VERSITY

Product Report

Master Thesis in Industrial Design
Aalborg University - Ma4-id4, June 2022
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Product Report
Ma4-id4
Master Thesis in Industrial Design
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INTRODUCTION

People are different, which also applies to people with diabetes. However, current state-of-the-art treatment with insulin pens does not consider the diversity between people with diabetes but instead relies on a preferred standard. It may change with The Versity family.

Diabetes type-1 is a lifelong chronic disease and includes a constant focus on blood sugar measurements, insulin treatment, potential diet or exercise, practical issues of bringing diabetes equipment around every day, as well as accepting life with needles. Unfortunately, this may be considered socially outside 'the circle of normal' and leads to people with diabetes feeling and experiencing prejudices related to their disease – especially when being young.

The Versity family intends to challenge these issues by giving the neglected person behind diabetes the possibility of choice. The Versity family includes a diverse selection of how insulin treatment can be integrated into the busy everyday life of different people and strives to create a life without fear of stigmatization. Hopefully, it will make it easier to be a part of 'the circle of normal' and have a better life with the disease.

Table of CONTENT

LESS DIABETES, MORE

27.614

PERSONS WITH TYPE-1

DIABETES IN DENMARK

(VIDENCENTER FOR DIABETES, 2020)

70%

OF THEM USES

INSULIN PENS

(NIELSEN & GOLUBOVIC, 2019, PP. 46)

78%

OF ALL DIABETICS HAVE EXPERIENCED STIGMA

RELATED TO THEIR DIABETES

(WILLANIG & SJØGREN, 2020)

WHAT IMPACT DOES DIABETES HAVE?

... feeling of having less value as a person

... feeling of being looked at and treated differently

... feeling ashamed for the need to treat themselves

... feeling of embarrassment over the signal values of being sick when using diabetes product

Setting the person in focus

Diabetes is prevalent both in Denmark and the rest of the world. Several diabetes aids and insulin treatments are available to control blood sugar. However, the current treatment with standard insulin pens does account for what is best suited to the personal lives of people with diabetes. Unfortunately, the current insulin pens come with the consequence of stigmatization, which can provoke a feeling of not being accepted.

Dare your VERSITY

Diabetes is a full-time job and must therefore be included on the go. The Versity family offers a new perspective on diabetes treatment, and the discrete design provides less attention to the person in a social context.

To give a helping hand, Versity memorizes the last injection and may assist in ensuring that no double-dosing insulin is taken. Moreover, Versity can inject half units, ensuring more accurate dosing for insulin sensitivity.

Product
FAMILIES

Versity comes in three variants, each fitted to three different lifestyles. Choose the one that matches your desires, needs, and likings. Versity Basic, Hanger, and Case are just the first three in a large product family.

BASIC

1.500,-

Dimensions
H 99 x W 22 x D 22 mm

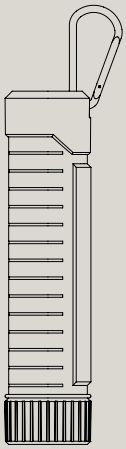
Weight
33 g

Expected lifetime
5 years

Colors
Base & Gold

Screen Inches
0.5''

Feature
Small and light



HANGER

1.600,-

Dimensions
H 99 x W 24 x D 24 mm

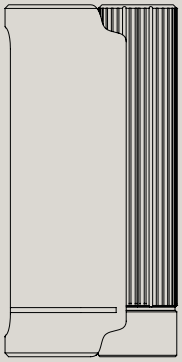
Weight
41 g

Expected lifetime
5 years

Colors
Orange, Green & Black

Screen Inches
0.5''

Feature
Keychain



CASE

1.800,-

Dimensions
H 99 x W 48 x D 24 mm

Weight
63 g

Expected lifetime
5 years

Colors
Black & Sliver

Screen Inches
0.5''

Feature
Needle case

It's really all about shaping YOUR diabetes so it fits YOUR life

Choose the Versity that suits you, whether for a practical, order, or trendy lifestyle.

// Before

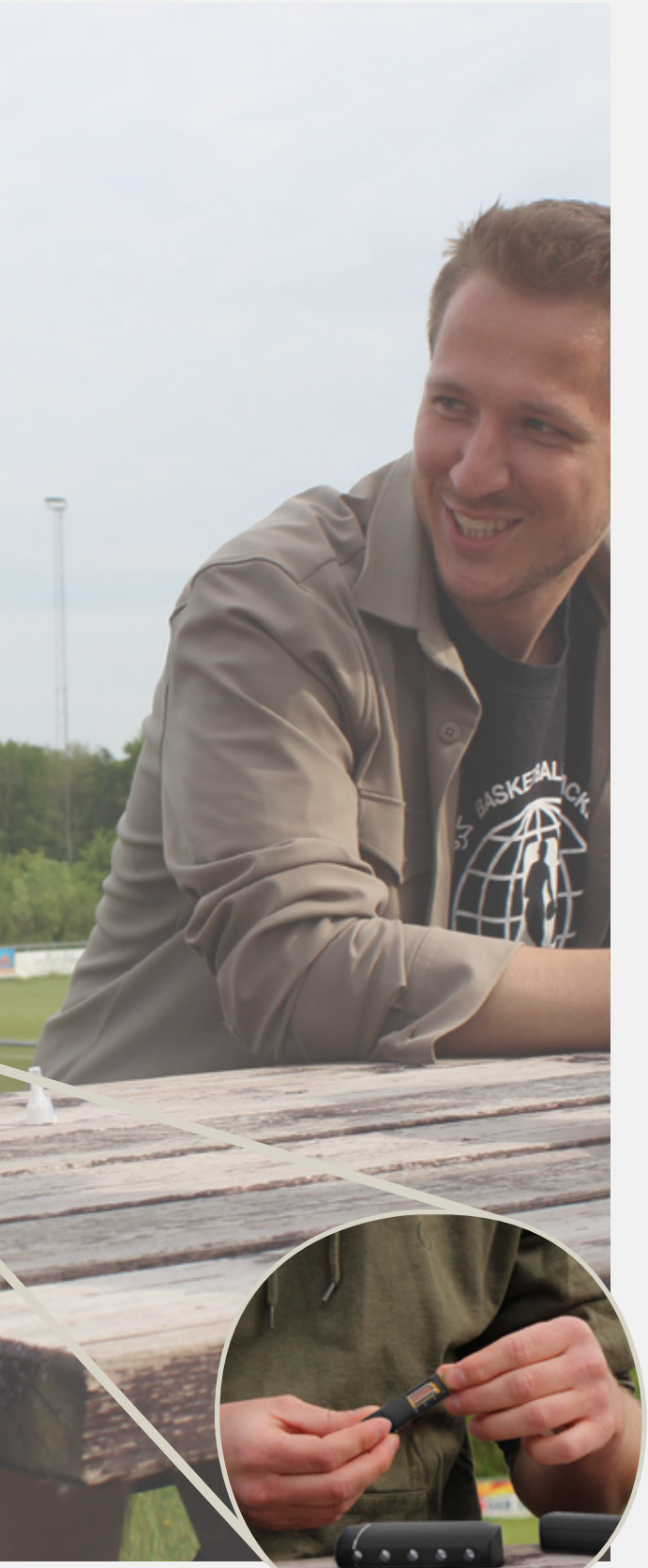
1. Time to take insulin?

Slide the needle container off to gain access to the needles.

// Prepare

2. Simple and easy access

Pick up a needle. Remove the lid from Veristy.



3. Prepare the insulin device

Attach needle and prepare Versity for injection. Afterward, adjust to needed units. Then you are ready to inject.

4. Inject insulin

Pull up the shirt, penetrate the needle into the skin, and inject insulin.

// After

5. Done, pack, and ready to go!

Place the used needle back in the needle container after use and slide it on Veristy.

... A known use with a different story

Each variant of Versity fits with the same base module (only the unit adjuster changes design). The way to adjust units, replace the cartridge, and screen with a memory of the last dose injected, are the same across all three variants. It ensures safe, easy, and straightforward injection, done after prescribed injection regulations.

Thread for needle

The needle is mounted here before injection

Unit meter

Shows how much insulin is left in the cartridge

Cartridge with insulin

Contains 1,5 ml insulin

Cartridge holder

Maintains the cartridge with insulin

Unit counter

Shows set units

The lock of the lid

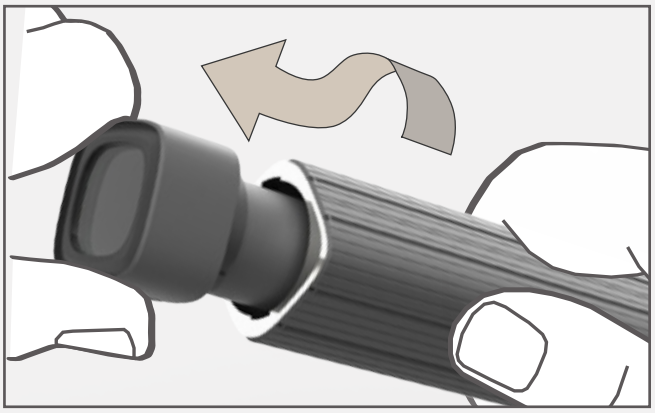
Securement of the lid

Unit adjuster

Sets desired units

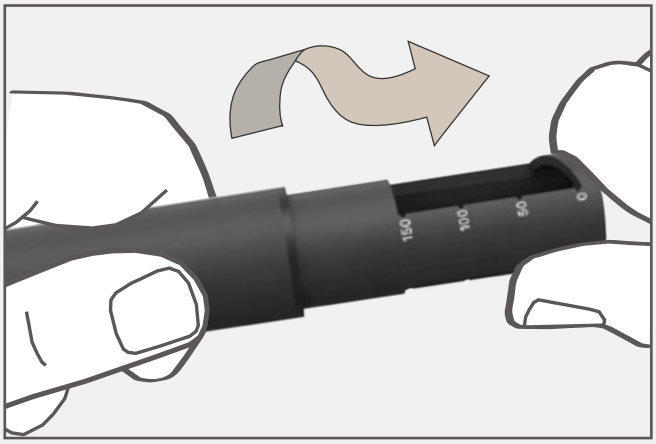
Screen with dose memory

Informs about units injected



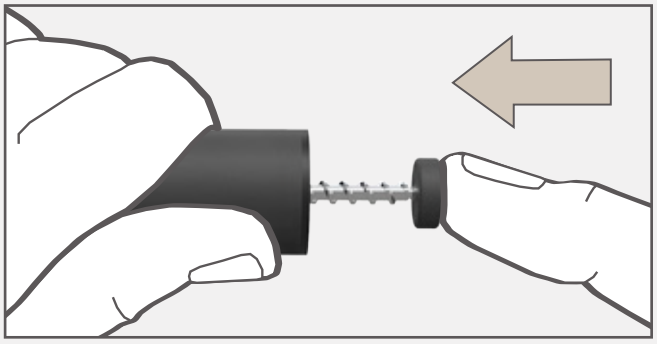
1. Remove the lid

Turn and pull out the protective lid on Versity, and place it aside.



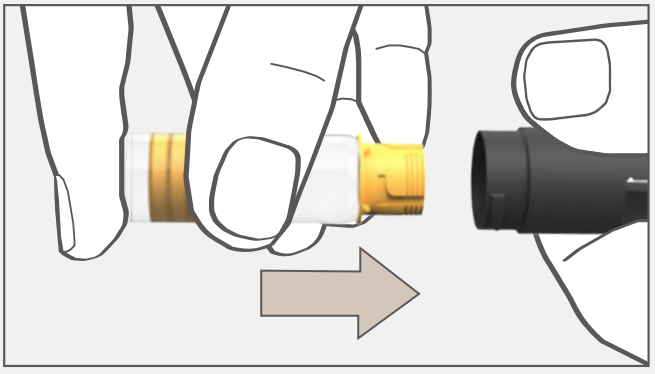
2. Remove the cartridge holder

Turn and then pull off the cartridge holder of the base. Place it aside for later use.



3. Push in the plunger rod

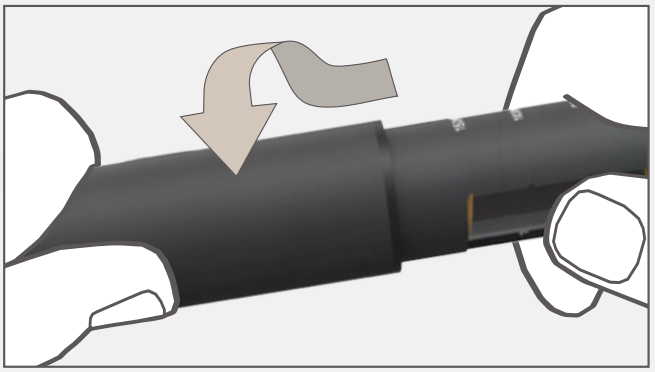
Ensure the plunger rod does not protrude from Versity's base. Is that the case, press it back in until it stops.



4. Place the cartridge

Pick up the cartridge holder once more and take a new insulin cartridge. Slide the insulin cartridge into the cartridge holder. Be sure to slide the insulin cartridge in with the thread first.

Note that the cartridge color can be different depending on the insulin type used.

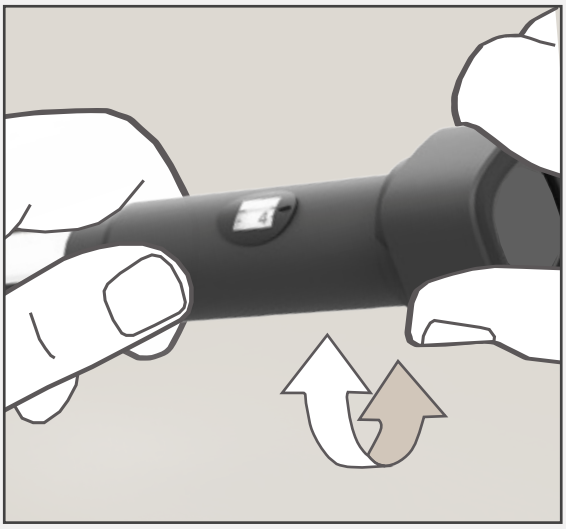


5. Secure cartridge holder

Turn back on the cartridge holder containing the new insulin cartridge. Stop when a click is felt. Then the insulin cartridge is held in place, and Veristy is ready for the next injection.

1. How to set units

The needle is mounted before injection.
Pull out the unit adjuster and select the needed insulin amount by turning the unit adjuster button.



2. How to see units

When selecting units, the unit counter shows the units adjusted.
When the suitable unit amount is chosen, Versity is ready to inject.

3. How to see units injected

After injection, the screen shows the units injected and stores it.

Units injected

Previous injected units

Time since insulin was last taken

Time is shown in Hours: Minutes

See last unit dose

Can't remember the last injection? Please press down the unit adjuster, and Versity will inform you about the previous injection dose and time.

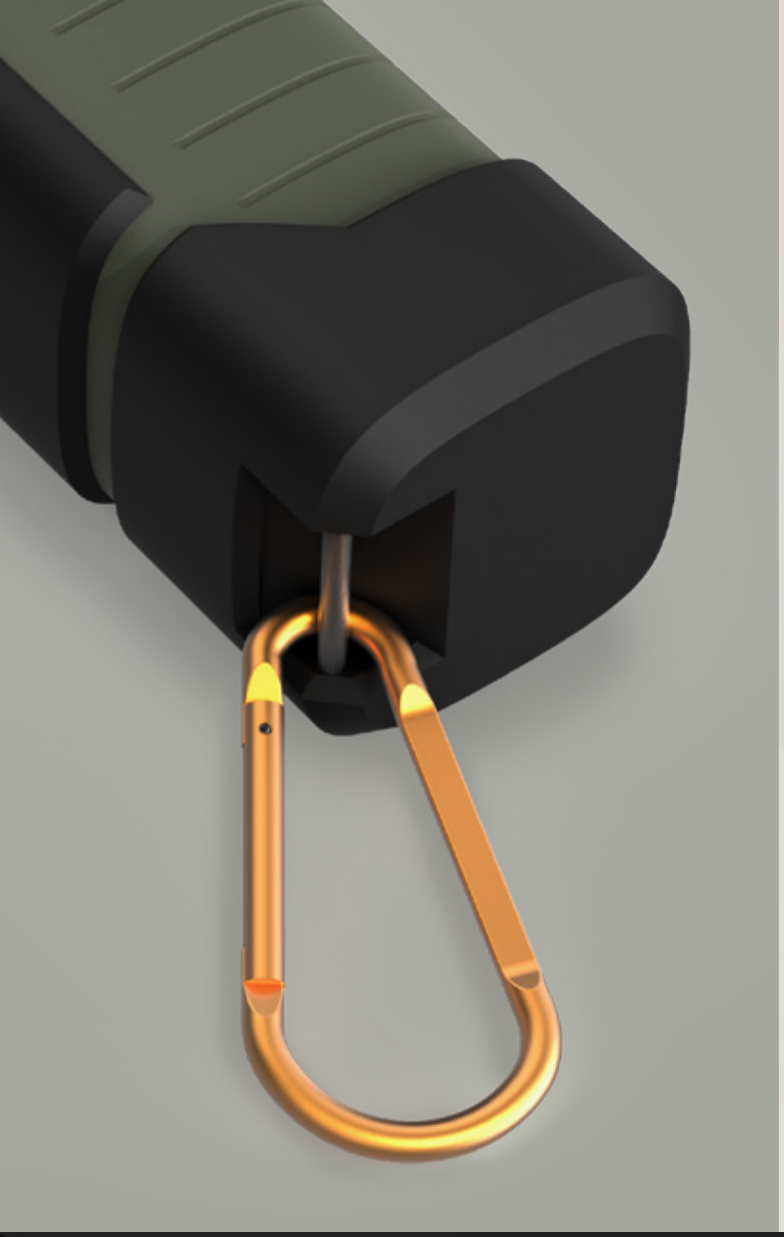
NFC & transmitting data

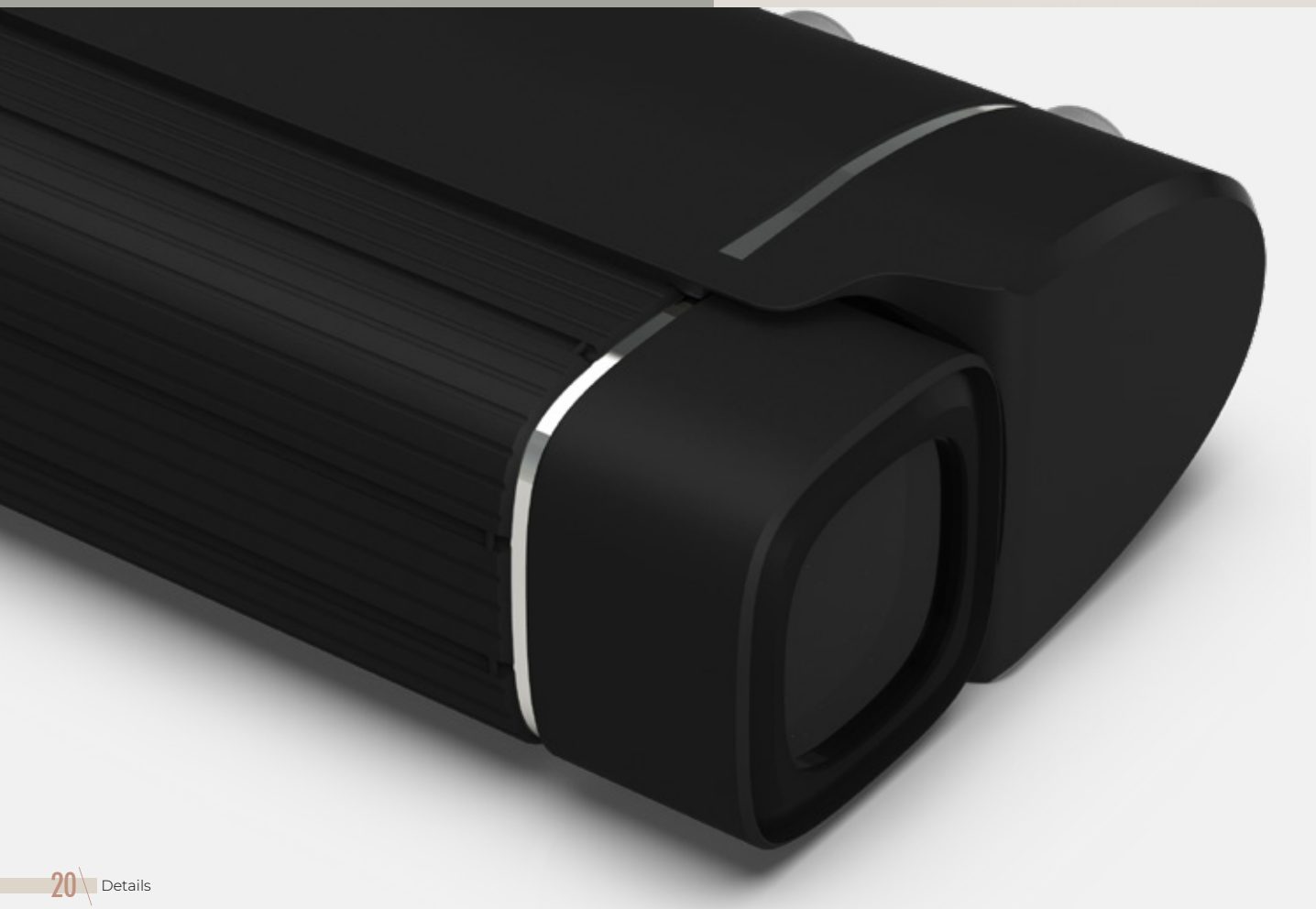
Follow the history.
Versity automatically stores the last unit doses injected. It allows the person with diabetes and the diabetes nurse to track and follow the treatment. The data is easily transferred to the nurses' database through a simple NFC.

