iPhone Charger Protector

IB Design Technology SL Internal Assessment

Candidate ID: 050086-0021

Word Count: 1875

Criterion A

Problem Statement

Electronics, prevalent in everyday life, typically depend on chargers in order to function. With a limited battery life, they often need to be recharged daily, making having a working charger very important for their use.

A common problem is that chargers often break. On average, an iPhone charger lasts one year in perfect working condition (Dinita 1). After one year or so, the cable part near the port starts fraying (figure 1). In extreme cases, the cable sheath may expose the conductors inside. But normal wear and tear is not the only way that chargers break (Dinita 1). Many times, people break it by either pulling it out of the wall or device too roughly, spilling something on it, and more.

A broken charger can be very dangerous to the user. Using damaged cables or chargers, or charging when moisture is present, can cause fire, electric shock, injury, or damage to iPhone or other property (figure 2). One person used a frayed charger, and “After the surge of electricity she felt through her body and the burn mark left on her driver's seat, she believes it's critical that everyone hears the potential danger of using a damaged iPhone cord” (Cox Media Group). On top of the potential danger provided by a broken charger, there is also the inconvenience of getting it replaced. They can be expensive and people often cannot go without them because their electronics will die. Therefore, the breaking of chargers is a problem that needs to be addressed.

Figure 1

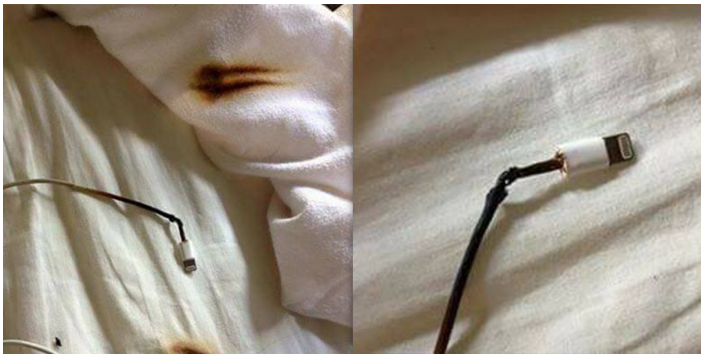


Figure 2

Design Brief:

A designed product that can be attached to a charger can help solve this issue. My intention is to design a product that prevents chargers from breaking or fraying to keep people safe and to prolong the life of chargers. It should be designed for people that have laptops, people that have mobile devices, people whose jobs or education requires them to use an electronic device, people that have any devices that need to be plugged in or unplugged. The design should be able to attach to a charger and protect damage in spots that often receive a lot of wear and tear. It should be lightweight and easy to use, along with durable so that it does not break. Also, it should fully cover spots that are prone to fraying to prevent burns or exposed wires.

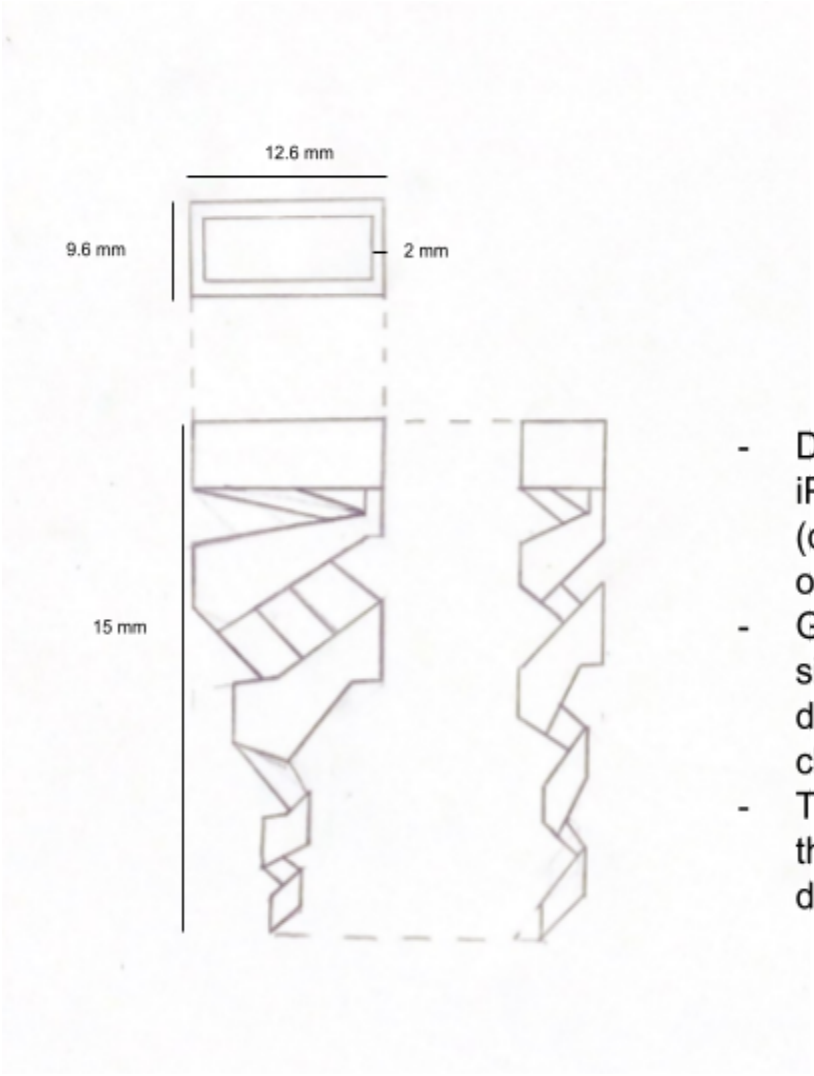
Design Specifications:

1. Material Selection and Aesthetics	The material selection would be about durability, aesthetics, safety, and availability. Specifically, a good material would be a stronger plastic that will not burn easily. It needs to provide protection from the charger, both breaking and burning people. To prevent breakage, the product would need to be a material that withstands stress and protects the charger when pulled and used daily. Also, the material needs to offer protection if the charger does in fact have breakage. If the charger starts to fray, the material has to cover it and prevent the user from electrocution. Plastic would be useful for designing because it can be various colors and have different designs for users to choose from. Plus, plastic is something that is normally highly available for use.
2. Target audience	The target audience would be students, workers, and anyone that uses electronics. Students that plug in and unplug their computers all of the time have a high risk of breaking their chargers. The same applies to workers, who also often use chargers to keep their devices alive as they work. Additionally, people that use electronics in general need to often charge their devices, whether a phone, laptop, or controller. When charging devices, there is a risk of breaking the charger or making it fray, which can be a hazard, and there are tons of people that charge their devices. The audience should include a lot of people due to the high number of charger users.
3. Function	The function of this product would be to protect chargers. When a charger is plugged in or unplugged, it can either break or fray, which can be inconvenient or dangerous. The product would have to make sure chargers don't break by being durable. In doing this, it will prevent users from having to buy replacement chargers all of the time to save money. Also, if the charger does fray a little, the product should be able to protect the user from being electrocuted, and should protect exposed wiring from starting fires. It should also be portable. If it is portable, then it can move from place to place, where the device is likely to get charged. The product also should have to fit the needs of many different charger types and brands.

