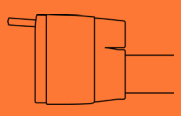
LIFEHAMMER SOLUTION



Graduation report

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LIFEHAMMER®

SUMMARY

The following report is the result of a graduation project done for Lifesafety Products B.V., otherwise known as Lifehammer.
Lifehammer makes emergency hammers for cars. The most well-known use case for these products is when a car crashes into water. Which, to no surprise, happens quite often in the Netherlands when compared to other countries. Despite no regulatory mandates by the government, car dealers and importers have decided to take matters into their own hand, and most newly purchased cars in the Netherlands come with a Lifehammer.
These hammers are praised as quality products and have been tested to be working as intended. The same cannot be said of the attachment systems, which provide the mounting of the hammer to the car. There are currently two widely used attachment system. While one works fine, it cannot be fitted on all cars. The other, which is mounted the more universal side pocket of doors, comes with a variety of problems, all caused by the great variety that side pockets have. These problems are great enough for some users throw the hammer in a storage compartment, with some users and car dealers going as far to throw it in the trunk, where it will do no good in an emergency.
The aim of the project was to find a better design which would be less intrusive and fit most, if not all, cars on the market. As the project progressed, the brief was adjusted, as the size of the hammers and limitations of the design environment were too great to overcome. Instead, a smaller hammer was developed which is to be mounted on an even more universal location than the side pockets; seat belt receivers.
The main challenges during both most of the project was the context; car interiors. The car industry is affected by tight safety regulations, which do not cover crashing in water. These regulations limited the possibilities for new locations. The initial expectation that seat belt receivers had universal designs turned out to be only half true. Though nowhere near as diverse as side pockets, there were still small deviations which made designing the product harder. Fortunately, the dimensions of different receivers were relatively similar, thus a one-size-fits-all solution could be designed.

GLOSSARY

Windshield
The front window of a car (or other vehicles).

Laminated glass
Layered glass with polymer between the layers. Industry standard for windshields. Does not shatter.

Tempered glass
Treated glass which is much stronger than regular glass. Tempered glass can shatter.

Original Equipment Manufacturer (OEM)
Manufacturers who produce sub-assemblies for original products.

Glove compartment
Storage compartment located on the dashboard. Usually at the passenger-side.

Seat belt retractor
Mechanism that retracts the seat belt, and locks in place when under high acceleration.

Side pocket(s)
Compartment located on the interior of car doors. Sometimes function as cupholders as well.

Middle console
Elevated part running through the center of the car, often in the length of the interior. Original function is to provide space for the transmission box.

(Seat belt) Webbing
The textile/belt part of the seat belt. Made of Nylon/polyester blend.

(Seat belt) Receiver
The "female" part of a seat belt buckle. Industry standard features a top-down red button. Older cars may have side release button.

(Seat belt) Tongue
The "male" part of a seat belt buckle. Has a visible metal "tongue".

Powered window
Car windows that open through the push of a button. Has become a standard in contemporary cars regardless of price segment.

Crank handle
Found on car windows that have to opened manually. Only found in older cars.

Platform (automotive)
The "skeleton" of the car, if you will (but not the frame). The platform determines most dimensions. Often shared by different brands due to high development costs.

Crumple zone
Zone in cars specifically designed to "crumple" in a crash to decrease G-forces.

Pedestrian safety zone
Softer zones in car exterior, designed to minimise (fatal) injuries to those that get hit by the car. The windshield counts as "soft". Will still hurt.

Curtain airbags
Airbags that come from the ceilings on the side to prevent passenger ejection (ie. being launched out the car sideways).

Side airbags
Airbags meant to provide additional protection for passengers from side impact crashes. Usually located in the seats.

Grab Handle
Colloquially known as the "o sh*t!"-handle. Located on the roof of most cars. Usually lacking on the drivers side. Got to keep those hands on the steering wheel.

CONTENTS


PULL

INTRODUCTION

EMERGENCY HAMMERS

Car safety has come a long way since the introduction of the automobile to the masses. Crumple zones, seatbelts, and airbags are but a few safety measures that have been invented over the course of years, now implemented in cars of virtually all brands and models. Many of the existing safety measures have been integrated into car design itself, but there are also after-market products aimed at increasing the chances of survival after an accident. The emergency hammers of Lifehammer fall within this category; an emergency tool which can cut through seatbelts, and most importantly, shatter car glass. Lifehammer currently produces three emergency hammers; the Lifehammer Plus (henceforth mentioned as Plus), and Lifehammer Evolution (henceforth mentioned as Evo). The original Lifehammer was renamed into Lifehammer Classic (henceforth mentioned as Classic). See Figure 1.0.

Two of these, the Classic and Plus, are "traditional" emergency hammers; they need to be swung by the user. The Evo is a "spring-loaded" hammer; it stores the energy generated by the user in its springs and releases the ceramic "hammer" when the threshold has been reached. Due to its springs, the Evo always delivers the same amount of force in the correct direction. All three hammers also include a seatbelt cutter on the bottom of their handles.

The contemporary hammers have been praised for their quality (Radar. 2014), but their attachment systems fall short of the same standard. The assignment for this project is to improve, or find a better alternative for the current **attachment systems** in consumer cars.

Figure 1.0: The current hammers of Lifehammer.

ATTACHMENT SYSTEMS

Since the emergency hammers are after-market products, there is no dedicated place in car interiors to hold them. For this reason, Lifehammer has developed several attachment systems, which serve to convert certain car parts into viable fixation points for the hammers. The attachment system for the Classic can either be screwed into a surface, or pinned to a soft surface, such as the carpet or ceiling. The contemporary hammers use different systems, which can be used for both the Plus and Evo, but not the Classic. These are the: Quick Click System (QCS), Easy Fix System (EFS), and the Pro Adapter (PrA).

THE CLASSIC

The Classic, has its own dedicated attachment system. However, the Classic has had a virtually unchanged design since the 80's, with only minor changes, and is starting to look dated. The Plus was specifically designed to be the successor of the Classic. This means that Lifehammer is hoping to stop the production of the Classic somewhere in the future. Another problem with the Classic is its many imitations on the market. For this reason, the Classic and its attachment system will be left out of the scope for this project.

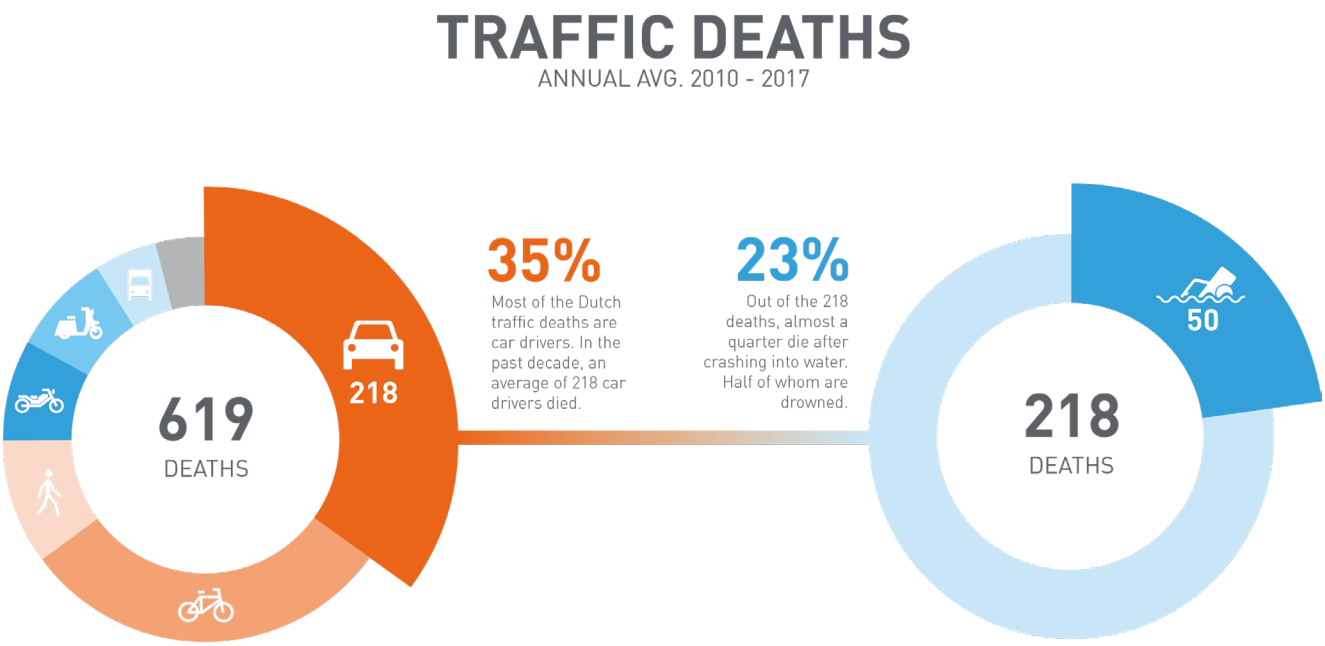
Figure 1.1: The attachment systems for the Plus and Evo

Figure 1.2: The Classic and its attachment system

A WATERY GRAVE

The hammers have been developed to shatter glass in a myriad of situations. These include, but are not limited to: when the car is on fire, when the electrical systems are down (powered windows and central lock), or even to break the glass of other cars when a child or pet is trapped in it (H. Van Rijn, personal communication, November 23, 2018). In the Netherlands, the most relevant scenario is being stuck in a sinking car, as it is a country which has many roads next to water, even in some cities. This means that the Netherlands has a disproportionately high number of water-related traffic accidents compared to other countries (L.T.B. van Kampen.t 2002). According to Van Kampen, police reports indicate that most of the water related fatalities occur during weekends, nights, and on provincial roads. The same article notes that a Swedish research pointed out that many drowned drivers had no major injuries, meaning that the leading cause of drowning was the inability to escape (Stjernbrandt et al., 2008). According to the CBS, between 2010 and 2017, about 619 people died in traffic every year (CBS. 2018) . Of these, about 218 victims are car drivers. What is particularly noteworthy is the number of deaths caused by cars ending up in water, which amounts to about 50 a year, half of whom drowned (SWOV. 2012). This means that almost a quarter of car deaths are related to water. In contrast, water related fatalities amount to 1% in the United States (R. Austin. 2011).

There have been attempts by the Dutch government to make the emergency hammer mandatory in cars (Ministerie van Verkeer en Waterstaat. 2009). Though the attempts failed, it did not withhold Dutch car importers from taking matters into their own hands; almost all importers have decided to supply new cars with one or two emergency hammers (H. Van Rijn, personal communication, November 23, 2018).



Sources:
CBS. (2018). Retrieved December 18, 2018 from http://statline.cbs.nl/Statweb/publication/?DM=SLNL&PA=71936NED&D1=a&D2=0&D3=a&D4=0,4,9,14,(l-1)-l&HDR=T&STB=G1,G2,G3&VW=T

SWOV. (2012). Retrieved December 18, 2018 from https://www.swov.nl/sites/default/files/publicaties/gearchiveerde-factsheet/nl/factsheet_auto_te_water_gearchiveerd.pdf

Figure 1.3: Traffic and water related deaths between 2010 and 2017

Figure 1.4: Dutch Fire fighters recover a sunk car

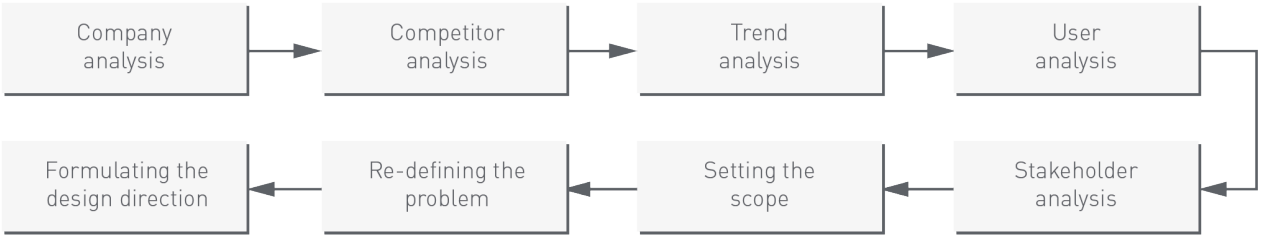
THE ASSIGNMENT

The high number of water-related deaths makes the emergency hammer especially relevant in the Netherlands. However, even in the Netherlands, there is little knowledge among consumers concerning the dangers of driving into water. A small survey among acquaintances showed that only 11 out of 27 respondents knew or assumed the right course of action (Apendix I). The Dutch car importers have noted the high amount of water-related accidents and decided to supply their dealers with one or two emergency hammers whenever a car is sold. Due to the variations in interior design, a single attachment system does not fit all cars, which is why there are three attachment systems. During visits to car dealers, some representatives noted that they do not install the hammers due to prior complaints from customers, and the intrusion on the interior aesthetics. It should be mentioned that these dealers sell luxury brands. Yet even if the car dealers install it without consent of the consumer, there is a chance that the hammer will be removed from its original position due to its perceived intrusiveness. These problems can lead to situations where people need an escape tool, but cannot find one. Moreover, even if they can, there is a chance they use it too late. Therefore, the assignment of this project is to come up with an attachment system that requires no knowledge from the user, and also meets the demands of car dealers and owners.

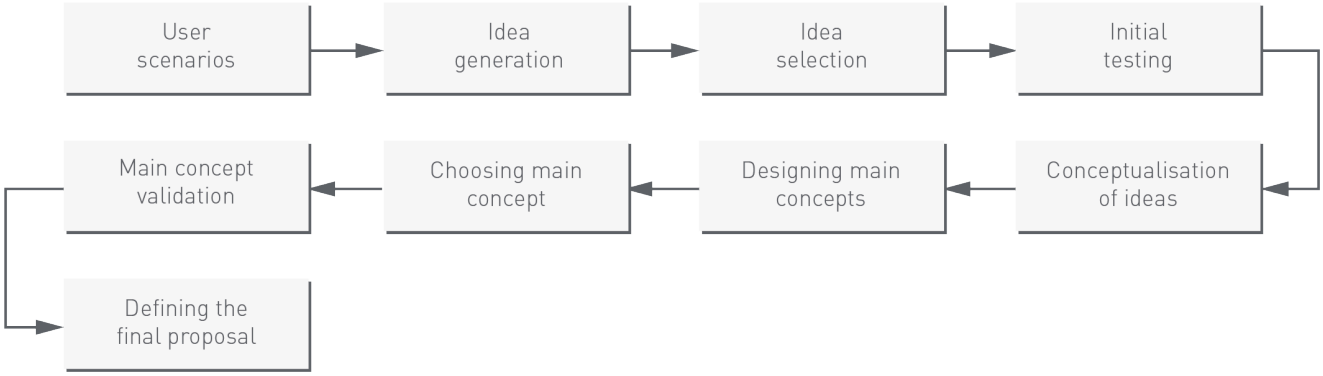
THE APPROACH

This project will consist out of three main phases; the exploration, conceptualisation, and the embodiment. The exploration phase will cover most of the needed research and analysis in order to start designing. During this phase, the scope of the project will be determined as well. From the findings of this phase, a design direction will be chosen. Using this design direction, several ideas and concepts will be created during the conceptualisation phase. At the end of the conceptualisation, one final concept will be selected. The details, precise usage, and aesthetics will be covered during the embodiment phase. The product will also be tested to make sure that it will meet the requirements. The full process is shown in figure 1.5. Since a design process is not always chronological, the figure serves as a simplification of the process, as there was much going back and forth during the project.

EXPLORATION



CONCEPTUALISATION



EMBODIMENT

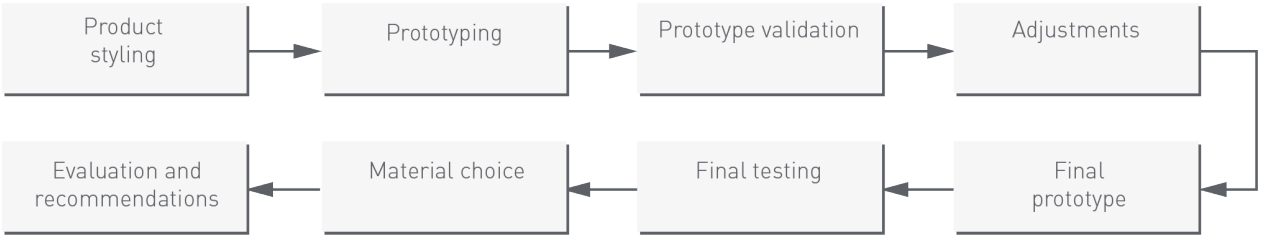


Figure 1.5: The structure of the project

01 EXPLORATION

This phase of the project has a focus on information gathering. The findings of this phase will determine the direction of the rest of the project. During this phase, there will be a closer look at the known problems with the existing attachment systems. This is done to understand the underlying reasons for the problems. The industry trends will also be covered, as the potential success of the project is highly dependent on it.

THE COMPANY

BRAND IDENTITY

Lifehammer started out as a reseller of car related safety products. After it had acquired the patent for the Classic, it developed more as a brand. These days, Lifehammer wants to be seen as a professional, reliable, and innovative brand. This was one of the reasons why the Classic was redesigned into the Plus, and why the Evo was developed. The design of their newer products has been done by professional designers, as opposed to the Lifehammer Classic which was designed by its inventor. These new products have been given a much more contemporary look, with clearer indications for use. The hammers are also sold directly to car importers, meaning that Lifehammer has a connection to the car industry that their competition does not, at least not in the Netherlands. This further emphasises the professional and premium image that Lifehammer strives for.

BRAND IMAGE

A survey showed that consumers seem to agree that the Evo and Plus look like quality products (Franke, M. 2018). However, the brand itself is obscure, as only 2 out of 12 knew Lifehammer as the brand. When asking acquaintances, very few knew the brand itself. It could be argued that anonimity is part of Lifehammer's image. However, the lack of a strong brand image does not have to be a great disadvantage, since Lifehammer is an after-market brand aimed at the automobile branch; a market filled with brands who have a very distinct image with whom Lifehammer will not have to compete for attention. Of those who did know the name "Lifehammer", some believed it was the name of all emergency hammers (ie. the product category). Though the visited car dealers could tell the difference, the sales(wo)men at retailers knew very little of the subject.

Figure 1.6: First aid kit

Figure 1.7: Left to right:
Child Safety belt
Window tool
Flashlight

Figure 1.8: Safety vest

Figure 1.9: The hammers

THE COMPETITION

THE VARIANTS

Though one of the most famous brands, Lifehammer is not the only company in the market of emergency hammers. There is a wide variety of emergency hammers being sold in all shapes and sizes (Figure 1.10), many of which are brandless. All hammers have one of two working principles: "traditional" and "spring-loaded".
Traditional hammers use a steel head which needs to be swung. The reliability depends on the strength and skill of the user, as well as the quality (hardness) of the steel and its sharpness.
Spring-loaded hammers, as the name suggests, have a spring mechanism that stores the user's power and "shoots" the tip when a threshold is reached, meaning that users with less strength or mobility can use it with relative ease. An additional benefit is that the tip is always shot in the right direction; a traditional hammer may be swung in such a way that the plastic, and not the steel tip, makes contact with the glass. Most of the spring-loaded hammers are "pocket-sized" and often sold as gadgets. The Evo is one of the few spring-loaded hammers which are regular sized due to its patented working principle.

Figure 1.10: A few(!) of LIfehammer's competitors. Note the last hammer, which is almost an identical copy of the Classic.

DIFFERENCE IN QUALITY

To ensure that its hammers will work, Lifehammer tests its hammers on tempered glass plates which are thicker than car glass; the testing glass is 5mm thick; car glass is typically 3.9mm thick. Lifehammer also tests its competitors under the same circumstances. Due to a lack of regulation, many of these hammer fail (Figure 1.11). Some of the failing hammers have even been certified TÜV Rheinland, a Germany-based industry safety standard company. It is however possible that some hammers failed due to the thicker glass used by Lifehammer. Still, in the television show Radar, some hammers even break when used on actual car glass.

The difference in reliability is caused by the quality of steel and machining in the hammer. The tips in the Plus, for example, uses high carbon steel. These tips have been hardened to a degree that they will not deform, whereas the tips of failed hammers, and even the Classic do. Once a tip has been deformed it has a greater contact surface, which means that the glass will only break under brute force. At times, the polymer grip will break before the glass does.

The aesthetics of most of the models are also questionable, though some consumers seem to associate this with a better reliability (Appendix II); after all, safety is often not very "sexy". What is worrisome, is that some consumers prefer some hammers which are unreliable, showing a clear lack of knowledge. Fortunately for Lifehammer, professionals seem to recognise the superior quality of its products, as the Evo was considered as the best emergency hammer in 2014 by Radar, a Dutch television programme by AvroTrosOE. Though the broadcast did give Lifehammer's brand image a boost, this surge of awareness quickly faded as can be seen on web-based product reviews (Appendix III). This means that despite its superior quality, consumers are not knowledgeable enough for it to be a distinct advantage, especially since some prefer the inferior models. To make things even worse, there are plenty of copy-cats on the market of emergency hammers (Figure 1.10), which are not worth suing, as the costs would not outweigh the benefits. What does put Lifehammer in a strong position is its ties with the professional world. Emergency services, such as the police and rescue divers, use Lifehammer products. Just like Dutch car importers, who supply new cars almost exclusively with the Plus or Evo. The few notable competitors with a brand are ResQme, with its compact spring-loaded keychain hammer, and Happich, whose hammers are often seen in public transport vehicles. Both brands have been proven to offer reliable products (Figure 1.12). However, neither brand have similar connections to car importers.

Figure 1.11: Screen shot of a footage of a failing hammer

Figure 1.12: Reliable competitors: ResQme (L), Happich (R)

STAKEHOLDERS

SALES CHANNELS

According to Lifehammer's sales department, it currently operates three sales channels. During its first years, Lifehammer sold its products mostly to retailers. In 2006 onwards, Lifehammer struck a deal with several Dutch car importers, most notably Pon Automobielhandel, the importer of Volkswagen and its associated brands, such as Audi, Seat, Skoda, and Porsche. Other car importers followed suit. Currently, almost all car importers/brands in the Netherlands are clients of Lifehammer (H. Van Velzen, personal communication, November 26, 2018). This makes them the biggest buyers of Lifehammer, as they collectively buy more than half a million units annually; 420,000 Plus hammers, and 110,000 Evo hammers (H. Van Velzen, personal communication, November 26, 2018). Some of these "bulk" sales are targeted at emergency services, but these are negligible. What makes the importers and dealers a special case is that many do not involve their customers. Aside from a few luxury brands, the hammers are installed per default by most Dutch car dealers. This is confirmed by a questionnare, which showed that most responders had a pre-installed hammer, even those with a second hand car (Appendix I,II). During visits to several car dealers, it was found that they often leave the hammer in second hand cars in the showroom. Therefor, the lack of knowledge among consumers is not an issue for Lifehammer's sales, at least where car importers are involved.

Sales through retailers are about a tenth of the sales of importers. These sales, both domestic and international amount to 25,000 Plus and 32,000 Evo hammers annually. These hammers can be found in (web)shops like bol.com, ANWB, and Halfords. Not all retailers exclusively sell Lifehammer emergency hammers; they are often sold alongside their competitors. Amazon even sells imitations of the Classic hammer whilst selling authentic Lifehammer products (Amazon.com, 2018). Though the consumer segment has much room for growth, this project will focus on the importers and dealers. The third sales channel of Lifehammer is its own website. However, it serves mostly as a marketing channel with negligible sales; total sales amount to only one or two products a week, and these sales are not limited to the hammers. Due to the relatively small size of the company, decreasing need for retail sales, and the lack of knowledge among consumers, it is recommended that Lifehammer focusses more on the car importers than retail, at least in The Netherlands. Especially as this channel may open up a future possibility to become an Original Equipment Manufacturer (OEM), which would mean all car drivers of certain brands would come to own a Lifehammer.

Figure 1.13: Sales channels

According to the Lifehammer sales department, whenever a new car is purchased at a dealer, the importer sends the license plate along with a hammer and attachment system to the dealer. There are some brands that do not work like this, but the majority does (H. Van Velzen, personal communication, November 26, 2018.

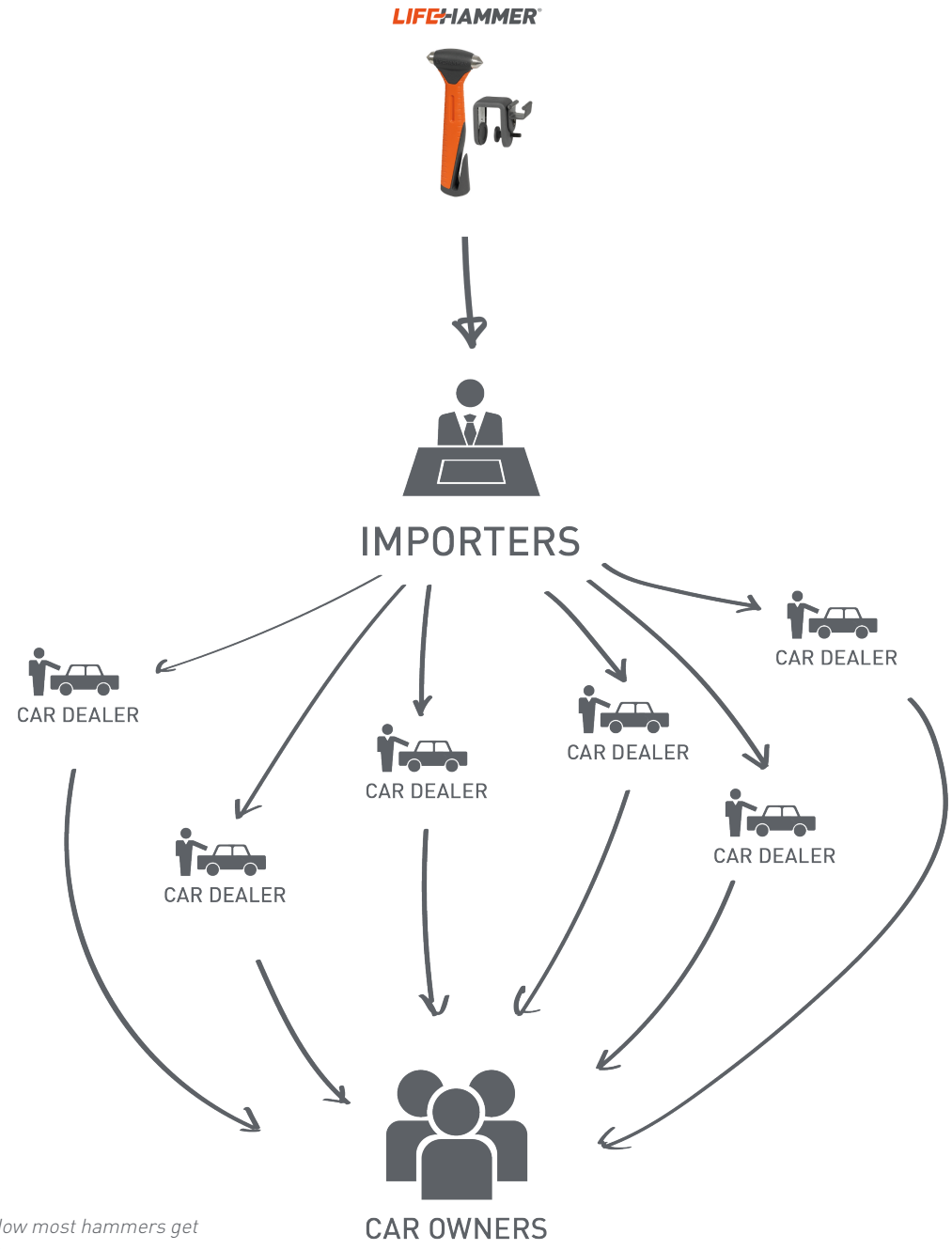


Figure 1.14: How most hammers get to consumers

THE STAKEHOLDERS

Not all parties involved with Lifehammer are taken into account in this project. Some stakeholders, such as the suppliers are left out of the scope, as these parties are replaceable. The stakeholders, both major and minor, are as follows:

- Lifehammer
- Car importers & dealers
- Retailers
- Mechanics
- Owners
- Users

Lifehammer (Major)

As the initiator of this project, Lifehammer is the main stakeholder. Its main concern is making profit. All other concerns are related to profit. For example, low quality products may fail and cause bad reputation, which in turn may lead to lower sales and thus profit. Currently, Lifehammer is in a strong position in the Netherlands, as almost all importers buy from Lifehammer. Since virtually all new cars are supplied with a Lifehammer, retail sales will become less important as time goes by (at least in the Netherlands), unless importers will opt for other brands. Since most Dutch importers have already become clients of Lifehammer, it is important for Lifehammer to keep their existing clientele and expand the same business in other countries. However, this has proven to be difficult so far, as foreign dealers want concrete proof (H. Van Rijn, personal communication, December 21, 2018). Such proof is hard to find; according to M. Christensen, a Dutch rescue diver, emergency services do not keep track whether a hammer was used by car owners in an accident.
As for their influence, Lifehammer unfortunately does not have any influence on car makers, who are not considered to be stakeholders, as their sales are not related to Lifehammer.
When considering consumers, their lack of awareness is a concern as well. Especially since they cannot differentiate between the high quality of Lifehammer and low quality of most of its competitors.

Lifehammer concerns:

- Lack of consumer awareness
- Low quality
- Low sales/profit
- High costs
- Bad image
- Lack of growth
- Losing market lead

Car importers & dealers (Major)

In the Netherlands, most importers are clients of Lifehammer. The car importers supply the hammers along with a new license plate to their associated dealers whenever a car is sold, which means that almost all cars in the Netherlands are supplied with emergency hammers. The hammer and the attachment system are then attached by a mechanic who is employed by the dealer. Most importers do not allow their dealers to involve their customers in the decision making regarding the hammers, though it should be noted that not all dealers follow their importers' policy. Some dealers have been reluctant to attach the hammers due to complaints from

their customers.
The primary concern of importers will be the costs of the hammer and its attachment system. However, they should still be concerned with the quality of the hammer and attachment system; a cheap looking hammer will reflect badly on their dealers, through which the importers make money. Due to the many different car models, importers will also prefer a general attachment system which fits on most, if not all models. This makes logistics much simpler. It should be noted that not all importers seem equally interested in proper installation of hammers. In the case of one Skoda dealer in Zoetermeer, the dealer purchased the EFS seperately; Pon only supplied the QCS despite the complaints of the dealer

The dealers have a smaller influence on Lifehammer, as it is the importer's decision to purchase the hammers. However, their complaints can have an impact on the importer. Such complaints could turn the importers away from Lifehammer. According to the initial brief, the mechanics mentioned that some systems are hard to install. However, there was no confirmation for this during visits to dealers.
Other complaints come from customers, who may feel that the hammer and attachment system are intrusive or ugly (Franke. 2018). These complaints were also heard during a visit to a BMW dealer; one customer complained about a loose attachtment, causing rattling sounds. Such a complaint was also found on internet reviews (ANWB.nl. 2018). If Lifehammer wants the dealers to attach the hammers in new cars, it must ensure that the product is not intrusive, especially since consumers are not involved in the decision making. After all, the hammers are supplied together with the car, implying that the hammers are part of the purchase. If the product is intrusive, it may negatively impact the customers' experience of the new car. Due to their close relationship, dealers and importers are considered as a single, major stakeholder.