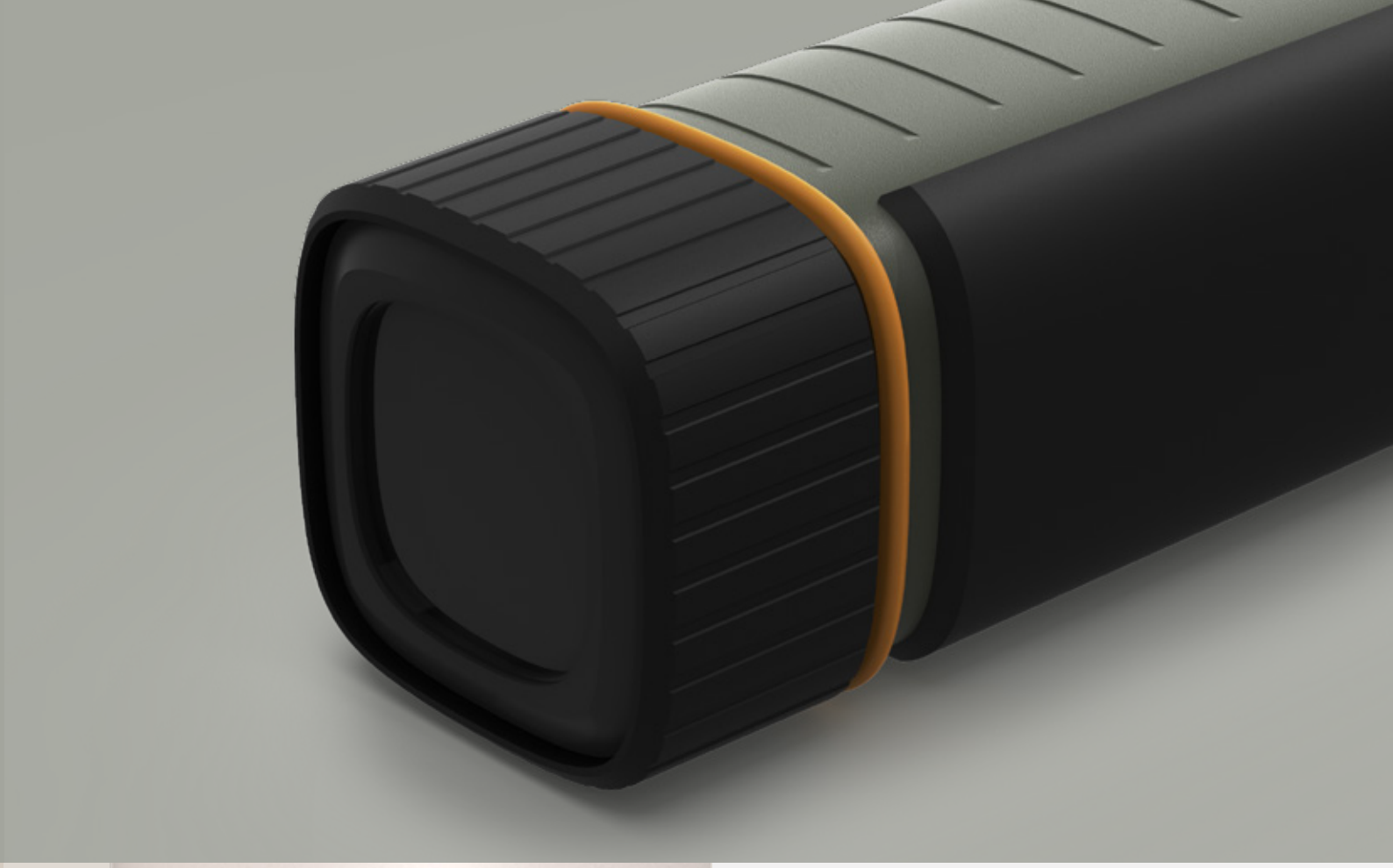
Don’t COMPROMISE

Small, easy and disguised

Versity Basic fits into small bags and pockets, making it easy to bring when leaving home. If you have room for your phone, you have room for Veristy!







Different people

DIFFERENT DETAILS

2022

2022

1

CREATE PARTNERSHIP

Period: Summer 2022

Goal: Make collaboration with Eli Lilly

Initial collaborations must be established to ensure accessibility to insulin types for the product and potential access to testing and manufacturing facilities.

2

TEST PHASE

Period: Summer 2022

Goal: CE certification of the Base

Manufacturing volume: 20-30 test versions

Manufacturing: CNC machining & 3D printing

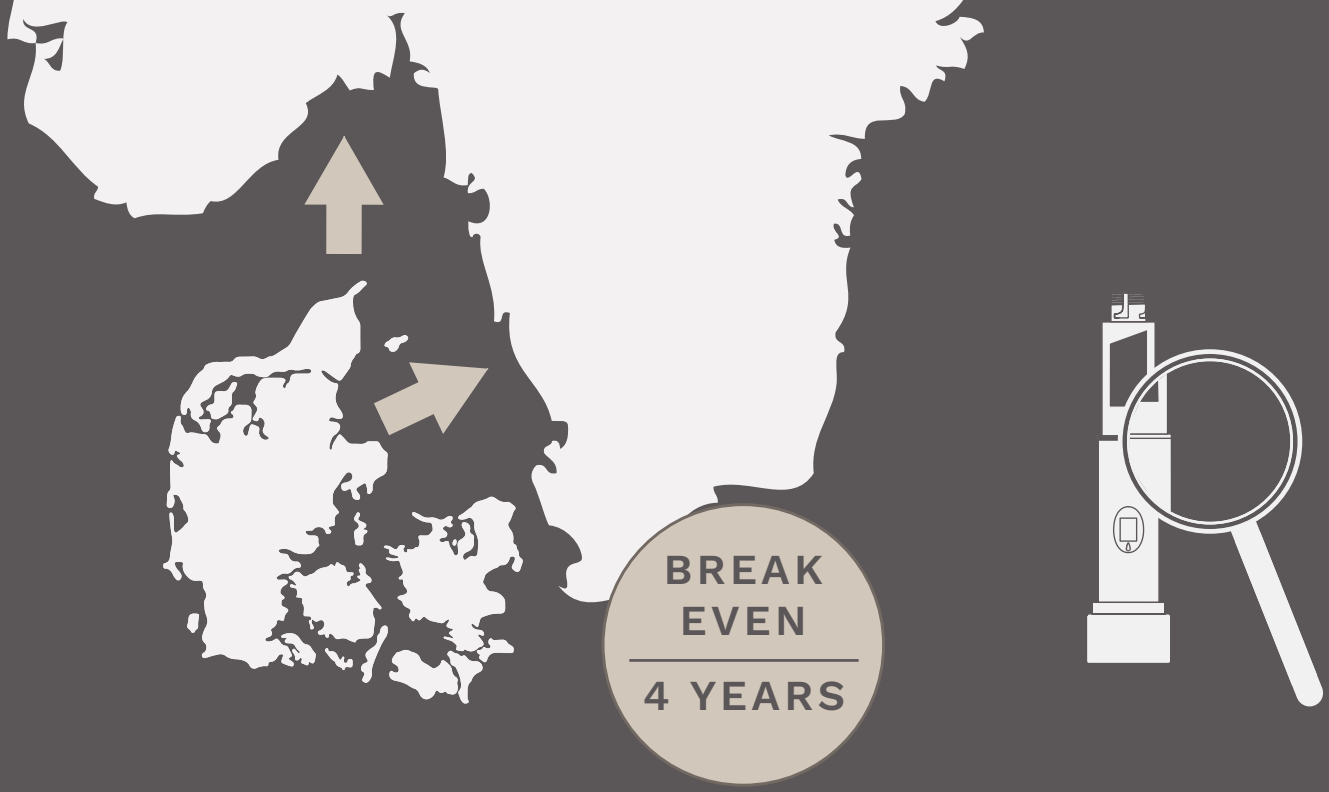
Investment: 1.903.000 DKK

Focus: Safety and performance test

The first test phase aims to manufacture beta versions of the base for testing. The base is the essential element, as it delivers insulin. The early test includes the technical test of function for delivering insulin and usability test. Additional clinical tests in accordance with DS/EN ISO 11608-1 must be conducted, ensuring it delivers with 95% accuracy.

CNC machining and 3D printing will manufacture the beta versions to avoid a large initial investment in tooling.

The ending goal in this phase is to get the Base a CE certification.



3

IMPLEMENTATION

Period: Summer 2023 - 2025

Goal: Implementation and expansion

Manufacturing volume: 34.995 units

Manufacturing: CNC machining & Injection molding

Investment: 29.514.085,8 DKK

Focus: Production, Sales, and stakeholder/user introduction

The second phase starts with an initial prelaunch sales plan, implementing Veristy in diabetes outpatient clinics where nurses, doctors, and treatment staff can present Versity in their treatment sessions for their patients. Marketing and promotion through influencers are initiated as well in this phase.

A shift and investment in tooling for injection molds to plastic parts are made, resulting in higher capability and cheaper unit cost.
The sales and expansion plan are here initiated. Each version is launched with one year staggered, ensuring constant development, the potential for upgrades, etc.

Expansion to other Nordic countries is also started in this phase.

Launch plan:

- Versity Case – the year 2023
- Veristy Basic – the year 2024
- Versity Hanger – the year 2025

4

CONTROL PERIOD

Period: 2023 - 2028

Goal: New CE certification

Investment: 616.000 DKK

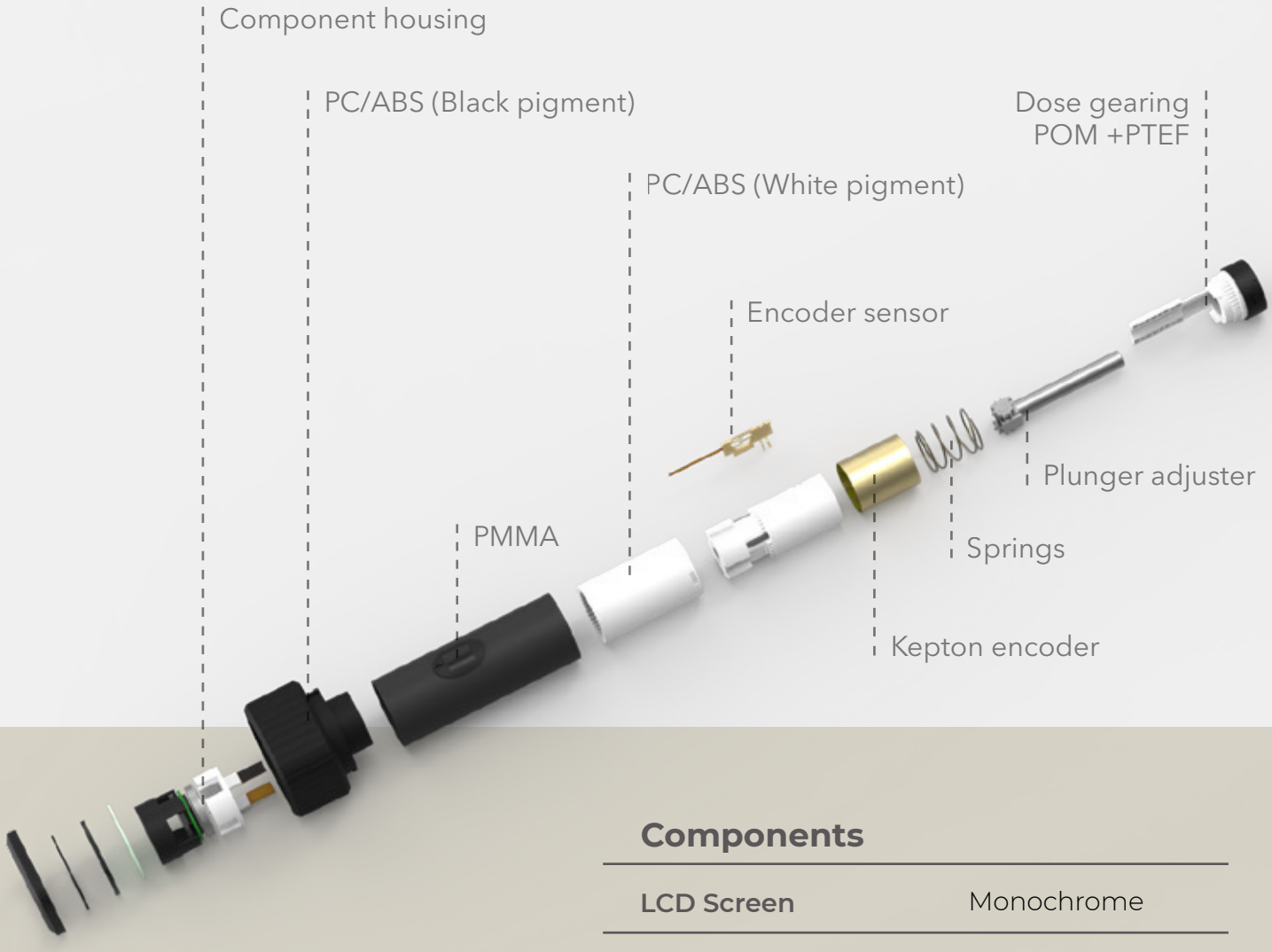
Focus: Surveillance & evaluate

As Versity is medical equipment, it requires observation of the product after launch. It ensures that if any failures are monitored, the product must be corrected immediately.

Every five years, the product must get a new CE certification to stay on the market.

Materials &
PRODUCTION

Versity is a needle-based injection system that must obey DS/EN ISO 11608-1 standard, where the mechanics must have fine tolerances to deliver an accurate insulin dose. Versity can deliver from 0.5 to 30 units of insulin in one injection.

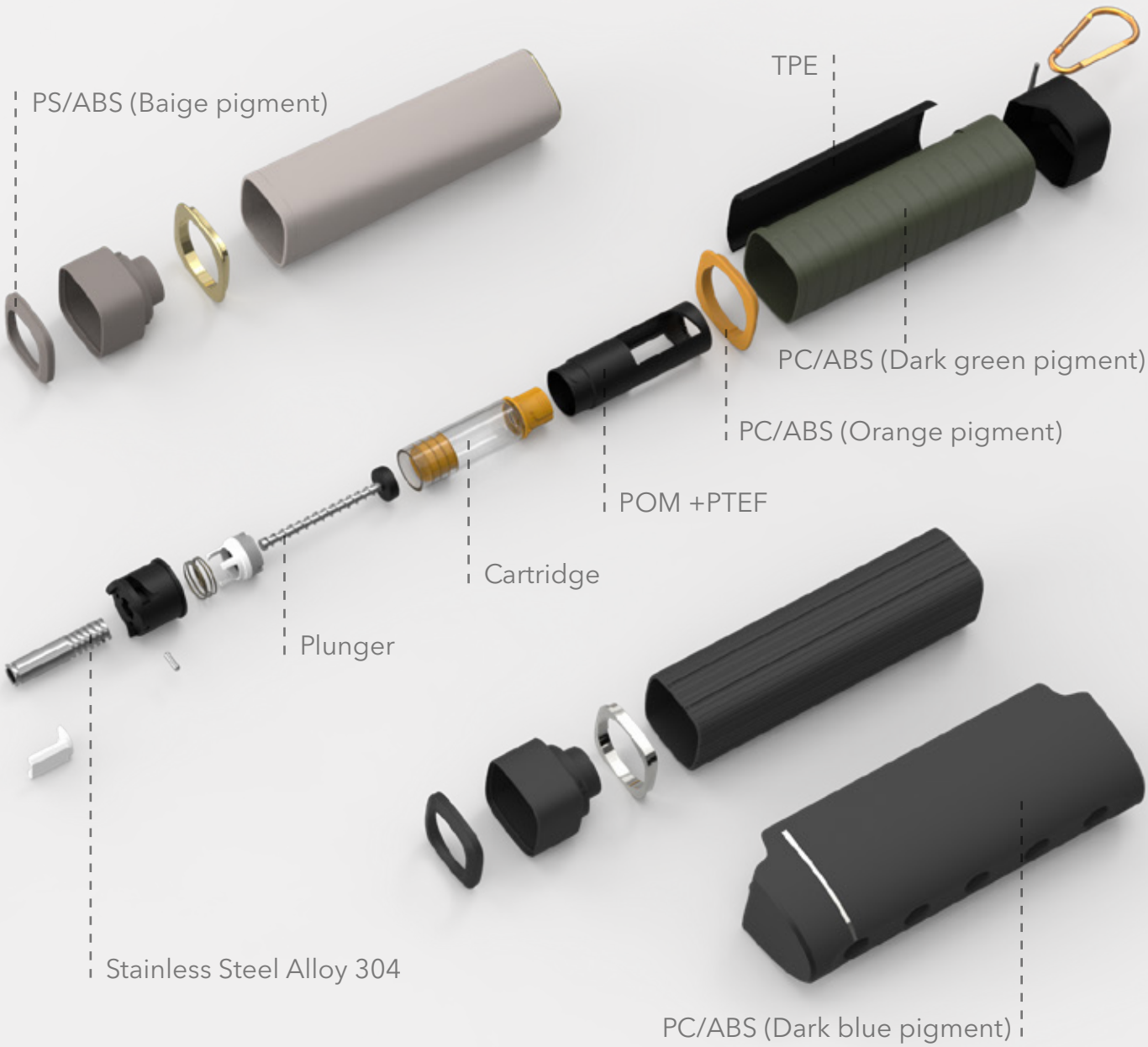


Manufacturing cost

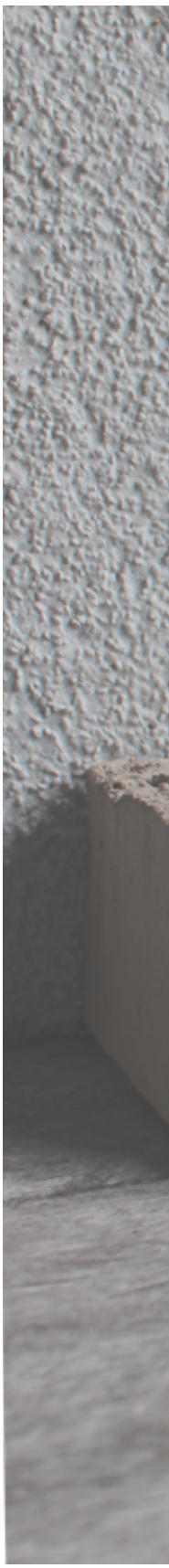
Versity Basic	517,18 DKK
Versity Hanger	517,16 DKK
Versity Case	517,82 DKK