4. Production constraints	Some production constraints are getting the materials needed and shaped how they have to be. The product cannot be easily broken or else it will be useless, so the model needs to have either a super durable material or a thicker layer of a weaker one. The materials received can limit the design, so it is important to find out what is accessible. The product cannot fulfill its purpose if it is made to be weak, so it could be hard to get the right resources to use. Also, some constraints will be my knowledge and skills when making the product.
Size of Product	The product will need to be large enough to cover or protect the charger. The dimensions will have to be greater than that of the charger. Additiotionally, there will have to be many different sizes because different devices have different chargers, and each charger has different brands. However, the product cannot be too large because something too bulky could take away the appeal. Also, it cannot weigh too much or it will put stress on the charger and may cause it to break, which would be the opposite of what it is supposed to be. Lastly, the size cannot be too large so that it is portable and the charger can be moved from outlet to outlet.
Quantity	One product will be made with the specifications listed.

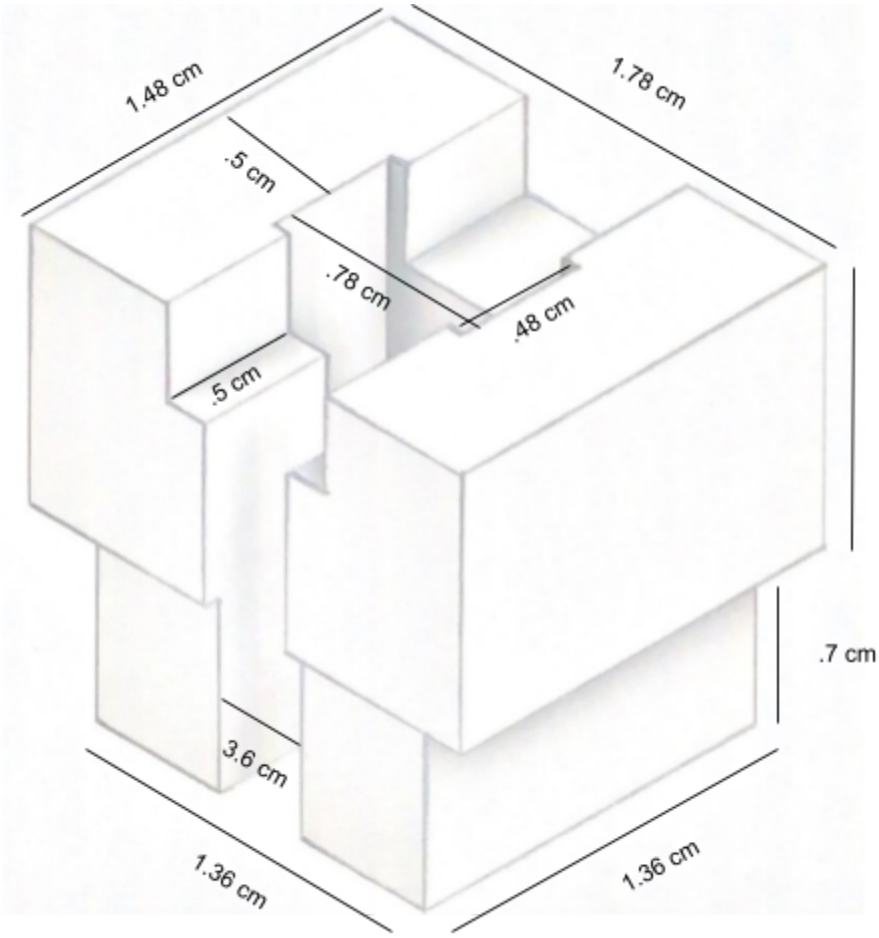
Criterion B
Possible Solutions

Idea #1



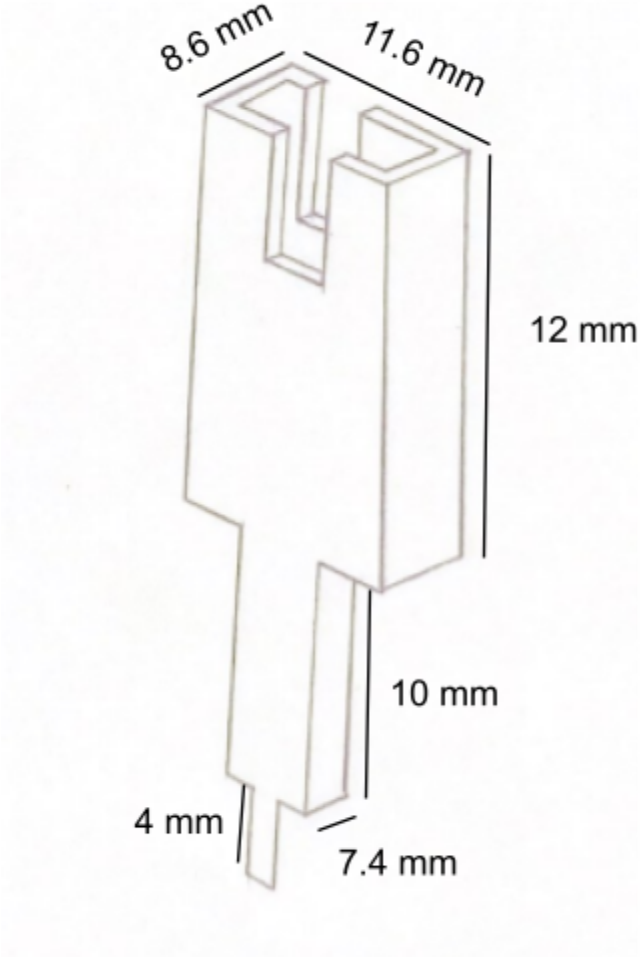
- Design wraps around an iPhone charger (dimensions specific to one)
- Gradually decreases in size to fit the decreasing dimensions of an iPhone charger
- There is more exposed in this charger protector design