Car importers/dealers concerns:

- Complaints
- Damage on the interior
- Low quality
- Few fitting models
- High costs

Mechanics (minor)

Those who install the attachment system to the car are referred to as mechanics. In most cases, the mechanic is employed by the dealer, who installs the system before a car ships out. In the case of retail, or if a car dealer supplies the hammer and attachment system separately, this group could include the consumer. However, in that case, the stakeholder will be referred to as the "user", but they will share some of the concerns.
As an employee of the dealer, a mechanic has little influence on Lifehammer, as he/she must follow the dealer's instructions. However, since the mechanic is the person who does the actual installation, they are still relevant; a poorly installed attachment system may cause annoyance to the owner, causing him/her to stow the hammer away. It is also possible that if the system is installed incorrectly, the system may come off during a crash; becoming lost somewhere in the car.

Mechanics concerns:

- Installation difficulty
- Unclear instructions

Retailers (minor)

The retailers are not responsible for the attachment or explanation of the product, and thus are not as knowledgeable as the dealers and/or mechanics concerning the installation. Retailers offer a great variety of products, most of which unrelated to Lifehammer or even competitors. They are therefore less invested in Lifehammer. Since the retailers do not help customers with the attachment, the hammers are sold in packages with user manuals. These packages can be regarded as a one-way communication line between Lifehammer and the consumer. Since virtually all new cars in the Netherlands are fitted with an emergency hammer, the need for retail sales will decrease over time. Especially as all the second-hand cars at the dealers were still fitted with their initial emergency hammers. International sales are still very dependent on retail sales, and it remains a market with much room to grow. However, this project will focus on the situation in the Netherlands, making retailers less important. Moreover, Lifehammer must compete with many alternatives in a market full of consumers who are not knowledgeable in the quality of hammers. Therefore, retailers will only be considered as a minor stakeholder.

Concerns:

- Low sales/profit
- Complaints/returns

Owners and users (Major)

The owner can come into possession of the product through several channels as mentioned before. In case of retail, the owner decides from the get-go where and if the product is attached. Depending on the knowledge, and the ability/ will to follow the manual, owners may install the system correctly or incorrectly, in which case they share the same concerns as the mechanics. The other way owners can obtain the product is through buying a new car from a car dealer whose importer is associated with Lifehammer. This makes it important that the hammer and attachment system emanate quality, otherwise the owner may experience less pleasure in their newly purchased car. Moreover, if the products are performing suboptimal, or look unpleasant, the owner may simply dispose of the attachment system and put the hammer out of sight and reach. It is also possible that mechanic has installed the hammer in an unfavourable place. This could mean that the owner or other passengers may find hinder from the hammer, which also result in the hammer being put away. A wrong placement can also mean that users may not be able to reach it after an accident, especially if the seat belt retractor is locked; this could even have fatal consequences. It is of course possible that an owner may correct the wrong installation, but for this project the worst-case will be assumed.
It is also important to make a distinction between the owner and a user. If the hammer has been put out of sight, an owner may still remember the place and find it when needed. However, a random passenger may not know about the presence of a hammer. A proper placement of the hammer is therefore important. The target group must be as wide as possible; almost anyone who can sit in a car should be able to use the product. However, exceptional cases are left out of the scope to keep things manageable.
Among users, there are also those working for emergency services (professionals). This group mostly uses the Classic. Rescue divers also make use of the Evo, as the water resistance makes it difficult to swing a conventional emergency hammer, though this does not mean that the Classic is not used at all (Appendix X). They do not, however keep it in an attachment system; it is part of their diving gear. One experienced diver,

M. Christensen, had a few complaints about the hammers; he noted that he and his co-workers had trouble with the seat belt underwater. It is not clear why, as the interviewee did not know why the cutter did not work. At Lifehammer, the cutter has been tested underwater in a sink, where it worked properly. It is possible that the low visibility and tactility underwater makes it hard for users to use the seat belt cutter correctly. More research may reveal the precise problem.

Assuming that one cannot put a price tag on a human life, it can be said that users of the product have the most to lose, and are therefore major stakeholders.

Younger groups are also possible users, but this project will focus primarily on adults.

Concerns:

- Damage on the interior
- Low quality
- High cost (retail)
- Installation difficulty (retail)
- Difficulty in reaching
- Difficulty in finding
- Difficulty in use (breaking glass)
- Inability to use

The government(s)

It certainly can be argued that the government can be a stakeholder. However, it will be difficult for Lifehammer to influence the Dutch government. Moreover, since cars are mass produced product which are sold internationally, they are also subject to regulation from the European Commission, which will even be harder to influence. Therefore, the government is not considered as a stakeholder. Their regulations however, are taken into account, as these can heavily influence cars, and the safety products installed within them. As of the moment, however, there are no laws or regulations concerning emergency hammers specifically. TUV Rheinland does have a set of requirements for its certificates. These will be taken into account.

FUNCTIONAL PROBLEMS

ATTACHMENT SYSTEMS

Both the Evo and Plus work according to expectations and have been praised by several institutions, such as the tv programme Radar and emergency services, with the exception of the seatbelt cutter when used underwater. The attachment systems however, are less well received. Internet reviews show that most of the complaints are aimed at the attachment system, which is usually the QCS, since the EFS and PrA can only be ordered separately (ANWB.nl. 2018, Bol.com. 2018). During conversations with several dealers, it was found that those who use the QCS have the most complaints, whereas those who use the EFS seem contend with it. However, this does not mean that the EFS is not without (critical) flaws.

QCS

The QCS is attached to the side pockets (door panels), and its problems are as follows:

- Often capable of lateral movement
- Sometimes capable of rotation, despite tight attachment
- Ambiguous attachment locations (inside vs outside side pocket)
- Difficult to install (especially when attached on the inside of the side pocket)
- Makes side pocket less usable when attached wrong (which happens a lot at Volkswagen & subsidiary dealers)
- Some car models have side pockets which are unreachable when seatbelt is locked
- Location can be intrusive
- Loosening due to vibrations

One problem with the QCS is its ambiguity. It can be attached in different ways. Even according to Lifehammer user manuals there is not one clear way. Even their online video differs from package manual. Many of the other problems are a result of it. This is especially the case with cars from Volkswagen dealers, including many of their subsidiaries like Skoda and Seat (Figure 1.17). The mechanics at these dealers install the QCS on the inside of the side pockets, which makes it very difficult to install/tighten. Moreover, the hammers are much harder to reach. During a visit to a Volkswagen dealer, there were at least two instances where the hammer could not be removed (Figure 1.17). According to Lifehammer's sales figures, the QCS is the most used attachment system.

Another major problem with the QCS is the location. Side pockets vary greatly in design, shape, and relative location to the chair. Figure 1.18 shows the side pockets of the top 10 car models sold in the Netherlands in 2018 (Autoweek.nl. 2018). That being said, the side pocket is a location that is present in almost all cars.

Figure 1.15: The QCS and its location. Note: the bolt is on the interior of the side pocket, which makes it hard to tighten.

Figure 1.16: Note the stress on the force distributor, as well as the bolt sticking out

Figure 1.17: Bad placement by Volkswagen mechanic; this hammer could not be removed

Figure 1.18: The side pockets of the 10 most sold models in the Netherlands, 2018). Images by netcarshow.com

EFS

The EFS is meant to be attached to the middle console; in most cars there is a panel separating the middle console and the carpet. The EFS is clamped to this panel. Due to its less ambiguous design, the EFS has fewer problems than the QCS. For instance, it is distinctly asymmetrical, so it is clear which side goes under the middle console panel. The tightening system does not loosen over time as easily either. However, not as many cars are suited for an EFS; all the cars that were in the showroom at several dealers had side pockets, while not all cars had a middle console. Considering that electric cars are gaining in popularity the EFS may lose its usefulness in the future, since electric cars do not require a raised middle console. This is due to the lack of a transmission box in electric cars. According to Wouter Kets who designed car interiors at Audi, the middle consoles will remain in most cars for now. An immediate problem however are cars with only two doors. Some of these cars may require the front seats slide forward to allow entrance and exit for rear passengers. It is not unheard of that an EFS may hinder such movement (H. van Rijn, personal communication. March 13, 2019). The known problems are as follows:

- Some car models have console panels which are too low to be reachable when seatbelt is locked
- Location can be considered as intrusive
- Not all cars have a middle console (electric cars)
- Hinders entrance/exit to rear passengers in some 3-door cars.

Figure 1.19: Some cars have no middle console: BMW i3

Figure 1.20: EVO on an EFS

PrA

The Pro Adapter is an alternative adapter for the EFS, though it can be fitted on the QCS in limited positions. However, this was not intended and means that it adds to the problem of ambiguity of the QCS. The PrA is different from the regular adapter as it holds the hammers on their "head" instead of their "neck" (Figure 1.21). The most significant difference is that the PrA can be

screwed directly into a surface of the car interior. This is one of the reasons that many dealers do not order the pro adapter; some only exclusively fasten the PrA on out-of-sight surfaces, such as the console storage compartment. The main reluctance of dealers is the permanent aspect of the PrA. Another problem is that it can be attached in less suitable places, such as the carpet or beneath the seat. Such places are unreachable should the seatbelt be locked. One car at a dealer had a PrA screwed to the carpet. Considering the state of the certificate sticker, the user had stepped on it multiple times (Figure 1.22). The hammers are also more securely attached to the PrA, than the carpet is to the floor; a user may inadvertently take the entire carpet instead of just the hammer. According to the sales department at Lifehammer, the PrA is the least used system.
The problems of the PrA are:

» Permanent fastening, thus damage (when used without EFS)
» Many unreachable locations (under seat, carpet, mid console carpet)
» Some locations are intrusive

Figure 1.21: Evo hammer attached with EFS and PrA

Figure 1.22: Plus + PrA on carpet.

GENERAL PROBLEMS

Car importers have several choices when it comes to the attachment systems. Though this does not have to be a bad thing, the problem is that it seems that not all importers put much effort into making sure that Lifehammer's information is passed down correctly. Some of the visited dealers, most notably the more luxurious brands, do not attach the hammers per standard procedure, even if it is the importer's policy. Consumers of such cars are thus even less informed about the intended use, as the hammer and attachment system are not supplied with a manual as is the case when they are purchased in retail stores. In the case of one luxury car dealer, the salesman gave wrong instructions on the EFS; he thought that the EFS was meant to be attached to the seat belt. When asked whether any information was given to customers, the salesman said he did not discuss the hammer with customers, other than that they would be given one.

IN WATER

WHEN A CAR SINKS

The product is to be used by anyone who is capable of using it when needed. Which means that is important to know what happens during a situation when the product must be used. Such events are rare, though, and most are fortunate enough to never experience such situations, let alone multiple times. Since only few have ever practiced such events, most do not have any experience (ie. unskilled). Moreover, many in the Netherlands do not even have theoretical knowledge of what to do in such a situation, despite the high number of such accidents (destentor. 2018, Appendix I). For example, there is a myth that one should wait until the car is filled with water, before attempting escape. This was confirmed by a small survey (Appendix I). However, experts say that people should exit the vehicle as soon as possible, with smashing the windows being the best approach, as opening a car door in water is very difficult due to water resistance and water pressure. Another misconception is that a car window can be opened when in water; due to the pressure exerting a high normal force unto the window, the friction between the glass and door panel becomes so great that even powered windows (assuming that electrical systems are still working!) cannot move the glass. According to experiments done by Mythbusters, powered windows do not generate enough power to open the window even if the windows are only partially submerged. Moreover, they also found that the crank handle, found only in older cars, will break sooner than the window will move (mythresults.com, 2007). The only time when one can open the door or window without tools is either at the very moment the car hits the water, or when the car is indeed filled with water. The first situation requires an immediate response, which requires both theoretical knowledge and certain practice (muscle memory), and the second situation is downright dangerous; the waters in the Netherlands generally have low visibility and there is a chance that victims may swim in the wrong direction due to disorientation. M. Christensen mentioned that having a visibility of 20-30cm is considered as a "win". Note that this is with diving goggles; it can be assumed that most drivers/passengers are not equipped with one, and therefore have even less visibility. Besides, the water resistance alone makes it difficult to open a car door under water; even experienced rescue divers, who are in excellent physical shape, smash the windows as standard procedure (M. Christensen, personal communication, January 7, 2019).
Considering the problems of attempting escape without tools, it is important that users are aware of the product and use it as soon as they can.

Figure 1.23: Road next to deep water in the Netherlands

"PANIC"

Both M. Christensen and Autotewater.nl, a Dutch company which specialises in workshops concerning escaping sinking cars, mentioned that many people "panic" when they wait until the car is submerged or filled with water. In one instance, a drowned victim had attempted to escape the car by clawing through the door panel. Even though such a description fits the popular definition of "panic", a more likely explanation is that the behaviour was caused by stress, rather than panic; The term "panic attack" is used by psychiatrist for a state in which "catastrophic interpretation of certain bodily functions" are felt and "involves perceiving these sensations as much more dangerous than they really are" (Clark. 1985). The bodily functions that Clark refers to are sensations such as palpitations, breathlessness, dizziness, etc. The article also mentions that the word panic is often associated with irrational behaviour, yet claims that people in panic do not necessarily behave irrationally. Several researches have noted that most people in dire situations act relatively rationally, even though onlookers may perceive their behaviour as panic. Fahy et. al argues that "human behaviour under stress is relatively controlled, rational and adaptive". People react to their expected level of threat and act according to what they believe is the right thing to do in to meet the perceived threat. The problem however is, that if such a person has misconceptions (such as waiting for the car to be filled with water), they will make decisions based on these misconceptions, and thus make the wrong decisions. The term is also often used for the behaviour of large crowds in threathening situations. Yet according to Fahy et al. the people in such crowds also behave rather rationally, and any disastrous outcomes are not the fault of the crowd. For the design of the product, this means that the product must be very easy to understand, intuitive even, so that users are guided by the product to do the correct thing, despite any pre-existing misconceptions of the user.

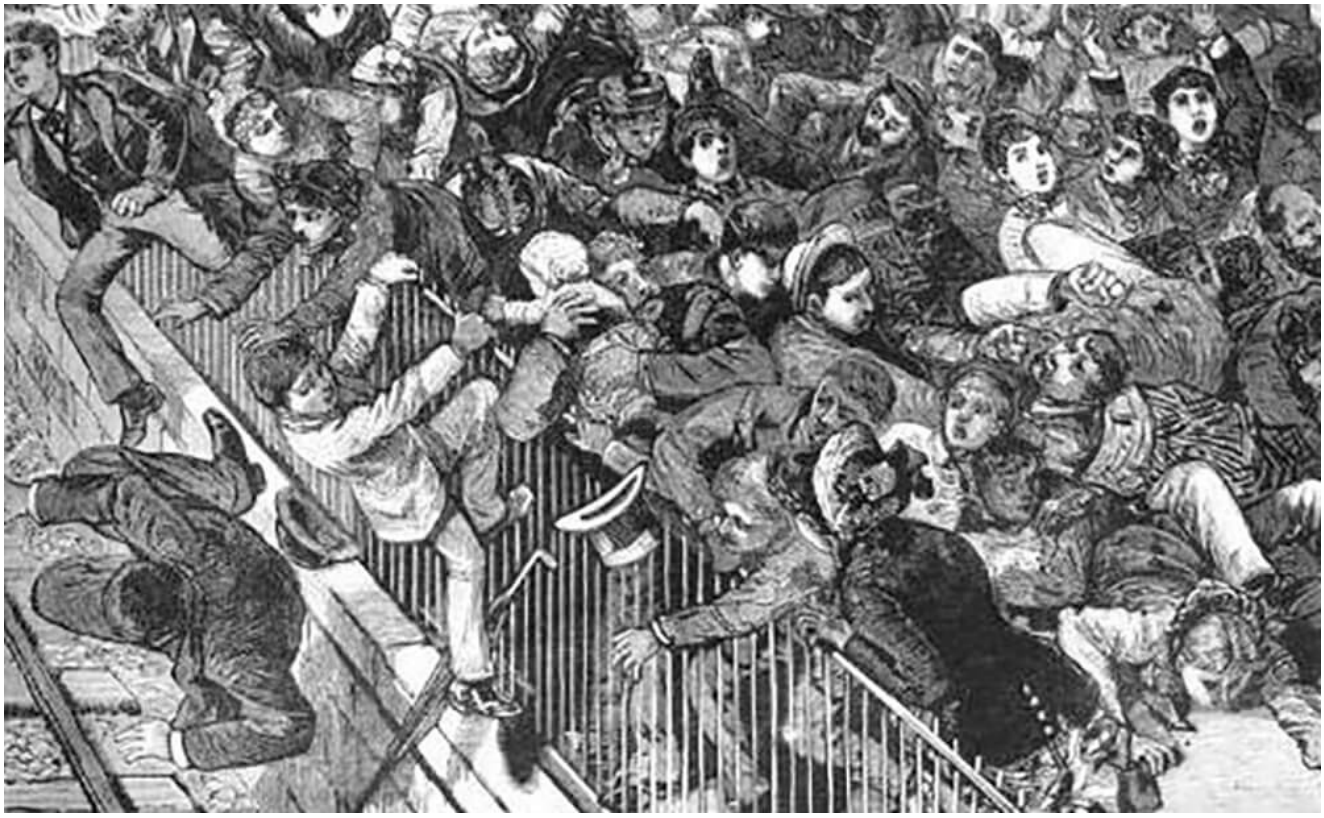


Figure 1.24: The desperate struggle for life - drawing by Frank Leslie's illustrated newspaper

CARS

INDUSTRY TRENDS

The car industry has not remained untouched by the technological advances and rapidly changing society of the past decades. Though it may seem that cars have remained relatively the same in the past decades, car experts expect that the industry will change significantly in the coming years (E. Grondelle, personal communication, December 11, 2018; jazelauto, 2018). Since Lifehammer products are strongly related to cars, trends in the industry must be carefully considered. The major trends include, but are not limited to: electric cars, autonomous cars, and car sharing. All these trends have an impact on the interior design, and thus the possible attachment locations for an emergency hammer. For example, electric cars do not have a transmission, and thus require no large centre console, which means that the EFS may become outdated soon as some electric cars have already gotten rid of their transmission box (Figure 1.25), Autonomous cars will not require a steering wheel, or at least a retractable one; Car sharing means that a single car will have multiple users, and thus must be easy to clean.

Since the problems with the current system needs to be resolved quickly, only the trends of the near future (1-5 years) will be taken into account. Of these trends, the electric car is the most relevant, since autonomous driving is still far away, and the market for car sharing is not as big as the market for privately owned cars.

Figure 1.25: BMW i3 interior. Source: Netcarshow.com

ELECTRIC CARS

One of the most well-known trends; the electric car. Aside from an increasing popularity, some governments want to mandate that all cars in the future are fully electric. The Dutch government for example, decided that only electric cars are allowed to be sold in 2030 (rijksoverheid). It should be noted that current car interiors (even full electric cars) still look mostly the same. This is due to the development progress of platforms, which often run into billions of Euros (E. Grondelle, Automotive lectures, 2016).
In order to save money, platforms are often developed for multiple cars of different brands. some electric car models are mere conversions of an existing production line, such as the Volkswagen e-Golf. Due to the still-present popularity of combustion engines as well as the high development costs of a new platform, car makers will keep producing cars which have a combustion engine version, and an electric version. This means that electric cars of the near future (1-5 years) will not look very different from current cars. W. Kets noted that interior designers prefer an interior without a middle console due to the extra space it provides; he said that designers have to "fight for every centimetre". He added that despite this preference, many electric cars will still have a middle console in the future due to the costs of developing a new platform from scratch, and still-present popularity of combustion engines.
When looking at the long-term, it is much more like that new platforms will be tailored specifically for electric cars. Some of these cars already exist, such as the BMW i3 (shown earlier in Figure 1.25). For this project, the most relevant impact of electric-car-trend is the reduction in size/removal of the middle console. However, since this project is aimed at the near future, the trend of electric cars will be of little significance.

Figure 1.26: Opel Ampera-e interior. Source: Netcarshow.com

SAFETY TRENDS

Car safety has been an aspect of car design that has been developing since the widespread adoption of cars. Many of contemporary safety features are mandated by jurisdiction. Some of the regulations are global, whereas others are determined on a national scale. Yet even regional regulations may have a significant impact on globally sold cars, as developing a car requires a big investment.

Whichever the case, car design is heavily influenced by regulations. Some of these safe measures have a big influence on how the car looks; the crumple zones and pedestrian safety have even caused significant changes in proportion, and therefore the look of cars (eg. larger bonnets) (E. Grondelle, Automotive lectures, 2016).

The interior has also been influenced. A prime example are steering wheels, which have become significantly larger due to the required space for the airbag, which have become a standard. A more recent safety measure are the side airbags and curtain airbags. According to the visited dealers, these have become a standard as well, though there are car models

Figure 1.27: A Maserati with frameless laminated glass.

where it is offered as an option. This trend reduces the space that could be used to place an emergency hammer on the B pillar and the roof. In the United States, the National Highway Traffic Safety Administration (NHTSA) has passed a ruling in 2011 that by 2018, all cars must have safety measures to "reduce the partial and complete ejection of vehicle occupants through side windows in crashes, particularly rollover

Figure 1.28: Several places where airbags can be found. Source: whichcar.com.au

crashes." Two most commonly used measures are larger side curtains (airbags) and, or with laminated side window glass. The former means that most, if not all cars in the United States will feature curtain airbags. The latter would make emergency hammers obsolete, as laminated glass cannot be shattered. M. Christensen noted that rescue divers need more than 30 minutes to saw through laminated glass or polymer safety windows (found in police cars).

Laminated glass is currently used for windshields of all contemporary cars; the side windows are usually made of tempered glass, though some models have laminated side window glass. E-mail correspondence Dutch car importers showed that some brands list laminated side windows as an option for their higher-end luxury models (Appendix X). This is due to the fact that laminated glass has better UV protection (preventing interior discolouration), and it has better soundproofing. The latter is especially beneficial for cars with a frameless window (Figure 1.27). The most common cars in the Netherlands are not (yet) available with laminated glass, meaning that at least for the near future, Lifehammer will remain relevant. Due to the high costs and relative small impact on safety, laminated glass will not likely become mandatory soon (NHTSA, 2017). Moreover, several North-American emergency services have shown concerns due to the difficulty of cutting through laminated glass. Lifehammer should still keep an eye on this trend in the future.

As for this project, designing a tool to (quickly) cut through laminated glass are not considered to fall within the scope, since the great majority of cars on the market still have tempered glass. This is not likely to change within the next few years. Moreover, even trained rescuers, equipped with large tools, need quite some time to saw through laminated glass; a small hand-held tool to quickly get through laminated glass may not be realistic.

Figure 1.28: Firefighters breaking through laminated glass. Soucre: Wikipedia.org

AUTONOMOUS CARS

There also a consensus among experts concerning another trend. All the mentioned experts agree that autonomous cars is the future of the automotive industry. The visited dealers think this as well. However, there is also a concensus that this trend will likely not happen any time soon. According to W. Kets, design trends associated with the autonomous cars involve flexible interiors, such as a stowable steering wheel. E. Grondelle also noted that the trend may ensure that car interiors will resemble living rooms as opposed to cock pits, as the experience of comfort becomes more important (Figure 1.29). Since neither Lifehammer, or the importers/dealers are currently interested in a solution for that far in the future, autonomous cars, and its associated trends, will be left out the scope.

Figure 1.29: Concept car of the future. Source: Reuters

DESIGN TRENDS

Visits to dealers showed that the most visible change in interior design comes from the interface. These days, most cars come with a touch screen (Figure 1.31). In the top 10 sold car models of the Netherlands, 2018, only the Volkswagen Up comes without a full scale touch screen. W. Kets noted that the introduction of touch screens meant that there were fewer buttons needed, as the interface of a touch screen is dynamic. Aside from the touch screen, W. Kets mentioned that cars, and their interiors, look more similar to each other, due to standardized platforms. This is especially the case with car brands who have cooperated by using a shard platform (Figure 1.31) The use of materials has also shifted to cheaper materials in order to keep cars affordable. According to Kets, cars have become more expensive due to emission laws, and since the petrol engine is at the apex of its development, not much can be done to make it cheaper. Car manufacturers, including the more expensive brands, opted for cheaper materials instead. Luxury brands try to limit this to the areas which are less visible.

There have also been experiments with (mood) lighting strips in some car brands (Figure 1.30), though it is too soon to say whether this trend will continue.

Figure 1.30: LED strips in the interior of a BMW.

Figure 1.31: Interiors of top 10 most sold models of 2018 in the Netherlands (random order). Note the clearly visible platform sharing in the Toyota Aygo and Peugeot 108; third row. Source: Netcarshow.com

MARKET TRENDS

Considering that it is very desirable for all the stakeholders that the product fits on most cars, a closer look as given to the most sold cars in the Netherlands (Autoweek.nl. 2018, Appendix VI). These cars have been divided into their respective segments, as classified by the European Commission (European Commission. 1999). According to the sales figures of autweek.nl, the most popular brands are the following (Figure 1.32):

CAR SEGMENTS

When looking at the exact models and their segments (Figure 1.33), it is clear that the J-segment, also known as Sports Utility Vehicles (SUV), is currently gaining in popularity. Note that these percentages are only from newly sold cars in 2018, and not the percentages of all cars currently owned. The J-segment is somewhat ambiguous, as it is not based on size; the Renault Clio is only 4.1 metres long, which is shorter than a Volkswagen Golf, while others like the Range Rover are more than 5 metres long (auto mobiledimensions.com. 2018). The one thing most SUVs have in common is their high-ride position, and emphasis on comfort.
The SUVs sold in the Netherlands are short, rather than long. This, combined with the large number of sales of the A, B, and C-segments, means that most cars in the Netherlands are relatively small. A good thing for Lifehammer, since virtually none of the cars in these segments come with laminated side glass, as opposed to the E and F segments.

Figure 1.32: Top 10 best-selling car brands in the Netherlands, 2018

CAR SEGMENTS

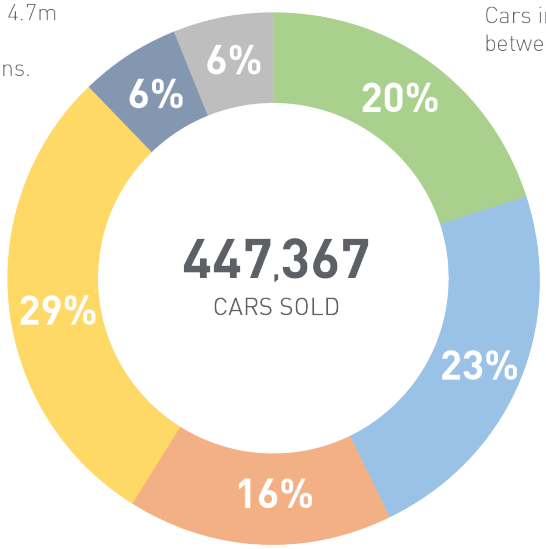
SOLD MODELS IN 2018, THE NETHERLANDS

D

Also called Large cars. Cars in this segments are approx. 4.7m in length. These cars are typically sedans and wagons.

A

Also called Mini cars. Cars in this segment are between 3.3 and 3.6m.



J

The fastest growing segment. Cars in this segment are also known as SUVs. There is a high variety in sizes. Emphasis is on comfort and a high-ride position.

B

Also called Small cars. Cars in this segment are approx. 4m in length.

C

Also called Medium cars. Cars in this segment are approx. 4.5m in length.

Other segments

E

Also called Executive cars. Cars in this segments are over 5m in length, and often luxurious.

F

Also called Luxury cars. These cars are even larger and more luxurious than E-segment cars.

M

Also called MPVs. These cars are known for their multi-tasking capabilities.

S

Also called Sport cars. Cars in this segments are known for their driving capabilites.

Sources:
Autoweek. (2018). Retrieved January 21, 2019 from https://www.autoweek.nl/verkoopcijfers/2018/

Communisites of the European Communities. (1999). Retrieved January 21, 2019 from http://ec.europa.eu/competition/mergers/cases/decisions/m1406_en.pdf

Figure 1.33: Cars sold in the Netherlands in 2018

LOCATIONS

POSSIBLE LOCATIONS

The current locations used for the attachment systems have in common that both are relatively global features in cars, exceptions notwithstanding. However, due to variations in design, these locations come with problems. Other general locations also come with issues. An extreme example is the steering wheel, which of course needs to be free. Some locations were eliminated during the ideation phase. These locations include the A- and B-pillar (Figure 1.34). The fabric on both pillars can be ripped apart when curtain airbags deploy. Moreover, in the case of the B-pillar, the curtain airbag will make it difficult to find the hammer (Figure 1.28, P-28). Especially during a stressful situation. The ceiling was also taken into consideration, as it is within sight and reach. However, the aesthetics become an issue when placing the hammer on a highly visible surface which is continuous. This would not be an issue if the design of the hammer (or container of the hammer), fits the interior of most cars. Unfortunately, there are many different interiors, which may share the same features, but vary greatly in "style". Cars can be designed to convey a sporty, aggressive experience, or a cute and friendly experience (E. Grondelle, automotive lectures, 2016). These differences can even be exacerbated by the various segments; it is not necessary to have an expert's eye to see quality differences between a cheap and expensive cars. From a purely statistical point of view, however, the focus can be put on the cheaper cars, as they hold a much greater market share (Figure1.33)(autoweek.nl).
Most dealers noted that they would rather not put a hammer on the roof as well. The same applies to the sun visor; both locations were considered as "too much in line of sight). Moreover, though there are little variations on them, sun visors are not a very secure location. During a crash, they can easy become dislodged. Not strange, since they can be dislodged with one hand.
Most cars seen at the dealers also had compartments in the middle console. Putting a hammer there would certainly take away the aesthetics problem, but it would also make it less easy to reach; opening the container is an additional action a user needs to perform. Despite their problems, all of the aforementioned locations were taken into considerations during the ideation, though not all locations yielded promising results. Other locations which were considered were the seats, head rest, seat belts, and rear view mirror.