Components

LCD Screen	Monochrome
CPU	Microcontroller
Battery	Lithium, 3 V
Data transmitter	NFC
Encoder sensor	Rotary encoder



Material parts	Production
PC/ABS	Injection molded / multishot molded
TPE (rubber)	Multishot molded
PMMA	Laser cut and multishot molded
POM + PTEF	Injection molded
Stainless steel Alloy 304	Metal injection molded and CNC milled



MSc04 Industrial Design 2022
01.02.22 - 25.05.22

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VERSITY

Process Report

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0.0 TITLEPAGE

Project name	Versity
Report type	Process Report
Project group	Ma4-id4
Project theme	Master Thesis in Industrial Design
University	Aalborg University
Education	MSc04 Industrial Design S2022
Project period	01.02.22 - 25.05.22
Main supervisor	Christian Tollestrup
Co-supervisor	Lars Rosgaard Jensen
Number of pages	114
Number of spreads	57
Appendix	414

Benjamin Liboriussen

Emma Rosendal Jensen

Katrine Timmermann

0.1 PREPHASE & ACKNOWLEDGEMENTS

This Master Thesis was prepared in the spring semester of 2022 by the group Ma4-id4 consisting of three students, Benjamin L, Emma R. J., and Katrine T., at Industrial Design, Aalborg University. The group prepared the project over the period from 01.02.22 to 25.05.22. The project deals with redesigning current insulin pens for diabetes type-1 treatment. The development of the product proposal is documented in a process report with an additional appendix. The proposed solution is presented through a product report and belonging technical drawings

A big thank you goes to our supervisors, Christian Tollestrup and Lars Rosgaard Jensen, and the expert panel: Nurse Anette B. Hansen, Nurse Karina K. Hansen, and Chief Physician Klavs W. Hansen for good insights and collaboration. Additional thanks to other participating experts that has provided the project with insight into the diabetes market; Cartridge expert Niels S. Jørgensen, Social adviser Steen Højer, Chief Physician Sanne Fisker, and Aalborg municipality.

Furthermore, a big thank you must also go to our participating users Christian Petersen, Malene Boll, Marthine R. Jensen, Liv Jensen, Sofie Johnsen, Sanne M. Jensen, Rune S. Jakobsen, Jens Ulsøe, Lia Papazu, Martin Kaae, Katia M. Rasmussen, and Kathrine R. Lauersen, for good insights and collaboration. And to all the users on social media that responded to our survey and posts for help.

0.2 ABSTRACT

This process report represents the development of a redesign and reinterpretation of insulin pens used to treat diabetes type-1. The project investigates emotional, practical, and stigma-related issues when treating diabetes with insulin pens. Having diabetes and sticking yourself with insulin needles several times a day often creates stigma and judgmental glances from surroundings.

Therefore, this study will investigate how to challenge the design language of the classic insulin pen so that the user gets a more significant affiliation with it, like a new accessory or gadget. The process consists of interviews with users, several rounds of knowledge and concept iterations, and mock-up testing with users. The final product proposal is a smaller physical product platform where the ‘base’ device is repeated within each variant. The group has proposed three designs with three individual features that will hit selected user groups.

0.3 READING GUIDE

This process consists of three main parts: process report, product report, and technical documentation. In the process report, you'll find the progress from the very beginning to the final product proposal. The technical drawings present size specifications on each part and not production tolerances.

To get the best understanding of the product, it is suggested to read the product report first, followed by the process report. Additionally, it is recommended to read the technical drawings lastly. If more process details are needed, they are found in the appendix. Each appendix is made with a hyperlink in the appendix table of contents to gain quicker access to the preferred appendix if needed.

The process report is divided into 6 phases; 1) Discover, 2) Define, 3) Develop, 4) Deliver, 5) Implement, and 6) Epilogue.

References along the journey are specified in the Harvard format (Name, Year, page number). The full list can be found in the literature list on page 101.

Illustrations are numbered by "ill. 'Number'" and are likewise referred to in the text. Own illustrations will not be listed in the illustration list.
Appendix references will be referred to as "App. 'Number'" and are likewise referred to in the text.

Within the process report, there is used symbols and indication boxes, which are marked as follows:

Each section will have an introductory text, which will be marked in '***bold italic***' writing.

Important keypoints found within the preformed section or task.

Requirement found within the processed section or task.

Marks delimitations/boundaries or deselected requirements in the section

// EVALUATION

Evaluation, where a summary and evaluation for the current section will be displayed as shown

0.4 INTRODUCTION

This thesis is driven by the missing focus on the individual people that live with diabetes. It is a chronic disease that can strike at any age. According to most type-1 users, the current equipment for insulin pen treatment is clinical and draws attention from the social environment in everyday life.

It creates individual stigmatization, being different and feelings of being a person with less value, creating a constant reminder of their disease. Additionally, being a diabetic also requires planning, and practicality, with all the equipment that must be used every day. These products can often be unhandy and a challenge to bring around due to the vast amount. Therefore, this thesis seeks an opportunity to challenge the current products and create more value for everyday life with diabetes. The project focuses on creating more disguised options for insulin pen users, accommodating their everyday challenges of being 'on the go'. Creating a product platform gives them the opportunity to decide which style fits their needs.

0.5 CONTENT

DISCOVER

01

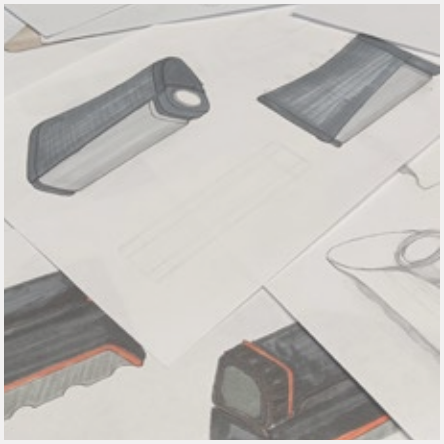
DEFINE

02

DEVELOP

03

DELIVER



04

IMPLEMENT

05

EPILOG

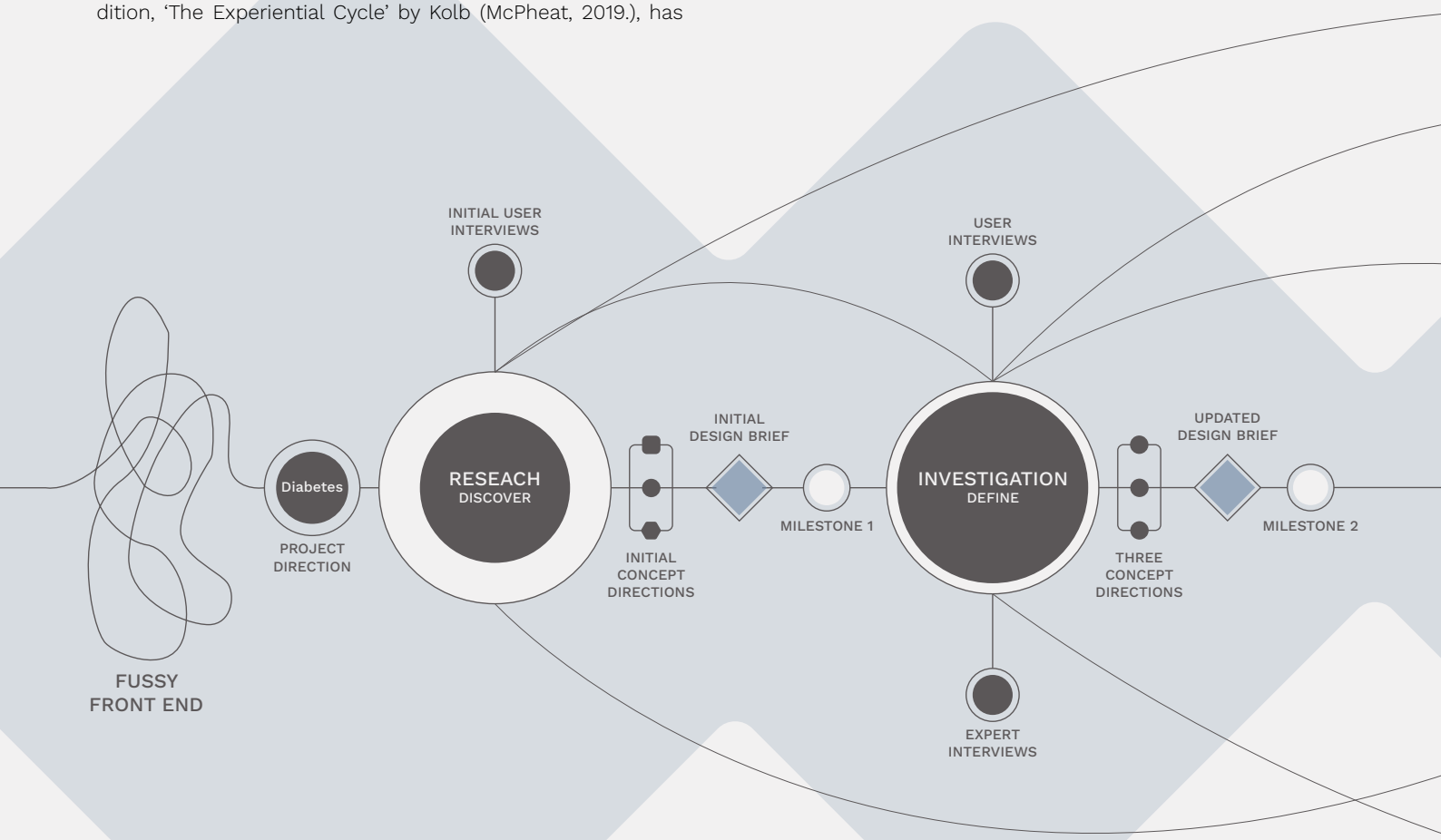
06

0.6 APPROACH

PROJECT PROCESS & PHASE OVERVIEW

The overall project approach was iterative and structured within different process models. The start of the project was defined with a 'fussy front end' approach (Koen et.al., 2002), with a search for a project focus. Subsequently, the Double Dimond (Design Council, 2005) was used as an overall linear structure of the process, alternating divergent and converging phases. In combination, two iterative processes have been used between the different phases. Striim's ideation process model (Striim, 2001) was applied to which ideas and concepts have been going through creative and logical thinking. In addition, 'The Experiential Cycle' by Kolb (McPheat, 2019.), has been applied to gain learning and reconfigure requirements and concepts within the project. The four models can be found in App. 0.1.

Ill. 1 shows how each phase has divergent up and converging down before going into the next. The overall process has been converging, which is demonstrated by how the sizes of the phases become smaller. Elements that have been considered iteratively through each phase are highlighted with the lines connecting them.



ILL. 1

FUZZY FRONT END

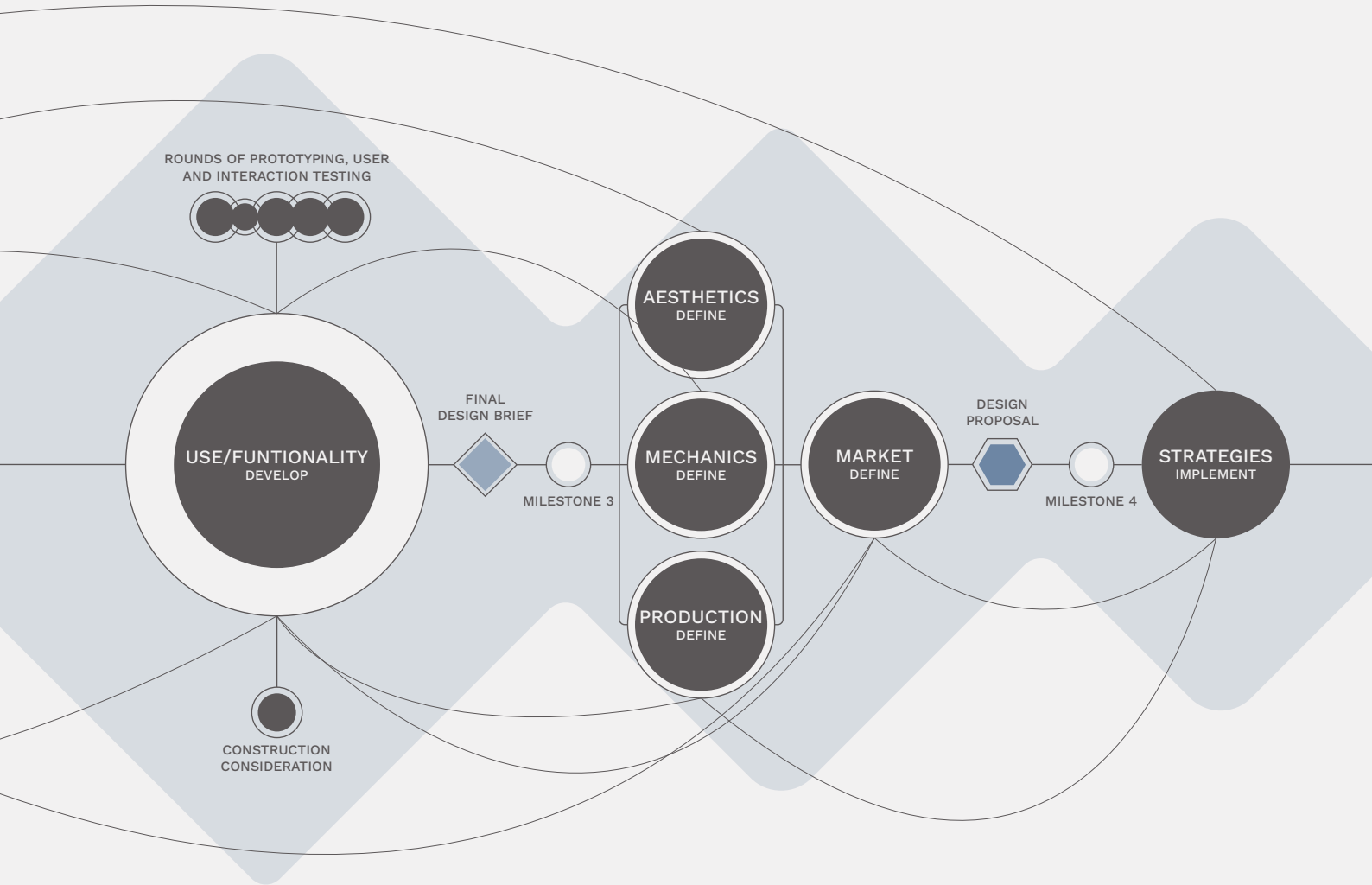
The group explored potential project directions in chaotic research, with many different possibilities before the focus was set on Diabetes.

DISCOVER

Initial understanding of what it means to be a person with Diabetes type-1 and the problem will be unfolded, current market possibilities will be covered, and an initial idea of potential solution direction of redesigning insulin pumps will be uncovered. The phase is concluded with an initial Design Brief and a Milestone.

DEFINE

Discovery of user insight and understanding of needs and problems based on interviews were gathered and analyzed, and an overview of the insulin pen will be conducted. The group obtains a greater understanding and investigates the potential solutions space using Striim's ideation process, culminating in three concepts, an updated Design Brief and a Milestone.



DEVELOP

The group gathered insights from experts and conducted analyses of insulin products. Exploration of the solution space was made through loops in the 'The Experiential Cycle', with multiple ideation rounds, mock-ups, and user testing. The concept is broken down into elements, where iterations through prototyping are conducted. The phase culminates with a final Design Brief, ending with a Milestone.

DELIVER

The phase is divided into four co-existing sub-phases of detailing. Elements of the concept are specified within aesthetics exploration using Striim's ideation process, mechanics and components, and material and production. The phase culminates with the final design proposal and a Milestone. The starting point of the market potential is also investigated in this phase leading into the implementation.

IMPLEMENT

The group creates an overview of the market regulations within the medical market for diabetes. It creates strategies and implementation plans to conduct a feasible business plan to enter the market.

Discover

The initial phase set the project focus on persons with type-1 diabetes. It covers initial information regarding diabetes, stigma, and product on the market, gathered through research, a survey, and Facebook posts in diabetes groups. The research leads to broad ideation for investigating the overall project's frame. As a closing statement, it is collected into an initial Design Brief.

01

ILL. 2

1.1 INITIAL THOUGHTS AND TRIGGERS

A theme for the project had to be chosen. Many different directions were brainstormed and investigated in the project start. An overview of these can be found in App. 1.1 and 1.2.

After a confusing start-up of the project, where the group spent a long time in 'The Fuzzy Front End' (Koen et.al., 2002), the theme was defined after brainstorming different user groups. Here diabetes triggered the group's interest. One group member, living as a relative to a person with diabetes, highlighted several everyday problems for the person living with diabetes. It opened initial considerations regarding different problem areas to dive into. These could be both from the person with diabetes perspective or/and the relative's perspective

INITIALT MEETING

An initial meeting with a person with diabetes was Rune Sejer Jakobsen, who emphasized that they, as diabetics, were often forgotten in the "big system" and that there is a person behind the term "patient". Rune also explains that when growing up with diabetes, several products highlighted his illness and made it feel like he was given a "brand mark". He especially remembers when he used an insulin pump to treat his diabetes, and this made him feel insecure in his teenage years and added:

> *"We all strive for the illusion of the normal life. - Rune S. J."*

The group than initially looked at a diabetes pump solutions and the insulin equipment Rune uses in the present time. Here the group considered some initial considerations regarding the design and symbolic value. The group observed that these products seemed "disease-like" and gave the initiating thought:

There is a need to rethink diabetes products and get the person with diabetes more focused and adapt them as individuals.