Idea #2



- Charger goes in through the middle
- The slit allows the charger to go inside of the case
- The case is a half centimeter all of the way around to protect the charger
- It is slightly shorter than the length of a charger so that it does not interfere with the charger going into the phone

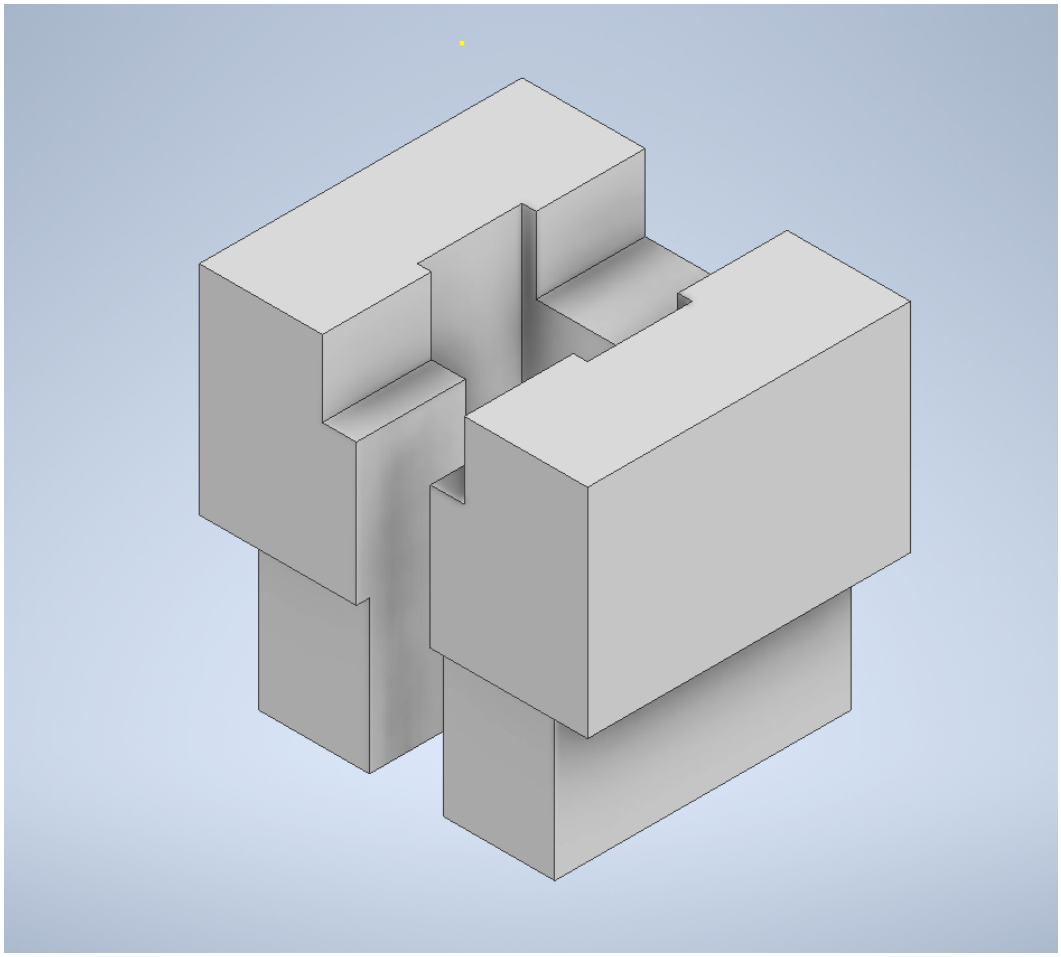
Idea #3



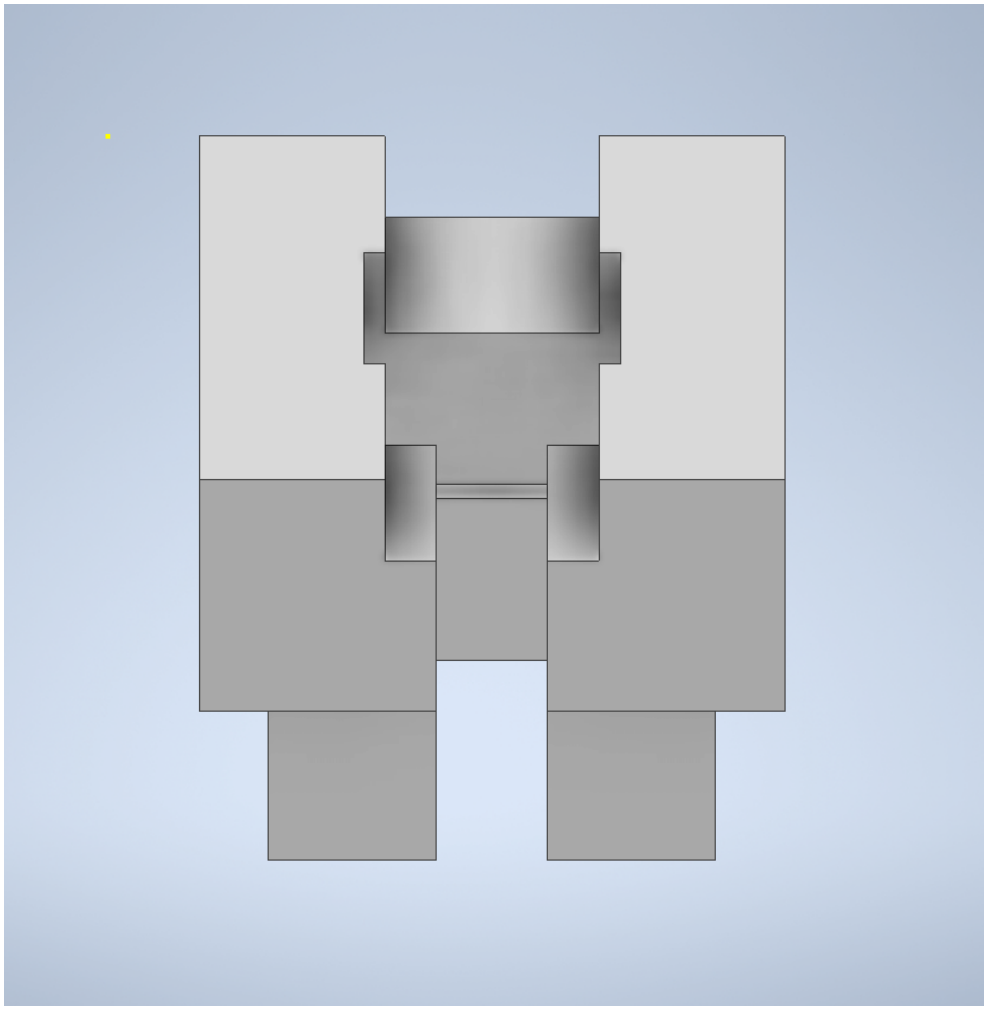
- 2 mm thick
- iPhone charger fits through the middle
- forms a protective layer around the charger
- A thinner, more protective coat around the charger