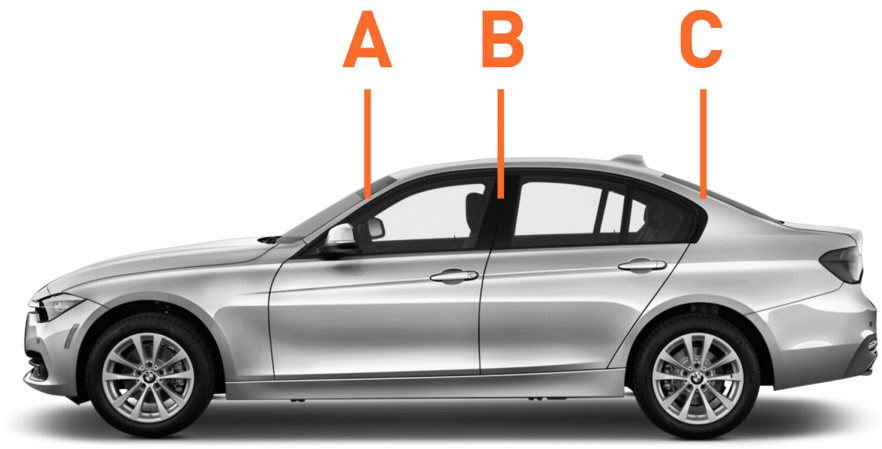


Figure 1.34: A, B, and C-Pillars

PRIOR RESEARCH

Lifehammer has had other student projects before concerning the hammers and their attachment systems. One project in particular featured a research on the reachable locations within a car. M. Franke took the dimensions of a P5 international woman to find out which locations could be reached. A string with the same length as the right arm and half of the hand was used to see the potential reach of a user (Figure 1.35). This string was 604mm in length (M. Franke, 2017). The "anchor" point of the string was determined by using the shoulder width and shoulder heigth (sitting) of a P5 international woman. It is unclear if the seat had been properly adjusted. However, if the seat had not been adjusted, it would only mean that the reach would be higher, since an unadjusted seat would be further back from the steering wheel. Conversely, this may also mean that some locations, such as the back seats are not reachable. As with the locations mentioned in the previous paragraph, the ideas were not strictly limited to the reachable locations, as an idea could potentially increase one's reach.

Figure 1.35: Reachable locations for P5 international women in a Skoda Octavia. Source: M. Franke.

Figure 1.36: Research setup. Source: M. Franke.

BRIEF

After the analysis and during the ideation phase, it was felt that the original brief was not in the best interest of the stakeholders. The ideas aimed at the currently used locations (side pockets and middle console), quickly turned into slight variations of the existing attachment systems; these ideas still had some of the same fundamental problems (such as reachability, and intrusiveness).

The focus shifted to the other locations, and using a new compact hammer. This would mean that the original brief, which stated that the attachment system were meant to be used with the current hammers, was had to be revised.

The choice to opt for the importers/dealers as the main target group also had an impact on the revised brief; a non-intruding aesthetics became more important.

The new personal design brief was to design an attachment system OR a hammer-attachment combination which was easy to find, yet would blend into the interior design.

02

CONCEPTUALISATION

This phase of the project had a focus on generating a variety of ideas, from which the most promising were selected in order to be developed into concepts. Lifehammer was consulted about the several ideas, but the three concepts were deliberately selected without a vote. The final concept however was selected in cooperation with Lifehammer.

THE SCENARIO

WORST-CASE

The current hammers were developed with several scenarios in mind, as mentioned earlier. It was felt that the scenario in wich a user ends up in deep water was the "worst-case" scenario, as it is the scenario where quick action is most vital. The same could be said about fire-related accidents, but no large numbers could be found on fire-related accidents, aside from arson cases; these do not involve occupants (AD.nl, 2017). Moreover, when crashing in deep water, there is a certain threshold after which chances of a good ending decrease drastically (M. Christensen, personal communication, Januari 7, 2019). When completely submerged, the visibility (in Dutch waters) are abysmal. Moreover, since Van Kampen noted that most water related accidents happen after dark. M. Christensen and H. Van Rijn, who are both experienced divers, noted that it is easy to become desoriented in dark water. Moreover, a car may end up on the roof, desorienting the user even before the car is exited.

Though not exclusive to this scenario, another potential problem for users is that a car can end up in water after another accident; a car may have had a collision with another car or object prior to crashing into water (Stjernbrandt et al., 2008). Stjernbrandt et al. also mentions that often, the victims are intoxicated, but this will not be a major focus; the problem with drunk drivers requires other solutions.
Thus, even though the other scenarios are kept in mind, the focus will be on water related accidents. The problems of this scenario are summarised as thus:

- Lack of knowledge (what to do)
- Life-threatening and stressful situation
- Limited time
- User may have sustained injuries
- Low visibility
- Car may be upside-down
- Seat belt retractor may be locked

Figure 2.0: Car in water. Source: Stefanverkerk.nl

GENERATING IDEAS

The first ideas were generated based on the currently used locations; side pockets and middle consoles. As this did not yield satisfying results, other locations were used as well. These locations were determined during the analysis phase. After the first initial sketches, the ideas were clustered based on the location, and were refined into a single representative idea. There were exceptions to this process, as some ideas did not need any refinement; the final concept was such an exception.

Some locations were completely eleminated during the refinement, as the limitations of the locations were deemed too difficult to overcome. For example, the A-and B-pillar were eliminated early, due to the side and curtain airbags. The side airbags could also hinder movement, as they stay inflated for longer. Ideas involving compartments, such as the dashboard, were also eliminated during the refinement.

Figure 2.1: The refined ideas

PULLIT (WINDOWS)

The pullit was a solution where a compact product would be directly attached to the window, or on the B-pillar. The user pulls the pin when in an emergency situation; the pin would release a small ceramic or steel tip which is powered by a spring under tension. The most apparent advantage is that the product is already placed where it is needed. The greatest disadvantage is that it hinders the opening of the window; a big drawback for a product which many may never use. However, this idea may still be interesting for Lifehammer, as it may be useful for public transport vehicles, where the windows cannot be opened anyway.

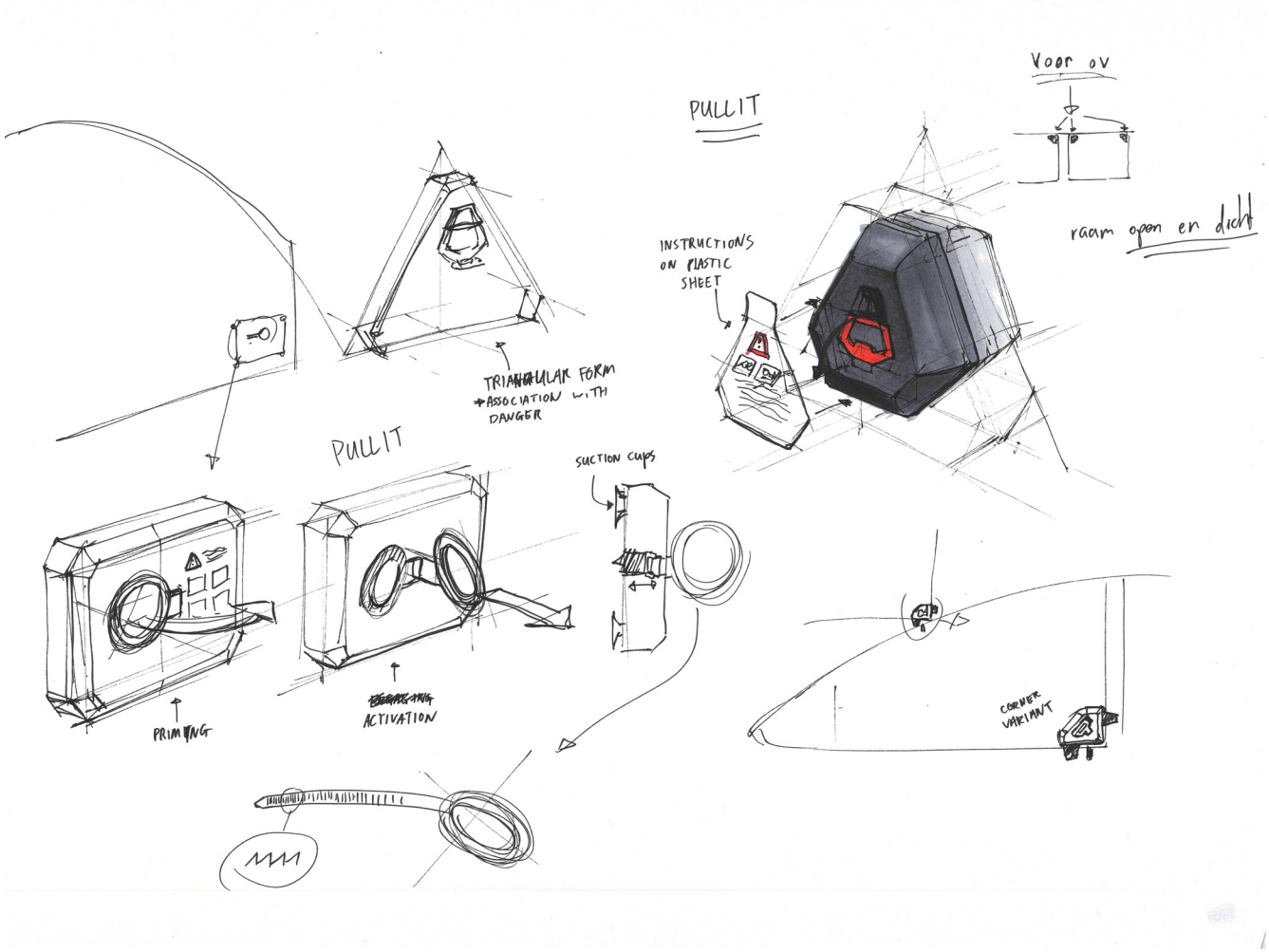


Figure 2.2: Pullit idea sketch

MIRROR MOUNT (REAR VIEW MIRROR)

The Mirror Mount was an idea involving the development of a new compact hammer with the same working principle as the Evo. As the name suggests, the Mirror Mount is mounted on the rear-view mirror. Which, according to the ergonomics test of M. Franke is reachable for P5 women (international), which is one of the benefits of the idea. Another benefit is that the idea covers both driver and front passenger, though not the rear passengers. The location is also clearly visible, which is both an advantage and disadvantage. For importers and dealers, it may be a bigger disadvantage though. Another disadvantage is that rear view mirrors vary in design, most notably the thickness. The illustrated version would not fit many mirrors, as many contemporary cars have little space on the "neck".

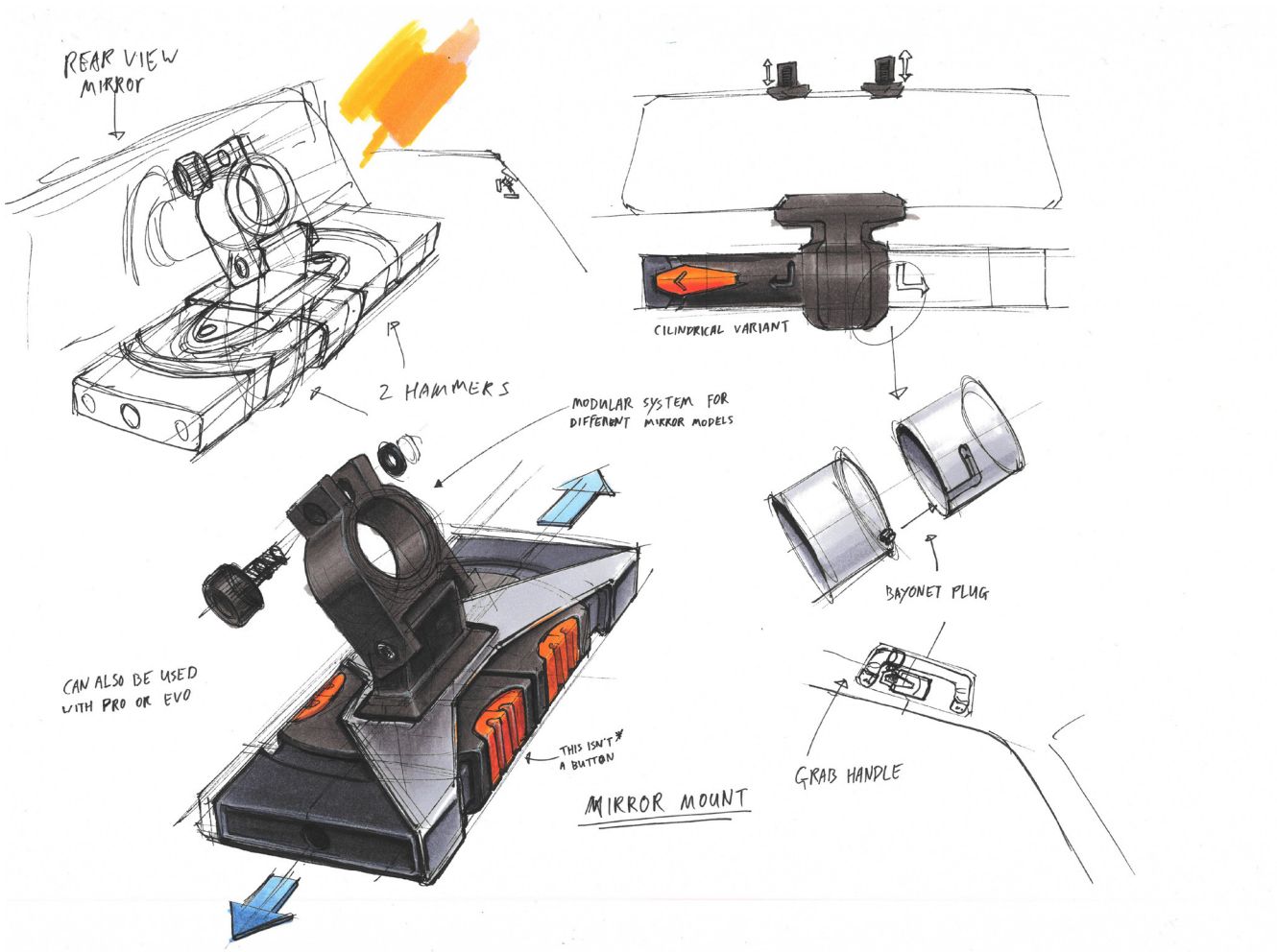


Figure 2.3: Mirror Mount idea sketch

QCS PLUS I (SIDE POCKET)

This idea direction is more catered to the original brief, which asked for an improvement for the current systems. Since the problems of the EFS are related to the location, and not the attachment system itself, only the QCS was considered for this direction. The main reason for this idea was to keep the "costs" concern of Lifehammer in mind, as well as the immediate need for a better alternative. The QCS Plus I works with a torsion spring and a screw. The torsion spring would provide the clamping force, whereas the screw would lock it in place. The advantage over the original QCS is that this idea does not require any tools to install. Its design is also clearly asymmetrical to make sure that the product would be attached correctly. However, it still has all the location-related problems of the orignial QCS. Moreover, a possible disadvantage was that the spring would not provide enough force to keep the attachment system securely in its place.

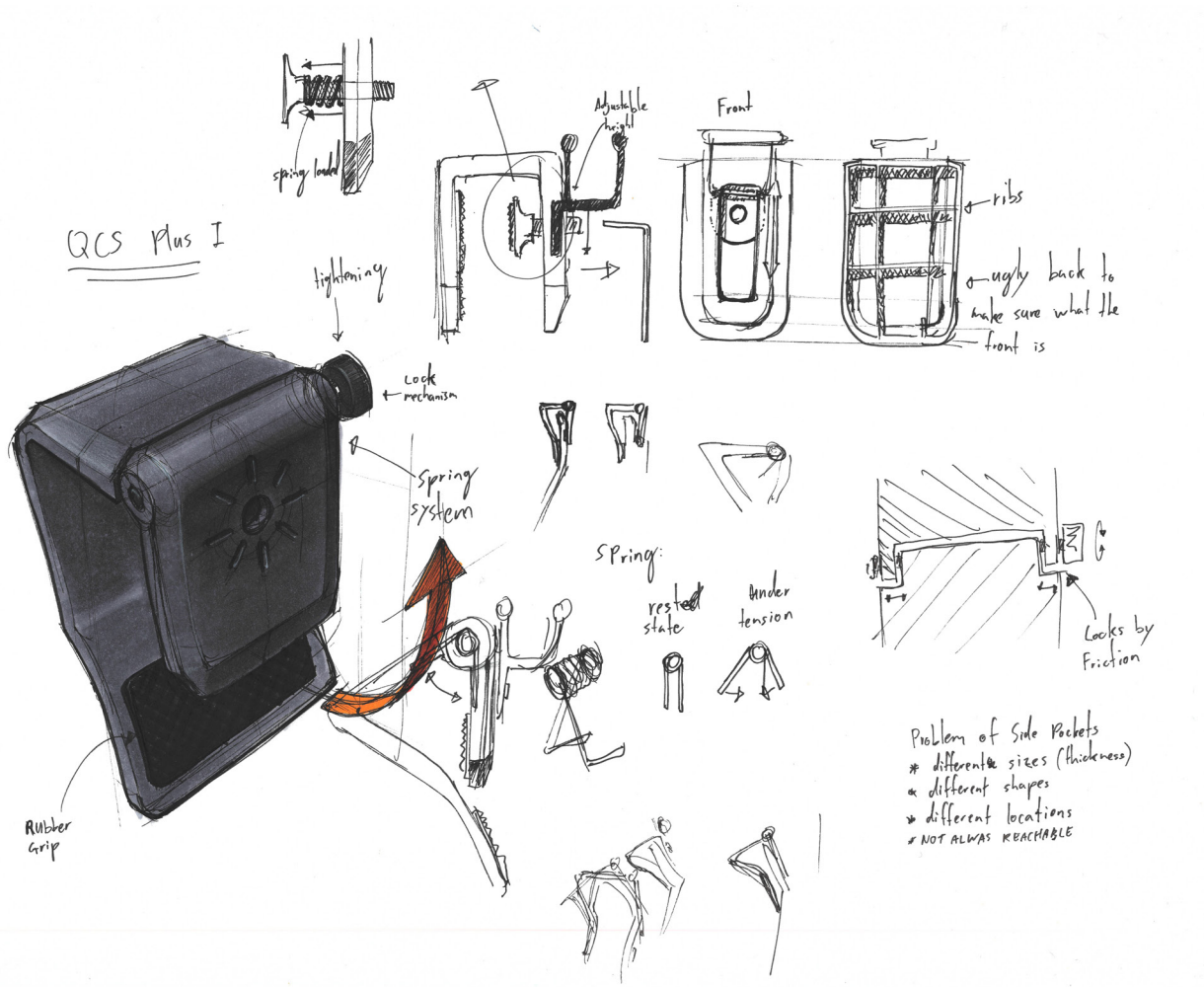


Figure 2.4: QCS Plus I idea sketch

QCS PLUS II (SIDE POCKET)

The QCS Plus II was another variation to the QCS. Like the QCS Plus I, there is only one correct way to install it. If the product would be secured wrongly, it would stick out more; something that the mechanics of Pon (Volkswagen group) dealers try to avoid. Another advantage is that the force distributor is adjustable in height, so it could fit more car models appropriately. Like the QCS Plus I, it has the same fundamental problems as the orignial QCS. It is also less advantagous than the QCS Plus I, because of its need for tools.

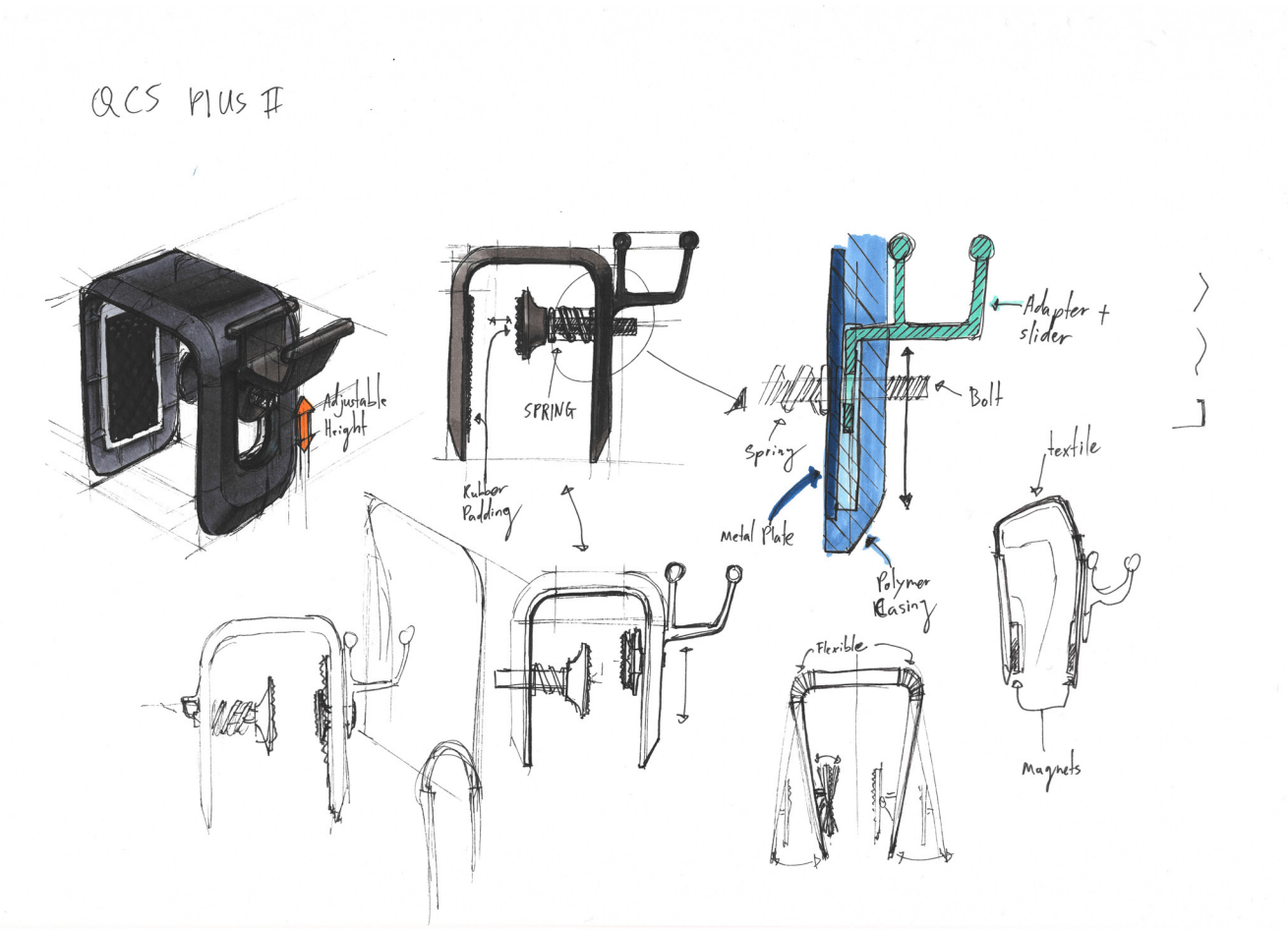


Figure 2.5: QCS Plus II idea sketch

GRAB HANDLE ATTACHMENT (GRAB HANDLE)

The Grab Handle Attachment (GHA) involves a new compact hammer, more like the ResQme (aforementioned competitor), rather than the Evo. The GHA is supposed to be attached to the grab handle. The main benefit is that it is in plain sight, yes does not disturb the interior design, as it is "enclosed" by the grab handle, maintaining the principles of design. However, this would make the grab handle less useful. Also, not all cars have grab handles, and they tend to differ in design (hinged, versus unhinged). The greatest disadvantage is that some dealer already use this place for their own options, such as coat hooks, or at at least one instance a sunglass holder (Renault).

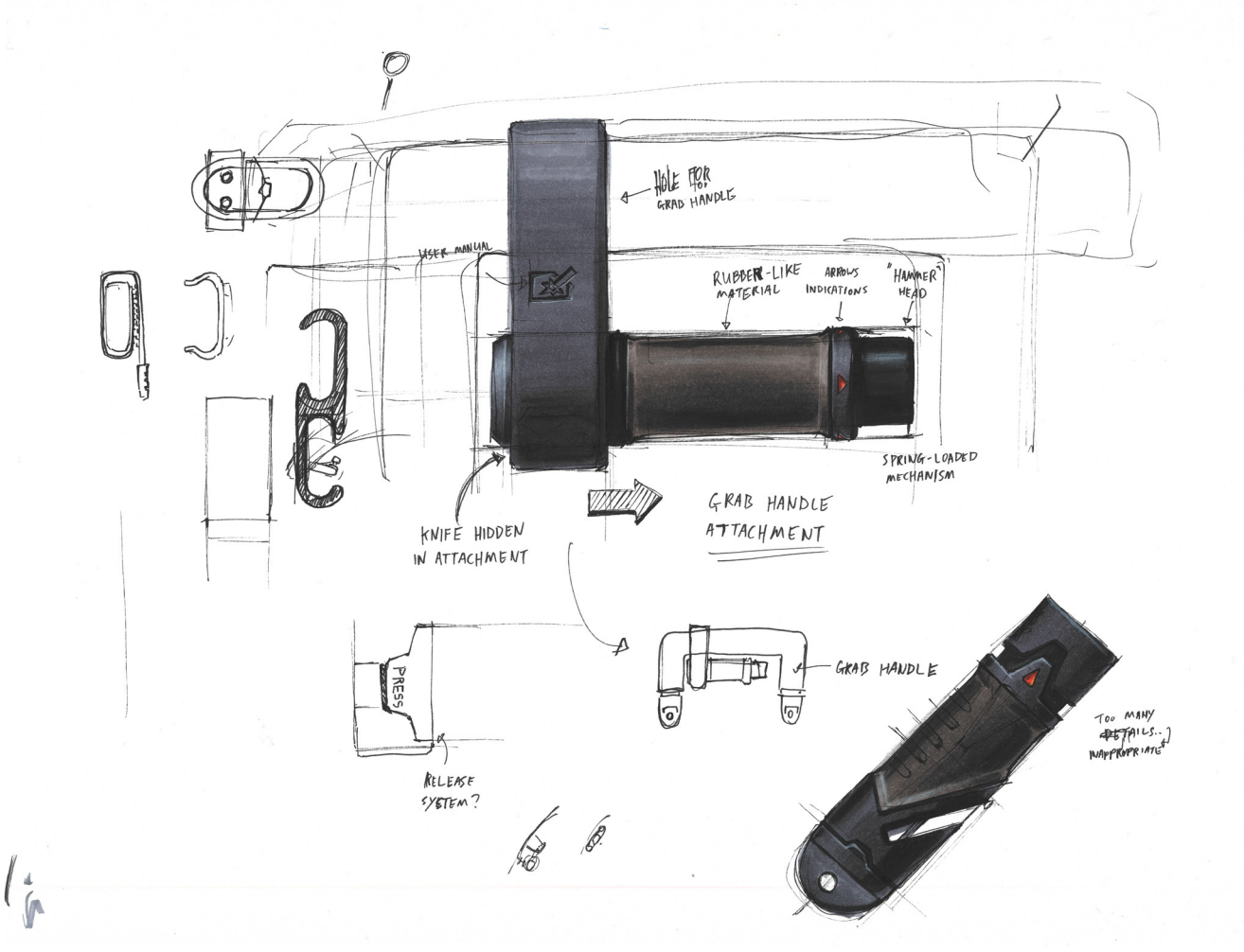


Figure 2.6: Grab Handle Attachment idea sketch

TEXTILE SOLUTION (ENVELOPABLE AREAS)

The Textile Solution was an idea which came from looking at alternative materials. Since the emergency hammer is a tool, it also felt appropriate, since it may give users the association with utility belts. This of course, can also be considered as a disadvantage, since it emphasises the nature of the product; a safety tool feels somewhat out of place in a car interior, aesthetically speaking. Especially when considering importers/dealers this idea seemed less viable. However, Lifehammer could look into the viabilty of this idea for retail channels, as it is possible that some consumers may like the association with utility belts. A sure benefit of using textile is its flexibility, allowing the hammer to be attached to parts with varying shapes, such as the headrest. Again, however, it is felt that attachments to such visible locations may not be received well by importers/dealers. Moreover, the headrest is already used by some dealers for optional additions, such as entertainment systems, or coat hangers. There is also competition from other aftermarket products aimed at the location.

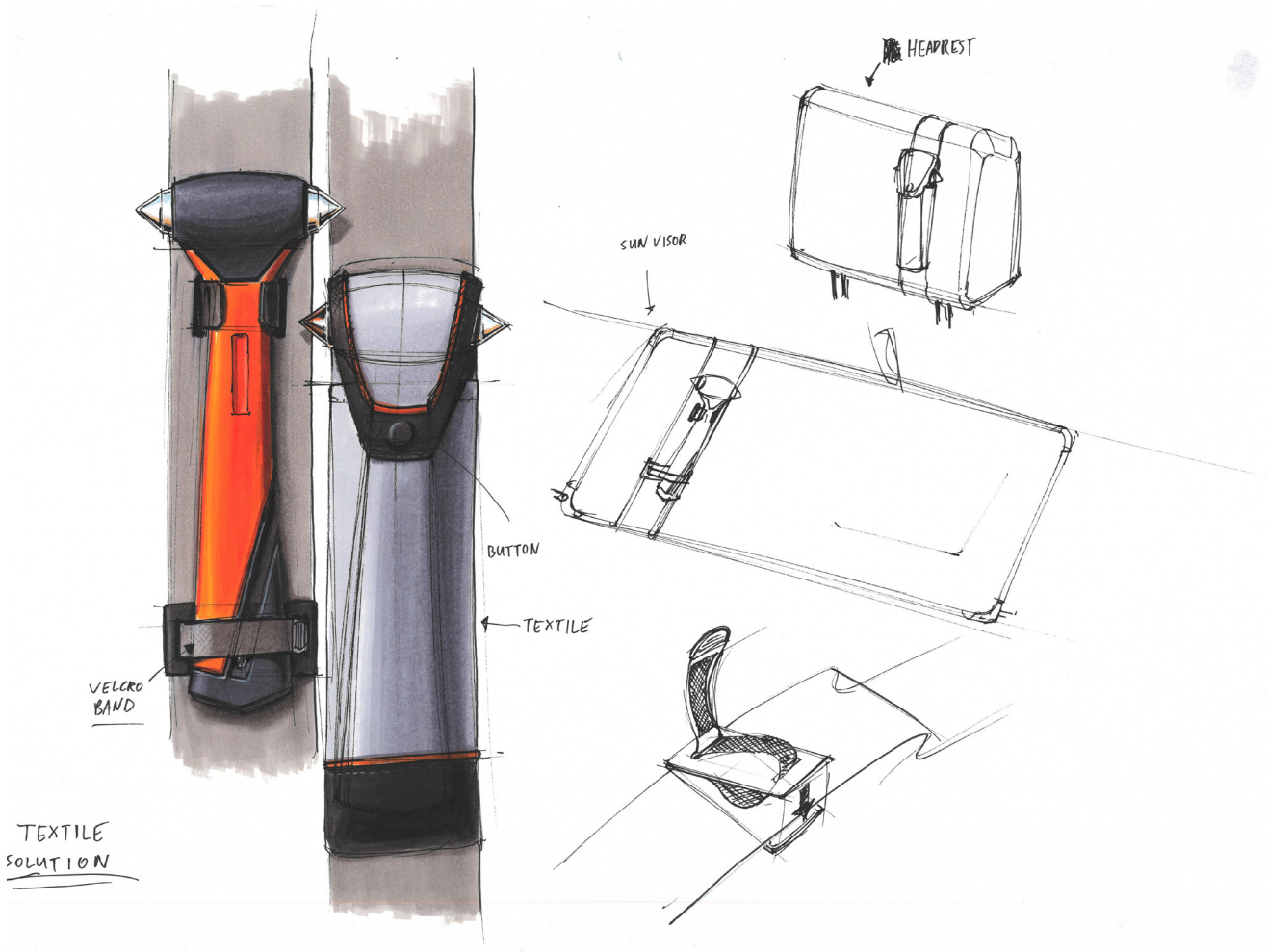


Figure 2.7: Textile Solution idea sketch

RECEIVER SYSTEM (SEAT BELT)

The Receiver System was another idea based on a new compact hammer. The product would be placed on the seat belt receiver, or buckle (female part of the seat belt). Aside from the universal location, it was felt that in personal experience, there were not many variations of the receiver. During the ideation phase, it was also thought that there was relatively enough space, as a compact hammer could be made quite small. Other advantages include the intuitive location; people can also find their buckle in the dark. Moreover, finding the location would be in users' muscle memory, as each time a user enters or exits a car, they use the buckle (if the user is law-abiding and cares about safety). The latter also means that reaching for the location is associated with exiting the car, meaning that finding the product may even be close to intuitive. Aesthetically, the idea also has few problems, as it is located at a place which is not well visible; when seated it is even close to invisible.