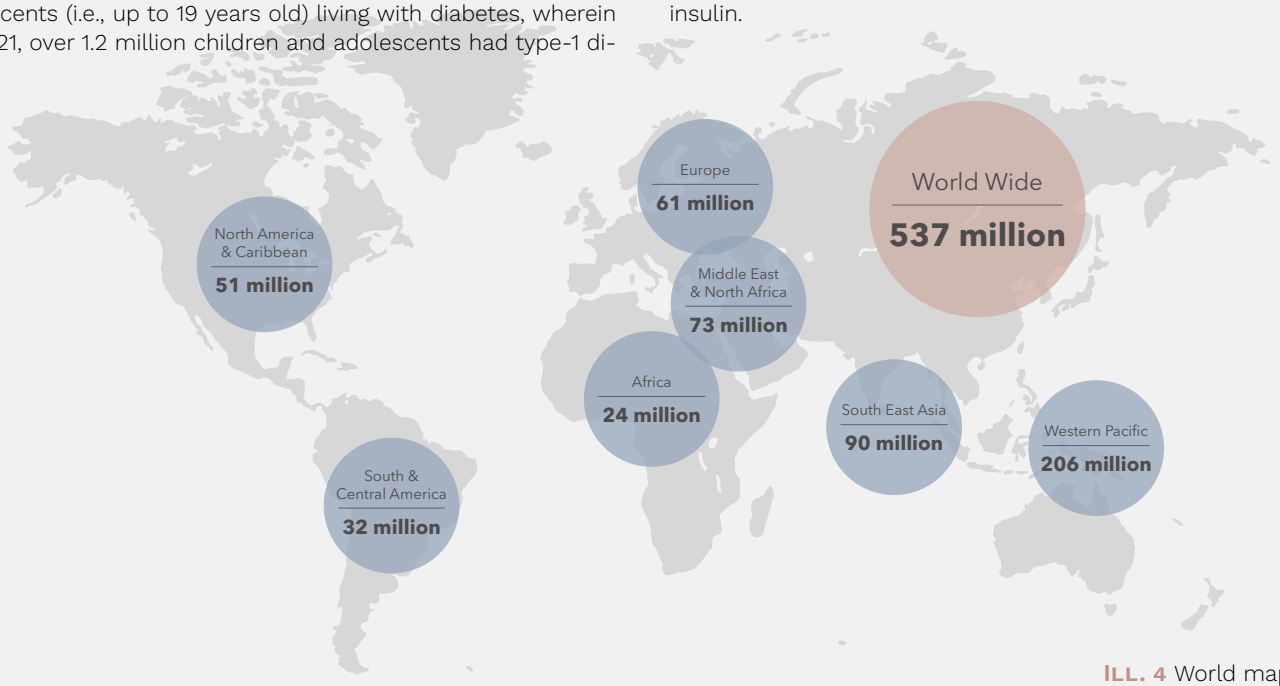
ILL. 3 Rune S. J. and equipment

1.2 MARKET OPPORTUNITY

With the chosen theme, diabetes, there was a need to gain deeper insight into whether there was a market potential and some overall opportunities within the project focus. It led to initial research on diabetes in the world and Denmark.

MARKET OPPORTUNITY GLOBALLY

Diabetes is one of the fastest-growing global health emergencies in the 21st century. In 'IDF Diabetes Atlas' 10th edition, published in 2021, it was found that 537 million worldwide have diabetes (Ill. 4), and it is projected that in 2030 the number will rise to 643 million and by the year 2045 to 783 million. Additionally, around 6,7 million people from age 20 to 79 will die from diabetes-related causes in 2021. Annually there is seen an incensement in the number of children and adolescents (i.e., up to 19 years old) living with diabetes, wherein 2021, over 1.2 million children and adolescents had type-1 diabetes. The health expenditure has caused a least 966 billion dollars and is expected to exceed in 2030. Alarmingly is the consistently high percentage (45%) of undiagnosed diabetes, which overwhelmingly is type-2. The most common is type-2 diabetes which accounts for over 90 % of diabetes worldwide. (IDF Diabetes Atlas, 2022; International Diabetes Federation, 2021.) Even though the disease is terrible, the numbers showcase a growing market need for diabetic equipment and insulin.



ILL. 4 World map

DANISH MARKET

27.614
persons have type-1 diabetes in DK

Diabetes in DK cost
31,8 Billion DKK
each year

252.516
persons have type-2 diabetes in DK

In Denmark, the number of persons with diabetes has triblet since 1996. Back then, 83.459 persons were registered with diabetes. Today this number is 280.130 (2017 numbers), of which approx. 10% (27.614 persons) are registered with type-1 diabetes, and approx. 90% (252.516 persons) are registered with type-2 diabetes (Ill. 5). The gender distribution is the same for type-1 and type-2, where 46% are women, and 54% are men. (Videncenter for Diabetes, 2020.)

Diabetes is expensive for the social economy. Calculations made in 2011 showed that it costs 31,8 billons each year in Denmark. The numbers are distributed between; lost earnings represent 41% (13,2 billion DKK), the care sector constitutes 20% (6,4 billion DKK), where treatment at doctors and hospitals is 17% (5,5 billion DKK), medicine expenses are 4% (1,1 billion DKK), and 18% (5,6 billion) goes to patient time, equipment and depreciation. (Diabetes foreningen, n.d.a; Sortsø et al., 2016.)

ILL. 5 Denmark map

// EVALUATION

The group gained a knowledge of the significant market potential and numbers and costs worldwide and in Denmark.

Overall, there is also an incensement in diabetes diagnoses and markets in Denmark and the world. As a result, this opens the possibility of creating new diabetes products.

1.3 DIABETES

To gain more profound insight, the group researched more about diabetes disease and types of diabetes. This section explains and narrows down the attention of the project to a more concrete focus group.

WHAT IS DIABETES?

Today diabetes is a chronic disease where sugar content in the blood is too high. The high blood sugar level comes from a reduced ability to utilize the hormone insulin. The lack of insulin is in which the pancreas, for various reasons, produces too little or no insulin. In contrast, the decreased capability of the utilization of insulin can be caused by the body having developed reduced sensitivity to insulin. Having diabetes means that the sugar accumulates in the blood, so the blood sugar rises, and too little sugar is transported out in the body's tissue. Untreated, elevated blood sugar levels over a long time can be a contributing cause to several severe and debilitating comorbidities. (Videncenter for diabetes, 2021a; Reersted, 2020.). Diabetes cannot be cured, but correct and careful treatment can increase a long and good life with diabetes (Reersted, 2020). There exist different types of diabetes, where the two main types are type-1 and type-2 (Videncenter for diabetes, 2021a; Videncenter or diabetes, n.d.)

> *Many people mistakenly believe that you should have insulin when you shake or have gone into insulin shock, but the opposite is true. There is too much insulin in the body, and you therefore need glucagon, which gets the blood sugar up and not down.*
> *- Quote from Diabetes foreningen, n.d.c*

DIABETES TYPE-1

Diabetes type-1 is an autoimmune chronic metabolic condition. It is characterized by the body's immune system attacking and destroying pancreatic beta-cells that produce the hormone insulin (Ill. 7 p. 7). Persons living with diabetes type-1 rely on daily doses of insulin injections or insulin infusions therapy to manage blood sugar levels. It must be aligned with mealtimes, food choices, blood glucose, and physical activity. Type-1 diabetes is often diagnosed in a young age. It is still unknown why people develop diabetes type-1. (Hansen et al., 2020; Videncenter for diabetes, 2021b; Reersted, 2020.)
On average, a person with type-1 diabetes measures their blood sugar at least four times a day. Most take 1-2 daily injections of basal insulin (slow-acting) and 3-5 daily fast-acting insulin injections. If a large amount of insulin is needed (e.g., 40 units), it can be uncomfortable, and it is recommended to divide the dose into two injections. (Diabetes foreningen, n.d.d; Lægehåndbogen, 2021)

DIABETES TYPE-2

Diabetes type-2 is the most common diabetes and is often diagnosed after the age of 30, however younger people can also get it. Unlike type-1 diabetes, where the exact cause is not known, it is known that bad living habits, overweight, and a lack of sports increases the risk of getting diabetes type-2. (Videncenter for diabetes, 2021c; Reersted, 2020.)

A combination of two things is the cause of type-2 diabetes, 1) Cells in the body become less sensitive to insulin, which is needed to absorb glucose from the blood. 2) The pancreas still produces insulin, but utilization in the cells is not good enough, called insulin resistance. (Ill. 7 p. 7). (Videncenter for diabetes, 2021c.)

Treating diabetes type-2 is by lifestyle changes, like eating healthy food, stopping smoking, doing sports, and losing weight if you are overweight. If the blood sugar levels can't come down to average levels it can be treated with tablets. For some, it may also be necessary to get insulin. (Reersted, 2020.)

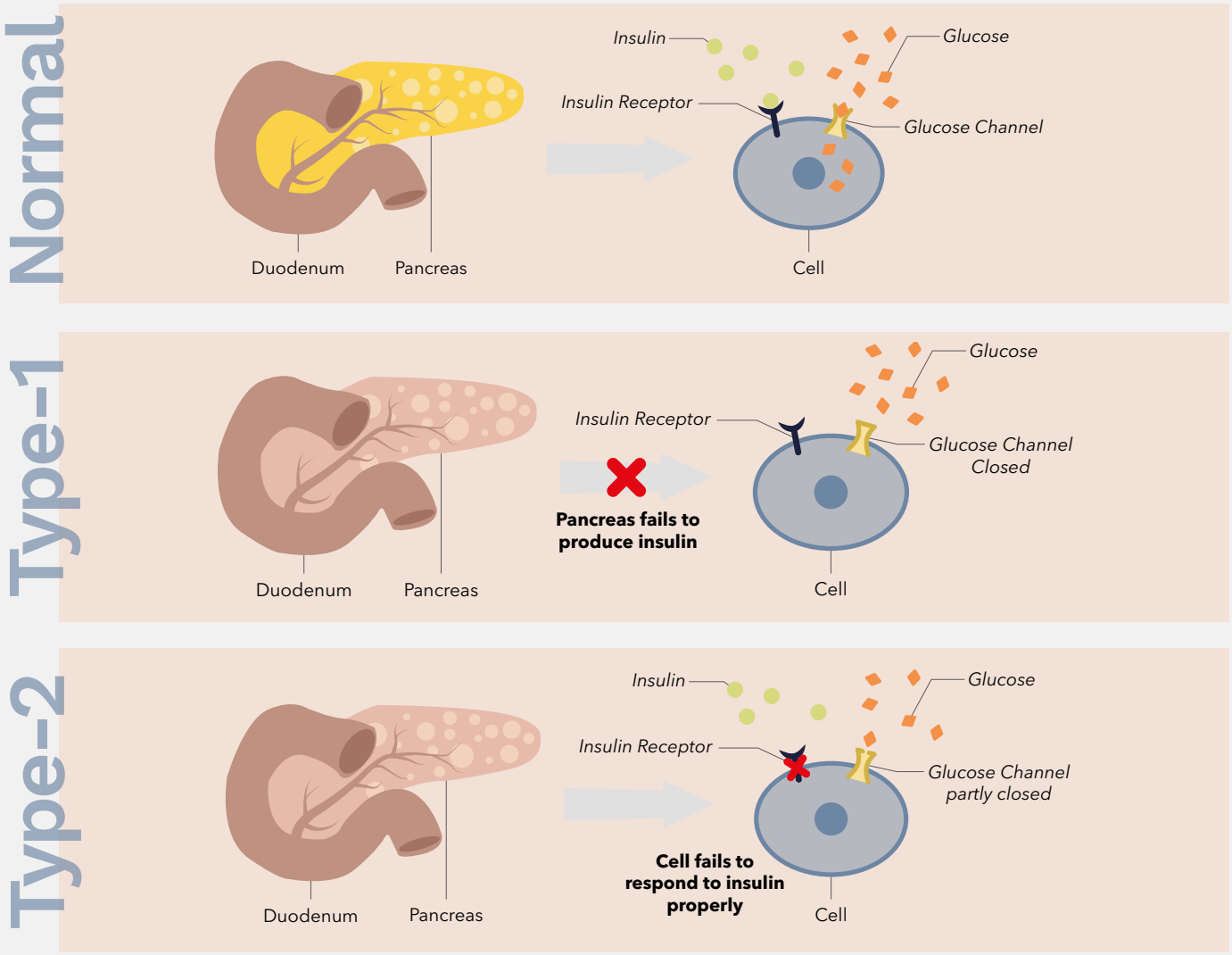
ILL. 6 injection

HOW DOES INSULIN WORK?

Insulin is a hormone produced in the pancreas. When digesting, the carbohydrates in the food are transformed into glucose. Glucose nourishes the body's cells and circulates in the blood. However, the cells need help to absorb the glucose. (Sundhed.dk, 2020). Here insulin can be seen as the key to unlocking the body's cells (Videncenter for diabetes, 2021a) and helps in three ways:

1. When insulin binds to the cell's surface, it makes it possible for glucose to access them. Here, it is converted to energy and helps lower blood sugar to a normal level after a meal. (Sundhed.dk, 2020; Videncenter for diabetes, 2021a).
2. If the insulin and blood sugar levels exceed the cell's needs, insulin helps store glucose in adipose tissue, liver, and muscles (Almdal, 2019).
3. Oppositely, when the insulin level is low, for example, at night, the glucose is released from its storage in the liver, muscles, and adipose tissue (Almdal, 2019).

Ill. 7 below showcases three cases: normal and healthy insulin production, Diabetes type-1, and Diabetes type-2.



ILL. 7 Types of diabetes

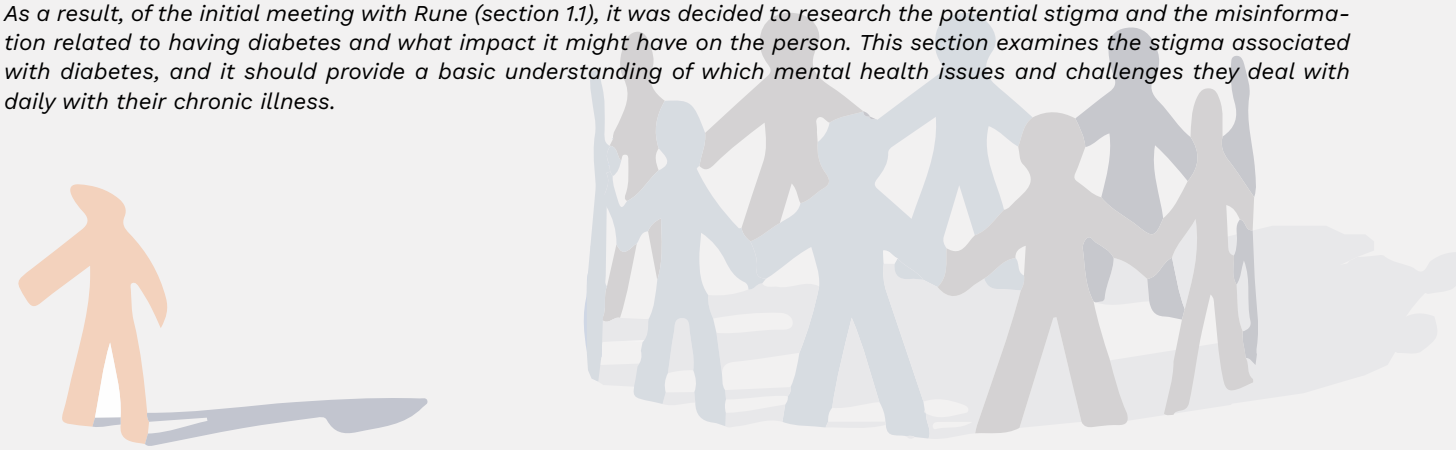
X	The group delimits from type-2 diabetes due to tablet treatment.
!	Insulin must NOT be given if insulin shock
!	Average: 4 blood glucose measurements, 1-2 injections of slow-acting insulin and 3-5 injections of fast-acting insulin daily

// EVALUATION

A greater understanding of type-1 - and type-2 diabetes was gained. Based on the research, the group decided to focus on type-1 diabetes, as this requires insulin coming from a product. In contrast, type-2 can also be treated by changing lifestyle or/and tablets. In addition, the group noted several misunderstandings about when to give insulin, which can have life-threatening consequences. Therefore, there will be potential in making a product with insulin that is only for the person with diabetes and cannot be identified as insulin by outsiders who are potentially misinformed and will misuse it.

1.4 STIGMA ASSOCIATED WITH DIABETES

As a result, of the initial meeting with Rune (section 1.1), it was decided to research the potential stigma and the misinformation related to having diabetes and what impact it might have on the person. This section examines the stigma associated with diabetes, and it should provide a basic understanding of which mental health issues and challenges they deal with daily with their chronic illness.



ILL. 8

WHAT IS STIGMA?

Erving Goffman has previously defined stigmatization as a "negative character-sending characteristic," which helps to distinguish the individual from others. In the worst case, this stigma can overshadow the person's other characteristics. (Sørensen & Jensen, 2019)

Furthermore, stigma can be divided into two types: 1) external stigma, meaning it comes from society and other people, and 2) internal stigma, meaning it comes from yourself. Some examples of external stigma could be if a person with diabetes feels shame if other persons ask them, "do you need more candy" or the person with diabetes being passed over for promotion due to their health. Where the internal stigma could be the person with diabetes feeling guilty about eating anything in their home or when they must check their blood sugar, 'Is it okay? Am I doing it right?'. They constantly evaluate if they are good enough to deal with their diabetes. (Yan, 2022)

> *Stigma is more about perceptions of those who stigmatize than facts about those who are stigmatized*
> *- Fonden, n.d.*

STIGMA AND DIABETES

The focus on the psychological problems associated with diabetes has increased in the last couple of decades (Krohn, 2021). Studies have shown an increase among people with diabetes type-1 and type-2 in affective disorders like depression and anxiety (Groot, et al., 2016).

A meta-analysis explained in a review showcased that depression among adults with diabetes increased by 21,3% for type-1 and 27% for type-2 (Groot, et al., 2016) compared to individuals without diabetes (Anderson, et al., 2001).
Importantly, stigma looks different for each person. People with diabetes could have a stigma associated with the need to inject insulin, track their blood sugar, or wear a continuous glucose monitor (CGM) or an insulin pump on their bodies. Others might associate stigma with specific body types.
A significant challenge for people with diabetes can be its stigma. Diabetes stigma can occur everywhere, including workplace, school, family, and healthcare settings. It can prevent people from seeking the needed care and managing their mental and physical health. (Yan, 2022)

WHAT CAN CAUSE DIABETES STIGMA?

The disease diabetes is complex, and it is a health condition that can result from many factors, such as lifestyle, environment, genetics, and socioeconomic factors. However, many people do not know enough about diabetes. One common misunderstanding is that diabetes is developed based on individual behaviour and poor health and food choices. It results in people believing that individuals with diabetes are entirely responsible for their condition. These misunderstandings often result in misplaced blame, judgment, and disrespect towards the person with diabetes. Some judgments are associated with using some technologies and medications. (Yan, 2022)

> *Many studies show that stigma and the media's image of mental illness are strongly related*
> *- Fonden, n.d.*

CAN STIGMA HAVE AN IMPACT?

