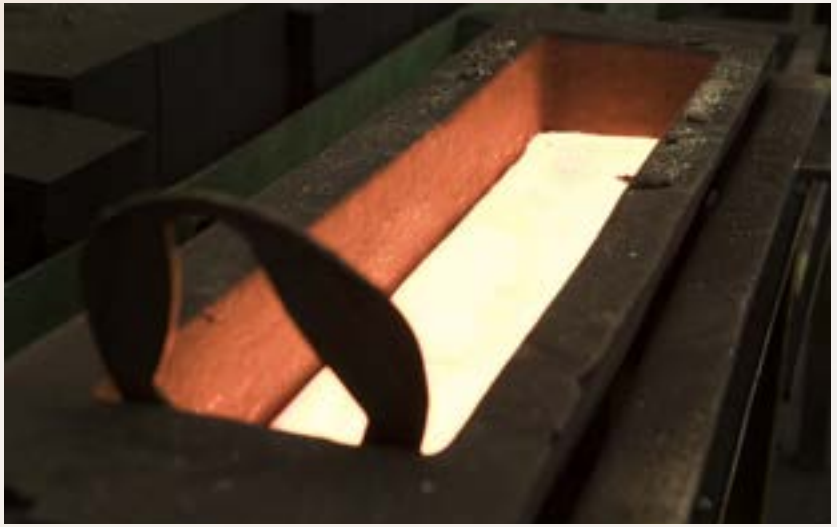

4.50



# FABRICATION

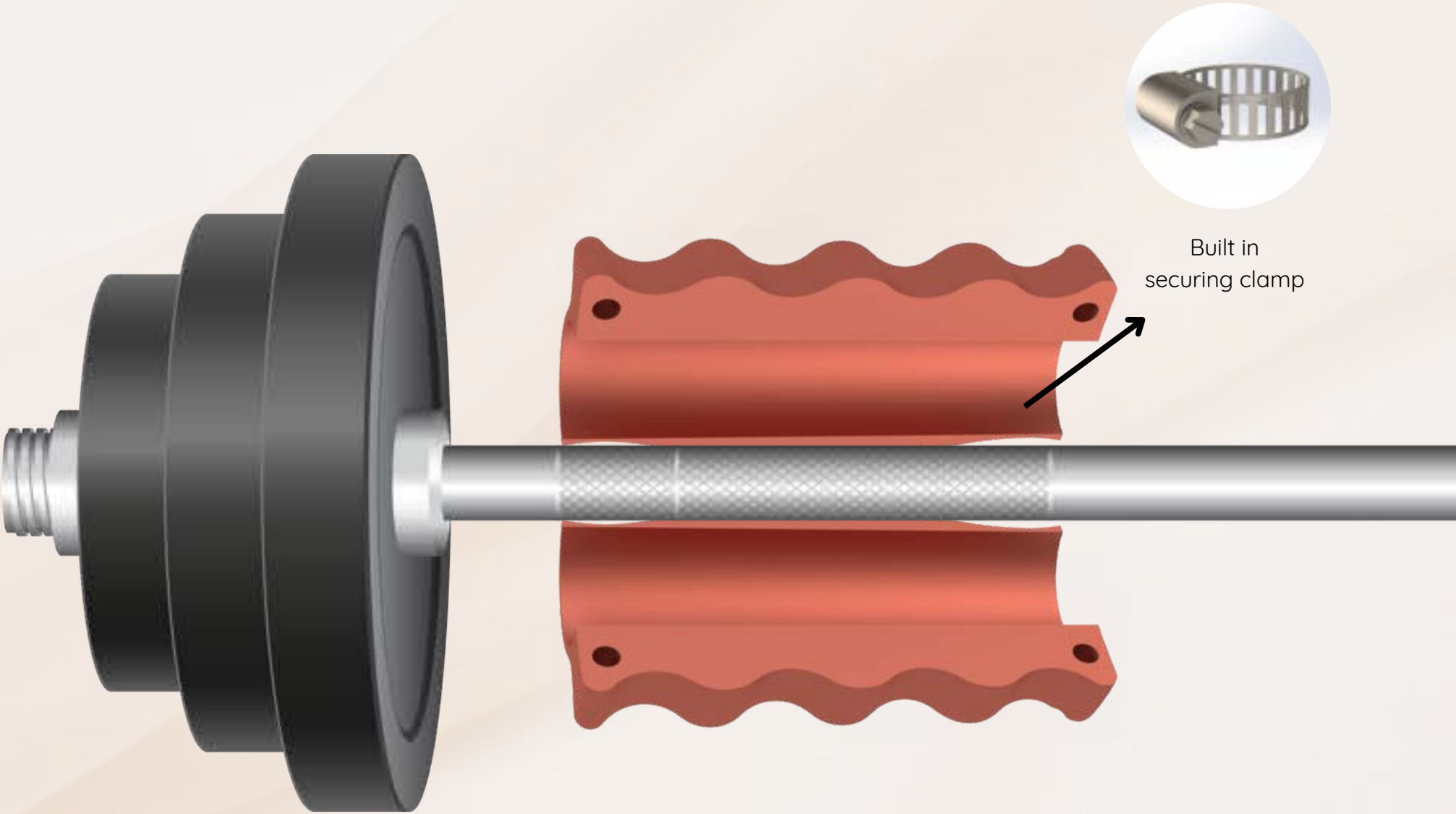
## METAL CASTING

Metal casting is the process of making objects by pouring molten metal into an empty mold. The metal then cools and hardens into the form given to it by this cavity. I would use this method with copper or white iron to make my grips (11 Metal Casting Methods, n.d.).



From: 11 Metal Casting Methods. (n.d.). Reliance Foundry. https://www.reliance-foundry.com/blog/metal-casting-methods

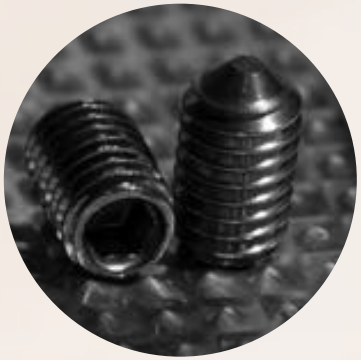
# INSTALLATION



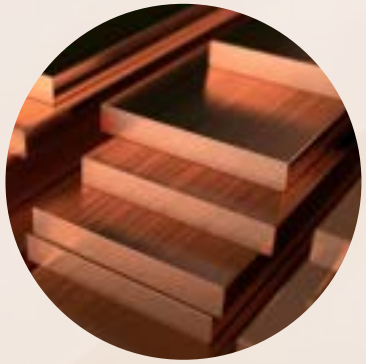
# FINAL CONCEPT

## MODEL 6

Negative/hollow area to comfortably fit calluses without adding pressure when gripped.