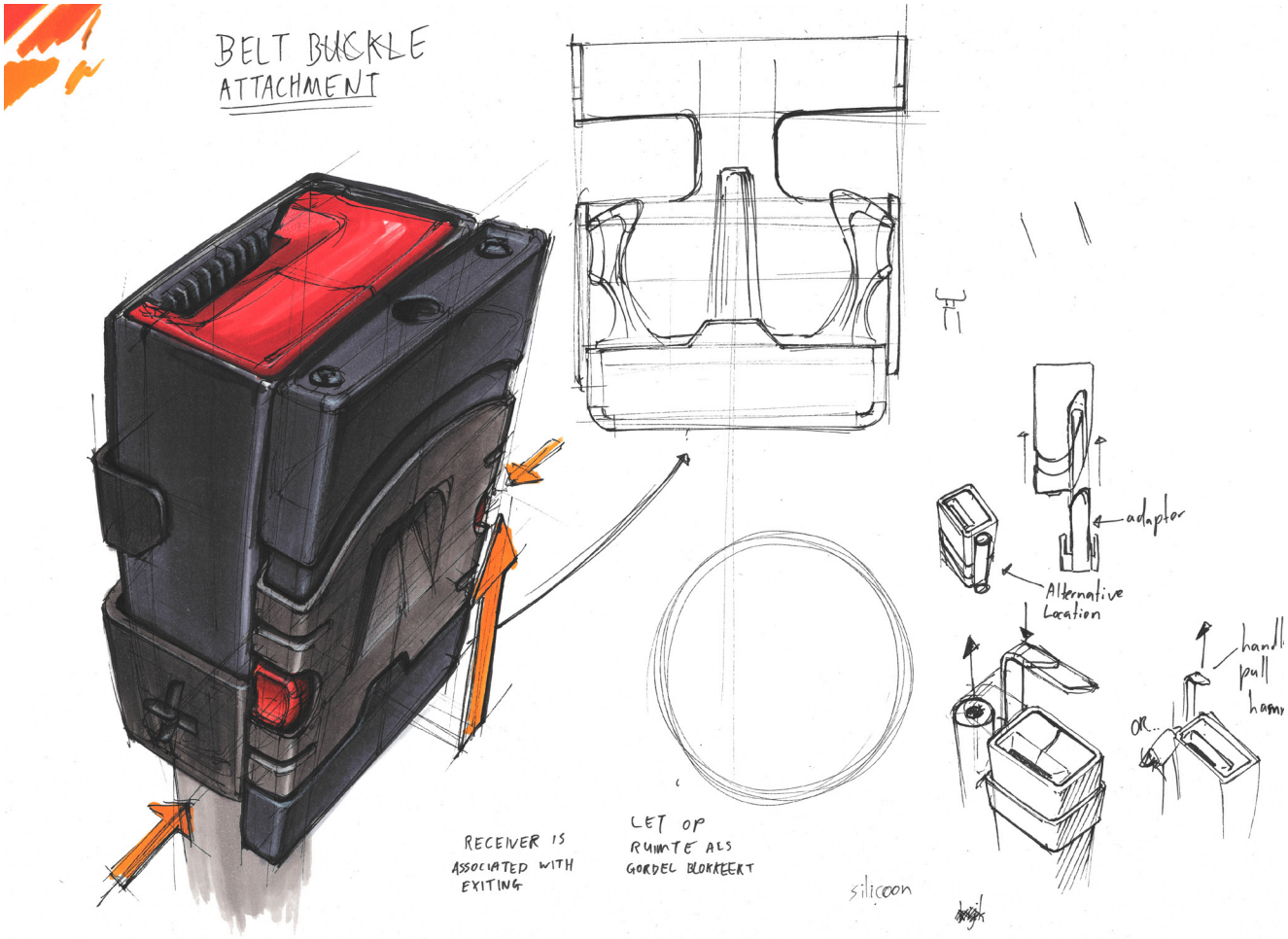


Figure 2.8: Receiver System idea sketch

CONCEPTUALISATION

All the aforementioned were presented to Lifehammer, with the exception of the QCS Plus I and II. The feedback was mostly about feasibility and desirability by importers/dealers. Some concern was raised that none of the ideas provided a solution for the current QCS. Therefore QCS Plus I and II were generated after the discussion and presented later. In order to make sure that at least one of the final concepts would address Lifehammer's immediate needs, the QCS Plus I was selected to be a concept.

A modified version of the GHA was also taken as a concept. The initial idea was to place a compact attachment system on the grab handle, and use the enclosed area for the positioning of the hammer. However, together with Lifehammer, it was found that a "modular system" direction may prove to be interesting due to the flexibility of such a product.

The Buckle Attachment was also selected as a concept. Its supposedly intuitive location as well as the unintrusive aesthetics were the main reasons for this.

QCS PLUS

The QCS Plus, or concept A, had the advantage of being a relative simple working principle. Since the product would keep many of its location-related problems as the original, only the difference needed to be tested. When comparing the QCS Plus I and II, the QCS Plus II seemed too similar to the current QCS, as it only added a vertical adjustability and merely removed one screw hole to make it less symmetrical. The former could even make the installation more difficult. The QCS Plus I, however distinctly asymmetrical due to its hinge. The bends in the other part accentuate the asymmetry, though the main function is to provide a better fit for varying models. The main benefit of the concept is that it can be used with the existing hammers and adapters. Aside from this, it also has the benefit that it requires no tools.

Figure 2.9: Buckle Attachment idea sketch

QCS PLUS TEST

Since only the QCS Plus mechanically differs from the original on only one aspect, a quick test would reveal whether the concept was realisable. For this end, an aluminium test model was made with two identical stainless steel torsion springs with many more than 10 windings were used; higher windings allow for a greater maximum angle (Figure 2.10. This was needed to make sure the product could easily be installed using no tools. These springs were under installed in such a manner that they would always be under tension, otherwise the clamping force would be much less.

The adapter was put on the plate with tape. Duct tape was also used to envelop the contact points of the aluminium plate to prevent scratches on car interiors.

The mock up was then placed in a side pocket of a car along with the hammer. The degree of portrusion was compared to the original QCS (Figure 2.11). When the QCS was installed as intended, the QCS Plus was slightly less portruding. However, when the QCS was installed the way many Pon dealers do, there were negligible differences. Moreover, the torsion springs did not provide nearly enough clamping force to hold the product firmly in its place. Stronger torsion springs were availabble, but they were significantly larger in size. Alternative materials were also looked at, no stronger alternatives could be found. There was also the possibility that sufficiently powerful springs could cause injuries among mechanics if handled carelessly.

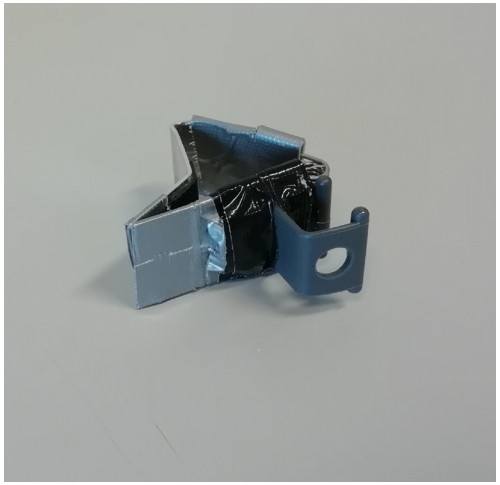


Figure 2.10: The test model

Figure 2.11: Negligible differences. Note the position of the adapters

RECEIVER SYSTEM

The most obvious change made to the Receiver system, or Concept B, during the conceptualisation is that the position of the hammer has moved to the "short" side of the receiver, as opposed to the long side. This was done as additional dealer visits revealed that some cars have very little space between the seat and the middle console. During the visits it was also found that some car makers put a textile protection patch on the receiver. This concept could provide that function as well. The Receiver System is secured to the receiver by a silicone band or other soft, elastic material. The metal-like hoop on top of the product, as illustrated in Figure 2.10, serves to provide the user with an easy way to pull the hammer out of its casing. The orientation of the hoop points away from the user; this was done to reserve space for the "tongue" (male part of the belt). The hammer itself is put into a "sheath", which in turn is attached to the receiver.

Figure 2.12: Receiver system

RECEIVER SYSTEM TEST

To test the viability of the concept, a mock up was made with estimated dimensions, based on the working principle of ResQme hammers (Figure 2.11); the working principle of ResQme allows for a more compact design. The "footprint" of the tongue was also taken into consideration (Figure 2.14). The mock up was made of polystyrene foam. This test model was taken to a second hand dealer to test the fit on cars of different brands. The test revealed that the mock up fit most cars without problem. However there was one instance where a plastic plate beneath the seat was in the way of the test model (Figure 2.16). The mock up was was used for a small use test; it was placed in a car before a drive to see if the product would be intrusive. The person claimed the product was barely noticeable, and forgot that the product was installed when driving.
Despite the one case where the mock up did not fit a car well, the tests were considered as a success.

Figure 2.13: ResQme; a very compact hammer

Figure 2.14: Seat belt "tongue"

Figure 2.15: The mock up in a tight environment

Figure 2.16: A worse fit

MODULAR SYSTEM

The modular system, or concept C, was a concept that did not feature much prototyping, since its working principles have been proven in other products already. For example, the version with a textile band, as illustrated in Figure 2.17, utilises the spring of the hammer to keep itself in place; a feature seen on some portable tire pumps for bicycles. The essence of the concept is that the rear can be swapped out to fit different attachment systems. The advantage is that the product will be very flexible concerning possible attachment locations. However, this does not take into account that some importers do not put much consideration into the hammers, meaning that a larger choice may prove to be detrimental, as variations may be sent to dealers which are inappropriate for a specific car models. It is possible that the concept is better suited for retail, but this will not be research in this project.

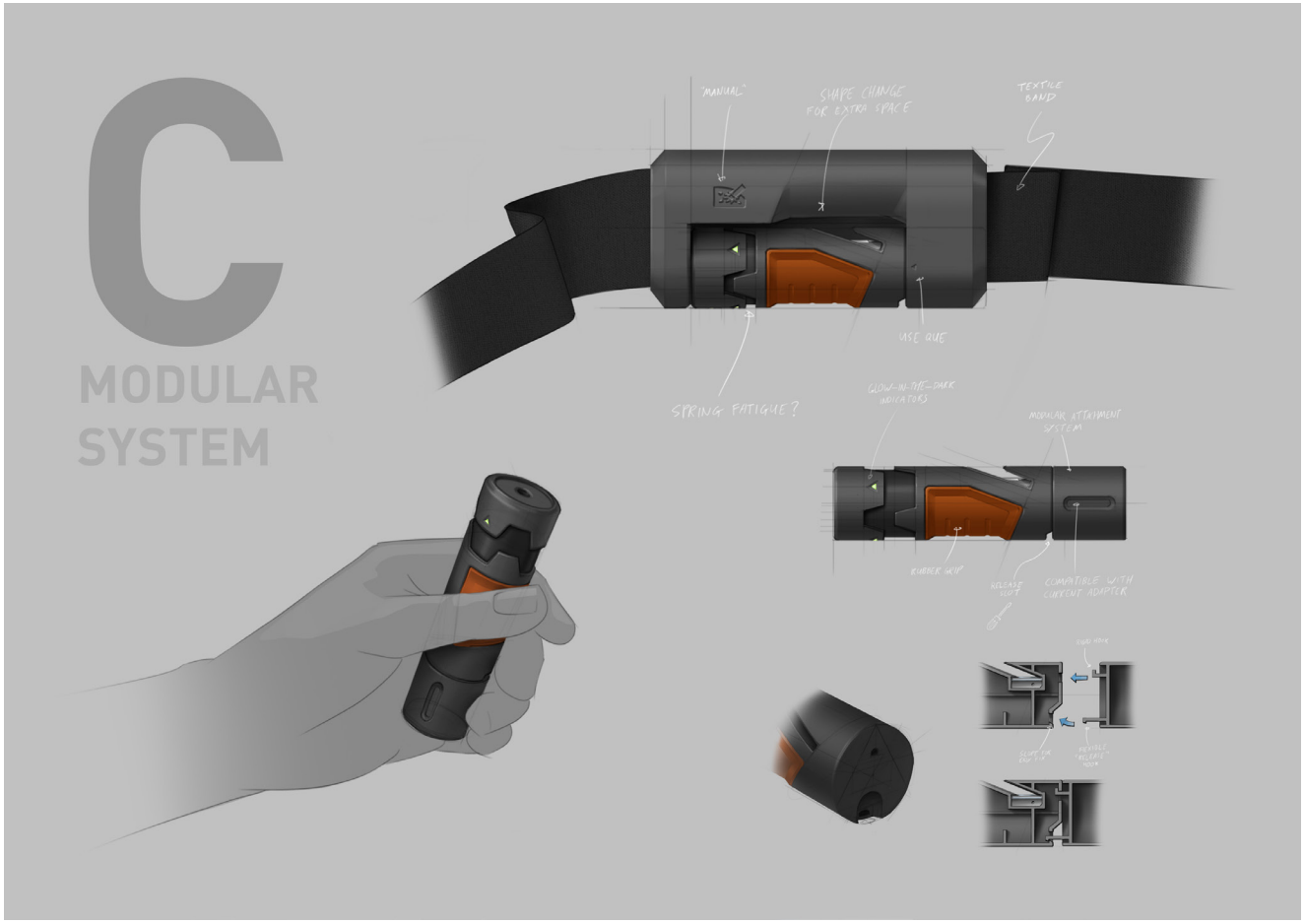


Figure 2.17: Modular system

CONCEPT SELECTION

REQUIREMENTS

At the time of the selection, only a basic programme of demands and wishes was created. The relevant demands are listed below. Note that not all demands and wishes have equal "weight"; some were considered more important than others.
See appendix X for the full programme of demands.

High priority

» Product must fit on a universal feature
» Product must be reachable by P5 internationl women
» Product must be findable in low visibility situations
» Product must not be detrimental to interior of cars
» Product must be easy to understand
» Product must not be intrusive

Low priority

» Product must be easy to install
» Product must not be expensive (including development)
» Product must be findable in low visibility situations

PROS AND CONS

It was expected from the get-go that no solution would be perfect. Whichever benefit a certain feature would bring, said benefit also came with a disadvantage. The pros and cons of the three concepts are summarised as follows. Note that some assumptions had to be made:

Concept A (QCS Plus)

+ Universal location
+ Easy to understand
+ Usable with current hammers
+ Little development needed
+ Less likely to be wrongly installed than current QCS

- Shares most of the problems with current QCS
- Weaker fastening than current QCS

Concept B (Receiver System)

+ Universal location
+ Universal dimensions of location
+ Findable in low visibility (intuitive location)
+ Does not break up interior design

- Does not work with current Lifehammer products
- New product (development and perhaps unrecognisable)

Concept C (Modular System)

+ Several possible locations (flexible)
+ Less dependent on dimensions of locations

- Can be installed in suboptimal locations
- Complicates logistics for dealers/ importers
- May compete with extra features offered by dealers (depending on the location)
- Requires most development of concepts

FINAL CONCEPT

The three concepts were first shown to various dealers; Volkswagen (Wittebrug), Volvo (Niham), Kia (Autohaag Zeeuw), and Peugeot (DAVO). In order to prevent any influence on their opinion, only an explanation of the working principles were given at first. After the introduction of the concept, the presumed pros and cons were "determined" together with the dealers. Of these four brands, only Volkswagen (and the subsidiary brands) currently uses the QCS. Interestingly, the salesman noted some of the problems with the current QCS, and he noted that the QCS Plus may not solve all of them. The dealer at Volkswagen, who used to work in Aviation safety, noted that the Receiver system had the strong advantage of being attached to a location that could easily be found, even in low visibility situations. This observation was made before any other pros and cons were presented.

As for the concept preference, all four dealers had a strong preference for the Receiver System. The dealer at Volvo noted that the concept "did not break apart the interior(design)". He also liked the "uniqueness" of the product. The other concepts were less well-received, with all four dealer noting that concept A and C, were intrusive concerning aesthetics. In hindsight, it is also possible that concept C was too complex.

The final choice was made together with Lifehammer, as it is the stakeholder who gave the assignment. This time, the pros and cons were discussed from the beginning, as well as the findings from the dealers. Those who were at the presentation, including yours truly, seperately ranked the concepts (Figure 2.18). Though less unanimous as with the dealers, there was a stonger preference for Receiver system. Not only did it come out of top in 3 of 5 cases, it was also not placed at the bottom. Moreover, it is felt that the Receiver system would address the problems found during the analysis phase. The final name of this concept is Seat Belt Attachment Systems, henceforth: **SBAS**.

PERSON	CONCEPT RANKING		
	1st	2nd	3rd
1	B	C	A
2	B	C	A
3	B	A	C
4	C	B	A
5	C	B	A

Figure 2.18: The rankings

Figure 2.19: The final concept.

03

EMBODIMENT

This phase had a focus on the embodiment of the final concept. Material choice, further testing, styling, and the working principles were taken further during this phase. It was determined that the hammer itself would not be developed into detail due to the limited time. Things went not as planned, and the result was a working hammer prototype.

THE SCOPE

REVISITING THE BRIEF

The brief had previously been revised to "design an attachment system OR a hammer-attachment combination which was easy to find, yet would blend into the interior design." When applying this to the Receiver system it would mean that the focus would mostly be on the attachment itself. Especially since the working principle of the hammer was based on existing product, most notably the compact ResQme hammer. Lifehammer agreed that the technical details of the hammer were less important for this project. However, during prototyping, it was decided on a whim to make a working prototype of the hammer as well. This resulted in an inadvertent priority shift to the hammer, instead of the attachment, which left less time for focus on the attachment. On the bright side... the prototype hammer turned out to be able to shatter glass.

The concept may also be limited to just the front seats, as the rear seats do not always provide enough room. According to a Trouw article of 2016, Dutch cars have an average of 1.3 occupants. Though the data is outdated, other sources mention that the amount of passenger cars have increased, whereas the percentage of those who use the car mainly as passenger has decreased (Kennisinstituut voor mobiliteitsbeleid, 2017). It is therefor decided that this is not a problem for now, as dealers and importer only install the hammer(s) near the front seat anyway. However, in the future, it is in the interest of Lifehammer (and car owners), that all the seats have a hammer; more profit for one, more safety for the other.

The aspects which fall into the scope are:

- Attachment method to receiver
- Attachment method of hammer to "sheath"
- Materials
- Ergonomics
- Styling

THE ENVIRONMENT

THE RECEIVER

The product is, essentially, placed on the receiver of the seat belt. One visit during the ideation phase showed that not all cars have much space between the middle console and seat, especially those with a higher middle console. Though this may be of a smaller issue with the long-term trend of electric cars in mind, current and near-future cars will not be much different from each other. It was found that the most "wriggling" room was found on the short ends of the receiver, especially when considering that the middle console may hinder movement when the product is placed on the long side (Figure 3.0). Another reasoning to place the product on the short end was "if one can reach the (release) button, one can reach the product".

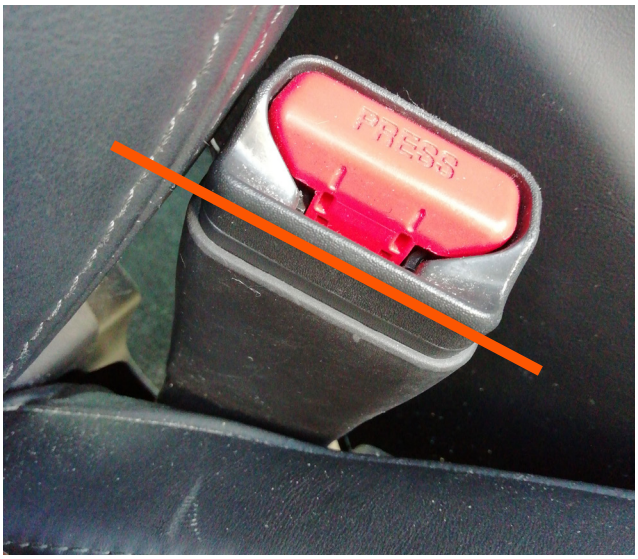


Figure 3.0: Orange line = long side. Note: this receiver has a sleeve.

VARIATIONS

One of the main problems from the start of this project was the variety found in cars and their interiors. The receivers are not exception to this, though to a lesser degree compared to other areas. Moreover, even cars within a single brand may have varying receivers, whilst some cars of different brands may use the same receivers. In other words, there is not much consistency. For example, a receiver found in a Toyota was the same as the one found in a Tesla, whilst two different receivers were found within two cars of Kia, both cars were made in the same year. (Figure 3.1). Volvo is the only brand found which has "unique" receivers (ie. not found on other brands). There are also some models that already have a polymer sleeve around the receiver. In any case, to get an idea of whether these variations resulted in a high degree of different sizes, some receiver models were measured (Apendix X). When it comes to the upper circumference, the smallest and largest of the measured receivers are 147mm and 175mm respectively (sleeve included, if present). The lower circumference (since receivers have a tapered shape) ranged between 123mm and 158mm. The height of the receivers varied between 71mm and 80mm.
Concerning the cars at dealers, it is noteworthy that cars of the smaller segments, seem to offer the most space, whilst sedans (C/D-segment or higher) offer less, exceptions notwithstanding.
When it comes to differing colors, only Volvo is confirmed to have a different color (beige). Note that not all brands/variations of receivers have been analysed.

Figure 3.1: Two different receivers in the same brand (Kia)

Figure 3.2: The same goes for even expensive cars (Jaguar)

Figure 3.3: Same receivers found in different brands (R: SEAT. L: Jaguar)

REFINEMENTS

MINIMAL DIMENSIONS

As mentioned earlier, the hammer itself will not be developed in full detail. However, in order to design the sheath, it is important to know what the dimensions of the hammer will be. Though ideal if the hammer is as small as possible, the working principle of ResQme is taken, just to be sure. According to Van Rijn, the ResQme does not have a strong patent on their working patent. The dimensions are 49.6mm in length, 16.5mm in height, and 14.7mm in width (Figure 3.3). Note: this particular part was taken from another brand (also working as intended). These dimensions include only the "hammer" part. The seat belt cutters on these compact hammers are often located on the side of the product. Since the Receiver system needs to have a small vertical footprint, the knife will have to be positioned in the length of the hammer (Figure 3.4). This will result in a thinner, but elongated hammer. Though it is preferable that the hammer does not stick out, this will not be a "hard" demand, since they location is not in sight.
Another important part to keep in mind was the tongue of the belt. If the seat belt would be jammed, the tongue could be in the way; the hammer needs to be taken out without being obstructed by the tongue. It was determined that a minimal space of 10mm was needed to allow enough space for hammer (Figure 3.5).

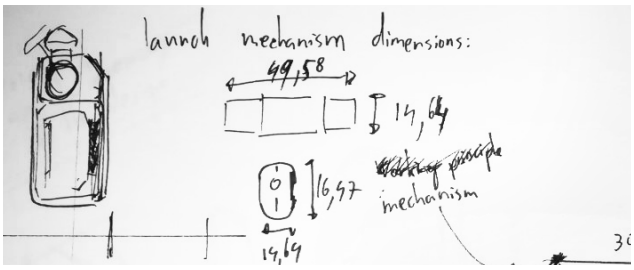


Figure 3.3: Swisstech dimensions

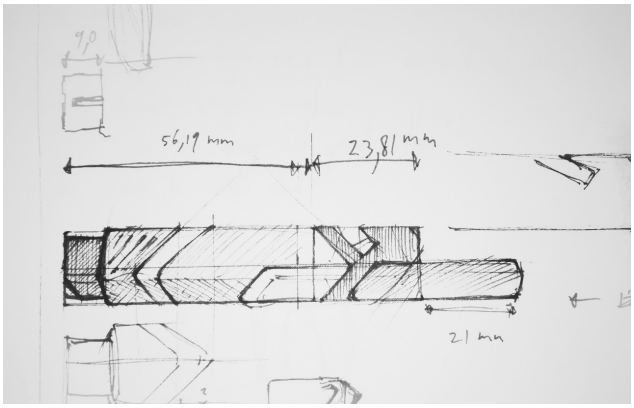


Figure 3.4: Elongation of hammer

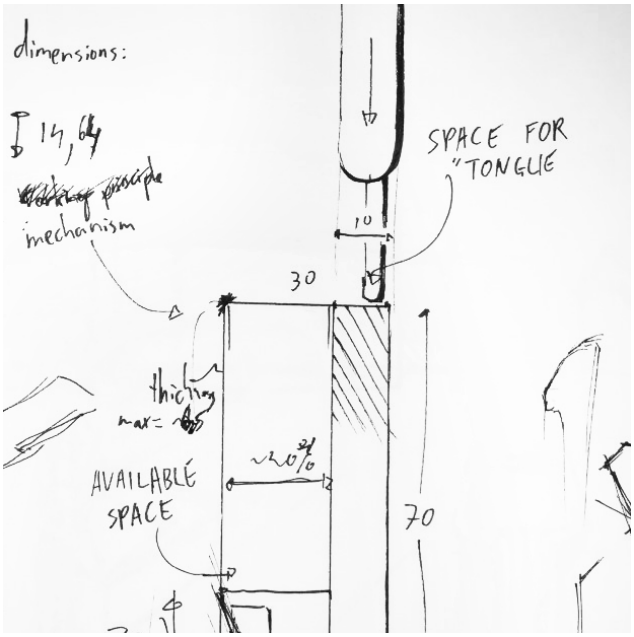


Figure 3.5: Tongue footprint

EARLY TESTING

To get an idea of how the product would fit on different car interiors, a mock up was made and taken to an "occasion" dealer (ie. second hand cars of several brands). The dimensions were determined by the measurements done earlier, with some extra margins. The mock up was 80mm in length (or height), 30mm in width, and 25mm in thickness (Figure 3.6). The body was made of polysterene foam, and the "handle" was made of thick paper. The attachment method for this early mock up was a non-elastic velcro band. The mock up was placed on several cars of different segments; some with much space, others with little. Even in interiors with little space, the mock up would fit (Figure 3.7). It could even be argued that the set up looked "better" on cars with little space. These cars tend to be more luxurious, which means the product looks "better" (or better hidden) in cars with "better" aesthetics.

However, there was one instance where the mock up could not fit right, as there was a "hard" part beneath the seat that blocked the test model; the mock up could not be pressed down entirely (sticking out), or it would have to be positioned in a skewed orientation (Figure 3.8). Unfortunately, no fix has been found for this problem.

The mock up was also used for a short user test, to see if it was intrusive during buckling/unbuckling and driving. The participant noted that the product was not intrusive during the buckling and unbuckling of the seat belt, and claims he had forgotten about the mock up during driving, yet he did notice/feel the product when using the seat belt, though he claimed that it was not intrusive at all.

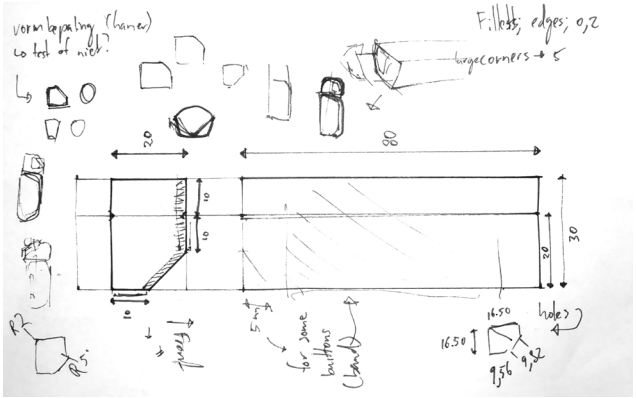


Figure 3.6: Dimensions of the mock up

Figure 3.7: Mock up in a car with little space between the seat and middle console.

Figure 3.8: Bad fit.

EARLY USER TESTS

To get a better idea on the "long-term" intrusiveness of the product, three additional mock ups were made to be installed on different cars. Simultaneously, these mock ups also served as an early test for different materials for the attachment band; each was equipped with a different fastener; elastic textile band, elastic textile band with velcro, and a silicone rubber band (Figure 3.9-3.11). These mock ups were installed on three owned cars to see the performance of the different bands. This was also done to see how intrusive the product could be (if at all). Also, whether the product would stay in place. This was done for three weeks. One of the testers, who had a mock up with just an elastic band mentioned that the prototype would occasionally slip down. According to him, there was a certain worry that the prototype would slide off, which is interpreted as an intrusive attribute. "Will it still be in place" (Dutch: "Zou het nog wel goed zitten?"), was one of his quotes. When using the receiver (entering and exiting) he would occasionally bump the product, but noted that it did not bother him. No other complaints were noted. The mock up with the elastic band and velcro unfortunately broke down after a few days. Even so, the user noted that the product did not bother him. The user who tested the mock up with the silicone band noted that she was constantly reminded of the presence of the product due to bumping into the product when using the seat belt, especially the first few days. She did not consider it to be intrusive and mentioned that she thought it was a good thing, as she said that a real model "reminded her where the hammer was, without being intrusive".