Worse health outcomes can be caused by stigma and discrimination. People with diabetes explain having feelings of embarrassment, blame, anxiety, guilt, fear, and low self-esteem as an outcome of being stigmatized. It can increase the risk of getting health complications such as vascular problems, sexual dysfunctions, and retinopathy due to the negative emotions leading to depression and higher stress levels. (Yan, 2022)

> *Society must not see diabetes as something you are - but like other diseases - something you have*
>
> *- Fonden, n.d.*

Stigma can also result in worse self-care and management of diabetes. The person with diabetes often worries about the harsh judgment that incites efforts to hide the essential diabetes treatment. For example, some people with diabetes reported avoiding social activities, making unhealthy food choices to prevent rejection of the offers, and only injecting insulin in public bathrooms or at home (thereby delaying or omitting the injections they need). If possible, they can manipulate their glucose diaries to avoid judgment from healthcare professionals or/and significant others. (Yan, 2022)

DIABETES DISTRESS

Diabetes distress is a psychological strain that people with diabetes can experience. It is not uncommon to experience both negative emotions and reactions to diabetes in their everyday life. If not treated or managed, it can become a challenge over a long period and develop into depression. Some of the typical situations that people with diabetes may experience as strains:

- Management of diabetes, where concerns such as low or high blood sugar or worries about the late complications of diabetes.
- Practical and daily chores such as: often measuring blood sugar, being aware of diabetes, restrictions on where and when to eat, and these routines that are not like the people around you.
- Social context where diabetes comes into focus, such as inappropriate comments from people around you, judgmental looks, discrimination, stigma, and the feeling that others will control your diabetes.

Diabetes distress is not an abnormal condition for people who have just been diagnosed with diabetes. It is a condition many people experience right after or during the first few years. A sudden change occurs from being healthy to suddenly being diagnosed with a chronic disease. (Videncenter for Diabetes, 2022)

ILL. 9

78 %

diabetic have experienced a form of stigma related to their diabetes

(Willanig & Sjøgren, 2020)

DIABETES STIGMA IN DENMARK

There is also a stigma in Denmark, where the environment stigmatizes people with type-1 diabetes in different circumstances. A new study shows that 78% of the participants say that they have experienced some form of stigma in connection with their diabetes. Here, it is mainly people with diabetes distress who share a significant influence on the stigma by their surroundings. The study also indicates that there should be a greater focus on the general knowledge about diabetes.

The research leader in the study, Ingrid Willanig from Steno Diabetes Center Copenhagen, divides the stigma associated with type-1 diabetes into three categories:

1. Having a feeling of being considered a person of lesser value due to having type-1 diabetes.
2. Having a feeling of being embarrassed due to diabetes and the health behaviors presented.
3. Having a feeling of being treated differently than others due to diabetes.

(Willanig & Sjøgren, 2020)

// EVALUATION

A broader knowledge has been gained that diabetes stigma, and distress can cause different problems. For the group, it is interesting to dive into the issues associated with using diabetes equipment, which is related to the embarrassment of the health behaviors. There is potential for exploring both diabetes products and the user experiences thereby. However, the problems of stigma and challenges of having diabetes need to be further explored. Therefore, it is necessary to search for users with diabetes to be able to confirm or deny whether the diabetes equipment can be an influencing factor.

! Several are misinforming and associating type-1 diabetes with type-2

! Those who have diabetes don't want to be identified as their disease

! The diabetes equipment should preferably not show it is disease related

ILL. 10

1.5 UNDERSTANDING OF USERS' ISSUES

Based on the previous research, there was a need to gain better insight into diabetes stigma and illuminate this from the perspective of the person with diabetes. Besides, it should confirm or deny whether diabetes equipment has an impact and whether this can help to frame the project's solution space.

DIABETES ON SOCIAL MEDIA

To better understand the users, the group reached out to several groups on Facebook dealing with diabetes (primarily type-1 diabetes) to see if there were patterns in the user problems related to stigma. In addition, this was also a way to reach out to many users at the same time quickly.

However, many of the comments were not as specified according to the topic of stigma. Therefore, a notice was posted in several of the groups to get more specific comments (See App. 1.3) regarding this mentioned stigma (see page 8). There was a great response to these postings, where the problems were both mental difficulties by diabetes equipment was highlighted.

Note that many of those who responded to the postings had diabetes; however, a large proportion were also relatives, which provided insight into problems. However, to narrow down the answers, there was primarily focus on the difficulties experienced by the people with diabetes and not the relatives. In addition, an observation from the Facebook comment was that the stigma had the most significant impact in the teenage years. (See selected comments on ill. 12 on next page)

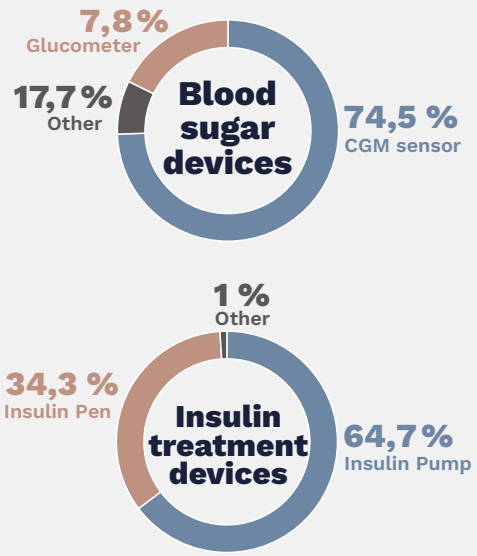
SURVEY

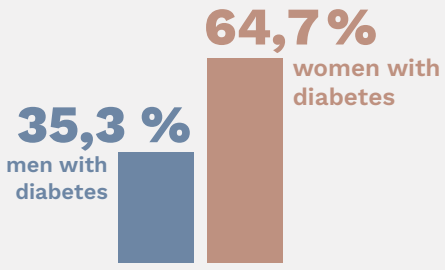
The group also did a survey in parallel with the Facebook postings (See App. 1.4). Which was to obtain more quantitative data concerning what equipment the users use and whether it is possible to identify a difference in this form of treatment (applications) with gender, age, or type of diabetes, as well as understand the relationship to diabetes stigma.

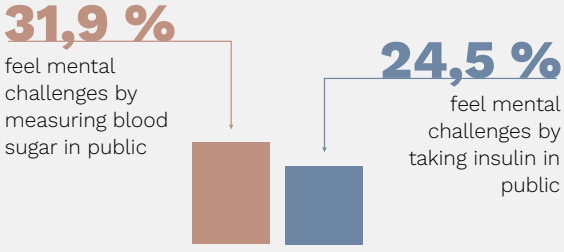
In addition, the group also had a presumption that the answers would be more direct and not hide any problems as the survey was anonymous.

As the Facebook posts, some relatives answered the survey on behalf of a person with diabetes.

The data from the survey are based on 204 responses (See App. 1.4). The majority of the respondents (99%) had type-1 diabetes. The respondent's age could not be used, as a significant proportion (44%) of those who answered as relatives wrote their age instead of the person with diabetes age. (See selected comments on ill. 12 on next page)







ILL. 11

Facebook comments

I am constantly aware of whether I have enough extra diabetes equipment with me, such as needles, batteries, and insulin
- Sanne M. J.

The many gadgets on my body also cause me to feel a little like a cyborg, and it affects me, in reality, more than what I wish it should do
- Jacob S.

It is not nice that others can see you have diabetes
- Anne K. L.

It could be nice if the world knew more about diabetes and the reason for it and not just assume it is because I ate too much sugar
- Linda S. B.

Survey comments

It is very intimate to involve others in your illness. In a crowded s-train, you cannot spare anyone from it. It feels uncomfortable

You would rather make it as invisible as possible to avoid questions and people who think they know everything about diabetes

My illness is very visible and I am therefore constantly thinking about what others think of me - It attracts bodily attention in all situations to sting

I have a lack of space for all my equipment

Some in my class are stupid and make vomiting noises when I take insulin

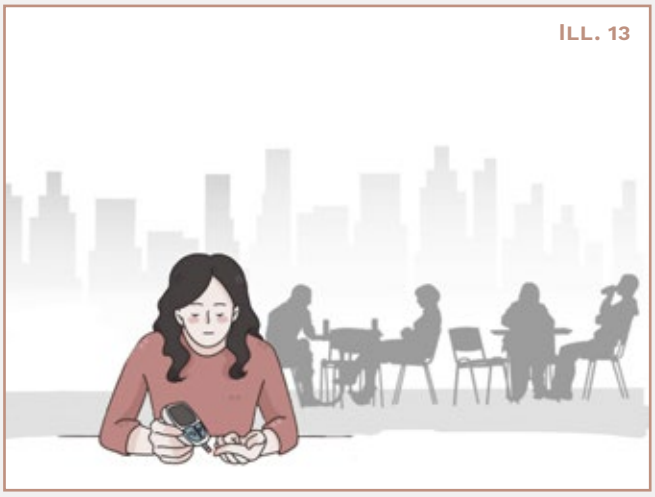
I want to hide my diabetes as I want to be experienced as a human who functions like everyone else on the job market

ILL. 12 facebook and survey comments (see App. 1.5)

COMPARISON OF SURVEY AND FACEBOOK COMMENTS

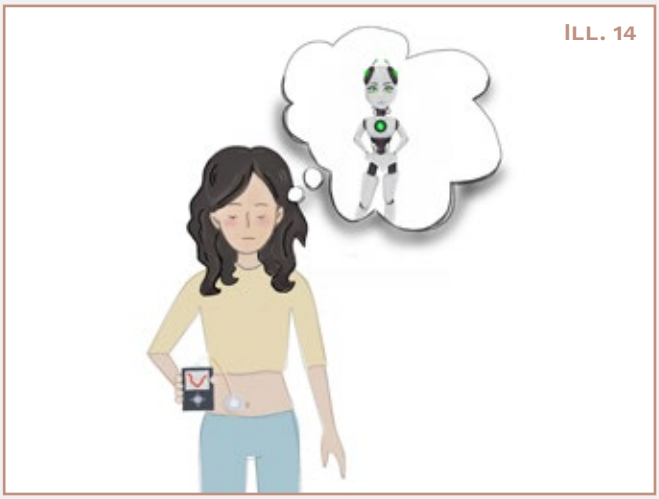
The Survey and Facebook post led to two of the primary issues where the diabetes equipment had an impact on their behavior and management of diabetes:

ILL. 13



1. Managing their diabetes in public spaces, primarily where there was a need for a stab with a needle include use of a glucometer and insulin pen.

ILL. 14



2. Carrying an insulin pump on the body gives both practical challenges and visual and mental issues.

// EVALUATION

The group gained a greater understanding of what people with diabetes manage in everyday life, and that stigma significantly impacts many with diabetes and their mental and physical well-being. Based on both the Facebook comments and answers from the survey, two main areas have primarily been found, where there have been the most recurring points. The two directions where a solution space could be seen were: 1) dealing with diabetes in public and 2) having an insulin pump mounted on the body. These two directions need to be further explored.

! It is primarily at a young age that stigma have the main impact most for diabetics

X The project delimits form working with relatives of a person with diabetes

1.6 MARKET SOLUTIONS

Besides the stigma, the group needed insights into the products and tools for the treatment of diabetes type-1 available on the market. Here the complexity of equipment and product combinations for the user became visible. The market research covers different treatment opportunities found but will not dive deeper into a specific product category.

ON THE MARKET

When looking into the market (App. 1.6 and 1.7) and the survey sent out through social media groups (see section 1.5 understanding of user's issues), it became evident that these products ranked from low to high tech in their usability. Ill. 15 below showcases a graph going from low- technological to high-technological with a selection of these varying products for diabetes treatment. Some of the equipment also have additional equipment, but these are not explained (see App. 1.6).

When searching and analyzing the diabetes equipment, it was observed that there was no significant difference in the variants of the products in terms of neither age nor gender - they seem to be 'one-fits-all'. Additionally, it is seen that these products have a partly clinical expression, and some look like iPods or other kinds of music devices (See App. 1.6).

ILL. 15 Types of diabetes equipment

ACCESSORIES

In the research of products on the market, the group found that other companies have created accessories for the main equipment to "hide" the products with rubber covers, in bags, childish toys, or cover them in stickers (see Ill. 16). It is done so that the products do not show the clinical features and potentially give the user a stronger connection to the equipment and give the possibility to style it (see App. 1.6).

ILL. 16 Accessories for diabetes equipment

ILL. 17 Measures blood sugar

THE TREATMENT JUNGLE

Besides looking at the overall equipment on the market, the group also dived into treatment options. It was to understand what types of equipment the persons with diabetes use and potentially combine in their everyday treatment of their disease.

It quickly becomes a jungle for diabetes equipment and a combination of products when diving into treatment options. Most diabetes equipment is cost entitlement and must be approved by the municipalities. It matters how much they individually want to spend on diabetes treatments for many regions and municipalities. To have a patient on the glucose meter (GM) with finger pricker treatment compared to a sensor-based glucose meter (CGM) is 3.000 DKK against 12.000 per year (Richter, 2022). When trying to understand the combinations of products for diabetes treatment, it quickly became clear for the group that this was a jungle to navigate. However, the group found some overall combinations and treatment possibilities. A simple description of the equipment can be found on the next page. For one person with diabetes, treatment requires a piece of insulin equipment and a glucometer. These can be combined as a 1) pen- and A) glucometer-method or 2) pump- and A) glucometer-method (see illustration on the next page). It is based on the overall market research in App. 1.6), and a larger mapping can be found of all the combinations of the diabetes equipment in App. 1.7. The descriptions are based on the interview, found in App. 3.1, 3.2 and 3.3 and section 3.1.

// EVALUATION

Based on the market and treatment research, the group found various equipment for diabetes treatments and combinations of this equipment. However, one major stakeholder is the municipalities, which regulate who can get grants for the different treatment methods. The diabetes equipment range from low to high tech in the products for use, and some can communicate with each other, like a CGM sensor and a Patch Pump.

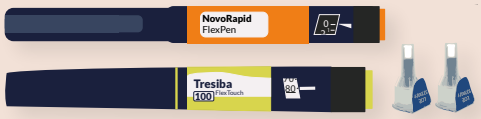
In addition, the group found that most of the investigated medical products on the market have a clinical visual language and seem to be designed for one-fits-all. Instead, the users can use accessories to hide the pumps, pens, measuring devices, etc., from the public eye or make them more stylish.
Depending on the direction, more in-depth market research on a specific product might be needed later.

! There are only accessories to give the diabetes products more identity - these are very conspicuous in terms of colors and shapes and covers and stickers are the primary

! The diabetic needs a (C)GM combined with a insulin treatment device (pen or pump)

1) Pens

Every injection with a pen is recommended a fresh unused needle.

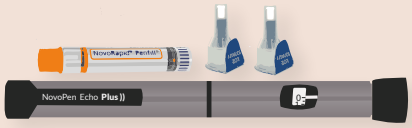


Slow and fast insulin disposable pens

Slow and fast-reacting insulin (prefilled). Slow insulin is injected once a day, and fast insulin is injected when blood sugars are high or before eating. When the pens are used, they are disposed of or returned to the local store for recycling.

Slow and fast insulin disposable pens

MixTard insulin pens are disposable pens filled with mixed slow and fast-reacting insulin. It must be injected two times a day, and the person must eat according to a scheme.



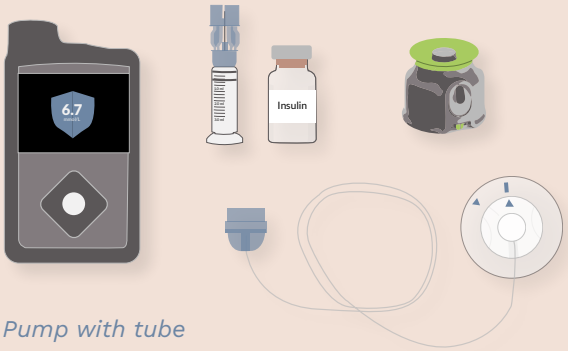
Replaceable insulin pen

A reusable insulin pen can be used for the insulin required for the user and comes in ampoules (the glass cylinder containing the insulin).

ILL. 18 Types of insulin pens

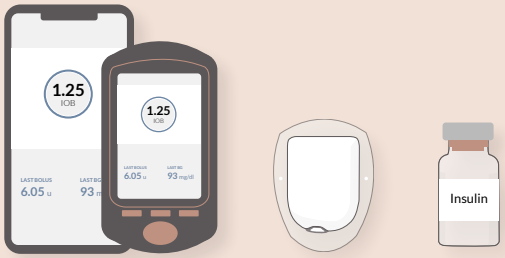
2) Pumps

Small computers that pump insulin into your body depend on the users' inputs and feedback from glucose monitoring, and they only contain fast-reacting insulin.



Pump with tube

Pumps with tubes can be positioned on the body, but the injection site is patched on the tummy. The user often refills them.



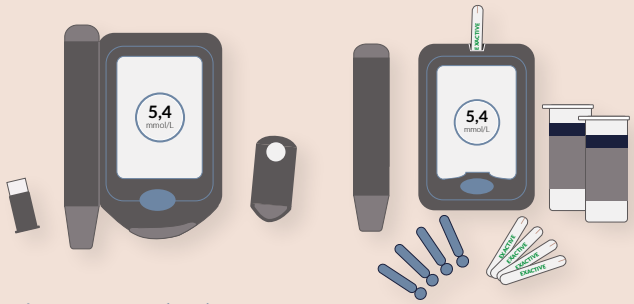
Patch pumps

A patch pump has no tube, and it sticks onto the skin where the needle is injected into the skin by the phone or the belonging control unit. Some pumps come prefilled, others must be filled with insulin by the user. The patch pumps are disposed after use.

ILL. 19 Types of insulin pumps

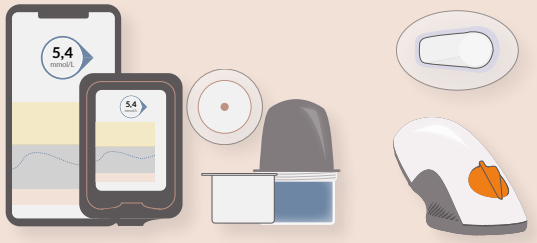
A) GLUCOMETERS

Glucometers measure the glucose levels in your blood.



Glucometers (GM)

A GM is a glucometer that measure blood sugar from a strip or strip roll. The user uses a finger pricker with needles to get blood from the finger. These comes I various sizes, and finger pricker and glucometer can also be combined in one solution.



Continuous glucometers (CGM)

A CGM is a sensor that continuously monitors your glucose levels. It comes in versions. Either as a flash scanner that provides retrospective data, you can read on your phone or a connected unit when swiping it over the sensor. It can also be a 'real-time' scanner that constantly sends data to your insulin pump, phone, or connected unit.

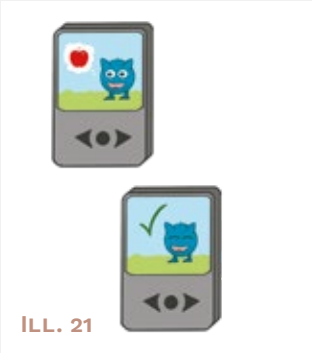
ILL. 20 Types of glucometers

1.7 INITIAL IDEATION

When analyzing and researching, many ideas often appear. Based on the gained knowledge, the group made a quick sketching round to start the initial ideation and to see if one of the found product directions could be a focus for the project. Here the group initially thought about the pumps and CGM sensors based on the research about diabetes stigma.