Secured with set screws



Casted Copper

- corrosion resistant
- Long-term cost efficienent

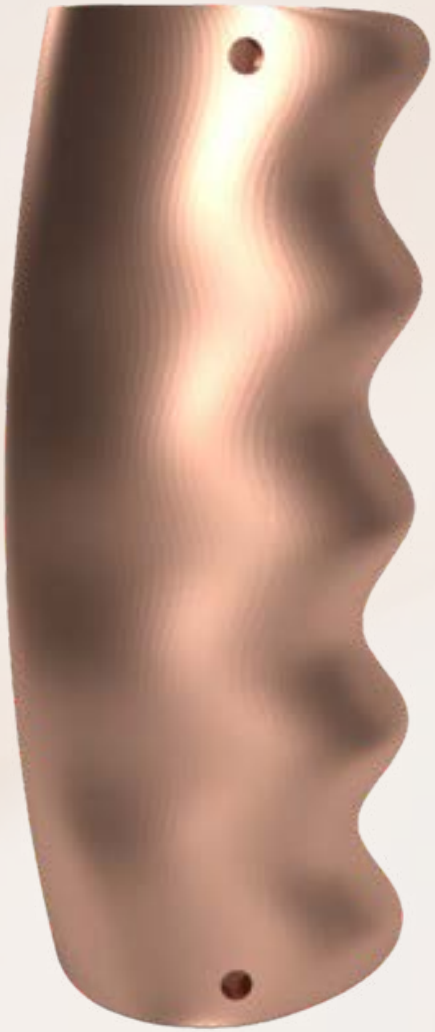
Palm Placement

Finger grooves

# VIEWS

**FRONT**

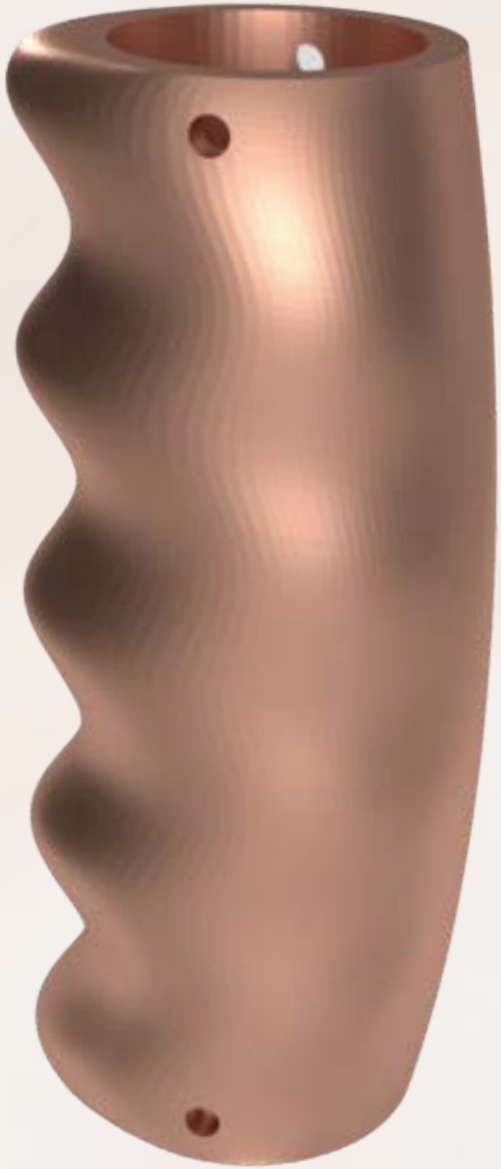
**SIDE**



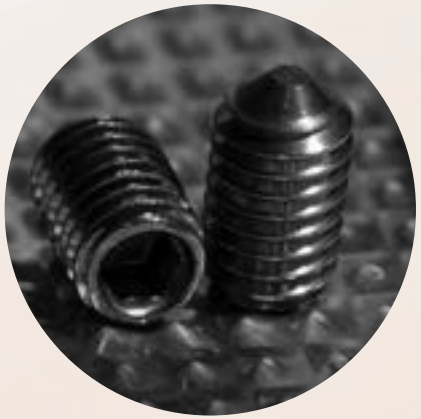
**BACK**

## 3/4

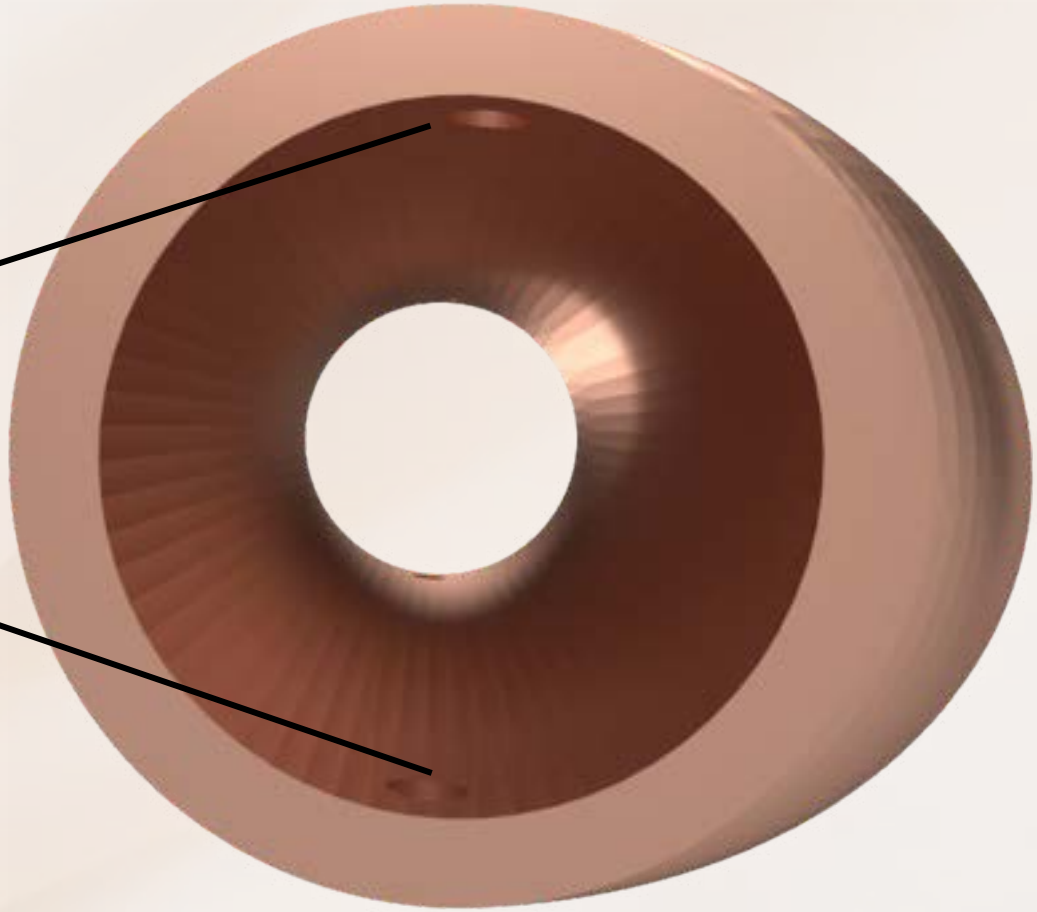
## 3/4 BACK

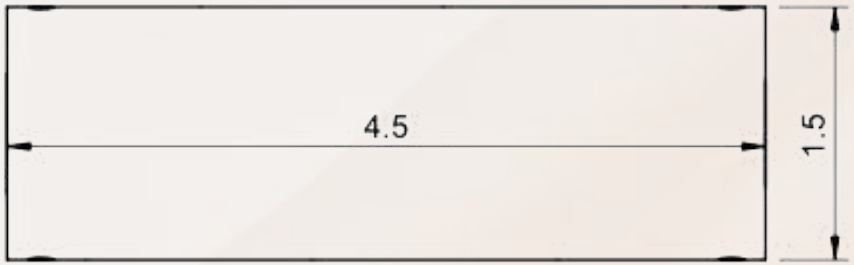


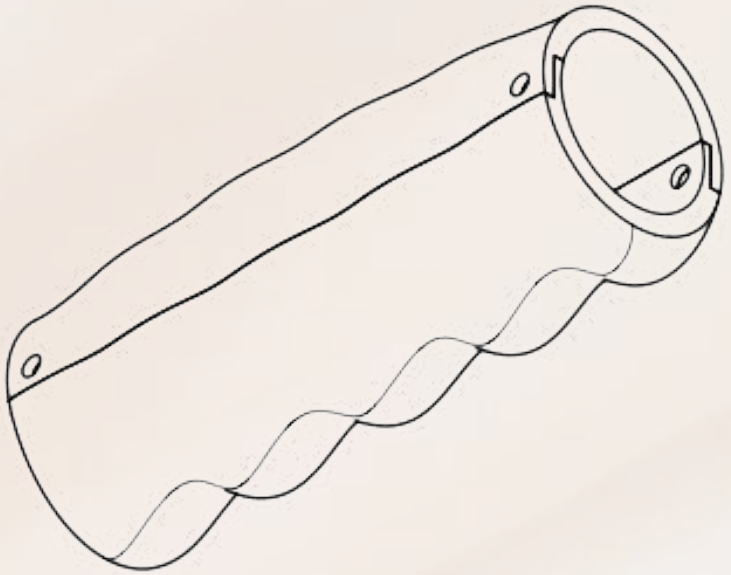
# TOP

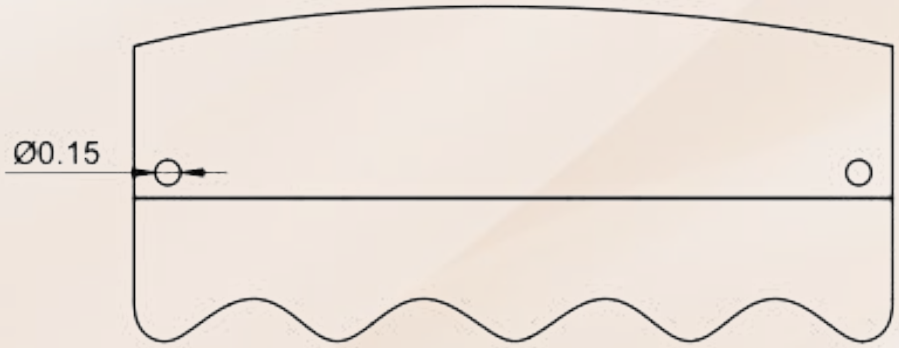


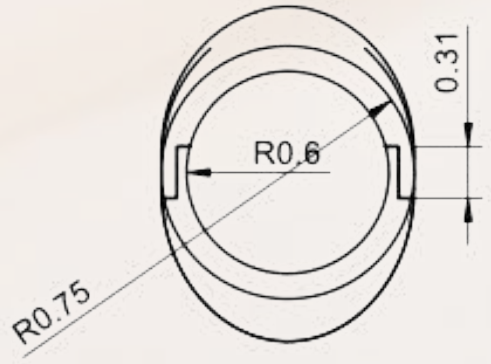