Concept Modeling

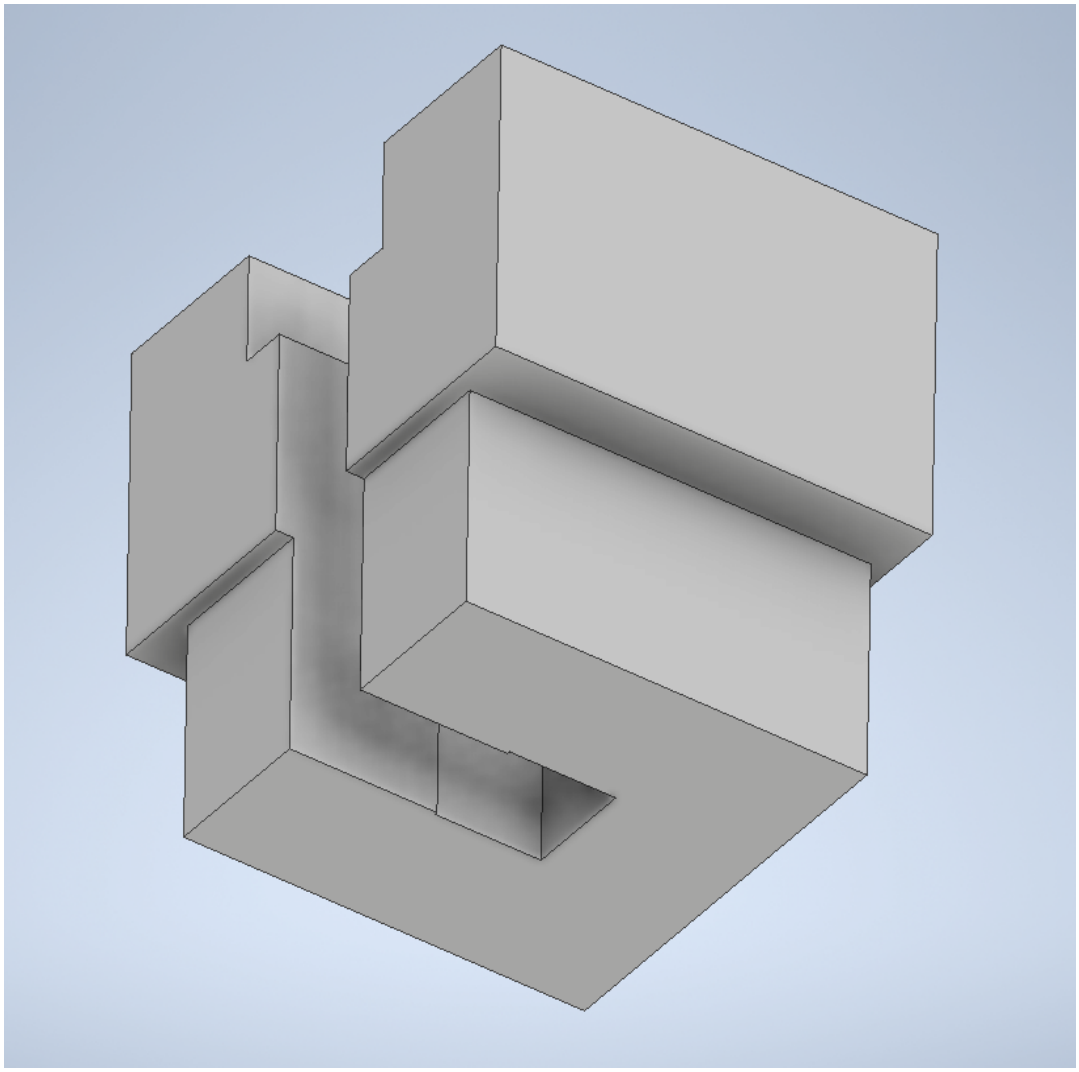
Design #2 on CAD Modeling Software:



- Isometric view of model on modeling software
- The protective thick edges all around the charger can be seen
- The protector appears around the same thickness as the charger itself, so it will be very protective
- The charger protector thins out towards the bottom where the charger gets smaller to show a better fit



- On the front, there is a gap where the charger can fit through
- The wire can fit through the gap in the front, then slide down



- The hollow center is where the charger would be
- From this lower view, it can be seen that the space is very narrow, as this is where the smallest part of the cord would be.