CRAZY EIGHT

A quick brainstorming ideation based on the method Crazy 8's was made to start the sketching. The method centers around drawing eight ideas in eight minutes to push the group members to generate various ideas and pushing one to go beyond the first idea. (Design Sprints, n.d.). After developing eight sketches each in the group, three initial directions for concepts were chosen (see App. 1.8). The directions were:

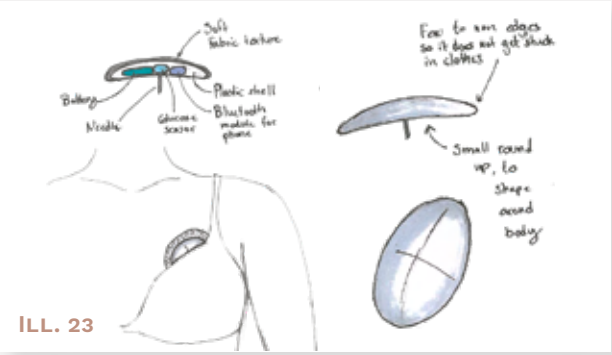


ILL. 21

1. Make it a more fun/ childish - the insulin pump

ILL. 22

2. Make the insulin pump as accessory



ILL. 23

3. Make the glucose sensor attached to the body more round to avoid getting stuck in clothes.

! The group formed three initial ideas. The next step was to get feedback on the ideas and the state of the project at millstone 1.

1.8 INITIAL DESIGN BRIEF

The initial Design Brief converts the collected data and creates the first foundation for the project and the ideas presented at milestone 1. The Design Brief contained a problem formulation, target group, stakeholders, and focus points.

Based on the group's previous research and ideation, it was chosen to focus on people with diabetes type-1, which in Denmark are 27.614 thousand. This type of diabetes is mainly diagnosed at younger ages, setting the target group to younger persons (see section 1.5). Based on the market analysis (see section 1.6), the group had different possibilities to adapt to the stigma around diabetes, create more personalized products, or make products that do not symbolize sickness and clinical equipment. The group, therefore, created this initial problem formulation:

PROBLEM FORMULATION

"How to design a product for a diabetic, that creates security and at the same time adapts to the individual's aesthetic identity. So, it would provide a social and individual acceptance around the condition?"

TARGET GROUP

- People with diabetes
- Diabetes type-1
- Young and young adults

STAKEHOLDERS

- The individual
- Relatives
- Hospital staff
- Municipalities

FOCUS POINTS

- Become an accessory
- Not show the equipment is for diabetes
- No clinical design

1.9 FEEDBACK FROM MILESTONE 1

The feedback in Milestone 1 viewed some valid considerations for the project from the supervisors. Overall, the audience received the approach of trying to create some identity in the products well. However, the focus seemed unclear, as there was no pinpointing on what this or these identities were. Various approaches were suggested, like looking into different identities, megatrends, and lifestyles and thereby creating schematics for setting a direction for the identities. Further, to ensure a design that angles identity, make variants that could hit different target groups and make the product differentiate on the market.

Personalizing/identity in creating a new insulin pump seemed off. Based on the feedback, it seemed that redesigning the pumps would be “boring” and that it would be more engineer-based rather than user and design-based. Looking back at the market solutions (see section 1.6), teh group acknowledge that pumps are very far in technology, and bringing something new would be challenging.

Additionally, it was questioned if anyone had challenged the design of an insulin pen or if it had just been the same since the 1980s, which was guessed to be the origin of the pen. (App. 1.9)

1.10 SUM-UP

ACQUIRED KNOWLEDGE

- Type-1 diabetes is often diagnosed at a young age, and insulin injections are vital as the pancreas does not function.
- There are 27.614 with diabetes type-1 in Denmark and around 1.2 million worldwide.
- There is a problem with diabetes stigma
- There is an extensive range of treatment combinations and insulin types.
- The equipment for diabetes on the market is mostly ‘one-fit-all’

FURTHER COURSE

- Change focus to insulin pens
- Specify the target group and get insights into their problems
- Understand user scenario for the use of insulin pens
- Research on current insulin pens available on the market
- Ideation on identity toward three concepts

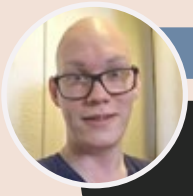
Define

The define phase contains knowledge optioned from user interviews and a visualization of their experience of accepting their disease. Additionally, a user scenario was made, understanding the current injection method and day of living with diabetes. Further, research on current insulin pens on the market is conducted. These analyses lead to the first rounds of ideation towards creating three concepts. In the end, the phase is summed up with a revised Design Brief.

02

2.1 TARGET GROUP AND USER INSIGHTS

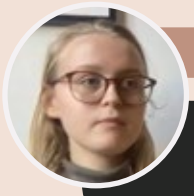
The group did parallel in the discover and define phase, online and physical interviews with users, and mail correspondences with questions sent to them. The interviews were kept as an informal conversation around general problems, their stories, use tendencies, and the daily life of having diabetes. In the discover phase, the attention was on pump users; however, after the Millstone 1, the group reframed the focus to users with insulin pens. The group decided to focus on young diabetics aged 15-30 years old in this relation. It is commonly known that identity is created in these years. The section gathers the information of all the users contacted (pump and pen) and creates an overview of the users, key insights, and understandings of feelings related to having diabetes. To gain a deeper understanding of the users' see appendix 2.1 - 2.11.



Pen & CGM user

Christian Petersen,
Age: 29 - 2 years with diabetes
Average daily injection: 4-6 times

Christian suffers from PTSD and social anxiety. When he feels stressed, he can have misleading glucose numbers, which may result in taking too much insulin. Christian prefers the pen as it feels safer because he can control the exact amount of insulin injected. He does not like to inject insulin in public, which he thinks could be because of his social anxiety (App. 2.1). Christian was interviewed online and has provided written feedback on concepts.



Pump & CGM user

Liv Jensen,
Age: 20 - 5 years with diabetes
Average pump replacement: 3. day

Liv is open about her diabetes and has no problem injecting herself in public with insulin pens. Today, she has a patch pump connected to her CGM, which means the system controls her insulin injections, giving her more freedom. She hates when people think she cannot eat sugar, it makes her want to take a big fat bite of a Berliner doughnut up in people's faces. (App. 2.4). Liv was interviewed online after the group changed the project focus.

Pump & CGM user

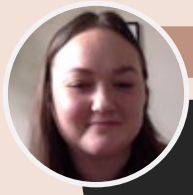
Malene Boll,
Age: 29 - 21 years with diabetes
Average pump replacement: 2.-3. day

Malene prefers an insulin pump with a tube. The tube is a reminder to refill the insulin. She feels the pump makes her diabetes more invisible, and it just looks like having a phone in your pocket. When using an insulin pen, she did not like to show stomach skin to strangers. She does not like when people interfere with how she regulates herself. She knows what is best for her. (App. 2.2). Malene was interviewed online when the focus was on insulin pumps.

Pump & GM user

Sofie Johnsen,
Age: 18 - 10 years with diabetes
Average pump replacement: 3.-4. day

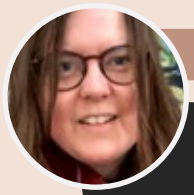
Sofie's free space from having diabetes is playing football. When using insulin pens, she used them before practice and games. Today she has a pump with a tube, where she needs to place the pump back on at half times. She thinks a lot about her eating habits as she is afraid of being stigmatized for eating sugar or exercising too little. (App. 2.5). Sofie was interviewed physically shortly after the group changed the project focus to insulin pens.



Pump & CGM user

Marthine Rose Jensen,
Age: 22 - 17 years with diabetes
Average pump replacement: 3. day

Marthine has both a sister and a father with diabetes type-1. As a teenager, she hid her pump in her bra because she had not accepted the disease entirely. When her sister got diagnosed with diabetes, she accepted her diabetes. She wanted to help her, which required her to help herself first. Now she works as a volunteer in the diabetes association. (App. 2.3). Marthine was interviewed online once after the group changed the project focus to insulin pens.



Pump & CGM user

Sanne Møller Jensen,
Age: 39 - 26 years with diabetes
Average pump replacement: 3. day

Sanne uses a tube pump, and she feels it was a significant quality of life chance. She tried to have an insulin chock, which gave her anxiety symptoms 10 years later. Today if she, e.g., is sick, she is unsure if it will return. High blood sugars and anxiety look alike. Sanne feels like a Cyborg with all the electronic things on her body (CGM sensor and pump). (App. 2.6). Sanne was interviewed online after the focus changed. She was older than the target group.

Pen & GM user

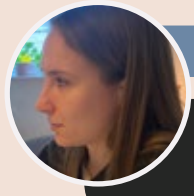
Rune Sejer Jakobsen,
Age: 30 - 26 years with diabetes
Average daily injection: 4-6 times

Rune tried a pump as a teenager. However, he felt it was a constant reminder of his diabetes. Once Rune experienced an insulin shock because his pump gave him too much insulin, and now he uses pens. Rune plays football, and sometimes the team members don't notice his diabetes, even though he injects himself while talking to them. (App. 2.7) Rune was interviewed at home and used several times to test and give feedback on concept mock-ups.

Pen & CGM user

Katia Midtgaard Rasmussen,
Age: 32 - 1,5 years with diabetes
Average daily injection: 4-5 times

Katia is newly diagnosed. She feels it is difficult to hide an insulin pen as they are long. However, she has a reusable pen, which can give half units, and for her, that is important as she reacts to a small amount of inulin. She is also very aware of the type of food she eats, as it impacts her diabetes. (App. 2.10). Katia answered questions about herself through emails and was a little over the target group's age range.



Pen & CGM user

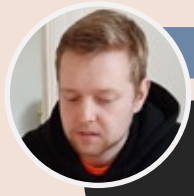
Lia Papazu,
Age: 26 - 1 year with diabetes
Average daily injection: 4-10 times

Lia is new to diabetes and has only used insulin pens. She refuses to hide it and is not afraid of what people think; therefore, she injects herself no matter the setting. However, it can still be a little anxiety-provoking for her. She needs control and has a notebook in which she notes how much and each time she injects herself. (App. 2.8) Lia answered questions over mail and participated physically in a user test with concept mock-ups.

Pen & CGM user

Kathrine Randrup Laursen,
Age: 19 - 10 years with diabetes
Average daily injection: 5-6 times

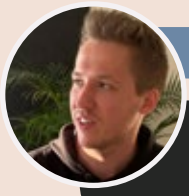
Kathrine had a pump. But in 10th grade, she was in afterschool, where she did a lot of water sports like kayaking and paddleboarding; this made her shift to pen, as she could not have the pump on during these active hours. She had a reusable pen, which she liked because it told her how much and when she last took her insulin (App. 2.11). Katherine answered questions by mail and participated physically in a user test with concept mock-ups.



Pen & GM user

Martin Kaae,
Age: 25 - 1 year with diabetes
Average daily injection: 3-4 times

Martin is newly diagnosed. It came as a chock for him. He had just found his identity, and suddenly he had to find it all over. He doesn't like showing his diabetes and hides it when injecting insulin. He feels people want to treat him differently because he is sick, and his pen and diabetes purse amplify those signals. (App. 2.9). Martin answered questions by mail and participated physically in a user test with concept mock-ups.



Pen & GM user

Jens Ulsøe
Age: 27 - 2 years with diabetes Average daily injection: 4-5 times

Jens is new to diabetes and is friends with Rune. Jens was afraid of pricking himself with needles. But he has become more used to it over time. He remembers a boy from his primary school who had diabetes, where it was easy for Jens to see that he was sick. Jens thinks the pens are ugly and signal you have diabetes. Jens was brought in later in the process and was therefore used for testing concept mock-ups. (App. 3.9).

> *I think It was really humiliating when I was younger, or when I was a teenager with the pump - that I should run around with that patch on my stomach - It was such a... almost a brand mark because here goes an abnormal - see! He is just released from the hospital*
> *- Rune Sejer Jakobsen (App. 2.7)*

Note: At this time in the process, the group also interviewed an expert, Anette Borre Hansen, who gave the group insight into diabetes and the hospital's relationship and the different types of treatment they offer. See further about the interview in section 3.1, and App. 3.1 , where the group drew the other experts into the project. Insights from Annette also contributed to later idea and concept development.

ILL. 24 Visit user

OVERALL INSIGHTS

This section provides categorized insights on the repetitive statements, problems, and experiences that the users interviewed have in common.
In this section, the essential points are marked with this symbol.

FEAR OF THE NEEDLES

When it comes to diabetes, the number of needle insertions differs from pump and pen treatment. Based on the users, inserting the needle with a patch when using pumps is done every second or third day as the insulin is injected into the body through the same insertion site. However, the average insertion is 4-6 times each day for fast-acting insulin and once for slow-acting for pen users. Both Liv and Marthine had a significant fear of needles, and Kathrine and Jens were very afraid of needles before getting diagnosed and when starting their treatment. Additionally, did many other users say it was a boundary to overcome when beginning to inject insulin. It clarifies that, especially in the beginning, the idea of injecting a needle can be terrifying, which is a fear that may follow them. For Liv and Marthine the pump reduces the number of insertions, as Marthine describes it:

> *I'm 'monster' scared of needles, so I would rather change the insert every three days.*
> *- Marthine Rose Jensen (App. 2.3)*

PRACTICAL THINGS

A common thing for the users is the large number of products they bring on the go every day. Each case was a little different depending on the products they used. However, Rune, Christian, Kathrine, Martin, Lia, Sofie, Jens, and Katia explained that the equipment takes up a lot of space; this means they bring a special bag or use a smaller one in their larger bags or have the things lying loose in their pockets or bags. The common thing is it's unpractical. Rune uses his pockets for needles, and this means both used and un-used needles are lying loose, and he has no overview of them. As he describes: "It is more annoying to have the needles lying loose. [...] Because when they are loose, they can get a little worn, here at the [paper protection] - and there can be a hole in, and then bacteria can enter, and that is not the intention." (App. 2.7) Kathrine leaves a needle on her insulin pen so she does not have to carry as many needles on the go and therefore uses the same needle several times. This is not smart as the needles are recommended to be used only once.

AWARENESS OF SURROUNDING AND OWN BOUNDARIES

There seem to be different degrees of awareness of the surroundings and the users' boundaries when injecting themselves. Martin, Christian, Sofie, and Malene (when she used the insulin pen) are about their boundaries of showcasing their diabetes and the possible looks from strangers. It relates to the stigma and taboo regarding diabetes (see section 1.3), where the users can feel people looking and treading them differently. Martin especially is aware of it: "I think the primary reason I take insulin a little hidden is because of the "judgmental" look. People are typically scared and judgmental about things they do not often see or do not understand. It's not always easy to handle, as there are many other things to handle at the same time, so it might also be to spare myself." (App. 2.9) Some users are more aware of the persons around them and how they feel about seeing someone injecting themselves. Kathrine works in a primary school, which means she is aware of how injecting herself could be violent and terrifying for the children. However, she also experiences that they are curious, and in these cases, she has a crowd when taking insulin. And Lia explains that she will make people aware that she injects herself, so they can look the other way if they do not like it. In all cases, the users experience getting more attention, either positive or negative. For some, this can be overwhelming.

'LIKE A PAIR OF GLASSES'

There are divided opinions when seeing diabetes as a part of one's identity. Liv, Marthine, and Kathrine distance themself from being a diabetic. As Marthine describes it: "Well, I'm just a diabetic, I'm not the diabetes, I'm not my disease. I just have it." (App. 2.3) Additionally, Liv was invited to group meetings with other diabetics when she was younger. For her, it was like being stereotyped and forced to have these chronic friends who, apart from diabetes, had nothing in common with her. However, in the case of Rune and Sanne, they are on the opposite end of the scale. Sanne feels the disease is 'her', and it simply feels so much of who she is and is a part of her identity. Like Liv, Rune has been on these trips where the plan had been about making diabetes normal. However, he feels a common denominator that relates both to diabetes and other chronic diseases, which is; 'the illusion of the normal life.' (App. 2.7) For him, diabetes is also a part of who he is, and he describes it as:

> *I would think that, in some way, it might be a bit reminiscent of wearing glasses - it's not something you might talk about in the first conversation - but it is also not in that way hidden.*
> *- Rune Sejer Jakobsen (App. 2.7)*

YOUNG, PARTY, AND ALCOHOL

For all of the users partying and drinking is a sore spot. Most of them take distance from drinking as it makes their glucose levels very hard to control, which can be deadly in some cases. Sofie, e.g., had a friend who drank too much one evening, which almost became fatal for her. In addition, many feel unsexy when they must carry around their diabetes equipment or walk around with a pump attached to their body when partying and looking for love. For example, Marthine had a friend who got dumped because the guy couldn't distance himself from her insulin pump.

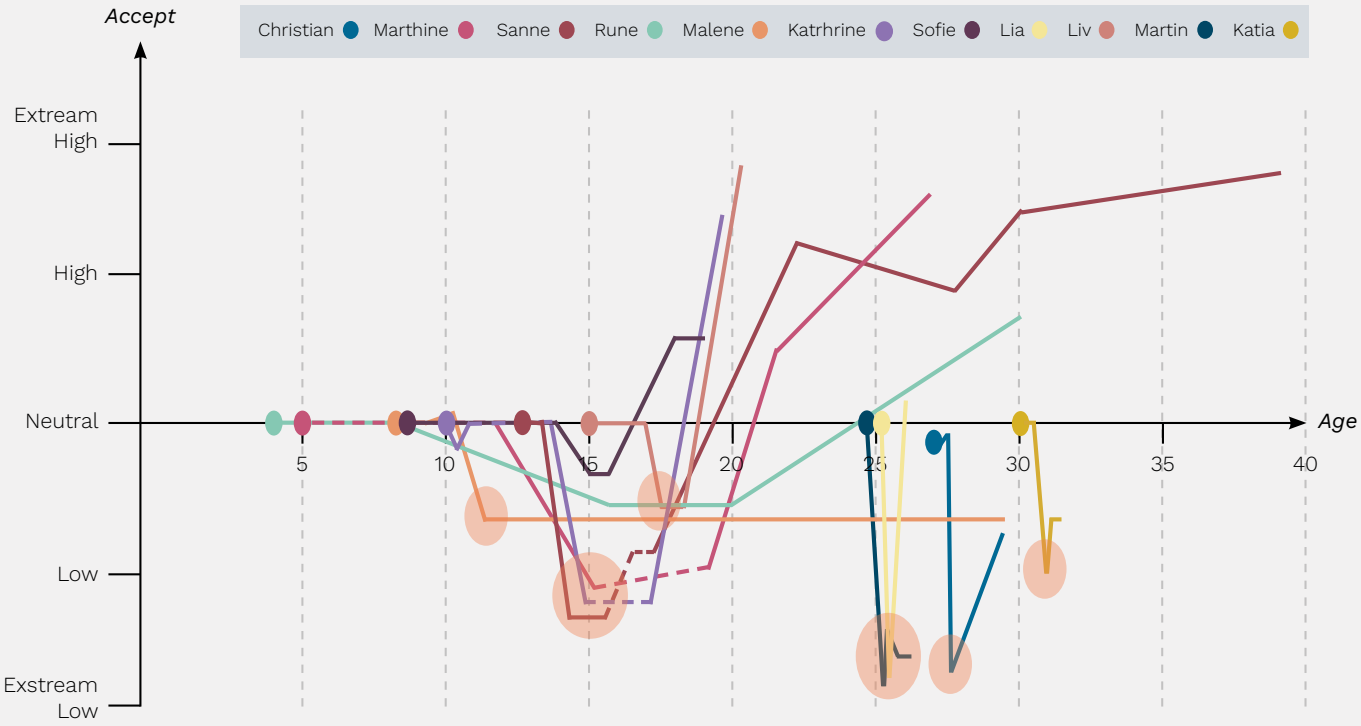
INSULIN ACCURACY

The group noted that the users had different needs regarding insulin dose accuracy. Through the interviews with pump users, the dose accuracy in the pumps was highly valued, as it helps regulate blood sugar more accurately. The group further noticed that this also was important for the users, e.g., Katia, as she had the opportunity to inject half units. This more accurate dose setting was a potential thing for further work.