Secured with set screws



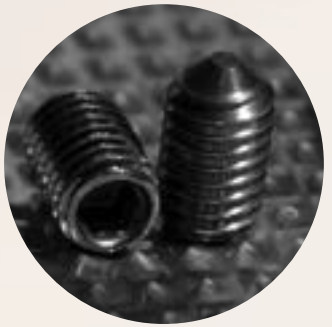

4.5
1.5



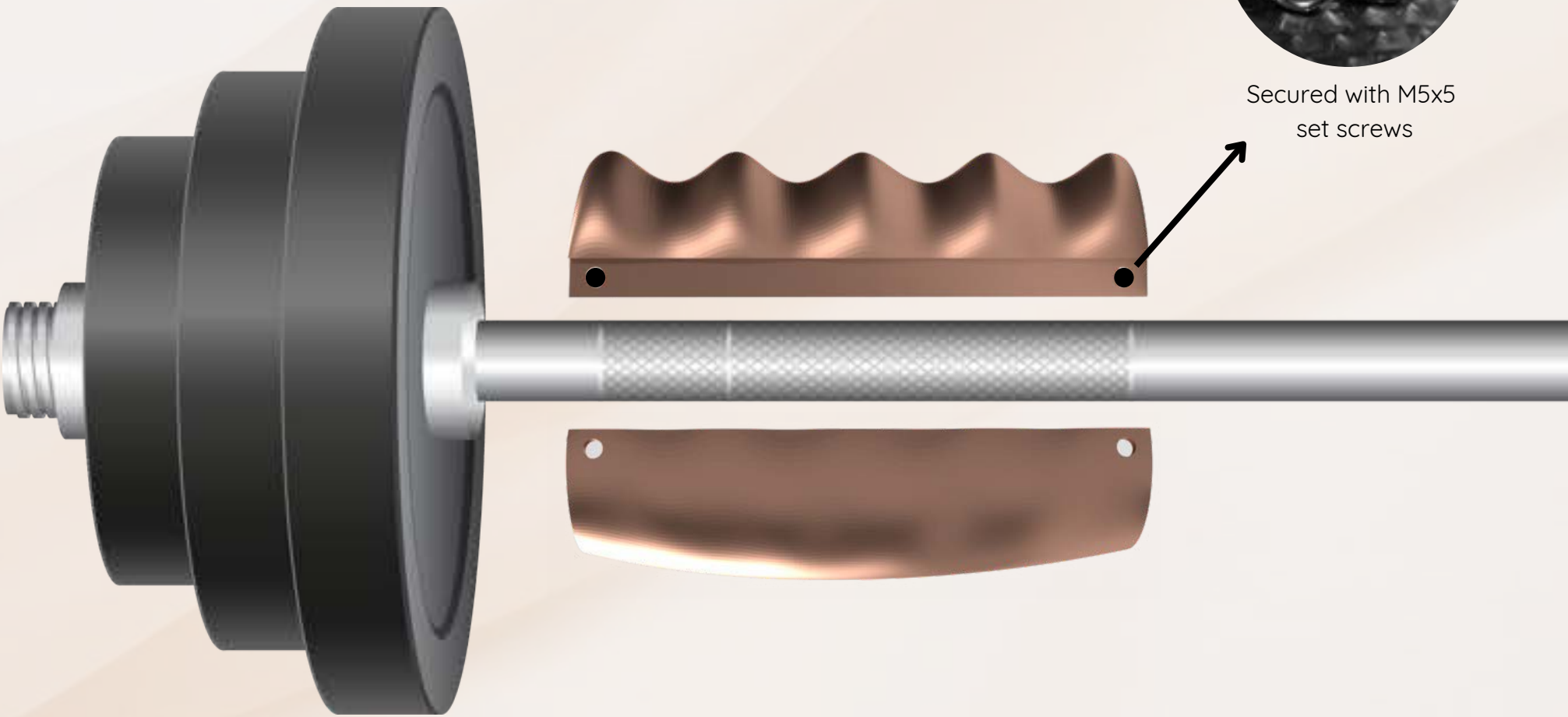

Ø0.15


0.31
R0.6
R0.75

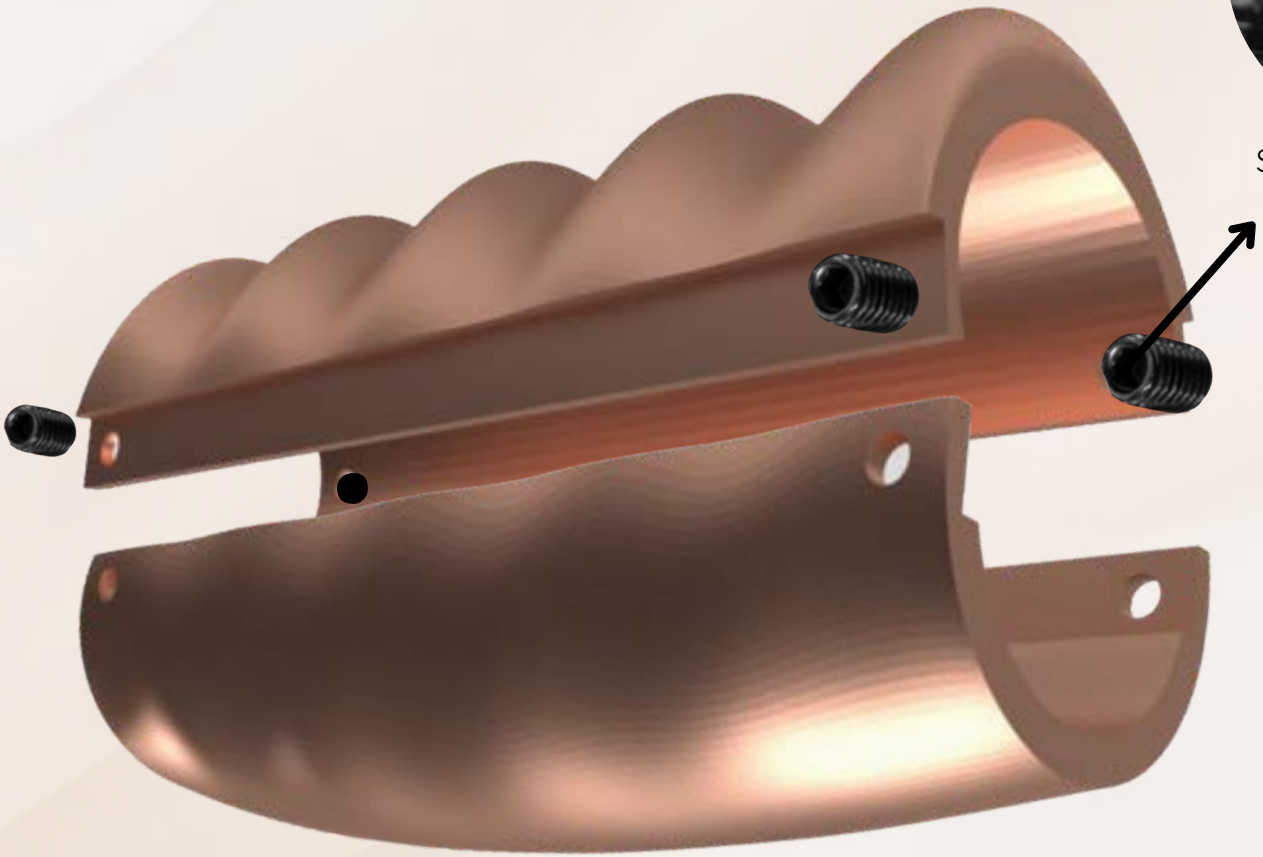
# INSTALLATION

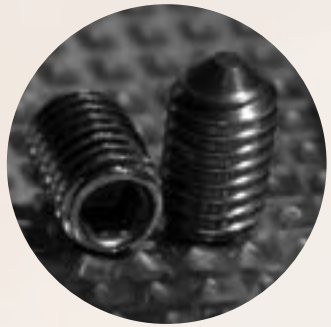


Secured with M5x5
set screws



# FASTENING





Secured with M5x5
set screws

# IN USE



Figure 15: Final Prototype In Use  (Photos: Sofia Garces)

# IN USE




Figure 16: Final Prototype In Use  (Photos: Sofia Garces)

# MODEL DEVELOPMENT

# REFLECTION



After carefully analyzing all the information that I have gathered through interviews, surveys, and observations, it became more evident that there was a substantial need for new material and design alternatives that attain comfort, safety, durability, and sustainability. My goal was to create a gym handle that reinforces grip and provides better support during physical exercise. Through the exploration of new materials, processes, and forms, I was able to create a solution that improves the user's hand-to-object interaction during workouts.

When analyzing the hand-to-object interactions that take place at the gym, none of the abovementioned needs is more important than the other. Safety is of vital importance when operating heavy equipment with sweaty hands, comfort is necessary to maintain proper form while exercising and prevent injuries, durability is essential for the rough nature of the sport, and sustainability is fundamental for the preservation of the environment, the community, and society.

After months of research, prototyping, and testing. I'm very happy and proud of the product I have created and brought to life. It was a very difficult, stressful but rewarding journey that helped me learn so much in the process. I am grateful to all my professors for all the feedback and guidance this year and throughout my career. Thank you for giving me all the tools to become the designer I am today and that I aspire to be. Thank you to my friends that have now become family, and thank YOU for taking the time to read my thesis!