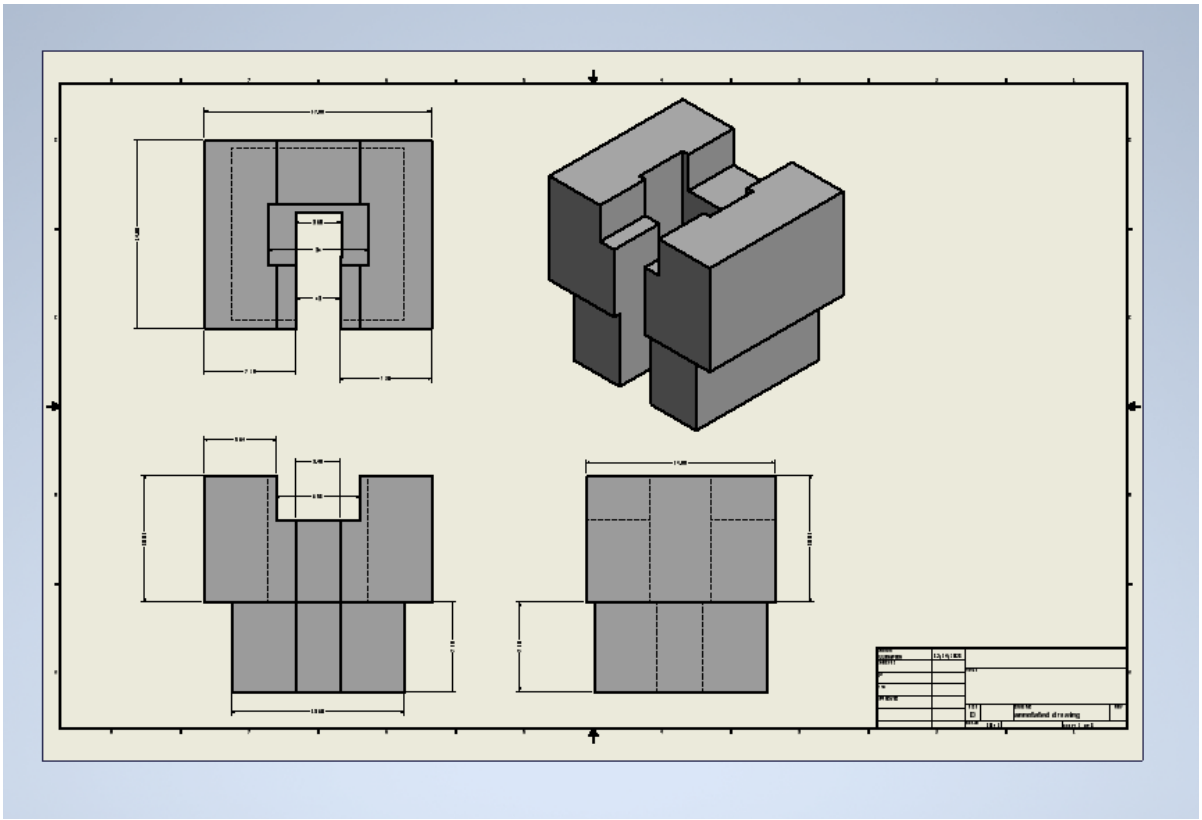
Chosen Design:

Design Matrix					
Design Decisions	Design Elements				
	Durability	Protectiveness	Fit	Materials**	Total
Design 1	3	3	5	5	17
Design 2	5	5	5	5	20
Design 3	2	3	5	5	15

**Materials refers to the availability of the materials used in the design

Key:
1 = The design does not meet the specification.
2 = The design minimally meets the specification.
3 = The design somewhat meets the specification.
4 = The design meets the specification.
5 = The design meets all aspects of the specification completely.

Design #2 Presentation Drawing: Orthographic/ Isometric



- top view, front view, side view, and isometric view
- the area in which the charger would fit through can clearly be seen, as can the width and protectiveness of the cover

Final Product Selection Justification:

I chose design #2 because of its durability, protectiveness, fit, and materials. Being the thickest layer of protection at a half centimeter thick (over double the width of the other two), it is the most durable and protective design. Since it is thick, it is unlikely that it will break, adding to its durability. Additionally, its thickness will prevent damage to the charger itself, adding to its protectiveness. As far as its fit, it is specifically designed to fit around an iPhone charger by using dimensions that I measured. This is the same for the other two designs, so this design element did not influence my decision as much as the other two mentioned. The last element was the materials. The material that I plan on using is plastic, specifically 3D printing filament. This material would have been used for all 3 of my designs, and it is highly available and easy to use. So overall, the factors that had the most impact on my decision were the durability and the protectiveness of my designs.

Criterion C:

Prints 1 and 2

Final Design: Print 3

Final Product/Selection Justification

When I made my final design, I 3D-printed FlexSolid Clear Flexible Plastic Filament. This requires an additive manufacturing technique. Additionally, printing this way allowed me to print my model both accurately and directly from my design on Inventor. Also, as someone with access to a whole roll of filament, there was no constraint on supplies. Therefore, I could redesign my model and reprint it as many times as I wanted.