Based on the interviews previously conducted, the group listed pros and cons from their viewpoint on the two overall treatment types (see insulin pen vs. Insulin pumps in App. 2.12). It is done to see possible solution space that might combine some of the functionalities of the two treatments.

One insight was that all with diabetes start with a pen and a simple glucometer with a finger pricker, as they need to learn the essential equipment for diabetes patients.

FEELING CURVE



Note: If the lines are stiplet is places in their life they are unsure, or can't really remeber how they felt.

ILL. 25

Parallel with the collection of user data, an overview of the acceptance of having diabetes type-1 was put into a graph (see graph on Ill. 25). The objective was to examine if the group found any patterns concerning the acceptance of living with diabetes type-1.

The graph is a rough estimate based on user data and histories. It goes from not accepting the disease to accepting it. As the type of acceptance is very individual, this graph mainly shows a visual representation of the changes in life stages and in which area the project's focus should be. This area is chosen as it could be a goal for the project to strive after making this acceptance curve softer.

A reflection upon this graph is that the age of diagnostics matters. When being a child, the impact and acceptance seem to be neutral, maybe due to not being all aware of what it means. However, experiencing diabetes in your teen years or

being diagnosed in your teen years, or as a young adult seems overall to impact the level of acceptance, as the curves drop. The impact of the diagnosis can, in some cases, seem to be like getting the rug torn away under one. As Lia explained:

> *It was hard to have been completely healthy the first 25 years of my life and then suddenly, from one day to the next, had to be chronically ill. It was a huge identity shock! I sometimes still feel weird that all the people I meet from now on will know me as her who has diabetes because that's not how I see myself.*
>
> *- Lia P. (App.2.8)*

This highlights getting diagnosed later in life can impact the understanding of your identity, who you are, and how diabetes is a part of your life. In relation to Lia, Rune also explains that diabetes impacts one's social identity as well (App. 2.9).
As described by Martin:

> *I sometimes feel like people want to treat me differently because I'm sick and have diabetes, and my pen/diabetes purse is helping to amplify those signals*
>
> *- Martin K. (App.2.9)*

Rune also explained: "There is no one who thinks more about it, than I do [...]. It was just mega hard to see... and hard to accept."

All these quotes from the users show that the user's acceptance of diabetes is a combination of how they see themself and how they feel other sees them.

// EVALUATION

One key learning is that no solution fits all users, which concerns the design, the treatment, and equipment. Considering the 'overall insight', the group found some critical points for the project and requirements (listed underneath). Further, by looking at the feeling curve, it focuses on the turning point of the users' curves. It is where they start accepting and creating an identity with diabetes as part of themselves. If a product does not highlight their diabetes, the group considered that it could soften this curve of acceptance, making it easier to let diabetes become a part of their identity. The group found that all people with diabetes begin with insulin pen treatment right after being diagnosed.

- ! The group chose to continue working with the target group aged 15-30 years
- ! Fear of needles - especially at the beginning of the diagnosis
- ! Their diabetes equipment takes up a lot of space
- ! Awareness of the surroundings - don't want to showcase their diabetes
- ! Many felt unsexy carrying around their diabetes equipment
- ! All diabetics start on insulin pen
- ! Make the feeling curve softer

- ✓ Inject half injection units
- ✓ Able to enter calories instead of units to adjust the insulin amount (For new users)
- ✓ Contain more needles in the solution/reduce the number of external units like the needles
- ✓ The insulin pen must collaborate with the CGM sensor or the glucometer
- ✓ Make injection more invisible to the social environment and for the user
- ✓ The device must be able to fit into a jacket/trousers/small bag
- ✓ The user should have a feeling of control
- ✓ The insulin injection can be done blindly

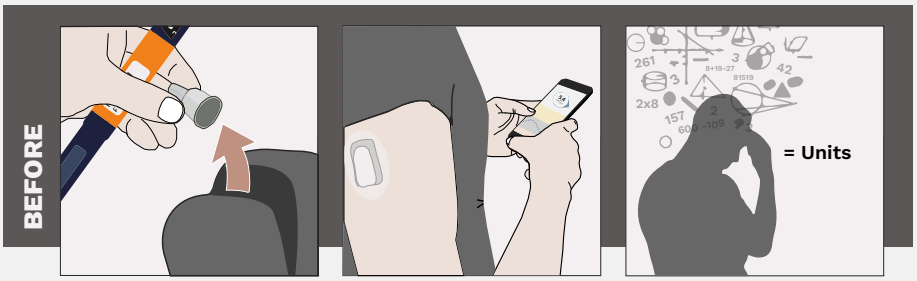
2.2 SCEANRIO AND INJECTION TECNIQUES

To gain better insight into an everyday life with diabetes, an 'Act out' (Bagger & Sperschneider, 2003 s. 45-46) was made by a person with diabetes and elaborated with questions to get the broadest understanding. This section outlines a typical everyday life with diabetes in a visual 'As is' scenario. Besides, the section will also dive deeper into whether there are special injection techniques that need to be taken into account.

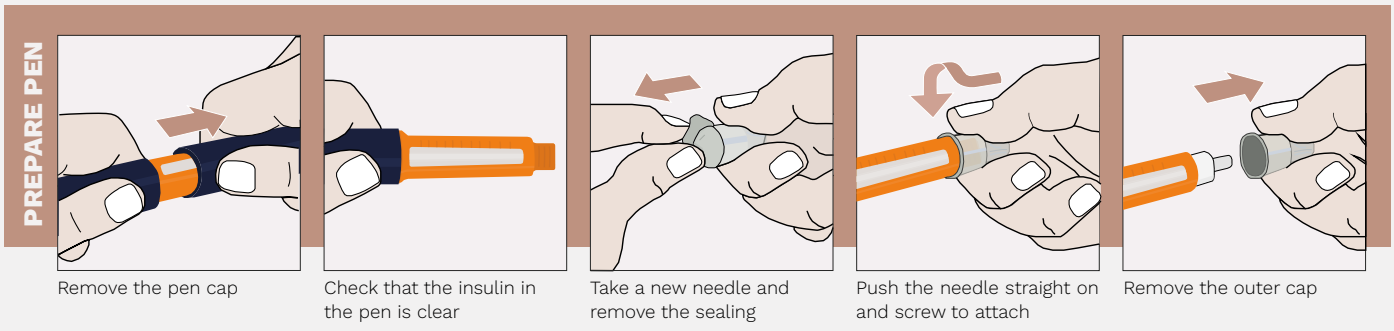
'AS IS' SCENARIO

The scenario is based on the interview and an 'act out' with Rune S. J., who has type-1 diabetes (see 'Act out' in App. 2.13), where there has been a focus on how many steps and active actions it takes to inject insulin (both before, during and after). Besides, it has been compared with the instructions for using an insulin pen (Novo Nordisk A/S, n.d.). Subsequently, this information has been processed and adjusted based on the other interviews and data from people with diabetes.
The 'As is' scenario was based on a person with diabetes who uses a CGM sensor to measure blood sugar and insulin pens to regulate blood sugar. Furthermore, action is included where the person with diabetes desires to hide his insulin injections for others - primarily in public spaces.
An overall scenario of a whole working day is illustrated on this page. Whereas on the next page, each step of taking insulin is represented.
All places in the scenario where this symbol is presented refer to the next page with the interaction with the insulin pen - both before, during, and after. After the last step of interacting with the insulin pen, continue back to the scenario on this page.

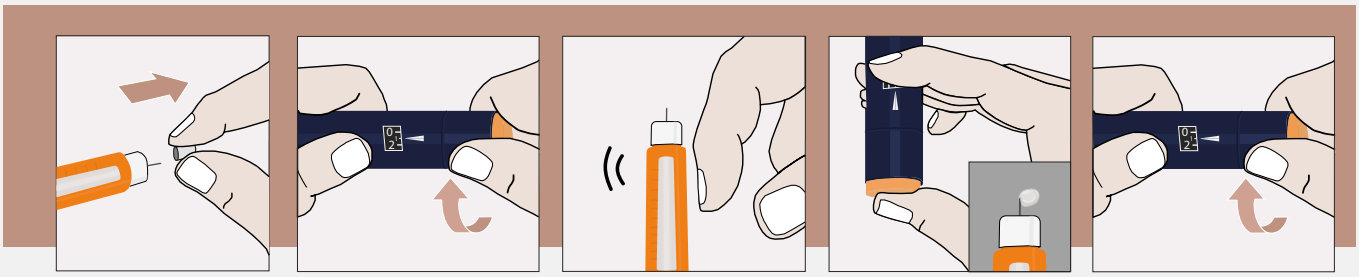
ILL. 26 Scenario



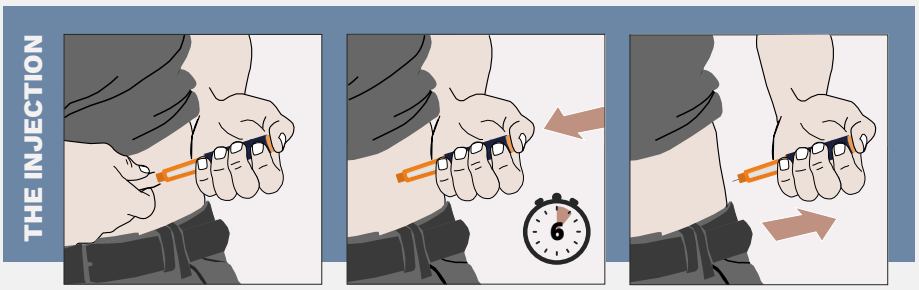
Finds equipment | Measures blood sugar level | Converts carbonhydrates to units



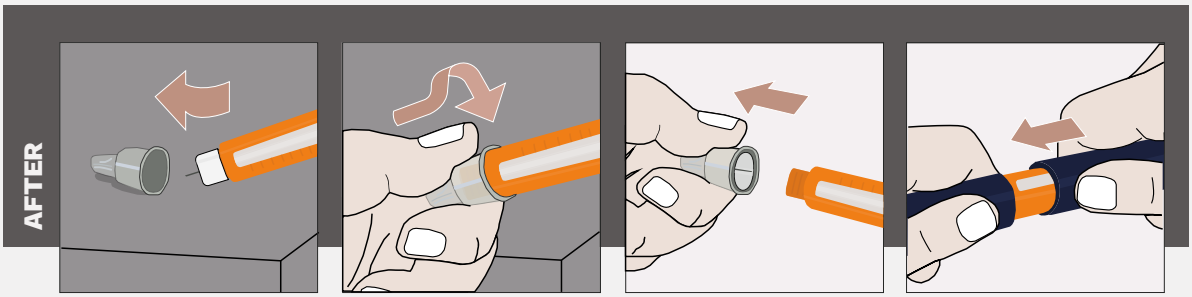
Remove the pen cap | Check that the insulin in the pen is clear | Take a new needle and remove the sealing | Push the needle straight on and screw to attach | Remove the outer cap



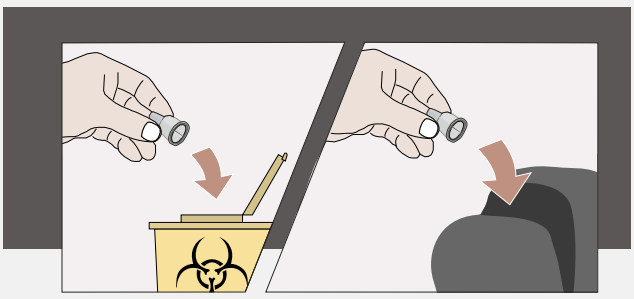
Remove the inner cap | Set the dose selector to a few units | Tap lightly on top to avoid possible air bubbles | Press the dose button, and a drop of insulin should appear | Set dose selectors to the desired number of units



Injects the needle | Press the dose button until it is back to 0. Wait at least 6 sec. | Pull the needle straight out of the skin



Insert the needle into the outer cap | Screw the cap on completely | Carefully remove the needle | Put the pen cap back on



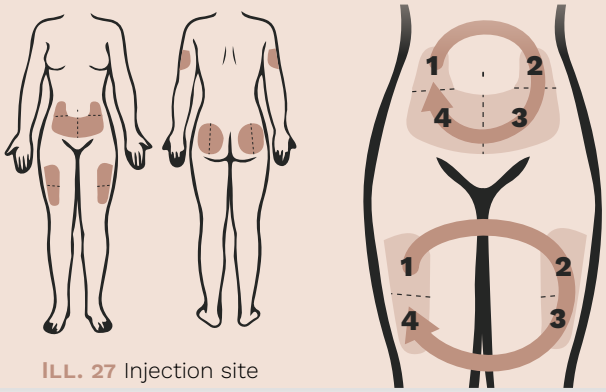
Dispose of the needle in hazardous waste - or safely put it back in the bag and dispose of when possible

It should be noted that the scenario is only an example of an individual's possible everyday life - an ordinary life with diabetes can vary greatly depending on the person and type of treatment. After gaining an insight into an 'As is' scenario, the group noted that a person with diabetes is often aware of diabetes and must respond to it in a timely and untimely manner.

After seeing an insulin injection in action, a need was seen to investigate whether there are professional recommendations on where and how to inject to get the best injection. Additionally, this also had to be investigated for the group to understand better whether there would be methods or particular areas that had to be considered in the solution space of the future concept.

INJECTION SITE

There are several places on the body where it is possible to inject insulin. Here it is recommended to talk to a doctor or nurse to find the best-suited injection area. It is possible to inject in the abdomen, thighs, back of the upper arms, or buttocks. Besides, it is also recommended that you do not inject in the same place but that you rotate the location of the injection clockwise, as in Ill. 27. (Nordisk, n.d.) Based on the group's user interviews (see App. 2.7), they often inject the long-acting insulin into the thigh and the fast-acting one into the stomach.



ILL. 27 Injection site

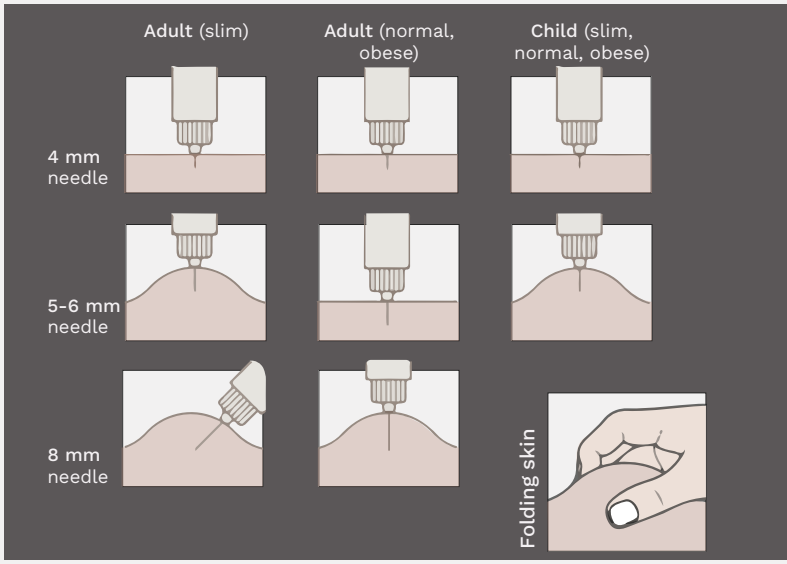
INJECTION TECHNIQUES

The insulin must be injected into the fat layer under the skin (see Ill. 28); this can be done with an insulin pen or an insulin pump. However, injecting the insulin with a pen depends on the person's build and the needle length. Again, the technique is best determined in collaboration with a doctor or nurse (see Ill. 28). Depending on the height and build, it may be necessary to "fold the skin" (see Ill. 28) to ensure that the insulin is injected under the skin. (Nordisk, n.d.)

When injecting:

- Choose the needle length
- Always use a new needle
- Angel the needle 90 degrees on the flat skin (see Ill. 28)
- Don't press too hard to avoid depression in the skin
- Don't inject through clothes
- Shift injection site at each injection

(Videncenter for diabetes, 2021d)



ILL. 28 Injection technique

// EVALUATION

Based on the scenario and the injection techniques, it was observed that there are many steps a person with diabetes should be aware of. Therefore, many requirements have been set related to the actual insulin injection. See the requirements below:

REQUREMENTS FORM SCENARIO

- ✓ Keep track of how much insulin there is in the equipment
- ✓ The user can control how much insulin there is being injected
- ✓ The needle should be replaceable
- ✓ When the needle is not in use, the insulin output must be protected
- ✓ A known area to place your fingers to complete the injection
- ✓ The insulin injection can be made into a one-handed operation
- ✓ A grip/neutral is to hold/place the finger/hand (must be stable during injection)
- ✓ Need visual contact with the needle when checking/pressing air bubbles out (doing a safety check)
- ✓ Decrease/reduce steps of injection of insulin

REQUREMENTS FORM INJECTION TECHNIQUES

- ✓ The injection should prevent the possibility of pressing so hard that you create a depression in the skin
- ✓ The injection should be possible to do at a 90-degree angle with or without making a lifted skin fold

2.3 INSULIN PEN AND MARKET

There was a need to investigate the insulin pen further and see its history and market. Here, the group must obtain a broader knowledge of the insulin pen and insight into whether there are shortcomings in the market.

INSULIN AIDS AND TREATMENTS

Before the group examined the insulin pen, it was necessary to research how many people had the insulin pen and other aids and treatments. Based on the diabetes report from 2019 with participants who have type-1 diabetes in Denmark, the proportion of aids and desired aids was: (see Table 1)

Remarkably, 70% have an insulin pen, and less than 1% want this aid. (Nielsen & Golubovic, 2019, pp. 46) This knowledge gave rise to further study of the current insulin pens on the market, and the development of insulin pens through history, to see if it has changed over the years.