Figure 3.10: Mock up with elastic band and velcro

Figure 3.9: Mock up with Silicone band

Figure 3.11: Mock up with elastic band

THE HAMMER

DIRECTION OF THE PRODUCT

The first "defininitive" styling was done with primarily the wrong placement of th QCS in mind. The hammer and the sheath were deliberately designed to be assymetrical in certain aspects to decrease the chance of them being installed improperly. This is partitularly important as an incorrect placement may cause the tongue of the seat belt to block the hammer. The "hammer" tip was styled after a diamond form as well, though it is assumed that this will not invoke that particular association with users. Indeed, none of the testers recognised the tip as a diamond shape (or they found it not noteworthy). As the product category is relatively unknown, it was also important to make sure that the direction of the product was clear. The ResQme in particular failed to make this clear, as the tv-programme radar showed that one user used the wrong end. To give a sense of direction, lines were used as a metaphor for acceleration. There was a concensus in a small survey about the direction of the shapes as shown in Figure 3.12. The rectangles represent the tip and hook. All participants were able to tell the "correct" direction in both cases, regardless of the orientation in which the figures were shown. It was decided that shape A was more preferable, as it gave the impression of an impact (the shape was based on bullet trails), whereas shape B gave the impression of accelerating forward. Even without such shapes, the hammer clearly showed a front, as the hook looks like the "tail" of the product. This shape was distilled into a more simpler design by using only the outlines (Figure 3.13). The current proposal also has two different colours and materials when it comes the the main part of the hammer. The added contrast of the colours are meant to accentuate the shape.

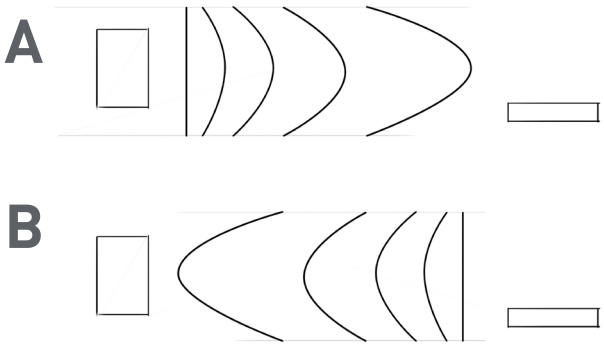


Figure 3.12: Shapes indicating directions

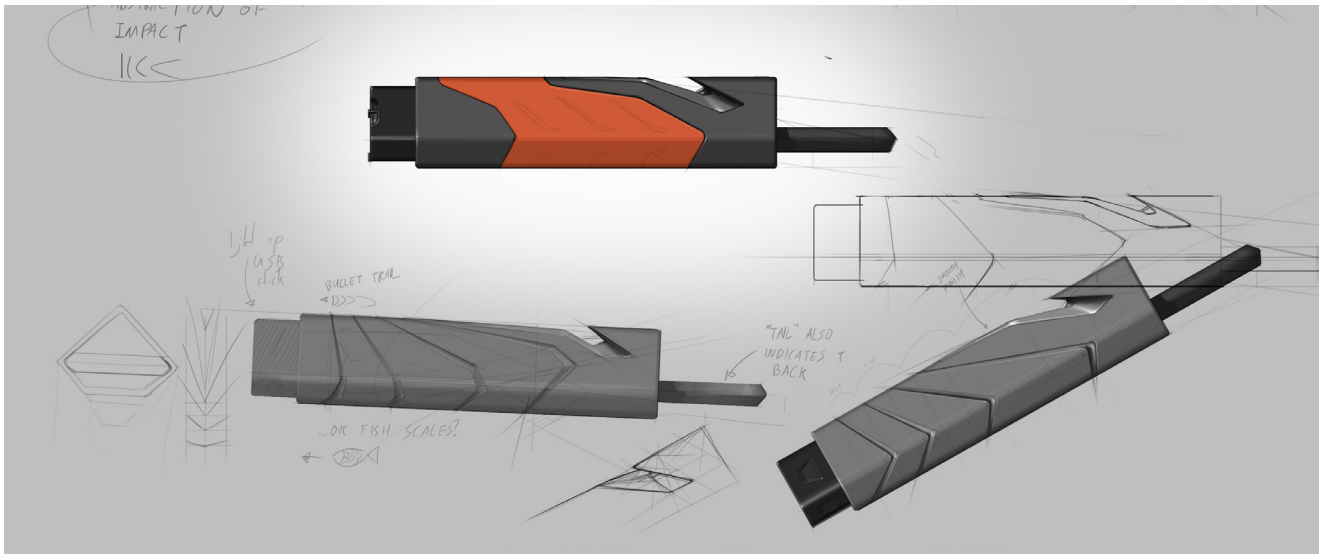


Figure 3.13: Distilling the shapes.

THE PROTOTYPE

The hammer was reverse-engineered from competitors. To be more precise; the same internal parts were used (Figure 3.14), and the casing was designed around them. Though this may not be a wise move for a production model, it was deemed justified for the purpose of making a working prototype. The initial prototype, both hammer and sheath) was 3D printed with the FDM method (Fused Deposition Method). Despite low tolerances, this method was chosen due to its cheaper price. Any mistakes could still be fixed before a more expensive and detailed model was to be printed. Due to the limitations of its tolerance, however, the parts needed to be filed extensively before they would fit together. Moreover, the springs, and hammer tip of the Swisstech hammer would not fit. The material was also too stiff to test the flexible parts which were meant to keep the hammer in its place; they broke before they would bend. This cavity is shown in Figure 3.16

After some initial tests, a more streamlined 3D model was made. This model was 3D printed using the SLS method (Selective Laser Sintering). Besides the better precision, this method was able to print in nylon and Duraform Flex (a flexible, rubber like material). This also meant that the hoop could be modeled more precisely to fit P95 (Dutch) male fingers, who have a diameter of 21mm (DINED). However, the current prototype has a smaller hoop.

The prototype of the hammer consisted of the casings (two halves), head, back end, and a flexible hoop.

Initially, the prototype of the hammer was to serve as a mock up, but as the prototyping progressed, it was decided to create a working model. Admittedly, this was done on a irrational whim; it just felt good to try to make a working model. Fortunately, the effort paid off, and the prototype is capable of breaking glass; two out of two glass plates were shattered with the prototype (Figure 3.17).

Surprisingly, the knife proved to be more troublesome. No matter how many different configurations was tried, it did not perform well. Several blades from the Evo/Plus were tried, but they problem lay with the design of the casing. The gap for the knife was set at about 3 mm. This is less than half what TÜV considers as the maxiumum (7mm).

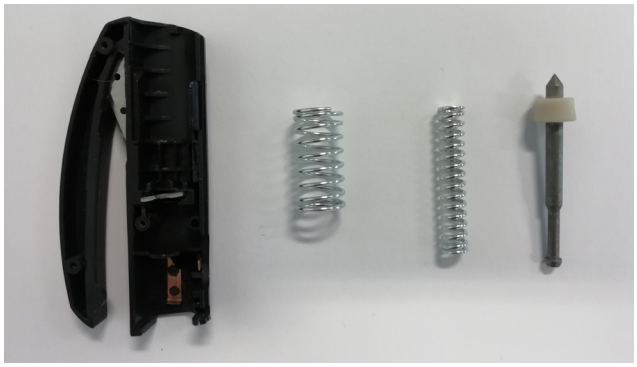


Figure 3.14: Internal parts of Swisstech

Figure 3.15: First prototype; size comparison and attached

Figure 3.16: Cavity for snap fit

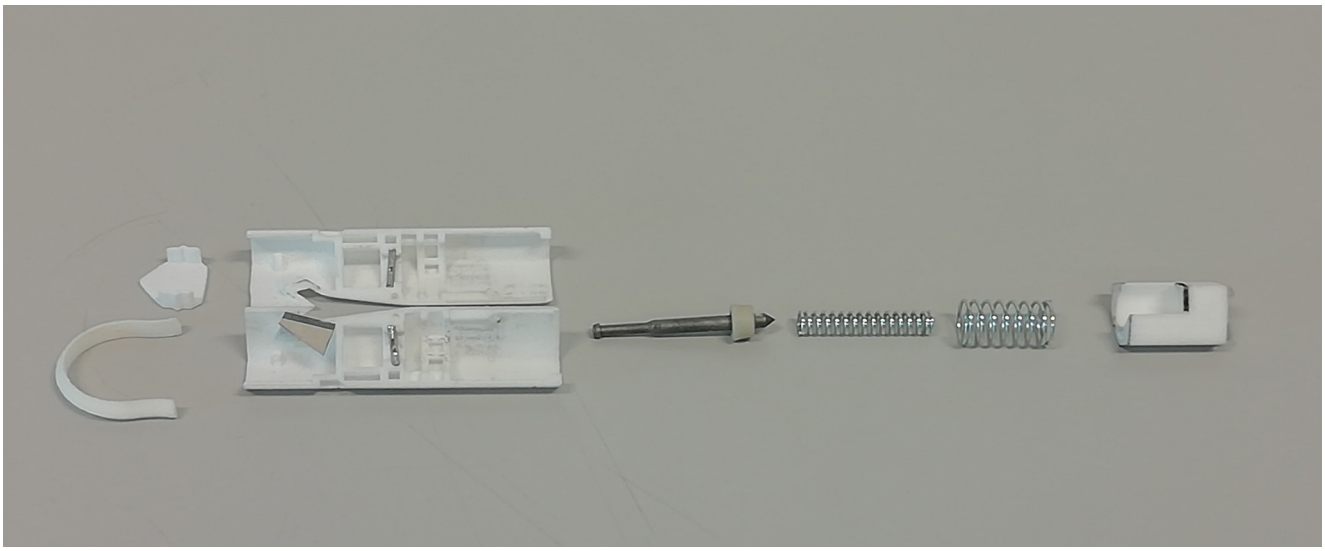


Figure 3.17: Exploded view of the final prototype (SLS 3D printed). Internal parts were "borrowed" from Swisstech.

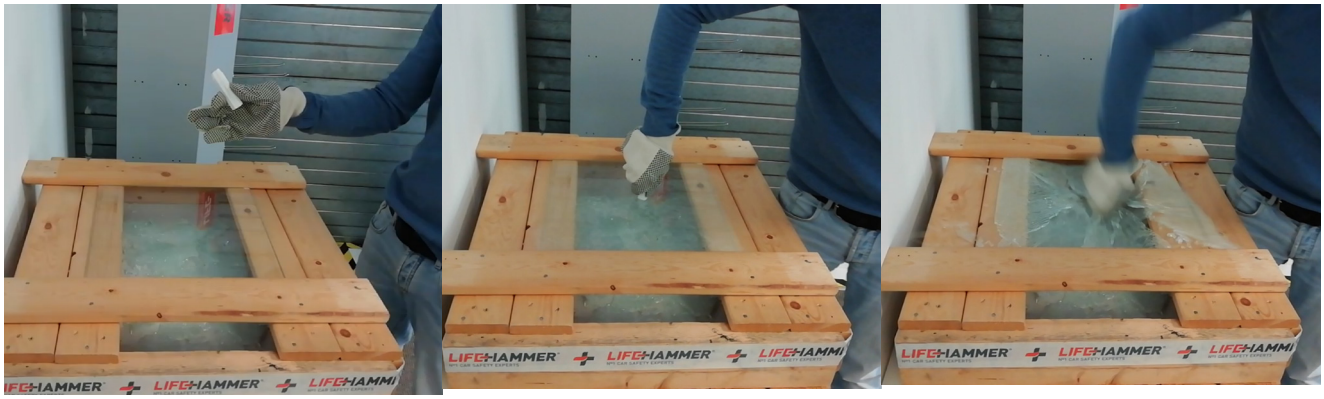


Figure 3.18: Testing the hammer breaks glass with ease...

Figure 3.19: ... yet is beaten by the belt.

THE SHEATH

FEATURES AND PROTOTYPE

The sheath is the part that holds the hammer, and is the connection point between the hammer and the car interior, or the seatbelt receiver to be precise. The sheath fits snugly around the hammer as to not make any rattling sounds. The TUV certificate does not dictate whether the product should stay in place when put under an acceleration. It only mentions a frontal impact of 20G during 30ms. It can be reasonably assumed that such an acceleration would crush the roof of most consumer cars; finding the hammer would be the least of concerns for victims under those circumstances. Even so, the hammer still needed to be placed snugly in the sheath, so a small "lip" was placed in the sheath (Figure 3.20). This lip would fit in a cavity in the hammer, keeping the hammer from inadvertantly falling out.

The sheath also has an edge all around the frontal area, to make sure that it will not slide in respect to the band that keeps it attached to the receiver. On the back, three EPDM rubber stickers are used to provide friction in regards to the receiver as well. Unfortunately, both the EPDM stickers and the silicone band were not enough to prevent movement when the seat belt was worn. The tenstion of the seat belt would pull the receiver towards the user, causing the sheath to rotate (Figure 3.22). Fortunately, it did rotate in the "correct" direction, making it easier to pull out the hammer. Aesthetically, it was less ideal.

It was also found that the lip did not provide enough pressure to provide the desired "click-like" effect. It is recommended that the lip pushes more inward to provide the necessary force. That being said, even without the wanted click-effect, the hammer would stay in the sheath even when shaken wildly up and down. This is mostly caused by the tolerances of the production method though.

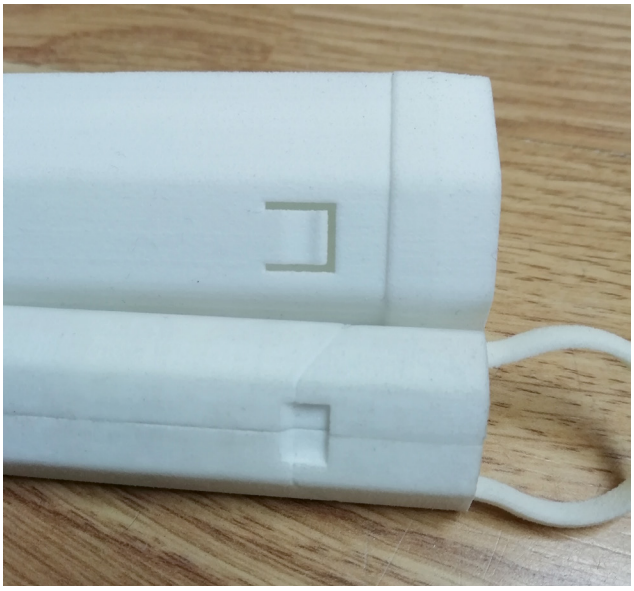


Figure 3.20: The lip (sheath) and cavity (hammer).

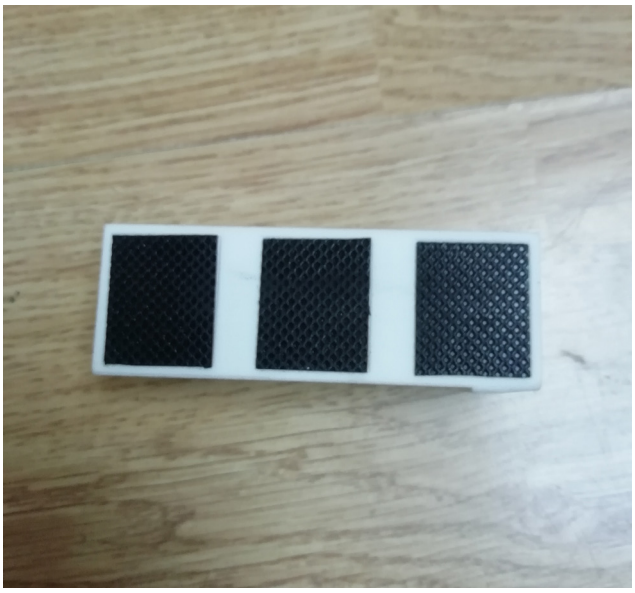


Figure 3.21: EPDM stickers

FINAL USER TESTS

A group of users were asked to "use" the product. The most pressing question was wether men with exceptional large hands (P95) would be able to use the product comfortably. Only one male user with large hands was found, though it is not known whether said user falls under the category of P95. He had no issue using the hoop and the hammer, and the way he handled the hammer was no different from what was seen with the other users; they held the product with the front between index finger and thumb, and also pressed with their palm against the rear during pushing.

All users were instantly able to tell what the front of the product was once they identified what the product was at all. The people who did not know much about the project could not figure it out on their own. This was not wholly unexpected since the product category is relatively unknown. After being explained what the product was, all users figured out how to correctly use the product without tips. However, none of the users without prior knowledge figured it out instantly; it took anywhere between 5 to 20 seconds. Considering a car in water becomes fully submerged in about a minute (mythresults.com), this is unacceptable. Potential users may also need to cut the seat belt webbing. Moreover, these testers were all in a safe environment and relaxed. Many would place the head (correctly) on the window, and initially thought that the hoop had to be pulled. As such, it is possible to use an expired patent where the hammer is activated by pulling a cord (in this case the hoop), though this means the product requires two hands.

The sheath would also rotate in one car when the seat belt was worn. This happened after the seat belt was worn for some time. It is not known wether a tighter band would prevent this, and further testing is recommended. It is also possible to add a backplate to the sheath, which extends behind the receiver, but the downside is that it is not known whether receivers with sleeves would provide enough space. Most importantly perhaps, none of the testers found the product intrusive (but they did notice it).

Figure 3.22: Rotation of the sheath.

Figure 3.23: Before the rotation started.

Figure 3.24: Using the prototype.

MATERIALS

The materials in a car interior have to deal with several environmental effects: heat, moisture, UV light, and ozone. The last (ozone) is mainly applicable to rubber parts, as some rubber materials can show cracks after longterm ozone exposure. This is not only an aesthetic problem, as it decreases the strength of the material.
UV light is mostly a problem for discolouration (aesthetic), whereas head and moisture may affect performance as well. The heat may cause certain materials to be more affected by creep set. The surface temperature of dashboards can rise to 90 degrees Celsius during hot summer days (rijschoolvandaag.nl). No data was found on the temperatures on seats or receivers. At such temperatures, some materials show a significant rise in creep set (CES). Since creep affects the material permanently, the elastic band may no longer function as intended, and seeing how cars are long lasting products, the SBAS must function for a long time as well. The opposite, coldness, may affect performance as well, but these extremes are less likely; TUV tests performance at -20 degrees Celsius, and most if not all considered materials would not be significantly affected (CES). Moisture is less of a problem, though the seat belt webbing is sudjected to strict regulations, the same does not apply for the SBAS.

HAMMER MATERIALS

For the hammer, the most significant factors were heat, though the hoop may be exposed to UV and ozone as well. The first (and final) choice for the hoop was silicone. Silicone is a material which has good UV and ozone resistance. Moreover, it is one of the rubbers that is least affected by creep under high temperatures, and yet it keeps all its properties in extreme colds as well. Unsurprisingly, the material is often used in food products. The price per kg falls anywhere between 3 euros and 17 euros, depending on the exact material properties. According to CES, the cheapest variant had all the neccessary properties for both the hoop and band (Appendix X). The only real disadvantage is that silicone tends to be a dust magnet (personal experience).
The casing of the hammer, as mentioned before, is preferably made of two materials and colours: a dark grey part made of PA6, and an orange part made of TPU rubber. This casing can be 2k-injection moulded. The TPU also serves to provide more grip to the user as well. Both materials are being used in the current hammers, and meet safety demands. Other factors such as UV and ozone resistance are less relevant for the hammer, as it is stored in the sheath. Since the highest factor for cost prise in current hammers is the material costs, it is assumed that the aforementioned materials are well suited; PA6 (glass filled 15%) and TPU are: 3 euros/kg and 4 euros/kg respectively, meaning that the addition of silicone will not drive up material costs, especially since the SBAS is much smaller than the Evo/Plus.

Figure 3.25: Ozone cracking

Figure 3.26: UV discolouration on the TPU of a Plus hammer

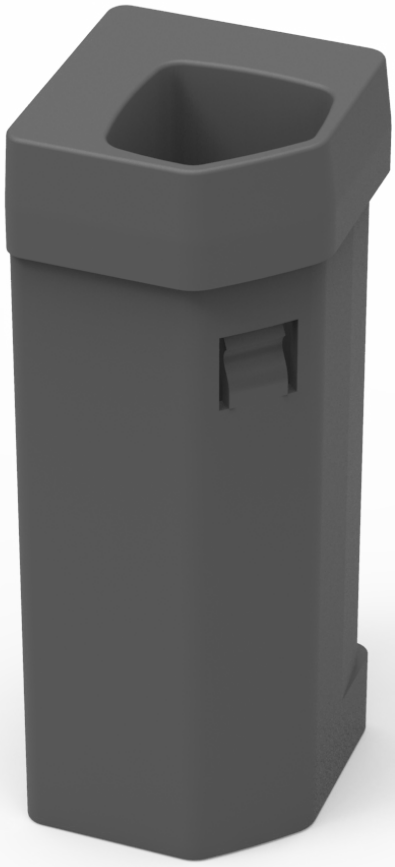
SHEATH MATERIALS

Since the sheath is the "visible" part, it is more exposed to the elements, especially UV light. Preferably, the sheath is made of the same material as the seat belt receiver, and in the same colour, as to maximise its camouflage. Unfortunately, only one manufacturer was found which showed their used material; Polypropylene. This material had worse qualities than PA6, though it is possible that certain additives make it a viable option. For this iteration, the choice fell on PA6, as it is a material that is currently used, and proved to be resistant to UV light, as well as having adequate resistance to heat and cold. For the future, it is recommended that Lifehammer tries to figure out if there is an industry standard concerning the material for receivers, and use that material instead. It has already been found out that not all receivers have the same shade of black, which means that the current iteration has a dark shade of grey that matches at least one receiver kind (the one that was used for prototyping).

The band will be subjected to the same factors, and is also susceptible to ozone, as it is an elastomer. Therefor, silicone was chosen, for the same reasons given for the hoop. EPDM is also a viable option, with only a little more creep at very high temperatures (5-10% vs 10-20% at 100 degrees Celsius) . It is cheaper than silicone as well, at about 1.70 euros per kg. However, it is felt that Silicone has the superior aesthetic quality (despite being dust magnets). This of course is a subjective observation.

The band used on the final prototype was made of silicone, and aside from the car where it allowed for rotation, it performed well. This may have been caused by the circumference of the band (about 160mm), as a custom made band was not deemed viable.

The padding connecting the sheath and receiver was made of EPDM in the prototype. However, a softer cell rubber (ie. more compressionable) may be better suited. Such a rubber may provide a better form fitting attachment, though it is unknown whether the added flexibility will case more possible movement.



COMPONENTS

The hammer consists out of nine parts: a hoop (1), a back end (2), 2 halves of the casing (3,4), a pin (5), a thin spring (6), a thick spring (7), and the head (8), and a steel plate (9). The functions of these parts are as follows:

» 1 Hoop: Silicone hoop to allow the user to pull the hammer out of the sheath.

» 2 Back end: a plate to fill the gap at the rear, and to hold the silicone hoop.

» 3,4 Casing, made of PA6 and TPU by 2k injection moulding. The halves are not identical, as there is a pin and cavities for easy assembly. The casing also guide the pin to a position where it can be launched when the pin is pushed down far enough.

» 5 The pin: the pin shatters the glass. The platform around the pin serves to guide the pin to the hole in the head, together with the casing and head.

» 6 Thin spring: the spring which actually launches the pin/hammer tip.

» 7 Thick spring: the spring that pushes the head back to its place.

» 8 Head: the head pushes the pin down towards a small ramp on the casing. The ramp puts the pin into a position that allows it to be launched.

» 9 Steel plate: a plate which holds the pin under a certain angle. Due to the angle, the pin rests against an edge of the head, which allows the pin to be pushed down. The aforementioned ramp ensures that the pin will straighten out, which alignes the pin with the hole and allows it to be launched.

The sheath is modeled in such a way that it (hopefully) can be cast in a single piece. For this end, the bottom is shelled out. Due to its length to width ratio, however, it may be not possible to cast it as one piece.

Figure 3.27: The bottom of the sheath.

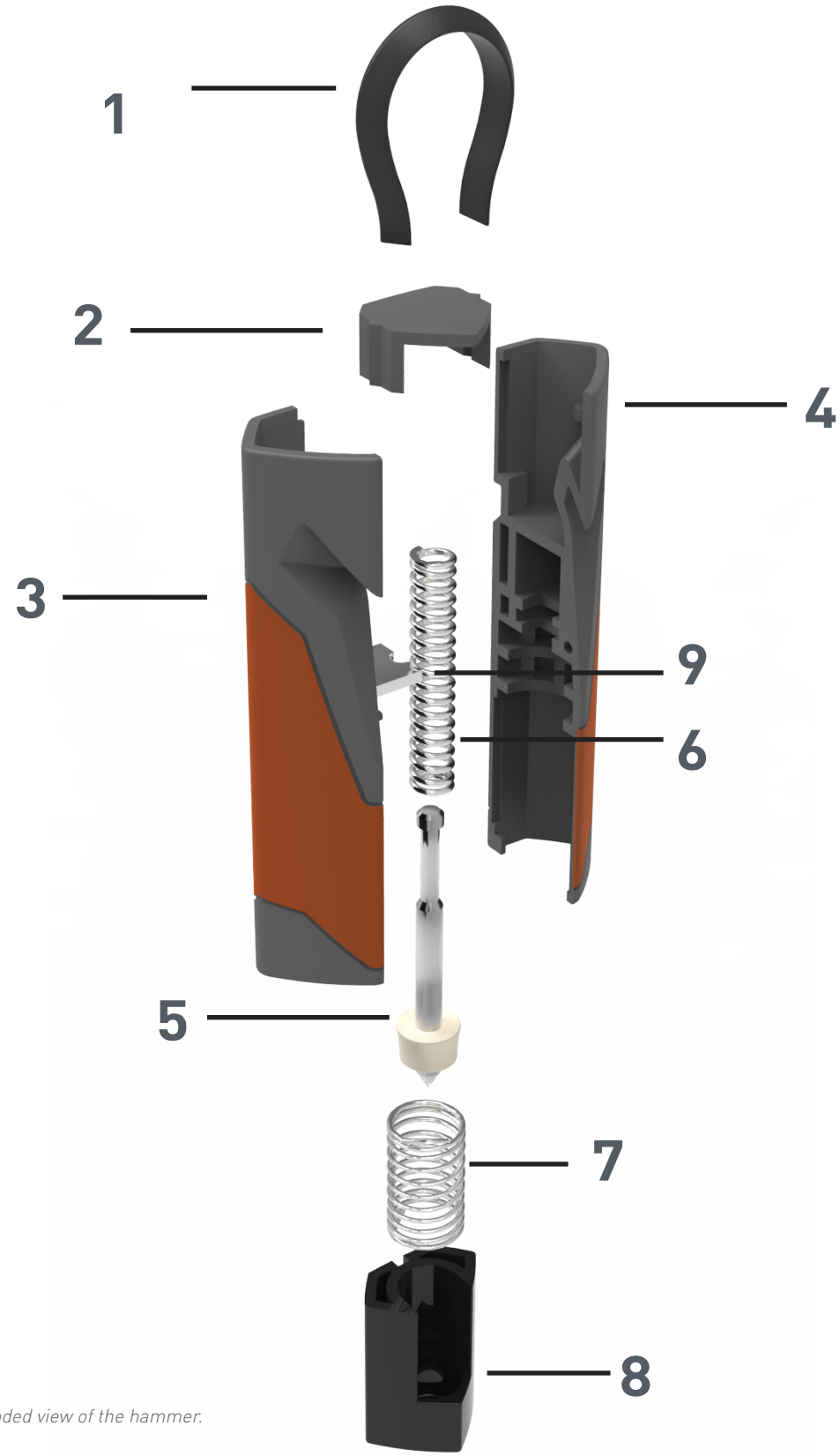


Figure 3.28: Exploded view of the hammer.

Special thanks:
H. Van Rijn for modelling parts nr: 5, 6, 7, 9

PROPOSAL

MORE USE QUES

Taking the findings of the tests into account, the most dire problem is the "understanding" part for users. To counteract this, a clearer indication is needed as to how the product must be used. Since the product is aimed at the sales channel through dealers, a small tag should be added (much like tags on new clothes). This small tag can hold all the needed information, such as the optimal place to use the hammer on (corner), and when to use it (as fast as possible). Concerning the hammer itself, a LED can be installed in the very back of the product, which shines all the way through to the front. The head of the product can be made from two materials for this purpose; a transparant part and a opaque part, which can snap in to each other (Figure 3.29). Due to the lack of space in the interior for the light to get to the front, its sole purpose is to indicate the front; NOT to illuminate the surroundings (its not a flash light). Glow-in-the dark options have been explored, but these only provide a faint glow, and require to "charge" up in light in the first place; the hammer is always in the dark. Other options include radioactive material, but these are only faint as well, among other problems.
The battery for a LED based solution should be a button battery; found commonly in watches and other long-lasting products. The lip in the

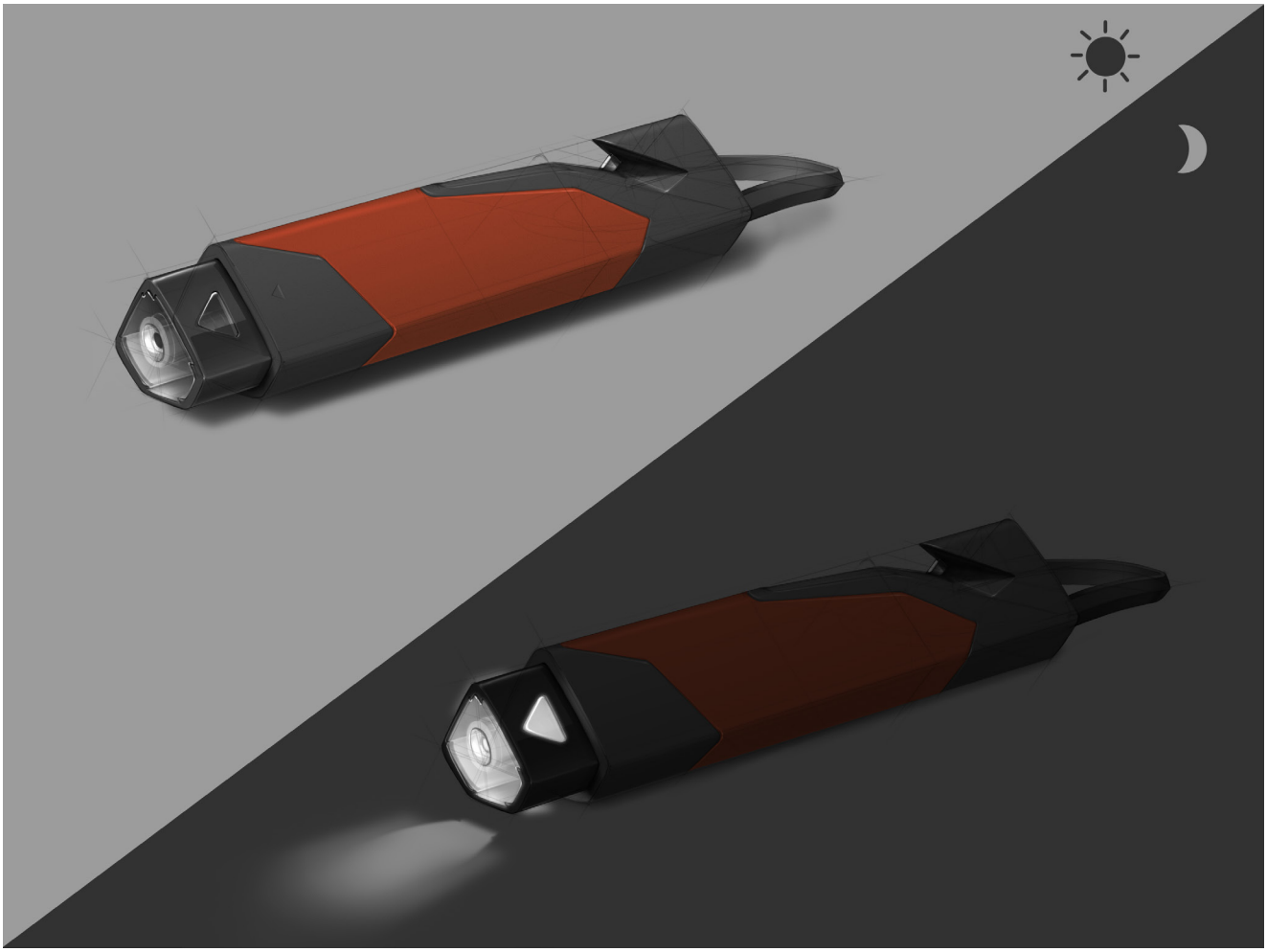


Figure 3.29: A LED based solution

housing can press a switch on the hammer; the switch will turn on only when the hammer is released from the sheath. Since cell batteries have a shelf life (ie. time it can spend idle without losing much of its capacity) of 10 years, they are up to such a task (batteries.com). However, having a LED may be less ideal concerning the costs. It is also questionable whether the light would get to the front in the first place. Moreover, since all users knew what the front was, the real problem may be lack of recognition of the product category. Due to the small size of the product, any text will barely be readable, perhaps even more so during stressful situations.
Therefor, it is felt that a tag will provide most information for the user.