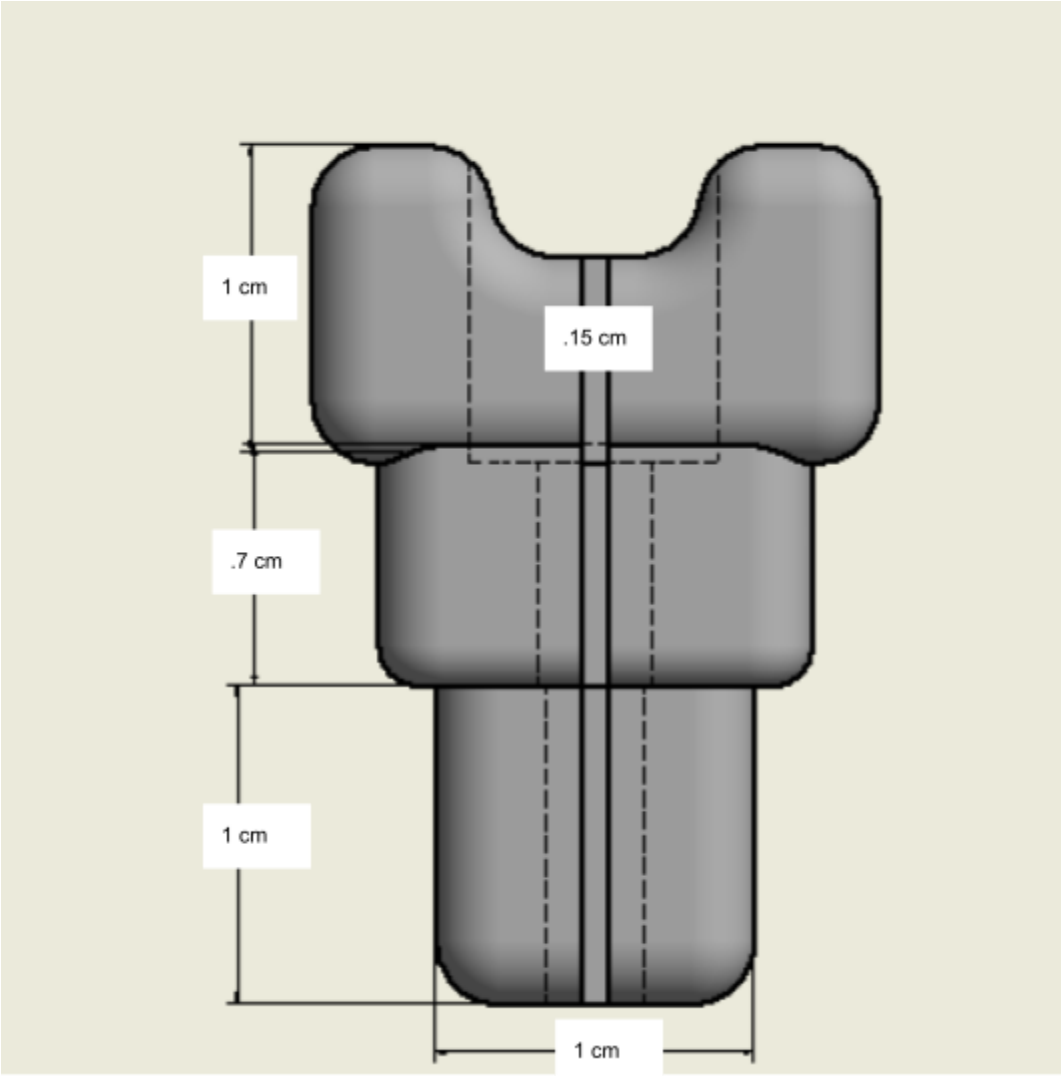
To get my final design, I had to redesign multiple times. After making my initial design, I found that the fit was slightly off. The hard plastic material I was using made the charger protector too tight and unable to be attached and unattached from the iPhone charger easily enough. The material was completely solid and I realized that I needed to find a material with more elasticity. This is where the FlexSolid Clear Flexible Plastic Filament came into play. This material was not only more elastic, but it was also more durable and flexible. It could fit around the charger better and be removed/put on more easily without sacrificing durability in the material.

After redesigning the charger protector's material, I decided to add another part to the bottom to add additional protection. In doing so, I extended the length of my model to protect a part of the charger exposed to fraying and damage that wasn't protected before. To make the fit even better, I also curved all of the edges of the design. Through the redesigning of my product, I created a final model with the FlexSolid Clear Flexible Plastic material and extended it to be more protective for the charger.

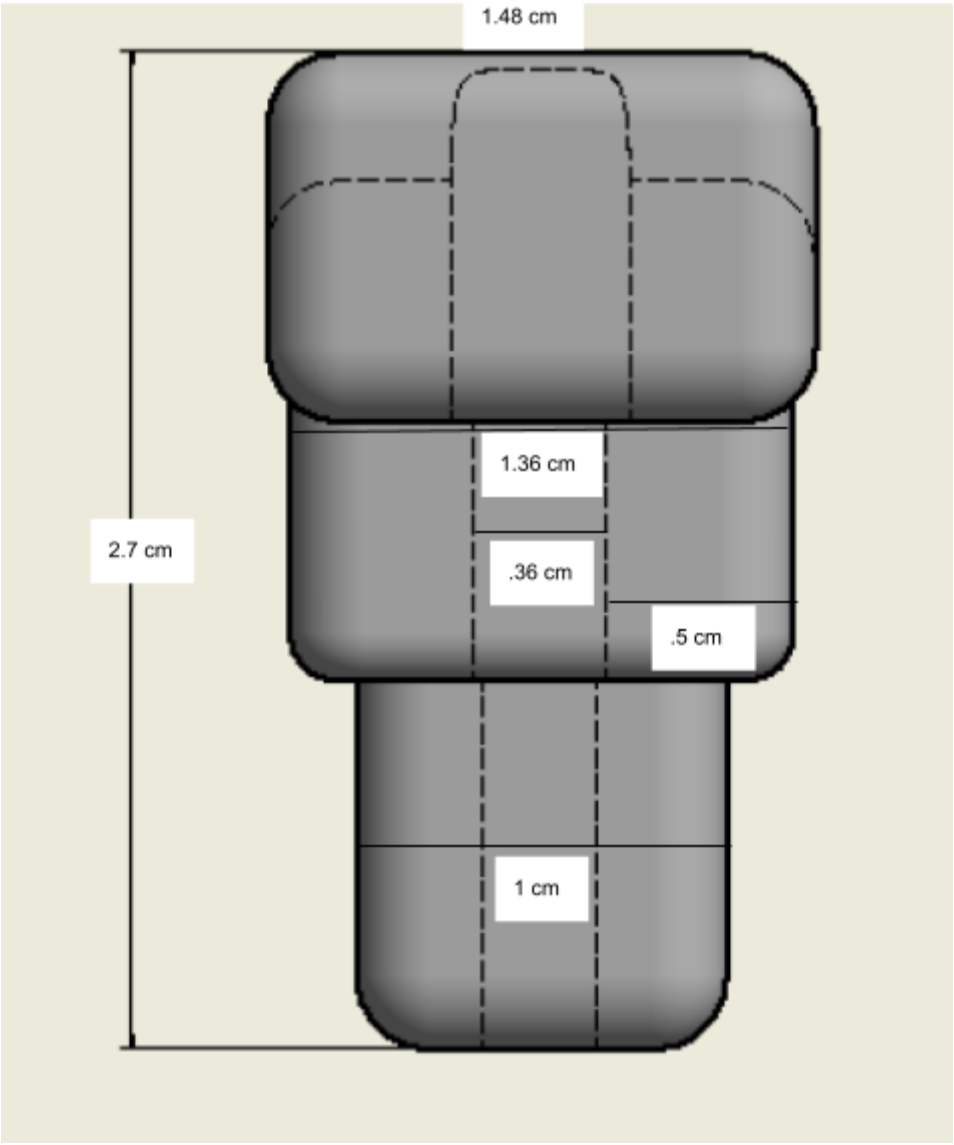
When considering the mass production of this product, I first thought of 3D printing. Through this additive process in which I created my prototype, I could print my design accurately, but at a slower speed. It took about 30 minutes each time I wanted to print my design, and this technique is just not fast enough. Additionally, after each print, I had to remove support beams and the base. Therefore, due to the extra labor and slower speed of 3D printing, I decided to consider injection molding. I would use the same type of plastic in the form of TPE

pellets, but the design would be formed in a different way. Instead of the filament being melted through a nozzle like in 3D printing, the TPE plastic would instead be melted and injected into a mold, where it would harden into the final product. Injection molding would be more effective in the long term by saving materials and labor.