# BIBLIOGRAPHY

Wheretheroadforks. (2021, October 4). *Types of bike handlebar grips*. Where The Road Forks. Retrieved October 21, 2022, from https://wheretheroadforks.com/types-of-bike-handlebar-grips/#:~:text=Handlebar%20grips%20play%20a%20major,blistering%2C%20cramping%2C%20and%20fatigue

*Why are hand grips so important?: Sinclair & Rush UK*. SinclairRushLtd. (n.d.). Retrieved October 21, 2022, from https://www.sinclair-rush.co.uk/news/why-are-hand-grips-so-important/?gclid=Cj0KCQjw1vSZBhDuARIsAKZlijSXsB-5g73wncgVlRcHozhaqpbf9Yyt8RWy2i-gPB2hD8L3B1rwP90aAk0aEALw_wcB

Megan, M. (2022, January 22). *Is rubber biodegradable? 8 common questions answered*. Citizen Sustainable. Retrieved October 21, 2022, from https://citizensustainable.com/rubber-biodegradable/#5_Is_Rubber_Biodegradable

Losek , J. (2021, September 14). *PVC injection molding 101: ICOMOLD*. ICOMold®. Retrieved October 21, 2022, from https://icomold.com/what-is-pvc-injection-molding/

*5 types of handles and what they're used for*. Home. (n.d.). Retrieved October 21, 2022, from https://www.reidsupply.com/en-us/industry-news/5-types-of-handles

Pros and Cons of Stainless Steel Handles. (2021, April 21). [web log]. Retrieved October 16, 2022, from https://monroeengineering.com/blog/pros-and-cons-of-stainless-steel-handles/.

Figure 1: Moulded PVC Handle Grips (Photos: Sofia Garces)

Figure 2: Rubber Handle Grips (Photos: Sofia Garces)

Figure 3: Silicone Handle Grips (Photos: Sofia Garces)

7 Types of Thermoplastic Elastomers (TPEs). (2022, June 27). Xometry. https://www.xometry.com/resources/materials/types-of-thermoplastic-elastomers/

Cable Machines. (n.d.). Fitness Avenue. https://www.fitnessavenue.ca/collections/cable-machines

Cast iron profile BC04 series. (n.d.). Direct Industry. https://www.directindustry.com/prod/leave-industrial/product-84285-1864263.html

Copper Casting. (n.d.). U.S.B.F.&M.I. https://usbfmi.com/copper/

Cork. (n.d.). Shutterstock. https://www.shutterstock.com/search/corck

Free weights. (n.d.). Shutterstock. https://www.shutterstock.com/image-illustration/barbell-kettlebells-dumbbells-black-plates-on-1967109910

O-001 Converging Chest Press. (n.d.). PowerMax. https://www.powermaxfitness.net/selectorized/o-series-c-54.html

Plastic Injection Moulding Process. (n.d.). RNA.

https://www.rnaautomation.com/insight/robotics-in-injection-moulding/

Gordon, Claire C. et. al 1988 Anthropometric Survey of U.S. Personnel: Summary Statistics Interim Report. March 1989.

11 Metal Casting Methods. (n.d.). Reliance Foundry. https://www.reliance-foundry.com/blog/metal-casting-methods

An Introduction to the Cable Machine / Fitness / Equipment. (n.d.-a). https://www.fitday.com/fitness-articles/fitness/equipment/an-introduction-to-the-cable-machine.html

curious. (2019, September 19). Polymers: from DNA to rubber ducks. Curious. https://www.science.org.au/curious/everything-else/polymers

Customer Login. (n.d.). https://www.materialconnexion.online/database/customer/account/login

DAPA Measurement Toolkit. (n.d.). https://dapa-toolkit.mrc.ac.uk/anthropometry/introduction/anthropometry

Dumbbells, Definition, Purpose, History, Description. (n.d.). https://reference.jrank.org/fitness/Dumbbells.html

Portugal, F. (n.d.). What is Cork. Amorim Cork Composites. https://amorimcorkcomposites.com/en/why-cork/what-is-cork/

Robotics in Injection Moulding. (2022, November 23). RNA Automation. https://www.rnaautomation.com/insight/robotics-in-injection-moulding/

Figure 14: prototype Testing (Photos: Sofia Garces)

Figure 15: Final Prototype In Use (Photos: Sofia Garces)

Figure 16: Final Prototype In Use (Photos: Sofia Garces)


Sof
INDUSTRIAL DESIGN