HAMMER STYLING

The rest of the styling has remained the same after the working prototype. Though it may seem from the side view, that there are arrow-like indications pointing to the rear, when the product is taken out of the sheath, it is the top view that is the first thing visible. From the top, the arrows actually point to the front. Should it be that the added wall thickness of 2k injection moulding (required for the 2 seperate colours and materials) proves to be unfeasible with the current dimensions, the casing can be made of one material and colour. It is still recommended to keep similar lines, as they may give additional clues to the user. The head and hoop are black, and darker than the other grey parts to indicate that these are the parts to be used. Making the hoop in the same grey as the rest may also help users into better understanding the product. This will most likely have no effect on the understanding that the hammer is supposed to get pulled out of the seath by the hoop, since the hoop speaks for itself.

Figure 3.30: The current proposal

HOUSING STYLING

Ironically, the greatest challenge in styling the housing were the varieties in receivers; the very same aspect that was the root for all the problems with the QCS and EFS, making the project basically come full circle. Some continuities were found, but even those proved not always usable. For example: all receivers taper inwards toward the bottom, but... Many receivers had a polyethylene (rigid) sleeve. It is assumed that these sleeves also house the wiring for seat belt sensors, and cannot be easily removed. Receivers were the widest in the middle, as opposed to the top, as is the case with sleeveless receivers. The receivers were also not equal in terms of width, height, length, and shape (ie. all dimensions). Of course one of the main selling points was that the SBAS is barely visible during driving, and that it is less intrusive than the current hammers. Regardless, it was desirable to come up with at least a decent looking product, if only for the purpose of its presentation. Therefor, two most seen receivers were used as the base. Note that not all cars have been seen and that the two receivers may not at all be the most common. One receiver was more rounded and short, with straight lines as well; more geometric one might say. The other had sharper edges, yet its lines were slightly curved. It was also longer (Figure 3.31).
An outline was made for the topview to come with a shape which would look decent on both shapes, whilst still keeping the important dimensions in mind. Since the sides are also differently shaped (straight vs slightly curved), a softer rubber is chosen for the final proposal. Due to the late stage at which this decision was made, no proper research could be done. The same goes for the side view. A final presentation sketch was made for only the slightly curved receiver (Figure 3.32).

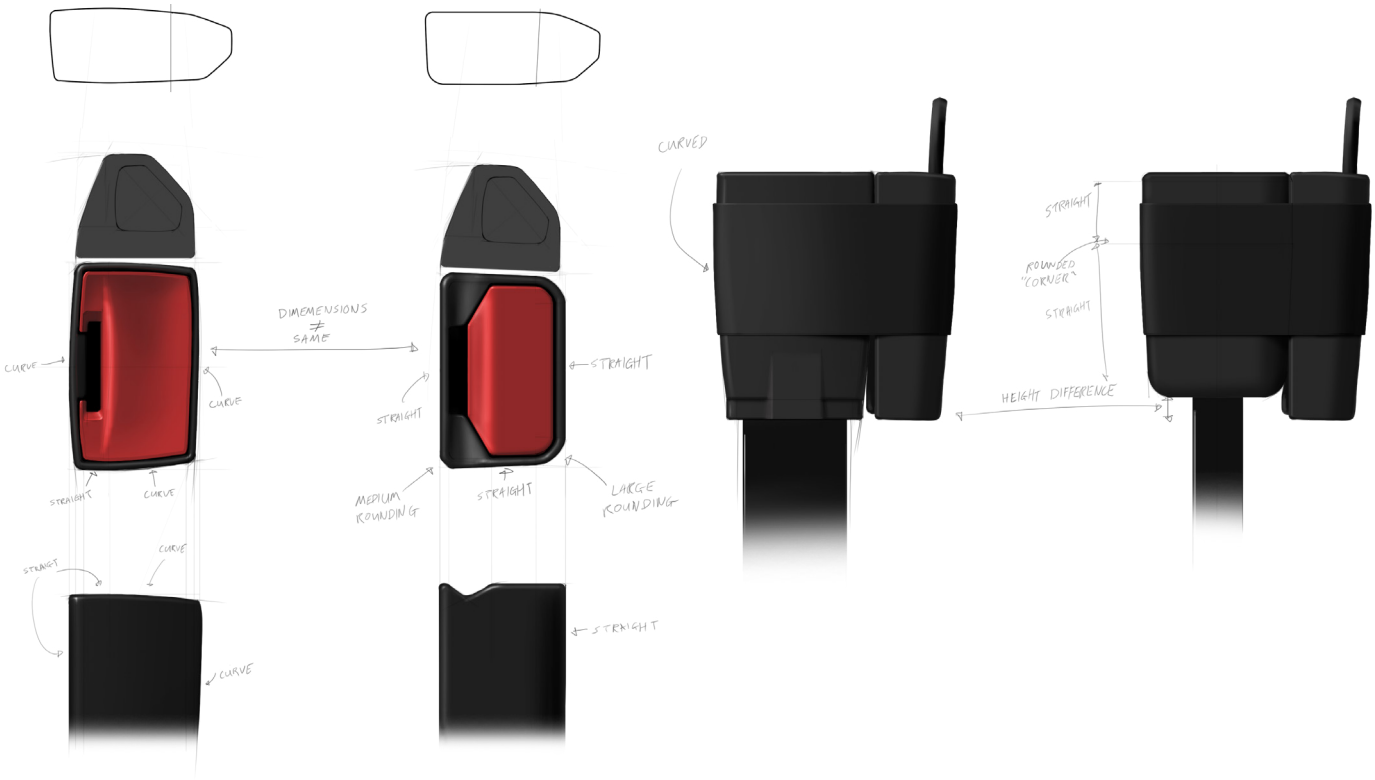


Figure 3.31: Restyle of the sheath

Figure 3.32: The restyled sheath on a receiver.

USER MANUAL

The research showed that the product was hard to understand. One of the ways to counteract this is to supply them with a user manual. Since the product is simple to use once it is clear what it does, a small folded tag was designed. The cover was made in bright "Lifehammer" orange to make it stand out. This folded tag contains three images which explain how to use the prodct. Since all testers immediately knew what the front was, the manual does not mention it. However, it does mention the front as the "head", implying that the pushable part is the front.

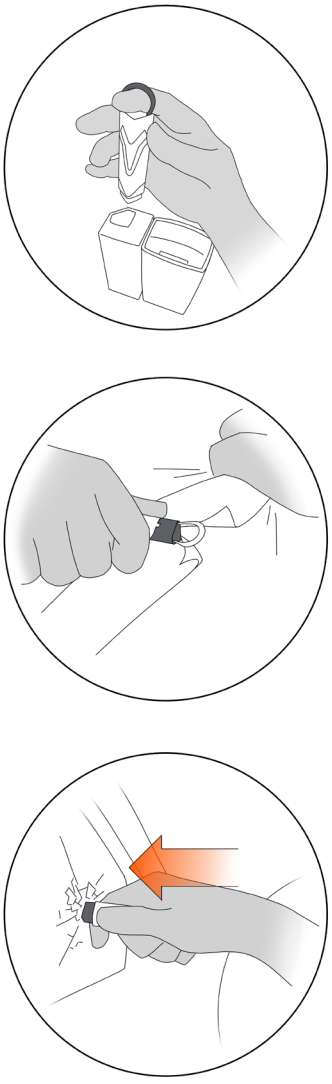


Figure 3.32: The three manual images

Figure 3.33: SBAS with user manual.

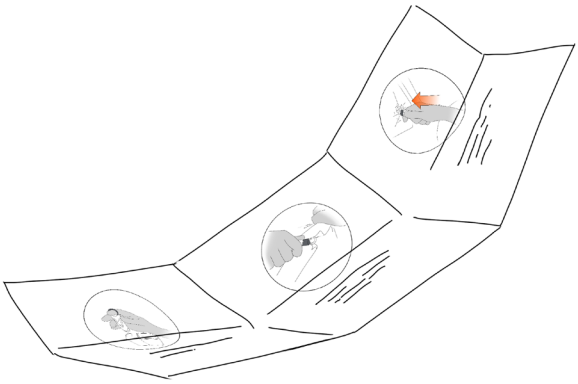
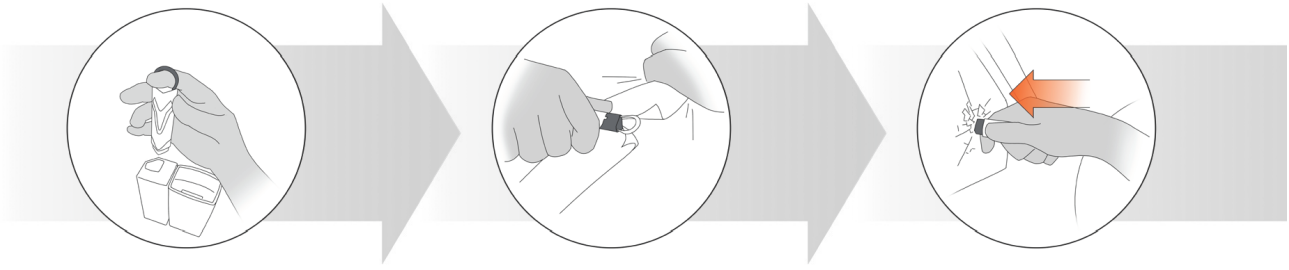


Figure 3.34: User manual folded out.

The interior of the manual explains how the product itself is to be used (Figure 3.35). The exterior explains the right course of action to debunk the widespread myths surrounding sinking cars. It urges the user to try to escape the car as fast as possible.



Haal de hamer uit de houder.

Snijd de gordel door, als de gordel niet los laat. Houd de gordel **strak**.

Zet de **kop** tegen een **hoek** van de zijruit, en druk door.

Figure 3.35: The inside of the manual

Wat te doen als u te water raakt? Geloof niet in de mythe dat u de auto moet laten vollopen. Met elke seconde verkleint u de kans op overleven.

Gebruik de Lifehammer SBAS om uw gordel los te snijden en om uw zijruit in te slaan.

Figure 3.36: The front and simoultaneously the back of the manual

04

EVALUATION

This section discusses the conclusion of the project and reiterates on the recommendations given in the previous chapters, whilst also giving new ones. Wether the project was a succes or not, is also discussed.

THE FUTURE

NOVELTY

The users who tested the early mock up for a several weeks all noted that they definitely noticed the product each time they used the seat belt, thus whenever they took a drive (it is assumed they always put on their seat belts). One user mentioned "worry" that the product would fall off. It can be assumed that this was caused by the attachment method, which was an elastic band that had not been dimensioned well enough. The person with the silicone band did not mention such worries. Both the long-term testers and short-term testers claimed that the product was not noticable once the seat belt was fastened. It is still possible that obese people might, as all the testers were "in shape". The biggest problem was the misunderstanding of the purpose of the product, and how to precisely use it. Compared to the original hammers, Evo and Plus, this is a major disadvantage. However, it was laid out from the start that the targeted sales channel was through dealer and importers. Many of the design choices were with their interests in mind, which is why the product is placed at the most out of sight and universal feature thinkable (and still reachable of course). Early interviews with the dealers showed that they considered the concept to be preferable to the current system. If this target group accepts the new product, all new cars in the Netherlands will soon have a Lifehammer SBAS. just like they have a Evo or Plus at the very moment. Once that happens, the SBAS may become an instantly recognised product in the Netherlands. It is also recommended to Lifehammer to try to get driving schools to inform student drivers on the product. Seeing how explaining the product only takes a few minutes, there is little reason why they would refuse, especially if the product comes with new cars anyway.

FUTURE POSSIBILITIES

Note that the following section is mostly speculation.
Aside from the earlier mentioned ergonomic and technical improvements/adaptasions that can be made, the product may also provide a new future for Lifehammer. Currently, the car industry is not concerned with the problem that Lifehammer solves. Personally, it is felt that the relative small size of Lifehammer is also what keeps it alive. As W. Kets mentioned, as well as other articles, succesful car accesories tend to get integrated into car design (such as cup holders). If Lifehammer would grow large, car companies may see an opportunity to best their competitors by integrating a glass breaker themselves, perhaps even automatic ones. The safest long-term route for Lifehammer may be to become a OEM. If Lifehammer finds a way to develop the SBAS further into an integrated seat belt receiver, they may become one. Once an OEM they may very well be able to sell the product to car manufacturers directly, as opposed to induvidual dealers and importers. However, seeing how yours truly is not a business student this section is to be taken with a grain of salt. That being said, the trend where succesful accesories get "assimilated" by car manufacturers is very real. Lifehammer, as an after-market company should therefor keep out an eye for such threats.

THAT D*MNED KNIFE

Despite several attempts to get the knife working, the prototype ended being able to cut the seat belt on a random basis, and whenever it did, it did so with the greatest effort. The only explanation is the shape of the casing, as the exact same knives (plural!) were used as the Evo. Lifehammer must get this working before producing the product.

CONCLUSION

IMPROVEMENT OR NOT

The project deviated from the original assignment, which was to design an improved attachment system for the current hammers. During the analysis and ideation phase it was found that the possible locations simply did not favour a full sized hammer, unless an integrated solution would be used. Since Lifehammer is not a car manufacturer, and has limited or no influence on the industry, this was out of the question. That was one of the reasons why the SBAS was thought of during the early ideation phase. It was even the very first real idea. However, during this phase, there was a lack of knowledge about the different variations on the receivers, and the difficulty those variances would provide. Ironically, there was an overlap with the problems the current attachment systems face. However, the differences in dimension and shape are nowhere as big in side pockets or middle consoles. Despite the current iteration not fitting perfectly on receivers, it is still considered to be less of a problem with the full size hammers (their size do not help in this case). The real problem is the novelty, as mentioned. But at the same time, if dealers are less reluctant about the SBAS compared to the QCS/EFS, the novelty may wear off. The product was also not experienced as intrusive by the testers, and they were very aware of the presence of the product, as they felt it every time when using the seat belt. These aspects, together with the intuitive location are considered to be a major advantage over the current hammers and their attachment systems; despite the recognisability, many users store them away, and some even do not know wether they have one.

The costs of the product may also be beneficial in regards to the current hammers. Though the exact figures are a confidential and cannot be shown here, most of the costs are for the material. By a large margin. The selected materials for the SBAS are either the same, or roughly equivalent concerning price per kg to the current hammers. As the SBAS is much smaller, it may also have a decreased material cost. However, the SBAS also requires more parts, which may drive up the costs.
The actual costs of mass-produced products are dependent on negotiations with manufacturers and suppliers alike. This was one of the reasons why the costs of the product was only kept in the back of the head.

All things considered it is felt that the SBAS is an improvement over the current hammers and their attachment systems. Seeing how Lifehammer decided to patent the system, it feels like there is much hope for the SBAS. Of course it is also possible that they simply want to cut off their competitors, but it is preferable to think that the product may actually be (mass) produced). However, even if it is mass produced and widely sold, its moral success is entirely dependent on users understanding the product. Wether this will be the case, only time can tell.

FINAL THOUGHTS

The reason I took on this particular assignment was the paradoxical nature of it; to put an after market product that is almost never used, but vital when needed, in an environment that all but universal, and incredibly focussed on aesthetics. This factor was also the main hurdle to overcome, and during the course of the project it never ceased to be both interesting and frustrating. It is perhaps fitting then, that the final result still has some conflicted properties. The location, though present in all cars (like side pockets) is diverse (like side pockets). Fortunately, this diversity is much smaller, as only several different receivers

were found, compared to the countless different side pockets.
Despite its flaws, I personally do feel that the most pressing problems of the QCS/EFS are covered with the SBAS; decreasing the likelyhood that people will remove the product from sight (and reach). It also seems likely that it is much easier for dealers across different brands to install it, as the product is well "hidden". Especially in luxury cars with a high middle console. Still, there is much to improve on the current iteration..

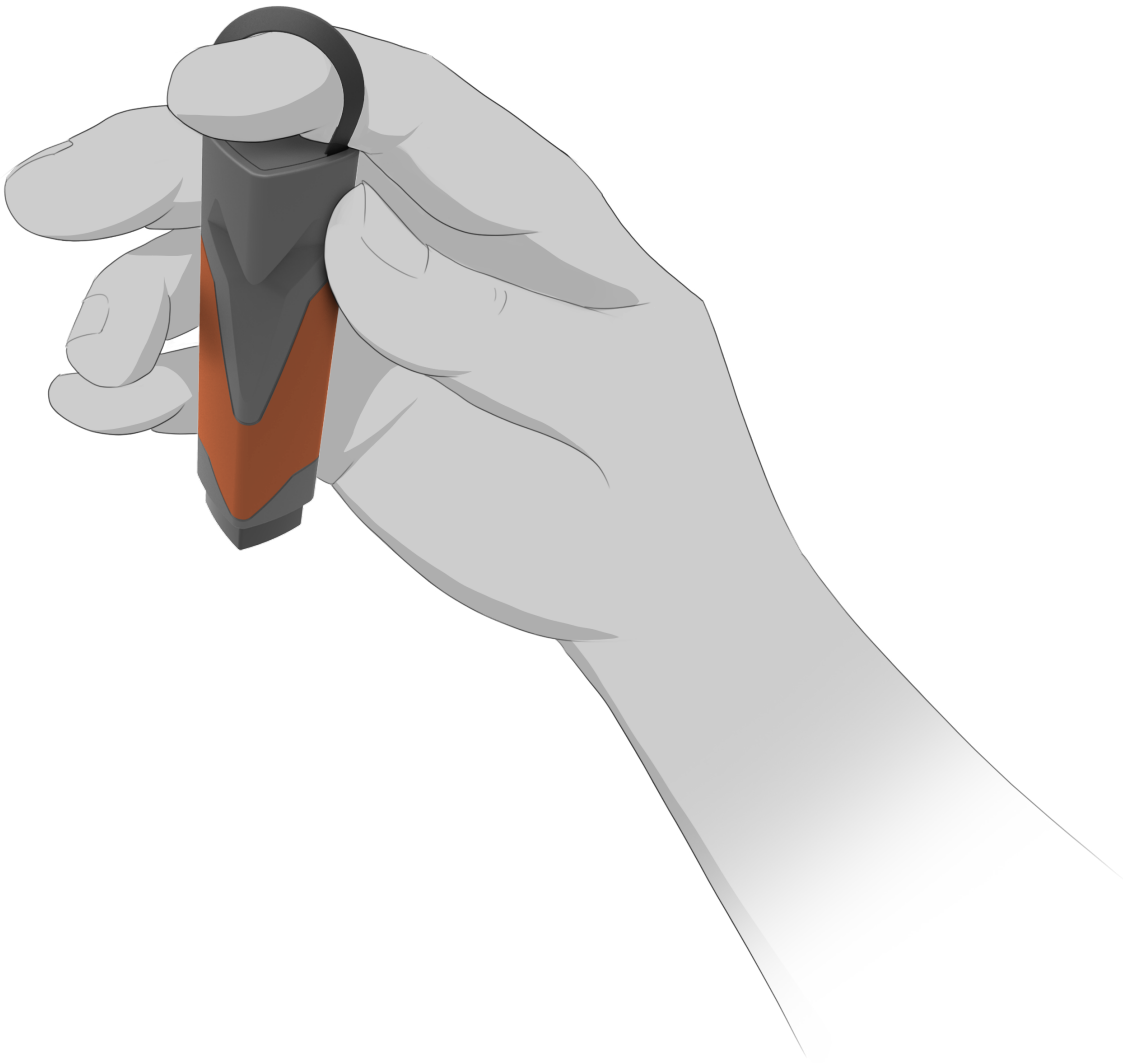


Figure 4: SBAS Hammer in hand.

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APPENDICE

This section holds all the appenice of the project.

APPENDIX I

SURVEY: WHAT TO DO?

Questions (Dutch):
1) Wat is uw leeftijd?

2) Welk merk/model is uw auto?

3) Is uw auto tweedehands?
- ja
- nee

4) Heeft u een noodhamer en waar is het gemonteerd?

5) Wat is de reden dat u (g)een noodhamer heeft?

6) Hoeveel auto's schat u dat er jaarlijks te water raken in Nederland?
- <500
- 500-1000
- 1000-1500
- 1500-2000
- >2000

7) Hoeveel mensen schat u dat er jaarlijks overlijden als gevolg van te water raken met de auto?
- <50
- 50-100
- 100-150
- 150-200
- >200

8) Stel: u raakt in diep water met uw auto, wat moet u doen?
- Zo snel mogelijk via de deur ontsnappen.
- Zo snel mogelijk raam openen en ontsnappen via de opening.
- Zo snel mogelijk raam inslaan en ontsnappen via de opening.
- Wachten tot de auto volledig met water is gevuld; daarna via deur ontsnappen.
- Wachten tot de auto volledig met water is gevuld; daarna ruit open doen en ontsnappen via de opening.
- Wachten tot de auto volledig met water is gevuld; daarna ruit inslaan en ontsnappen via de opening.
- Hulpdiensten bellen en wachten.
- Anders: ...

Survey on: https://docs.google.com/forms/d/e/1FAIpQLSd47M-m0exQ5f7jBoQpQokkeyRxYBEQpEq7Ois6h6LN-77Hjg/viewform?usp=sf_link

SURVEY REPLIES

Tijdstempe	Wat is uw	Welk merk	Is uw auto	Heeft u ee	Wat is de r	Hoeveel a	Hoeveel m	Stel: u raakt in diep w
2019/01/1	26	Volkswage	Ja	Ja, links naast bestuu		500 tot 10	50 tot 100	Zo snel mogelijk ruit i
2019/01/1	28	Volkswage	Ja	Weet ik ni	Nb	1000 tot 1	100 tot 15	Wachten tot de auto
2019/01/1	30	BMW 1ser	Nee	Links onder bij de rijd		500 tot 10	50 tot 100	Wachten tot de auto
2019/01/1	51	Toyota pri	Nee	Ja ligt los i	Veiligheid	1000 tot 1	50 tot 100	Wachten tot de auto
2019/01/1	28	Mazda 2 2	Ja	Ja, bij de v	Voor het g	500 tot 10	50 tot 100	Zo snel mogelijk ruit i
2019/01/1	27	Volkswage	Ja	Nee	Eeeh dont	1500 tot 2	100 tot 15	Zo snel mogelijk ruit i
2019/01/1	53	Chevrolet	Nee	Ja in het h	Zat bij de l	Minder da	Minder da	Wachten tot de auto
2019/01/1	40	Ford Focus	Nee	Ja, onder c	Deze was	Minder da	50 tot 100	Wachten tot de auto
2019/01/1	26	Renault cli	Nee	Ja, links na	Zat er al in	1000 tot 1	50 tot 100	Zo snel mogelijk via d
2019/01/1	28	Opel Corsa	Ja	In het dasł	In het geva	Meer dan	50 tot 100	Wachten tot de auto
2019/01/1	26	Subaru Im	Ja	Geen nooc	Nooit gekc	500 tot 10	Minder da	Zo snel mogelijk ruit i
2019/01/1	26	Mini Coop	Ja	Ja, in het p	Kansen ver	500 tot 10	50 tot 100	Wachten tot de auto
2019/01/1	28	Toyota Au	Ja	Ja, midden	Zat er al in	500 tot 10	150 tot 20	Wachten tot de auto
2019/01/1	29	Renault Cli	Ja	Ja, links va	Zat er stan	500 tot 10	50 tot 100	Zo snel mogelijk ruit i
2019/01/1	25	n/a	Nee	n/a	n/a	1000 tot 1	150 tot 20	Wachten tot de auto
2019/01/1	22	N.v.t.	Nee	N.v.t.	N.v.t.	500 tot 10	Minder da	Zo snel mogelijk ruit i
2019/01/1	5658	Volvo Di M	Nee	Ja, links bc	In geval va	1000 tot 1	50 tot 100	Lampen Aan, ramen c
2019/01/1	28	Renault Tv	Ja	ja, rechts v	Zat erin to	500 tot 10	Minder da	Wachten tot de auto
2019/01/1	34	Ford fiesta	Ja	Ja 2 stuks.	Vind het b	500 tot 10	50 tot 100	Wachten tot de auto
2019/01/1	28	Mini Coop	Ja	Ja, bij voet	Veiligheid	500 tot 10	Minder da	Zo snel mogelijk ruit c
2019/01/1	35	Toyota pri	Nee	Ja	Was al geÂ	Meer dan	150 tot 20	Zo snel mogelijk ruit i
2019/01/1	66	Toyota Pri	Ja	Ja	Deurva	Noodhame	1000 tot 1	50 tot 100	Wachten tot de auto
2019/01/1	22	Opel Meri	Ja	Ja, ligt in h	Veilig idee	500 tot 10	50 tot 100	Wachten tot de auto
2019/01/1	22	Alfa Rome	Ja	Nee	Simpelweg	500 tot 10	50 tot 100	Zo snel mogelijk ruit i
2019/01/2	26	Toyotta 19	Nee	Ja, in de de	Voor het g	500 tot 10	50 tot 100	Wachten tot de auto
2019/01/2	40 maar n	Skoda Oct	Ja	Ja, "los" in	Voor de ve	Minder da	Minder da	Zo snel mogelijk ruit i
2019/01/2	35	Peugeot 1(	Nee	Ja, rechts l	Dan kan ik	Minder da	Minder da	Zo snel mogelijk ruit i

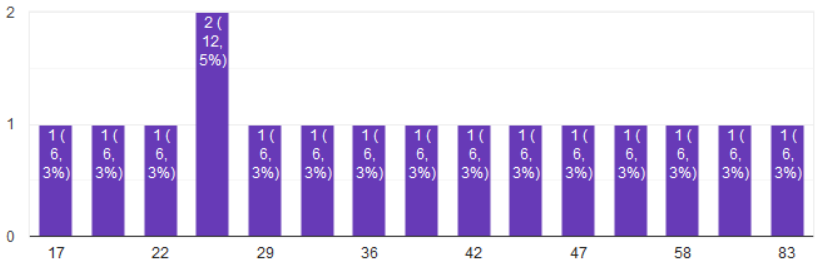
APPENDIX II

INTERNET SURVEY

VRAGEN ANTWOORDEN 16

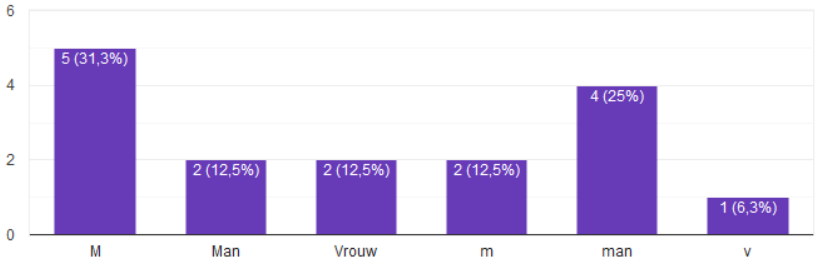
Wat is uw leeftijd?

16 antwoorden



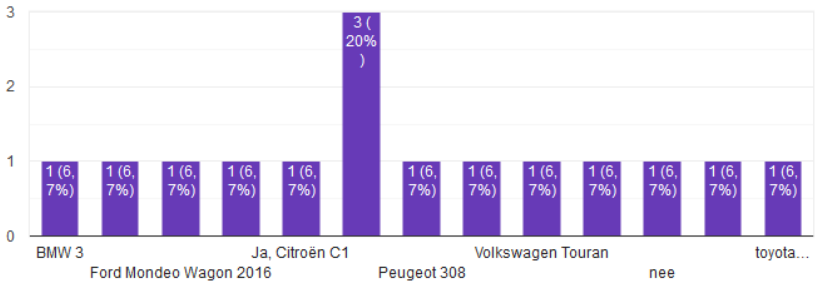
Wat is uw geslacht?

16 antwoorden



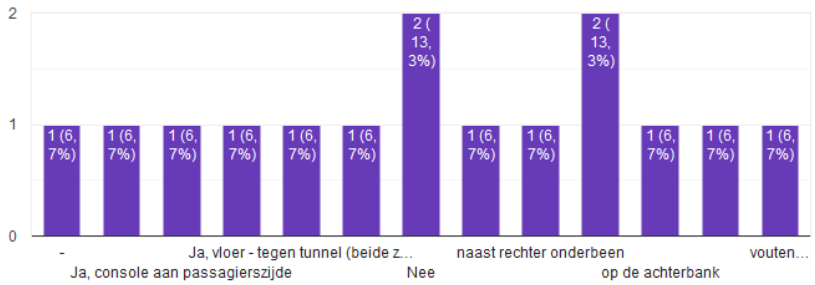
Heeft u een auto? Zo ja, welk merk/model?

15 antwoorden



In Nederland worden noodhamers bij de meeste dealers standaard meegeleverd. Heeft u een noodhamer en weet u waar het is gemonteerd?