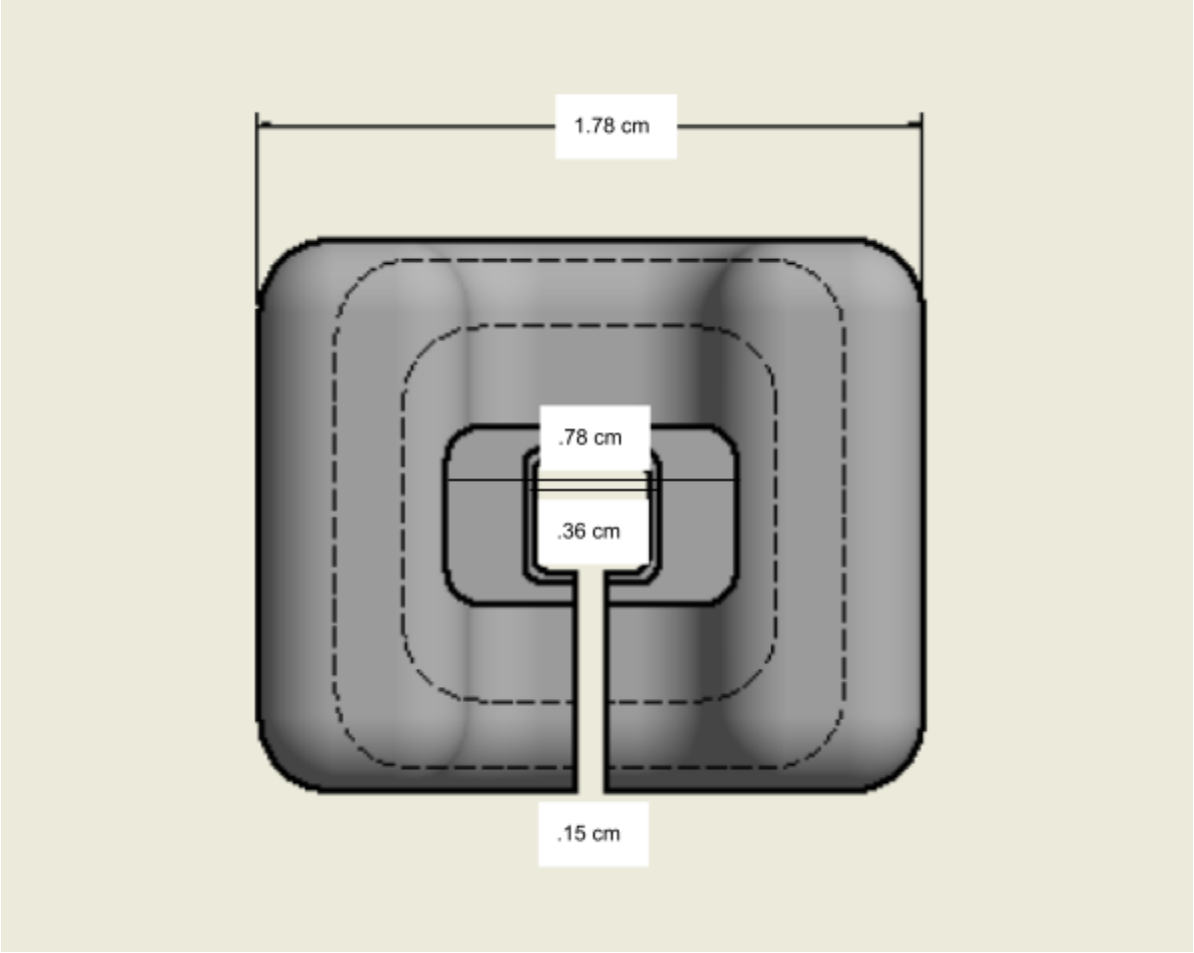
Design Proposal



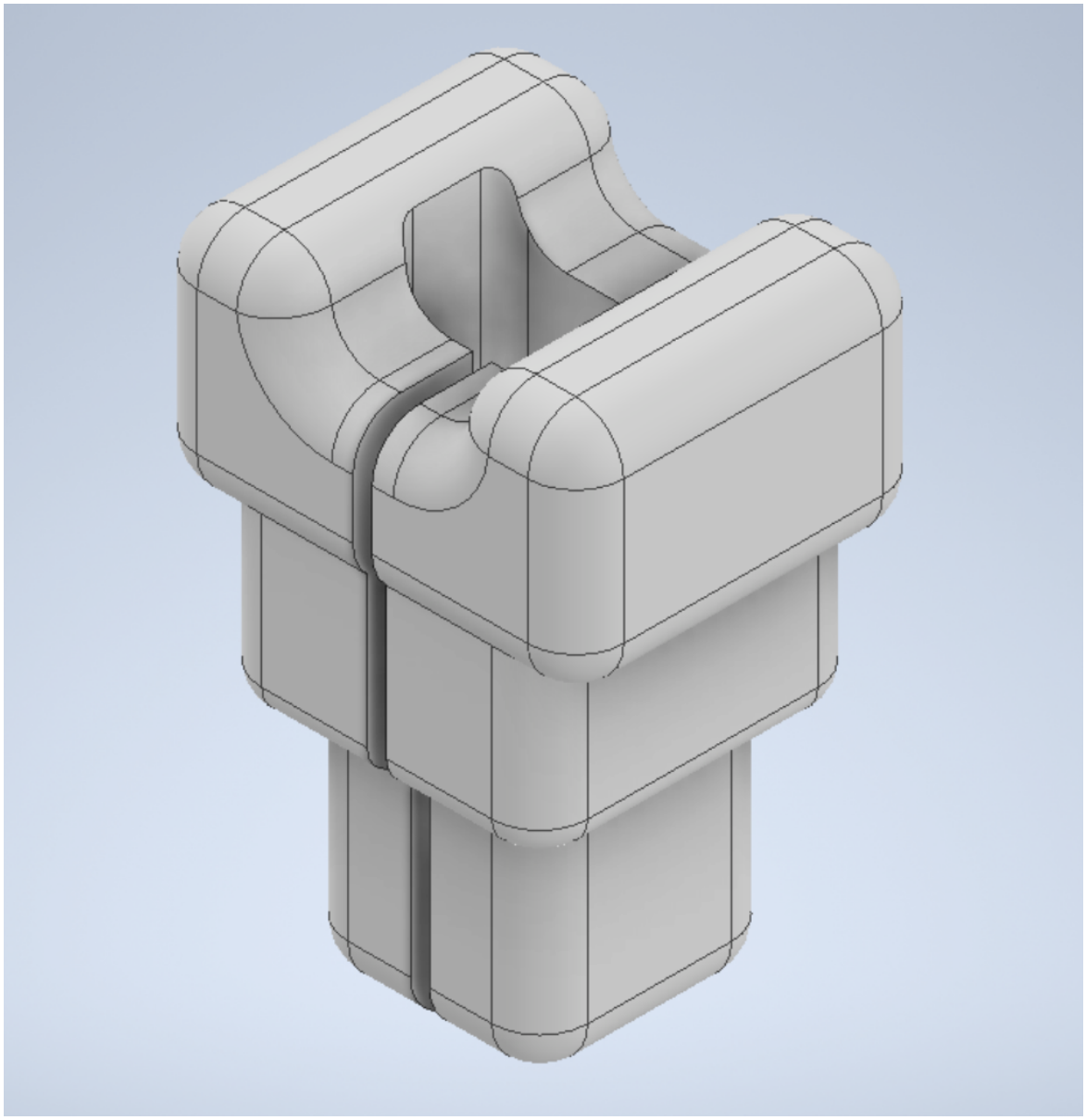
Front View



Side View



Top View



Isometric View

Bill of Materials:

Piece	Description	Quantity	Material	Diameter	Weight	Price
A	FlexSolid Clear Flexible Plastic Filament	1	thermoplastic elastomer (TPE)	1.75mm	0.50kg	$39.99

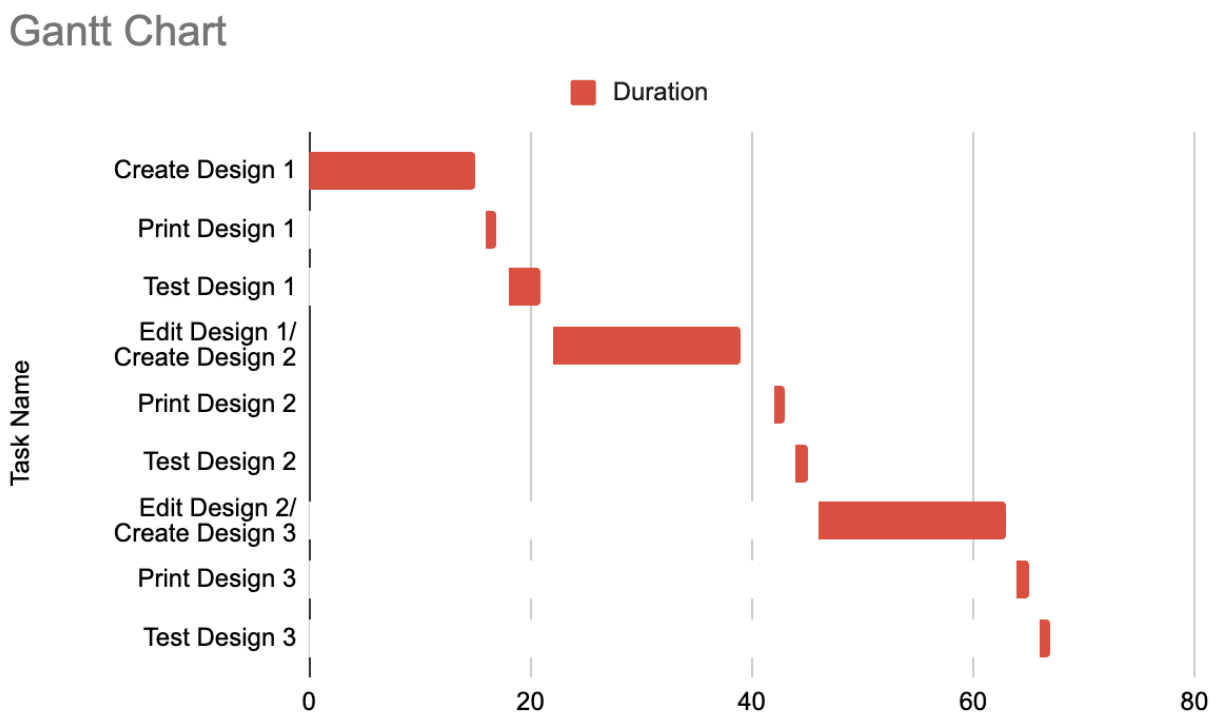
Justification:

When making my design, the material being very durable and flexible are two factors that I need to take into consideration. This filament is extremely resilient and flexible and does not tear easily like other filaments. Additionally, it has elasticity and ductility. It is ideal on anything that requires engineering tolerance without compromising on long term durability

Plan for Manufacture:

Plan for Manufacture			
Process	**Equipment**	**Scheduling**	**Quality Control**
Collect Materials	**Injection Mold, TPE pellets**	2 months	Make sure TPE pellets are high quality.
Injection Molding	**Injection Mold, TPE pellets**	under a minute	Check TPE hardens, check injection molds every couple runs.

Gantt Chart:



Works Cited:

Cox Media Group. “Woman Shocked by Frayed IPhone Charger Warns Others.” Boston 25 News, Boston 25 News, 11 Dec. 2017, https://www.boston25news.com/news/woman-electrocuted-by-frayed-iphone-charger-warns-others-1/662052656/.

Dinita, Madalina, et al. “How Long Do Iphone Chargers Usually Last?” *Technipages*, 17 Dec. 2020, https://www.technipages.com/how-long-do-iphone-chargers-last.