15 antwoorden



[redacted]

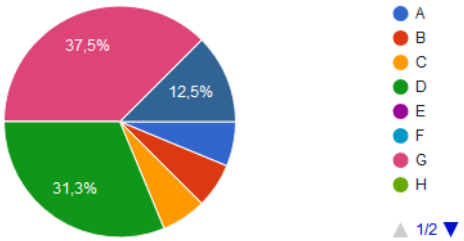
	A	B	C	D	E	F
1	Tijdstempel	Wat is uw leeftijd?	Wat is uw geslacht?	Heeft u een auto? Zo ja, v	In Nederland worden nooc	Stel: u raakt in diep water
2	13-12-2018 20:25:59	29	Man			
3	17-12-2018 11:29:26	83	v	mercedes g 63	op de achterbank	
4	17-12-2018 11:36:29	33	m	seat ibiza	ja, bij de voorstoelen tegen de middentunnel	
5	17-12-2018 12:01:25	36	man	Volkswagen Touran	voutenruimte passagier	
6	17-12-2018 12:24:25	43	man	Ja, Alfa Romeo 159 SW (	Ja, tegen de transmissietunnel	
7	17-12-2018 12:44:34	24	man	toyota corolla ea110	voetruimte passasier. binnen hand bereik.	
8	17-12-2018 13:03:38	22	M	Nee	Nee	
9	17-12-2018 13:59:41	37	man	Peugeot 308	Ja, voetruimte passagier	
10	17-12-2018 14:24:58	56	M	Ford Mondeo Wagon 201	Ja, console aan passagierszijde	
11	17-12-2018 14:33:20	42	M	BMW 5 serie	naast rechter onderbeen	
12	17-12-2018 14:53:27	67	m	nee	nee	
13	17-12-2018 16:58:14	58	M	BMW 3	nee	
14	17-12-2018 19:57:08	21	Man	Ja, Citroën C1	Ja, 1 aan de bestuurdersdeur en 1 aan de passagier	
15	17-12-2018 20:25:46	47	M	Porsche cayenne gts	Ja, vloer - tegen tunnel (beide zijden)	
16	18-12-2018 16:56:51	17	Vrouw	Nee	Nee	
17	19-12-2018 19:56:12	24	Vrouw	Nee	-	

Noodhamers

Welke hamer vindt u het meest betrouwbaar er uit zien?

Welke hamer vindt u het meest betrouwbaar er uit zien?

16 antwoorden



Kunt/wilt u dit nader inlichten?

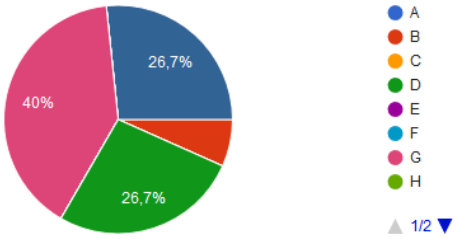
12 antwoorden

Deze zit volgens mij ook in onze auto. Daarnaast heeft hij het uiterlijk van een normale hamer en is hij dubbelzijdig, dus in een panieksituatie maakt het niet uit welke kant je gebruikt.
Ziet er stevig uit, aan 2 kanten te gebruiken, gordel snijder
heeft me al gered
simpel. duidelijke punt
Slaggedeelte aan twee zijden, duidelijk ontwerp zonder onnodig afleidende striping.
De rest lijkt een te korte steel te hebben om echt te kunnen hameren.
Plaatje is klein, maar ik denk een scherpe en een minder scherpe punt te zien. Handvat lijkt verder comfortabel.
het lijkt erop dat je hem kan laten tikken door de greep in te drukken
Door het oranje opvallend, twee "koppen" en dus geen gezeur met wel of niet goed om houden, gordelmes makkelijk te vinden
Ziet er degelijk uit
Het model is simpel en er zijn geen extra dingen erbij toegevoed zoals A

Welke hamer vindt u het meest professioneel er uit zien?

Welke hamer vindt u het meest professioneel er uit zien?

15 antwoorden



Kunt/wilt u dit nader inlichten?

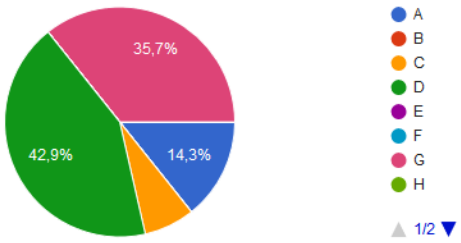
10 antwoorden

Dezelfde reden als hierboven. Ziet er uit als een echte hamer. Net zoals D, maar ik vind D meer plastic.
stevig handvat, geen poespas
lijkt op de meest voorkomende hamers
Zie vorige vraag
Geen. Nee.
door de zwarte kleur
Lijkt het makkelijkst in gebruik. Wat professioneel in dit geval zou inhouden zou ik niet weten.
Metalen look
Je kunt zien waar je grip hebt en er is iets extra aan de zijkant (en bovenkant). De kleur zwart met rood en oranje ziet er ook iets meer 'professioneel' uit
Vooral door de kleuren en het ziet er kwa model simpel uit.

Welke hamer zou u het liefst in een nieuwe auto willen?

Welke hamer zou u het liefst in een nieuwe auto willen?

14 antwoorden



Kunt/wilt u dit nader inlichten?

10 antwoorden

Ligt lekker in de hand en ziet er het meest betrouwbaar uit.
eenvoudig degelijk
lijkt op de meest voorkomende hamers
A.b.
De meeste modellen zien er bombastisch uit.
geen een. ik vind ze te lelijk.
Lijkt me een goede hamer, zie eerdere antwoorden voor extra uitleg.
Opvallende kleur, hamer 2 zijden
Als de hamer op een of andere manier valt in de auto terwijl het niet nodig is, wordt de auto beschermt voor krassen door het klepje.
Het ziet er simpelst uit/ Lijkt makkelijk te gebruiken en de kleur valt meer op dan van de andere modellen, dus kans dat ik het sneller kan vinden in noodsituaties.

APPENDIX III

PRODUCT REVIEWS ANWB

111 reviews over Lifehammer Evolution

Schrijf review

G Verschoor 16-12-2015

Beste uit de test

Mijn keuze voor de lifehammer is bepaald door een Radar test waarin deze als beste uit de test kwam. Ik ben er heel blij mee maar hoop hem nooit te gebruiken. Makkelijk te bevestigen en ik vertrouw erop dat hij in geval van nood doet wat hij moet doen.

M. de Boer 13-12-2015

Degelijke lifehammer

De Lifehammer Evolution wordt geleverd met een handige bevestigingsbeugel om deze in het zicht van alle inzittenden te kunnen monteren. Het product voelt degelijk aan en voldoet volledig aan de omschrijving op de website van de ANWB. Vrij prijzig, maar dat is dit product zeker waard. Het product onderscheidt zich van andere (goedkopere) lifehammers doordat deze ook goed onder water gebruikt kan worden.

Josephine 11-10-2015

Degelijk!

Gelukkig nog niet hoeven te gebruiken, en ik hoop nooit. Hij heeft een heel fijn ophangsysteem en zit goed vast. Hij ligt lekker in de hand en ziet er degelijk uit. Ik ben er blij mee!

J. Roelofs 02-10-2015

Lifehammer

Zeer goed werkende veiligheidshamer

M. Verhagen 24-09-2015

Prima lifehammer

4 stuks besteld voor onszelf en de kinderen; nu voor een mooie prijs. Ziet er goed uit, ligt goed in de hand, is beter te bevestigen dan de oude lifehammers. Eenvoudig te gebruiken, al is dat hopelijk nooit nodig. Ook door mensen met minder kracht toch goed te gebruiken.

P.A. van Kranenburg 18-09-2015

Lifehammer Evolution

Prachtig apparaat, geeft een veiliger gevoel dan het oude hamertje.

henk 24-07-2015

Of the 111 reviews, the latest was in 2015
Website: https://webwinkel.anwb.nl/webwinkel/lifehammer-evolution.html

PRODUCT REVIEWS BOL.COM

Goede rammelaar
EerlijkEerlijk | Groningen | 9 oktober 2018
✓ Ik raad dit product aan

+ degelijk product
+ goede grip
— inschuifbare kop rammelt
— bevestiging beschadigd portier

Het product is stevig en de keramische punt komt er krachtig uit als ik hem op mijn hand probeer. De handgrip biedt veel houvast door zijn rubberachtige coating. Hij lijkt perfect voor zijn functie.

Het vervelendste is dat de inschuifbare kop iets speling heeft, waardoor hij ergerlijk rammelt. Voor een veiligheidshamer die altijd in de auto zit een grove fout. Daarnaast heeft de houder die je in de portier bevestigd een klein kopje van hard plastic. Dit kan de portier beschadigen of bij portieren met zachte kunststoffen voor een blijvende vervorming zorgen door het kleine kopje.

Vond je dit een nuttige review?
0 0 Ongepaste review?

Gelukkig nog niet gebruikt
MR70 | emmeloord | 25 december 2014
✓ Ik raad dit product aan

+ Goede kwaliteit
+ goede prijs/kwaliteit verhouding

Of deze life hammer goed werkt, kan ik gelukkig nog niet vertellen. Het bestellen en de levering waren in ieder geval weer goed in orde bij Bol.com

De life hammer voelt solide en is gemakkelijk te bevestigen.

Vond je dit een nuttige review?
0 0 Ongepaste review?

3 kapotte broeken door houder!
MarcVerm | Hoek van Holland | 7 oktober 2018

De hamer (of eigenlijk schiet-pin-systeem) zal vast werken, maar bij de derde kapotte broek kwam ik erachter dat dit komt door de achterkant van het inbusschroefje van de houder die blijkbaar behoorlijk scherp is. Exact zoals geadviseerd aan de binnenkant van de deur op een vak bevestigd. Resultaat 3 winkelhaken in twee splinternieuwe en 1 oudere broek, schade zo'n 300 Euro. Fijn en bedankt! Dit is gewoon een designfout van de houder, de schroef (achterkant) moet gewoon afgeschermd worden, want bij het uitstappen raak je deze. Hamer nu maar ergens los in de auto gelegd :(

Vond je dit een nuttige review?
1 0 Ongepaste review?

Negative reviews regarding the QCS.
Website: https://www.bol.com/nl/p/lifehammer-evolution-veiligheidshamer/9200000033386885/

APPENDIX IV

INTERVIEW: M. CHRISTENSEN

The following text is paraphrased from the actual (Dutch) interview). Important statements were double checked with M. Christensen. The interview was conducted on January 7, 2019.

Do you see a certain trend concerning the year of manufacture of the cars?

Nothing in particular"

In what kind of state are the cars (smashed windows, blocked doors)?

Sometimes, a car ends up in water due to another accident (such as hitting a tree or another car).
The "cage" is usually intact the bumpers and engine cover are sometimes crumpled.
The seat belts are often blocked.

In what kind of state are the victims (what kind of injuries do they have)?

"Nothing noteworthy in particular" (There has been an increase in rescue operations for refugees)

Some are declared dead on the spot, others may die on their way to (or in) the hospital

"As soon as the car is completely submersed, the chances of survival are slim"

How do you get to the victims?

"The standard procedure is to smash the windows." Due to the surface area of a door panel, the water resistance is high. Moreover, a diver does not always have a surface to plant their feet in, making is difficult to open the doors. Smashing a window requires less time ; Tools use include (not limited to), the Evo, Classic, or dive knife. Certain cases require sawing; some police cars are polymer windows, which cannot be smashed.

What kind of impact do car-safety measures (safety belt, airbags, etc.) have on your work during a rescue operation?

The safety belts need to be cut through, as it is difficult to get to the receiver under water. The Evo is often used for this as well, but this seems to be difficult ("Knife/razor does not work").
Have you ever had to rescue someone who had an emergency hammer?

"Never experienced this personally, or heard of about it from others"
People are in such a state of panic that at least in one case, someone tried clawed away the lining of the door panel.

CONVERSATION WITH E. VAN GRONDELLE

The following text is summarised from the actual (Dutch) conversation). The conversation was held on December 18, 2018.

Accessories tend to become embedded into car design; after-market products get integrated during the design phase (eg. Cupholders and car radios).

Currently, the trends in the automobile world are a move towards autonomous driving and car sharing. Both trends have a significant effect on car (interior) design. In the case of autonomous driving, the car interior will become more like a living room, aimed primarily on comfort. Car sharing on the other hand, has different requirements. The ease with which a car can be cleaned, for example, since the car will have many users. This means that many compartments will disappear, and stain-resistant materials will be preferred over comfortable materials. In both cases, the interior will become highly flexible (eg. Different seat configurations like the Espace). This general trend of a more flexible interior design is a long-term phenomenon. On the short-term, most of the changes will be from a stylistic point of view; the much-used chrome linings will disappear.

With the progresses made in electronics, the interior will also become more spacious, though not long ago the opposite was the case, as the progression in technology meant that more and more features were added. Current interiors are saturated concerning these features, and these features will decrease in size.
Platform sharing; platform sharing means that designers have set dimensions to work with, limiting their freedom. This means that interiors may become more flexible to still allow for a distinct design.

Telematics; carmakers believe that driverless cars are the future. The required infrastructure is still lacking however. In order lay down the ground works, carmakers have started installing telematics in their cars, which provide data.

CONVERSATION WITH W. KETS

The following text is summarised from the actual (Dutch) conversation). The conversation was held on Februari 1, 2019.

After market products like child seats are taken into account when designing car interior.
Some industry "rules" (not due to regulations, but for more sales) are:

- Side door panels must fit an A4 (a map)
- There must be a cupholder which can fit a 0.5 L bottle (1.5L for large cars)

The middle console will remain in most near-future cars, even though designers prefer not to have one; the lack of a middle console creates a more spacious experience. Exceptions are platforms which are built from the ground for electric cars (such as i3). For this project, there will most likely be a middle console.
Designers have to "fight" for every single centimetre.
There are currently no specific interior trends to be seen when it comes to styling.
Due to CO2 regulations, car makers make more use of cheaper materials (mostly hidden from sight).
One on-going trend is standardisation, such as platform sharing, to reduce costs.

APPENDIX V

RECEIVER DIMENSIONS

	A	B	C	D	E	F
1	Car Brand	**L**ength	**W**idth	**H**eight	Cup	Clow
2	Toyota	51.2	32.9	73	173	157
3	VW	50.5	30.1	75	148	125
4	Citroën	49.5	32.1	78	148	123
5	Tesla	55	33.9	71	167	150
6	Mercedes	49.4	29.9	72.6	148	125
7	Fachin	50.5	29.5	79.8		

APPENDIX VI

POPULAR CARS IN THE NETHERLANDS

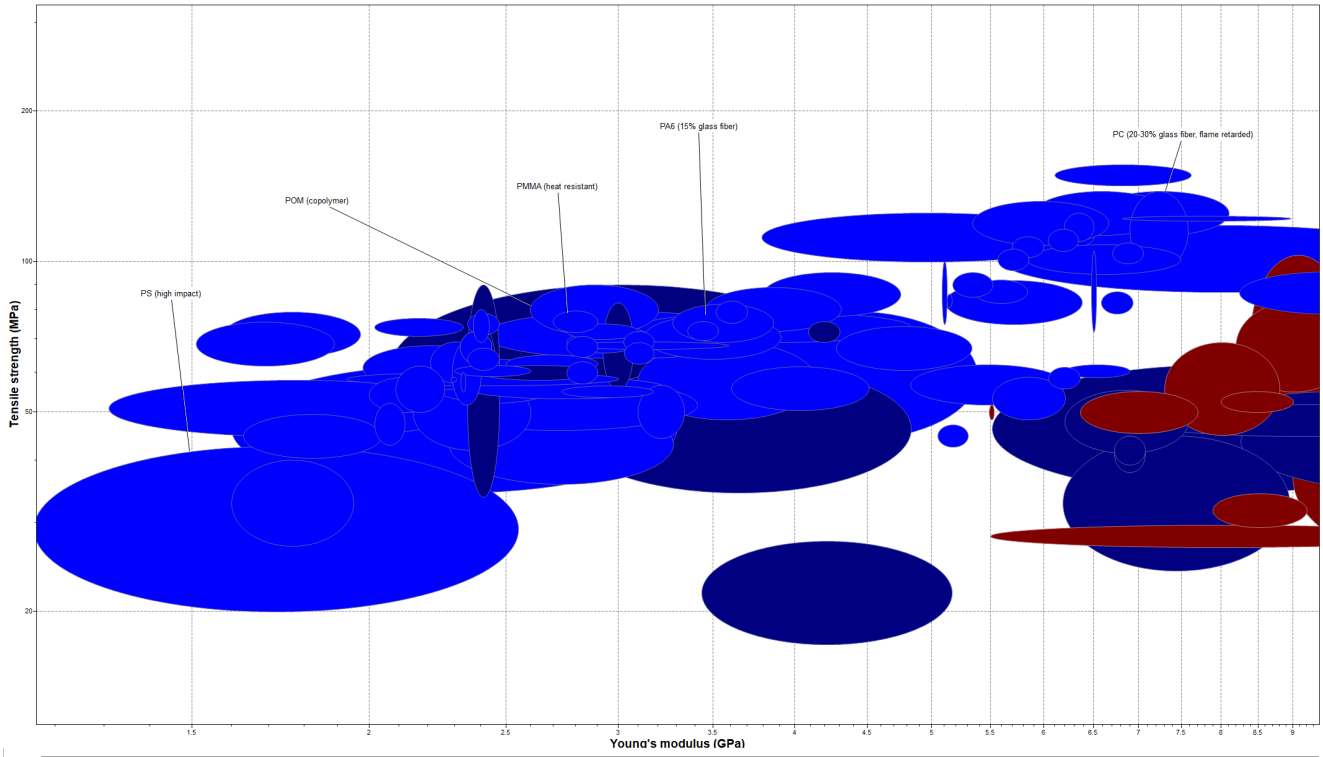
Brand n Model	Percentag	Aantal	segment
VW Polo	3.28	14676	B
Renault Clio	2.69	12023	B
Kia Picanto	2.46	11008	A
Ford Fiesta	2.44	10903	B
Opel Karl	2.27	10156	A
VW Up	2.26	10090	A
VW Golf	2.18	9461	C
Peugeot 108	2.03	9090	A
Renault Captur	1.76	7866	J
Toyota Aygo	1.7	7621	A
Opel Astra	1.61	7192	C
Toyota Yaris	1.55	6927	B
Renault Megane	1.5	6690	C
Skoda Octavia	1.47	6591	C
Peugeot 208	1.47	6589	B
Nissan Qashqai	1.4	6248	J
Ford Focus	1.37	6122	C
Hyundai i10	1.35	6050	A
Opel Corsa	1.31	5856	B
Kia Niro	1.31	5852	J
VW Tiguan	1.3	5805	J
Tesla Model S	1.26	5622	F
Fiat 500	1.06	4732	A
Toyota C-HR	1.05	4698	J
Renault Twingo	1.04	4665	A
Peugeot 3008	1.03	4596	J
Volvo V40	1.02	4547	C
Peugeot 2008	1	4489	J
Citroen C3	1	4459	B
VW T-Roc	1	4454	J
Nissan Micra	0.99	4424	B
Citroen C1	0.98	4369	A
Peugeot 308	0.96	4274	C
Mazda CX-5	0.95	4244	J
Mini Mini	0.94	4216	B
Opel Crossland X	0.87	3899	J
Audi A3	0.86	3841	C
Volvo V60	0.79	3553	D
Jaguar I-Pace	0.79	3526	J
BMW 3-serie	0.77	3453	D
Nissan Leaf	0.76	3384	C
Skoda Fabia	0.75	3366	B
Opel Grandland	0.75	3366	J
Mitsubishi Space Star	0.75	3335	M
BMW 5 Serie	0.71	3176	E
Suzuki Swift	0.68	3047	B
Tesla Model X	0.66	2963	J
Mercedes A	0.65	2924	C
Mercedes C	0.65	2910	D
Peugeot 5008	0.65	2898	J
BMW 1 serie	0.63	2828	C
Volvo XC40	0.63	2815	J
Seat Ibiza	0.62	2786	B
VW Passat	0.59	2641	D
Volvo XC60	0.59	2625	J
Suzuki Ignis	0.58	2593	J
Seat Leon	0.58	2588	C
Hyundai Kona	0.58	2562	J
Audi A4	0.56	2507	D
Toyota Auris	0.55	2480	C
Mercedes B	0.55	2452	M
Ford Kuga	0.53	2373	J
Kia Sportage	0.52	2341	J
Renault Scenic	0.52	2328	M
Renault Kadjar	0.52	2312	J
Ford Ecosport	0.5	2229	J
Skoda Citigo	0.5	2225	A
BMW 2 tourer	0.49	2176	M
Citroen C3 Aircross	0.48	2166	J
BMW X1	0.48	2164	J
Hyundai i20	0.48	2162	B
Hyundai Ioniq	0.47	2116	C
Seat Arona	0.47	2116	J
Audi A1	0.47	2104	B
Kia Rio	0.46	2074	C
Skoda Superb	0.46	2060	D
Mazda CX-3	0.46	2060	J
Kia Ceed	0.46	2056	C
Mazda 2	0.44	1980	B

A	B	C	J	D	E	F	M	
11008	14676	7192	7866	3553	3176	5622	3335	
10156	12023	6690	6248	3453	1646		2452	
10090	10903	6591	5852	2910	1332		2328	
9090	6927	6122	5805	2641			2176	
7621	6589	4547	4698	2507			1404	
6050	5856	4274	4596	2060				
4732	4459	3841	4489	1925				
4665	4424	3384	4454	1765				
4369	4216	2924	4244					
2225	3366	2828	3899					
1935	3047	2588	3526					
1615	2786	2480	3366					
1438	2162	2116	2963					
1333	2104	2074	2898					
	1980	2056	2815					
		1435	2625					
			2593					
			2562					
			2373					
			2341					
			2312					
			2229					
			2166					
			2164					
			2116					
			2060					
			1945					
			1801					
			1735					
			1679					
			1526					
			1510					
			1491					
			1472					
			1419					TOTAL:
76327	85518	61142	107838	20814	6154	5622	11695	375110
Percentag 20%	23%	16%	29%	6%	2%	1%	3%	

Kia Stonic	0.43	1945	J
Suzuki Celerio	0.43	1935	A
Mercdedes CLA	0.43	1925	D
Skoda Karoq	0.4	1801	J
Opel Insignia	0.39	1765	D
Citroen C4 cactus	0.39	1735	J
Opel Mokka	0.38	1679	J
Mercedes E	0.37	1646	E
BMW i3	0.36	1615	A
BMW 4 serie	0.35	1564	D
Audi Q2	0.34	1526	J
Skoda Kodiaq	0.34	1510	J
Seat Ateca	0.33	1491	J
Mini countryman	0.33	1472	J
Fiat Panda	0.32	1438	A
Dacia Logan	0.32	1435	C
Hyundai Tucson	0.32	1419	J
Citroen C4 Picasso	0.31	1404	M
Volvo V90	0.3	1337	E
Smart Forfour	0.3	1333	A
Audi A6	0.3	1332	E
Percentag	86.69		

APPENDIX VII

MATERIAL SELECTION



APPENDIX IIX

BRIEF

DESIGN FOR our future

TU Delft

IDE Master Graduation

Project team, Procedural checks and personal Project brief

This document contains the agreements made between student and supervisory team about the student's IDE Master Graduation Project. This document can also include the involvement of an external organisation, however, it does not cover any legal employment relationship that the student and the client (might) agree upon. Next to that, this document facilitates the required procedural checks. In this document:

- The student defines the team, what he/she is going to do/deliver and how that will come about.
- SSC E&SA (Shared Service Center, Education & Student Affairs) reports on the student's registration and study progress.
- IDE's Board of Examiners confirms if the student is allowed to start the Graduation Project.

USE ADOBE ACROBAT READER TO OPEN, EDIT AND SAVE THIS DOCUMENT
Download again and reopen in case you tried other software, such as Preview (Mac) or a webbrowser.

STUDENT DATA & MASTER PROGRAMME

Save this form according the format "IDE Master Graduation Project Brief_familyname_firstname_studentnumber_dd-mm-yyyy".
Complete all blue parts of the form and include the approved Project Brief in your Graduation Report as Appendix 1 !

family name	Park
initials	E H
given name	David
student number	4107772
street & no.	Buitenwatersloot 21 N
zipcode & city	2613 TA Delft
country	The Netherlands
phone	+31642675322
email	david_park20@live.nl

Your master programme (only select the options that apply to you):

IDE master(s): (★) IPD ( ) DfI ( ) SPD

2nd non-IDE master:

individual programme: - - (give date of approval)

honours programme: ( ) Honours Programme Master

specialisation / annotation: ( ) Medisign ( ) Tech. in Sustainable Design ( ) Entrepeneurship

SUPERVISORY TEAM **

Fill in the required data for the supervisory team members. Please check the instructions on the right !

** chair	ir. I.A. Ruiter	dept. / section:	ID / AED
** mentor	J. Kuiper	dept. / section:	ID / HICD
2nd mentor	H. van Rijn		
	organisation: Life Safety Products BV.		
	city: Zoetermeer	country:	The Netherlands

comments (optional)

Chair should request the IDE Board of Examiners for approval of a non-IDE mentor, including a motivation letter and c.v..

Second mentor only applies in case the assignment is hosted by an external organisation.

Ensure a heterogeneous team. In case you wish to include two team members from the same section, please explain why.

Procedural Checks - IDE Master Graduation

TU Delft

APPROVAL PROJECT BRIEF
To be filled in by the chair of the supervisory team.

chair ir. I.A. Ruiter date - - signature

CHECK STUDY PROGRESS
To be filled in by the SSC E&SA (Shared Service Center, Education & Student Affairs), after approval of the project brief by the Chair.
The study progress will be checked for a 2nd time just before the green light meeting.

Master electives no. of EC accumulated in total: EC

Of which, taking the conditional requirements into account, can be part of the exam programme EC

List of electives obtained before the third semester without approval of the BoE

YES all 1st year master courses passed

NO missing 1st year master courses are:

name date - - signature

FORMAL APPROVAL GRADUATION PROJECT
To be filled in by the Board of Examiners of IDE TU Delft. Please check the supervisory team and study the parts of the brief marked **.
Next, please assess, (dis)approve and sign this Project Brief, by using the criteria below.

- Does the project fit within the (MSc)-programme of the student (taking into account, if described, the activities done next to the obligatory MSc specific courses)?
- Is the level of the project challenging enough for a MSc IDE graduating student?
- Is the project expected to be doable within 100 working days/20 weeks ?
- Does the composition of the supervisory team comply with the regulations and fit the assignment ?

Content: APPROVED NOT APPROVED

Procedure: APPROVED NOT APPROVED

comments

name date - - signature

Initials & Name E H Park Student number 4107772

Title of Project The Lifehammer Solution

Personal Project Brief - IDE Master Graduation

TU Delft

The Lifehammer Solution — project title

Please state the title of your graduation project (above) and the start date and end date (below). Keep the title compact and simple. Do not use abbreviations. The remainder of this document allows you to define and clarify your graduation project.

start date 27 - 11 - 2018 — 14 - 05 - 2019 end date

INTRODUCTION **

Please describe, the context of your project, and address the main stakeholders (interests) within this context in a concise yet complete manner. Who are involved, what do they value and how do they currently operate within the given context? What are the main opportunities and limitations you are currently aware of (cultural- and social norms, resources (time, money,...), technology, ...).

With ever increasing safety standards for transport vehicles, it is no surprise that external companies have started developing safety products. One of such companies is Lifehammer Products, henceforth mentioned as Lifehammer, a company known for being the inventor of the emergency hammer. Lifehammer has noted that the current attachment system for their two main hammers are suboptimal. Though there is a third hammer, this one is mostly sold to public transport companies, and will be left out of the scope for this assignment.

The essence of the problem has been described by Lifehammer as a lack of awareness of safety in cars, or more specifically the awareness concerning emergency hammers; many consumers do not realise the importance of the emergency hammer; some even throw it in their trunk. As it stands, the mission of this project is to tackle this problem by "designing an aftermarket attachment system for consumer cars which is both easy to use and not intrusive."

Thusfar, the following stakeholders have been identified:
- Lifehammer
- Car importers
- Car dealers
- Mechanics,
- Retailers
- Car owners
- Potential users

Most of the hammers end up with consumers through car dealers; Lifehammer supplies the hammers to car importers, who then supply the associated dealers.
Lifehammer also supplies retailers with their hammers, such as ANWB shops.

When delivered by the dealer, the product is placed by them; consumers can choose whether to have it attached to the side panels (figure 2), or their center console. It is also possible to have it delivered loose. When the product is purchased separately, consumers will have to attach it themselves. Car companies do not fall within the scope, as they are not directly involved.

The result is currently set as a new or improved attachment system for the emergency hammers of Lifehammer. Unless there is a very strong argument for it, the hammer itself will not be a variable.

space available for images / figures on next page

introduction (continued): space for images

image / figure 1: The two hammer variants

image / figure 2: One of the possible positions

Personal Project Brief - IDE Master Graduation

TU Delft

PROBLEM DEFINITION **

Limit and define the scope and solution space of your project to one that is manageable within one Master Graduation Project of 30 EC (= 20 full time weeks or 100 working days) and clearly indicate what issue(s) should be addressed in this project.

It is reasonable to assume that the lack of awareness among consumers is a problem. Initial responses of acquaintances, friends, and family have confirmed this, as well as the complaints from car dealers. The awareness problem can be divided into several sub-sections;
- involvement; as many get the product without being asked to (specifically those who buy from Volkswagen dealers)
- visibility; some owners put the hammers out of sight, which means that a passenger may not know where to find one
- reachability; depending on where the product is located, some may not be able to reach it. It is also not unheard of owners putting the hammer in their trunks, making it impossible to reach it when needed.

Another problem is that the hammer in its current attachment system can be intrusive; many have knocked it over during (dis)embarking. This causes many users to simply put the hammer out sight and reach, which causes or exacerbates the visibility and reachability problems mentioned before. The aesthetics of the product will also play a role, since it must be visible. The fact that car interiors can be a decisive factor when choosing a car, so the product must not look completely out of place. The problem with this is that the emergency hammer is an after-market product, aimed at all/most cars, whereas a car interior is specifically designed for the car, especially luxury cars.

ASSIGNMENT **

State in 2 or 3 sentences what you are going to research, design, create and / or generate, that will solve (part of) the issue(s) pointed out in "problem definition". Then illustrate this assignment by indicating what kind of solution you expect and / or aim to deliver, for instance: a product, a product-service combination, a strategy illustrated through product or product-service combination ideas, ... In case of a Specialisation and/or Annotation, make sure the assignment reflects this/these.

The result of the assignment will an attachment system for emergency hammers in consumer cars. The design will depend on the results of research into safety awareness, the market, and user-friendliness.

The initial analysis phase will focus on the following:
- Ergonomics
- Aesthetics
- Trends
- Stakeholders

Based on the findings of the analysis phase, a new attachment system will be developed. This new design will be tested on the ergonomics and aesthetics, just like the current system. Naturally, the new design must be an improvement.

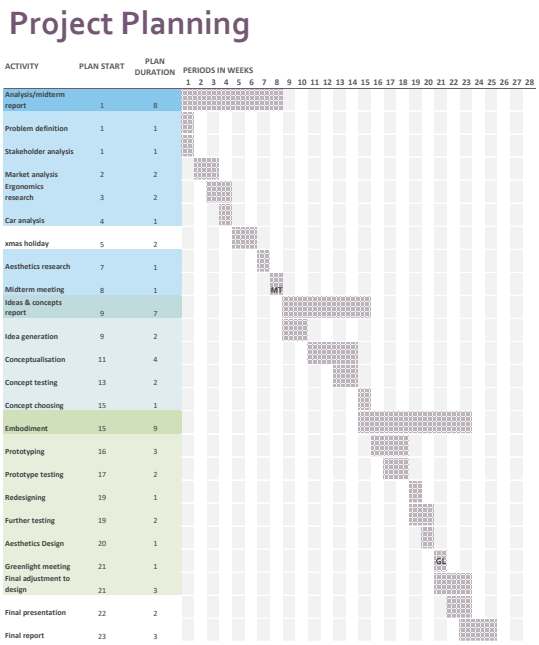
Initials & Name E H Park Student number 4107772

Title of Project The Lifehammer Solution

PLANNING AND APPROACH **

Include a Gantt Chart (replace the example below - more examples can be found in Manual 2) that shows the different phases of your project, deliverables you have in mind, meetings, and how you plan to spend your time. Please note that all activities should fit within the given net time of 30 EC = 20 full time weeks or 100 working days, and your planning should include a kick-off meeting, mid-term meeting, green light meeting and graduation ceremony. Illustrate your Gantt Chart by, for instance, explaining your approach, and please indicate periods of part-time activities and/or periods of not spending time on your graduation project, if any, for instance because of holidays or parallel activities.

start date 27 - 11 - 2018 14 - 5 - 2019 end date



The letters MT stand for the midterm meeting, and GL stands for greenlight. The kick-off meeting has already been had, but the company mentor is indisposed for the first few days, so the project will officially commence on November 27th. It should be noted that I still follow the old Masters programme, so the project is set for 33 EC, hence the total amount of weeks of 25.

The planning as shown above is based on the amount of weeks. The day to day planning will be done with post-its on my chamber wall, since I much prefer a more flexible approach when it comes to the smaller tasks.

Personal Project Brief - IDE Master Graduation

TU Delft

MOTIVATION AND PERSONAL AMBITIONS

Explain why you set up this project, what competences you want to prove and learn. For example: acquired competences from your MSc programme, the elective semester, extra-curricular activities (etc.) and point out the competences you have yet developed. Optionally, describe which personal learning ambitions you explicitly want to address in this project, on top of the learning objectives of the Graduation Project, such as: in depth knowledge a on specific subject, broadening your competences or experimenting with a specific tool and/or methodology, ... Stick to no more than five ambitions.

What I enjoy most in a design process is trying to find the essence of a multi-layered problem and coming up with realistic solutions. This is something I always aim to improve, as I believe that understanding the core problem is vital for any result. For this reason, the assignment as described by Lifehammer seemed a perfect match; the apparent simplicity of the issue hides several problems, all of which can be explored in depth and have a notable effect on the product.
Another competence I wish to improve is styling of products. Making something easy on the eyes is easy enough, but to make meaningful styling decisions with a reason d'etre is a skill I wish to develop further.
Since this is an individual project, I also consider the assignment as an opportunity to develop myself as a more independent designer. Seeing as I currently do not know in what field I wish to work, it may very well be the case that I will start out as a freelancer; being able to manage a project on my own would certainly be a welcome skill then. Besides, it would be nice for once if I did not have to pull off many all-nighters, though I do not mind one or two.

FINAL COMMENTS

In case your project brief needs final comments, please add any information you think is relevant.

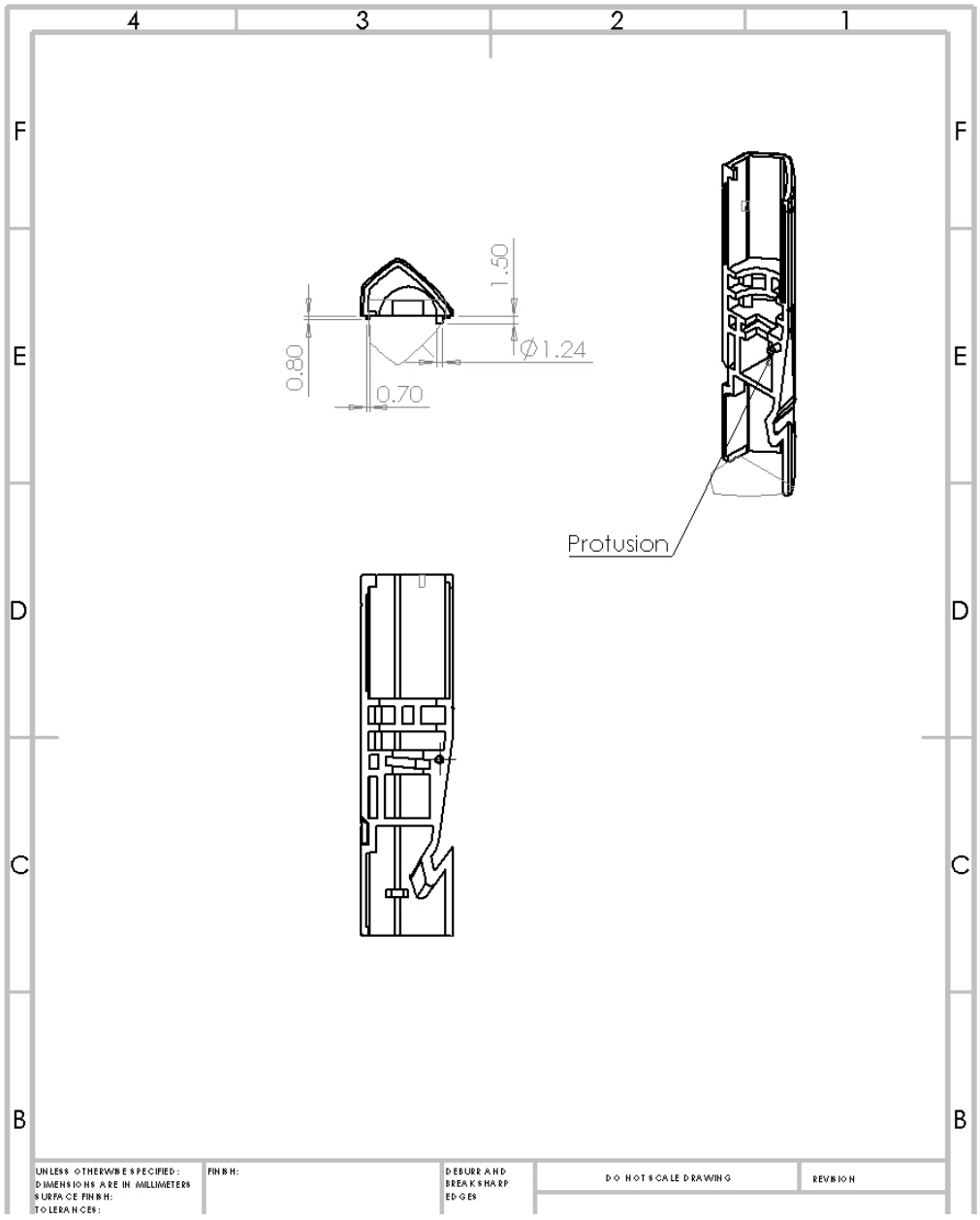
Initials & Name E H Park Student number 4107772

Title of Project The Lifehammer Solution

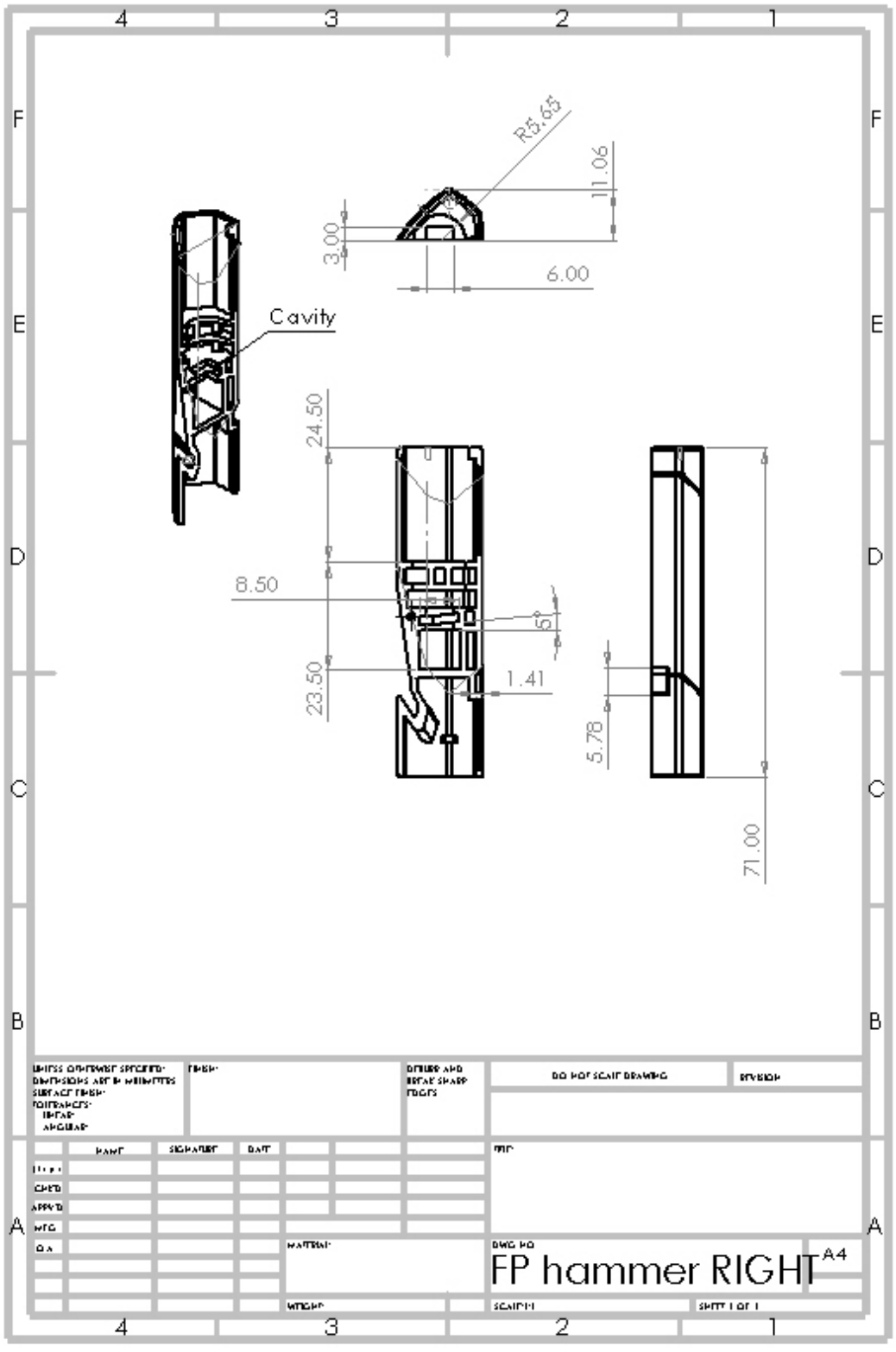
APPENDIX IX

PROTOTYPE

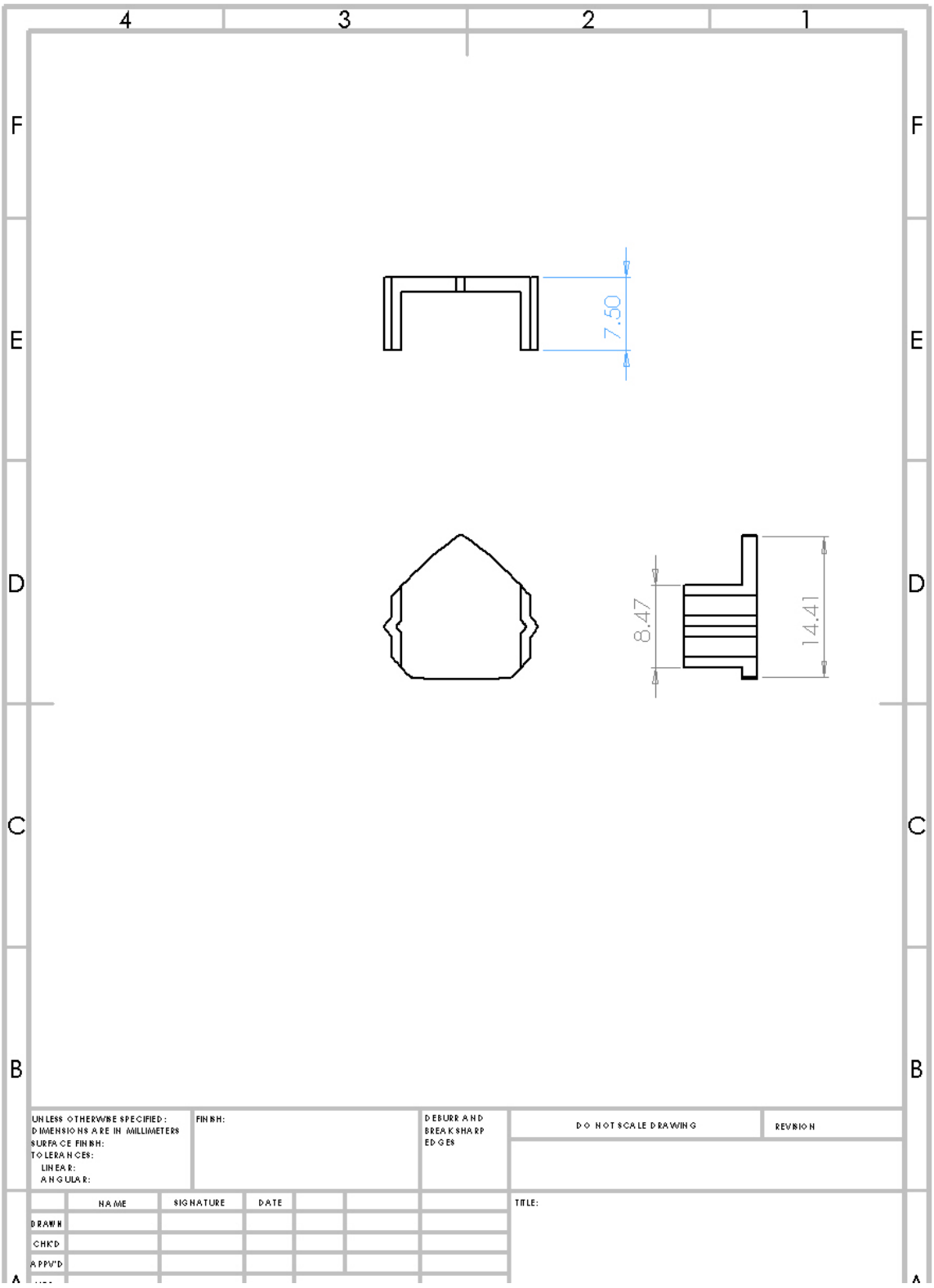
The following drawings are "technical" drawings of the prototype. Note that these are not for mass-production. Wall thickness is 1.5mm due to limitations of 3D printing. Special thanks to H. Van Rijn for improvements.



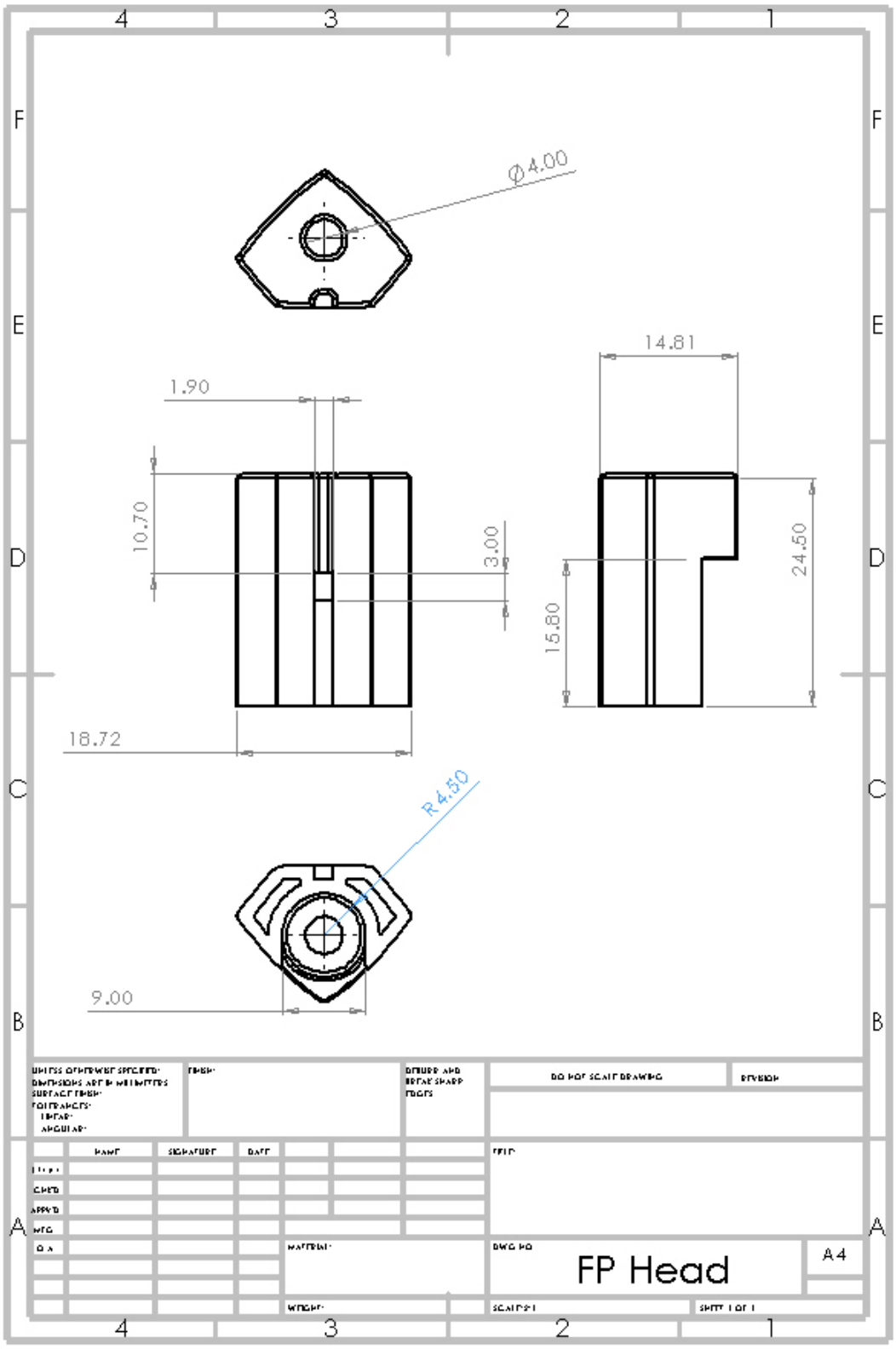
Left half of casing; this half has protrusions



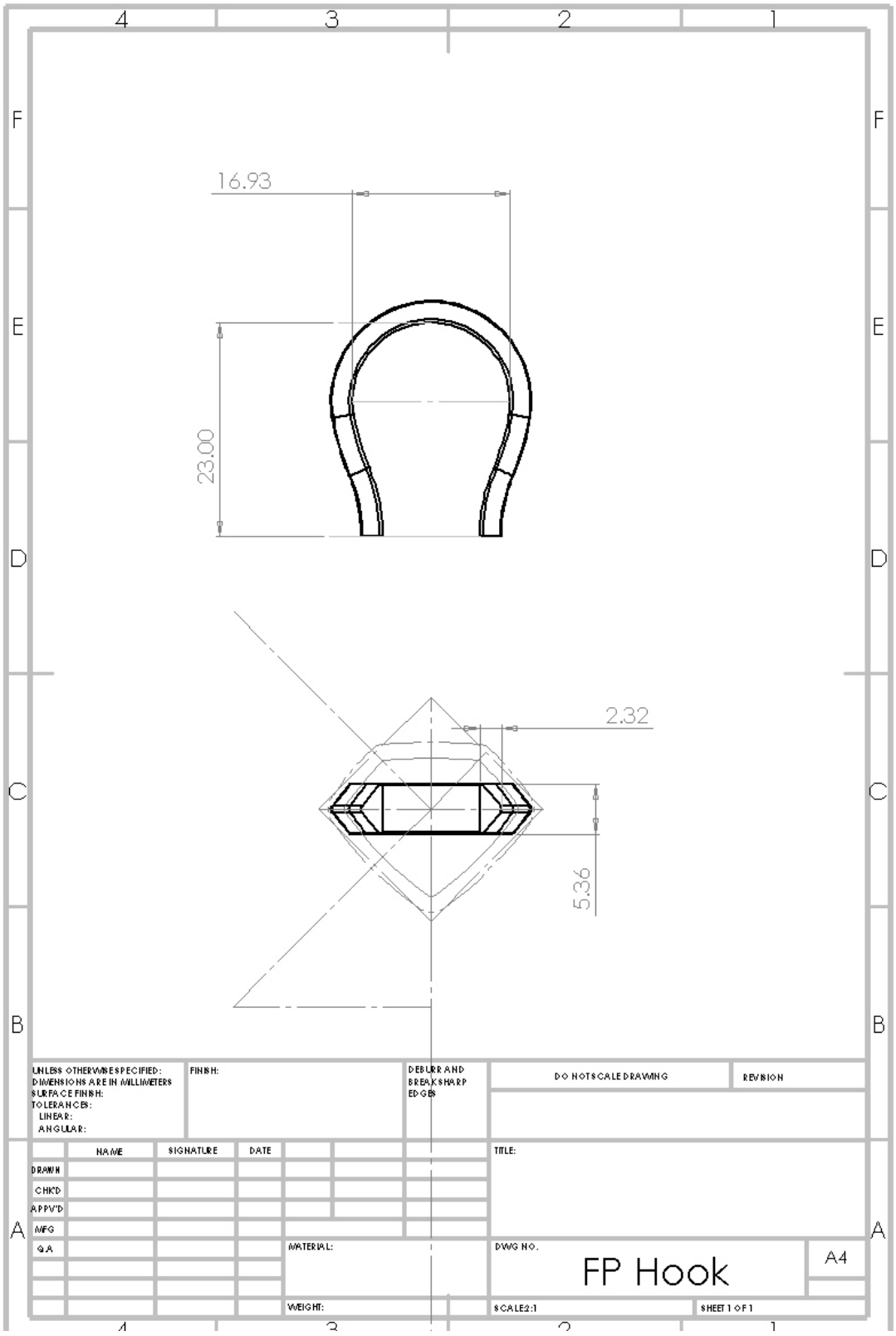
Right half; this version has cavities



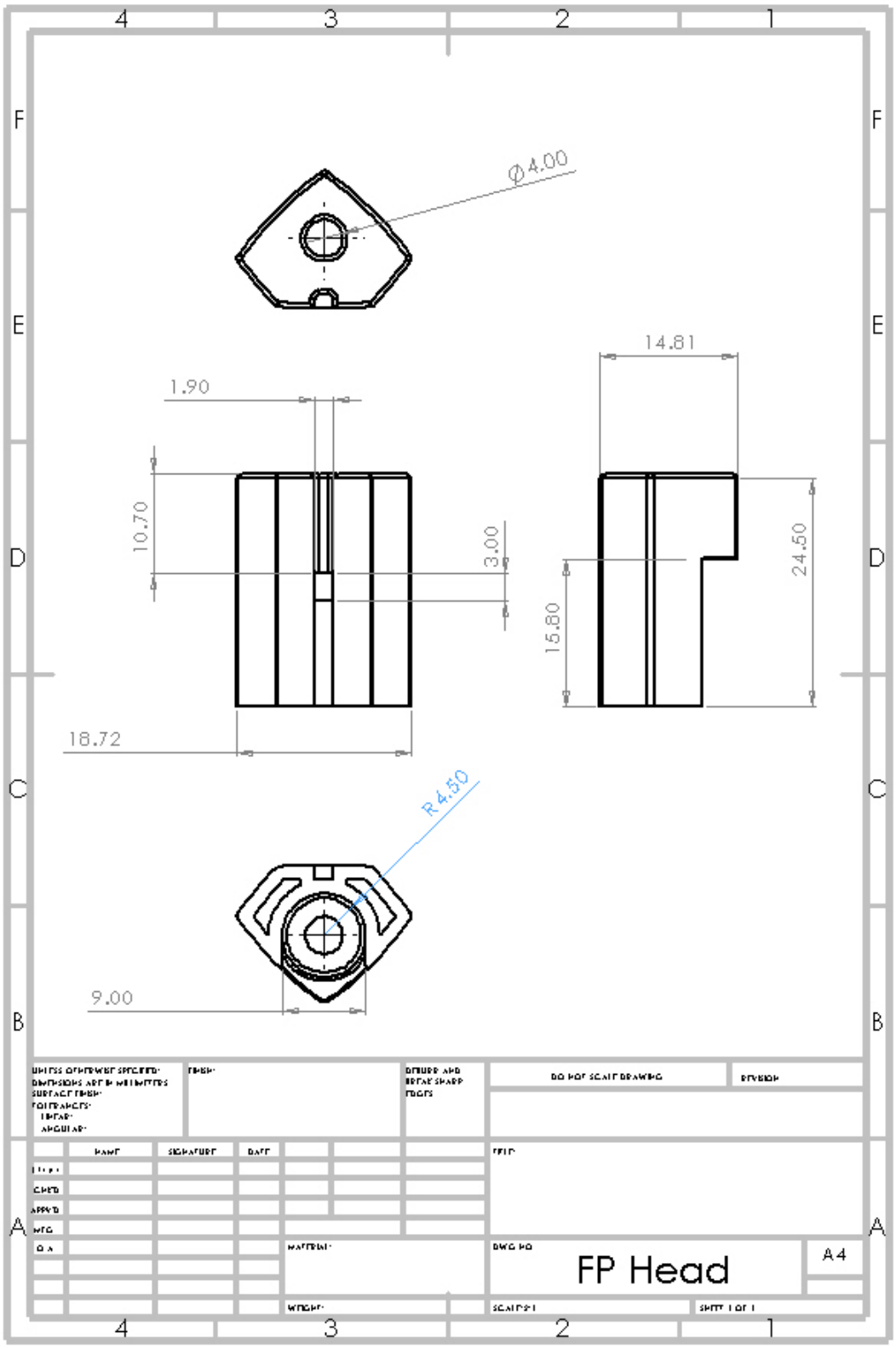
The rear end plate.



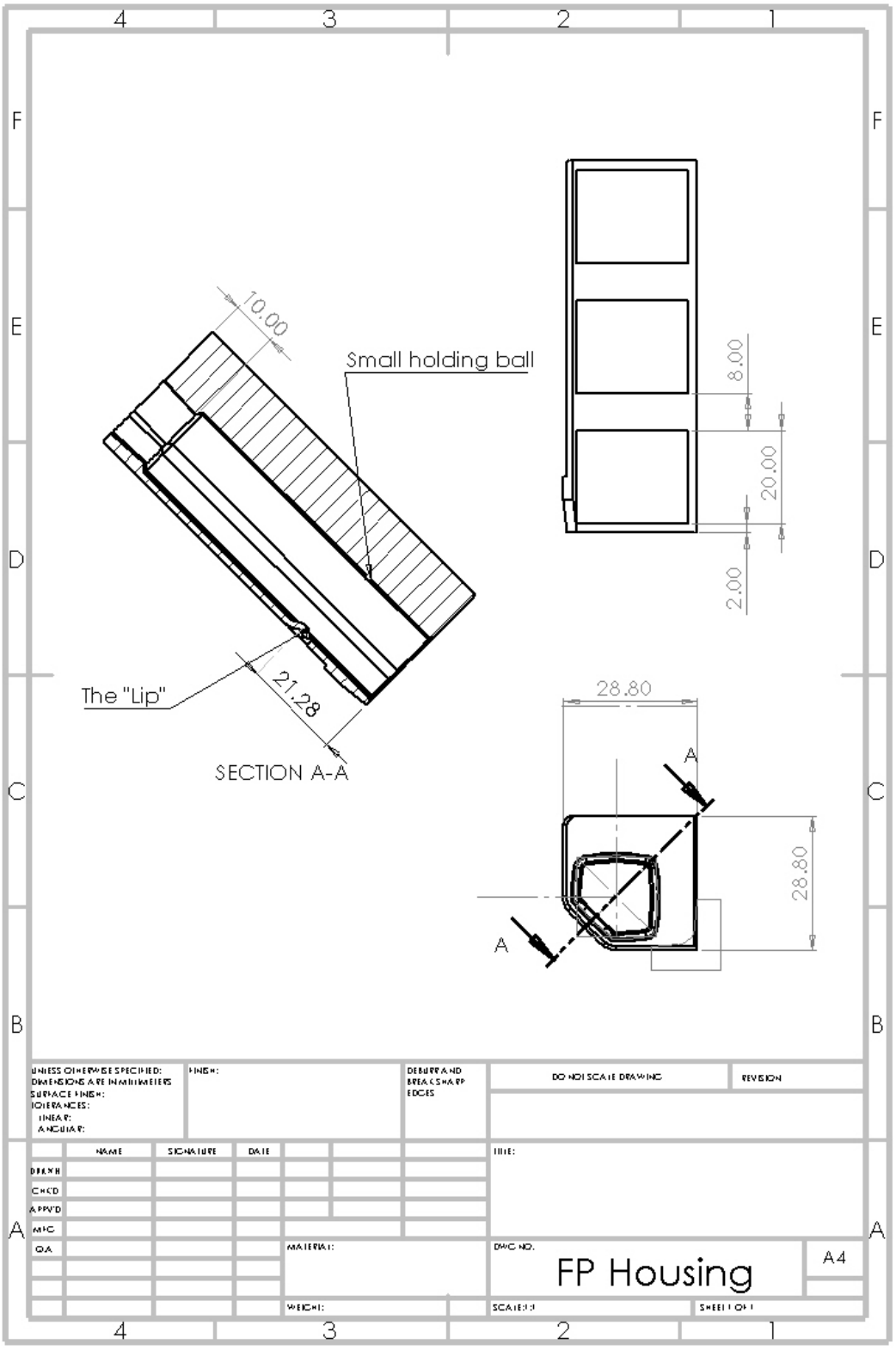
The "head"


16.93
23.00
2.32
5.36
UNLESS OTHERWISE SPECIFIED:
DIMENSIONS ARE IN MILLIMETERS
SURFACE FINISH:
TOLERANCES:
LINEAR:
ANGULAR:
FINISH:
DEBURR AND BREAK SHARP EDGES
DO NOT SCALE DRAWING
REVISION
NAME
SIGNATURE
DATE
DRAWN
CHK'D
APPV'D
MFG
Q.A
MATERIAL:
WEIGHT:
TITLE:
DWG NO.
FP Hook
A4
SCALE:2:1
SHEET 1 OF 1

The Hoop



The "head"


10.00
Small holding ball
8.00
20.00
2.00
The "Lip"
21.28
SECTION A-A
28.80
A
A
28.80
FP Housing
A4

The "sheath.