TABLE 1 (Nielsen & Golubovic, 2019, pp. 46)

TYPES OF AIDS	% WHO HAVE THE AID	% WHO WANT AIDS
Continuous glucose meter	32 %	22 % (510 of 2.369)
Another sensor-based glucose meter	26 %	22 % (530 of 2.369)
Insulin pump	27 %	13 % (317 of 2.369)
Insulin pen	70 %	< 1 %

INSULIN PENS

There is a need to see how large the current pen span is in form and use (see App. 2.15). Hence, it provided an opportunity to map these pens and assess whether the group could find potential gaps for a concept direction. There are countless products on the market where many can be seen as very similar in shape (see Ill. 29):

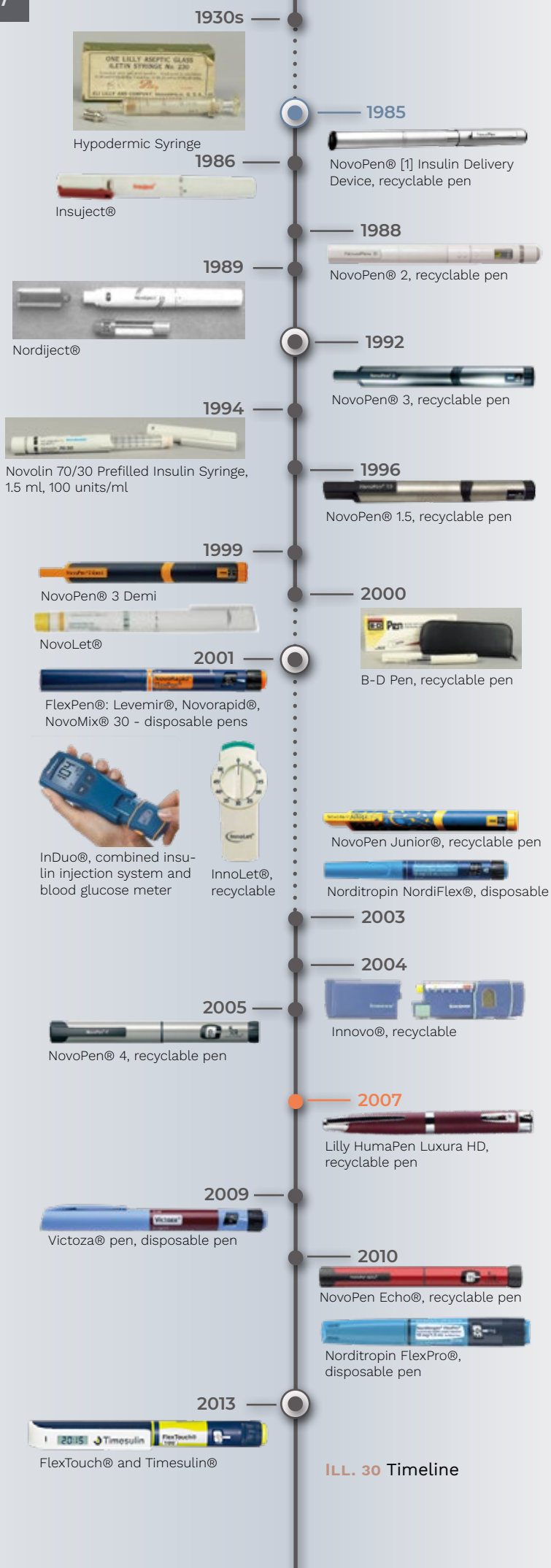
- All have this long pen shape
- They change in materials (plastic and metal)
- Colors changes (moves from toned-down to intense colors)
- Disposable pens have text markings – they look more "disease-like."
- Observed: many disposable pens on the market
- Observed: few reusable pens.

The group noticed that fewer reusable pens on the market create an environmental opportunity by reducing the amount of disposable pens. In addition, creating a reusable insulin device help to create a more personal device. It can also, be linked to more personality and style to the device, which is a desire for the person with diabetes to have a better relationship with their pen and not just throw it out after finished insulin.

> *"A few years ago, I just threw my disposable pens out after use, where today I have to collect them for a recycling system - for which I have to buy new ones as needed... so, it is no more personal than this soda can is"*
> *- Rune Sejer J. (app. 2.7)*

ILL. 29 Insulin pens

! A desire in the group appeared that the design should be made unique and that there may be an opportunity to choose something that suits the individual's overall style.



ILL. 30 Timeline

INSULIN PEN EVOLUTION

Looking back at the insulin pen's history, it was not until 1985 that Novo Nordisk A/S developed the well-known insulin pen. Several insulin treatment methods went from the well-known syringe to the pen (see the history of insulin in App. 2.15. As seen in Ill. 30, not much in the pen form, has changed since 1985. There have been a few insulin devices that stand out in shape. However, some of these have already been withdrawn from the market. Besides, the group has noticed that it is primarily the material and colors that have changed.

Through time more technology has also been added to the pen. Some of the new reusable insulin pens have added a screen that can electronically track how much insulin the user has taken and at what time (Novo Nordisk, 2022.a). The first insulin pen with a screen came on the market in 2007; see orange marking on Ill. 30. This feature helps to ensure that the user does not overdose on their insulin, as it can serve as a reminder. It is observed as an exciting feature.

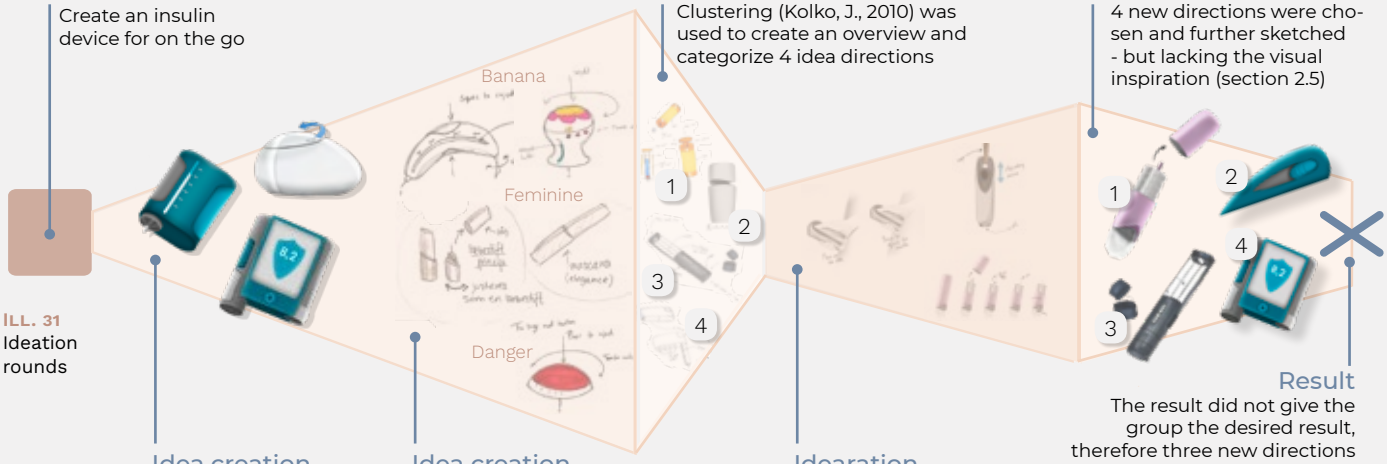
// EVALUATION

A majority with type-1 diabetes have insulin pens, but very few want this as their type of aid. That fact opens that there are some problems with the insulin pen, which have not yet been solved and is, therefore, something the group wants to dive deeper into. Additionally, it has been observed that the insulin devices on the market are very similar, both in terms of use and form. The group has chosen to continue working with a reusable pen rather than a disposable device. Based on this, requirements are formed, and the group can explore an understanding of the aesthetics of the insulin pen. Consequently, the next step is to explore the solution space and get initiating ideas out of the head through a sketch round.

- ✓ Keep track of the last time you injected insulin
- ✓ Keep track of how much insulin you took previous time
- ✓ A reusable insulin device

2.4 FIRST IDEATION

The group needed to get some of the initiating sketches out of their heads and start ideas for potential concepts. The group approached the first ideation round according to Striim's ideation model (Striim, 2001). This section illustrates the different idea phases inserted in the model, see larger and remaining sketches in the App. 2.16.



ILL. 31
Ideation rounds

2.5 PRODUCT UNIVERSES

Before further exploring concept directions, the group analyzed a product universe that provides insight into more personal products. It should provide some form of preferences that the group could use for further concept development.

ILL. 32

PERSONAL PRODUCTS

For many users (see section 1.5), diabetes is a personal thing, and it is often desired to hide it away from the public eye. To better understand more personal products used on the body and often in private surroundings. The group analyzed bathroom products to see differences in men's and women's related products and their colors and shapes. Seen on ill. 32, the colors are different for each segment, and the shapes and lines are also. The men's products have strong and bright colors and "fast" shapes, and the graphic is often meant to visualize "awesome and cool". On the other side, the women's products have pastel and lighter colors, curvy soft shapes, and the graphics are more refined and meant to visualize "beautiful". Both sides have forms referring to phallus symbolism (see App. 2.19).

// EVALUATION

Analyzing the bathroom products also gave some examples of shapes, colors, and differences in product categories - from here, the group highlighted several shapes. Differences were also seen between masculine and feminine silhouettes. The next step will be to convert some of this design language into the group's concepts.

2.6 CREATING CONCEPTS & USER FEEDBACK

With the understanding of different shapes and contrasts in the analysis of bathroom products, the group needed to explore other possible product ideas. Therefore, the group created a new sketching session to find three initial concept ideas. As the the group had a head time finding the project's focus, the intention was to create three different concepts focusing on various aspects of the users' problems. The group also sent the three concepts to some users for initial feedback.

APPROACH

BRAIN POOL

Based on the former user understanding, user scenario, and ideation rounds, the teams decided to make a Brain Pool sketching. In this method, the team's members create a pool of sketches. If a member runs out of ideas, sketches from the "pool" can be grabbed and used for inspiration for a new idea. (Tollestrup, 2004, pp. 284-286) Three rounds timeboxed in 5 min, with three themes, were made. The themes were: 1) User experience, 2) Product platform, and 3) Engineer/gathered solution. The sketches can be found in App. 2.20.

CREATING THREE CONCEPTS

The group then evaluated each pool of sketches, and three new headlines on directions were created, see table 2. Each direction in the table has a number (No.), a description of the direction focus (Direction), and the driving requirement number (Requirement No.). Note that the 'Requirement No.' comes from the Design Brief (p. 39) which were made parallel with this section. The group sketched more detailed ideas based on the brain pool sketching round under each new direction. It was also possible to incorporate features or ideas from the former sketching session (see section 2.4). Additionally, the group included shaping features and contrasts from the bathroom products analysis in some of the sketches. The group created eight ideas, each marked with the driving number from direction focus from the table 2, and a number for the sketch number, e.g., 2.3. These eight ideas were then combined, depending on their focus, into their initial concepts, see p. 28. The three concepts focused on different stages in the user scenario, found on p. 23.

USER FEEDBACK

Four users, Lia, Martin, Rune, and Christian, got mailed a document with a short description each and some questions regarding the concepts to get initial feedback on the concepts. Their feedback is described in the concept boxes on the next page and found in App. 2.21.

TABLE 2 number and direction

NO.	DIRECTIONS	REQUIREMENT NO. FROM P. 39
1	Create a pen with the same technology as a pump	10 and 12
2	Incorporate needle holder in solution	11
3	Hide injection - play with the sense of feeling	16 and 22

CONCEPTS

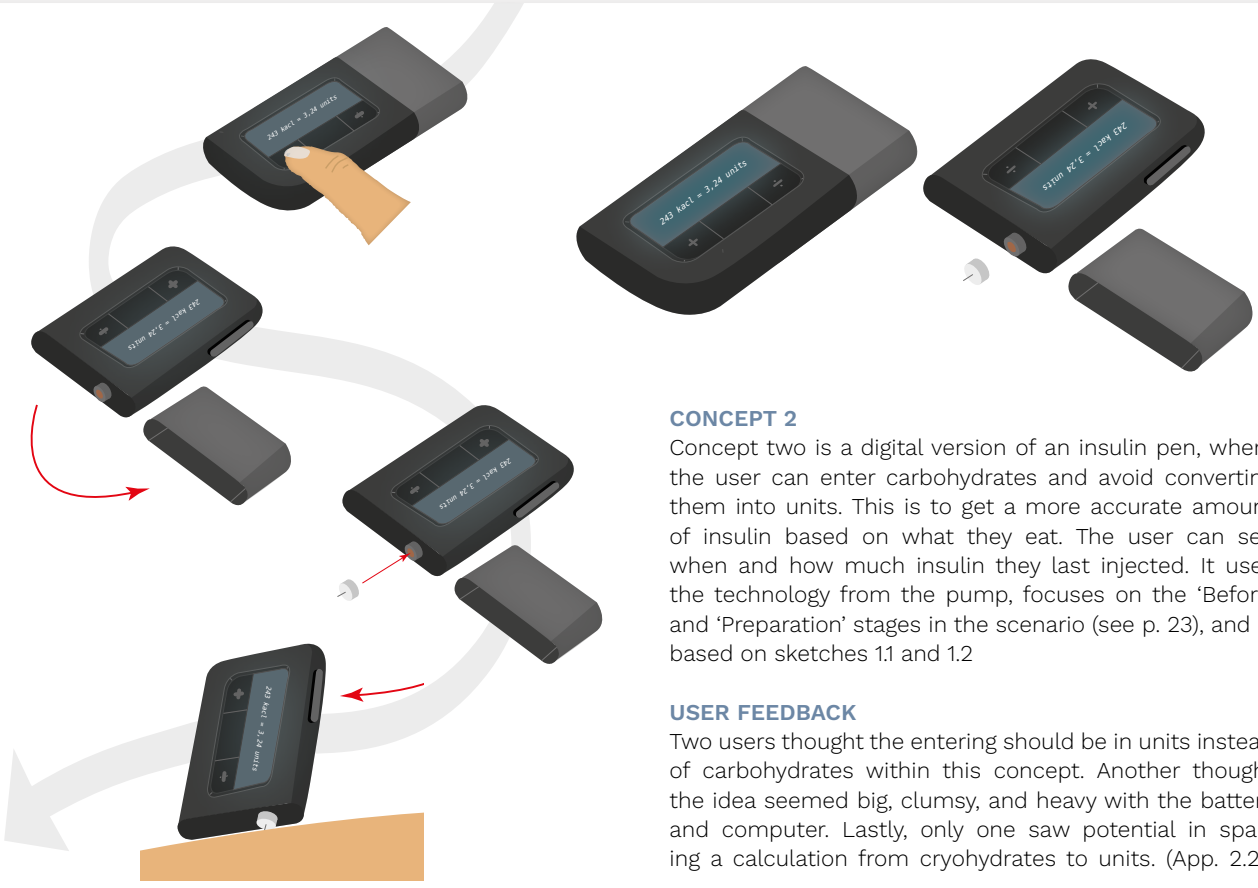
CONCEPT 1

Concept one is a man and woman version of an insulin pen. It uses the same technology as the current pens and incorporates a holder for the needles, which can be slid off the pen to access the needles. The concepts focus on the 'Before' and 'After' in the scenario on p. 23. It incorporates some of the shaping and color differences from the analysis of the bathroom products (see p. 28) and is based on sketch 2.4.

USER FEEDBACK

Three out of the four users could see a value in the concept, as it solved two practical solutions; where to place used and unused needles when being on the go. Additionally, they valued having a place to store the used needles until they got home, where they could trough the needles in the bucket. Using the needle holder to screw on the needles was also motioned as being a way to avoid stabbing themselves in the fingers when placing a needle on the pen. (App. 2.21).

ILL. 33 Concept 1



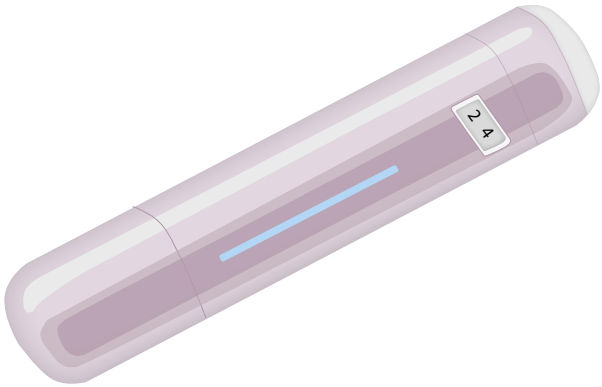
CONCEPT 2

Concept two is a digital version of an insulin pen, where the user can enter carbohydrates and avoid converting them into units. This is to get a more accurate amount of insulin based on what they eat. The user can see when and how much insulin they last injected. It uses the technology from the pump, focuses on the 'Before' and 'Preparation' stages in the scenario (see p. 23), and is based on sketches 1.1 and 1.2

USER FEEDBACK

Two users thought the entering should be in units instead of carbohydrates within this concept. Another thought the idea seemed big, clumsy, and heavy with the battery and computer. Lastly, only one saw potential in sparing a calculation from cryohydrates to units. (App. 2.21)

ILL. 34 Concept 2

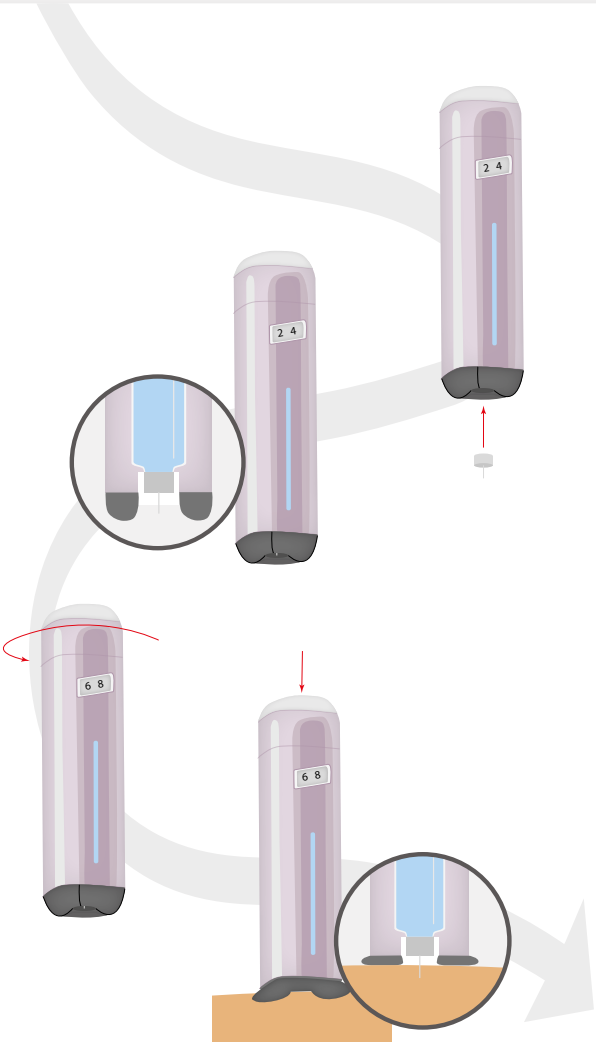


CONCEPT 3

Concept three focuses on the user's fear of needles. Here the needle is hidden under a soft pillow-like rubber edge, and this edge is what the user feels when pressuring the needle down and into the skin. It uses the same technology as the current pens, focuses on the scenario's 'The Injection' stages (see p. 23), and is based on sketches 3.7 and 3.8.

USER FEEDBACK

All users thought this concept idea would be a good starter solution when diagnosed with diabetes, as it hides the needle from the user. They also saw a value in hiding the needle for the soundings. One argued that it might not be that smart as the person needed to see where to inject so a blood vessel would not be hit. Another mentioned that the problem was not showing the needle but rather showing the stomach skin was an issue. (App. 2.21)



ILL. 35 Concept 3

// EVALUATION

The three concepts each had interesting features, which fit into different requirements focuses, and stages in the users' scenarios. The group drew the feedback from the users further for upcoming iterations. The group brought the three concepts to Milestone 2 for further feedback.

2.7 REVISED DESIGN BRIEF

The group revised throughout the second phase, 'Define', the Design Brief as requirements transformed. The group also made an Interaction vision and Values mission in this phase to create a direction for the project. However, the problem formulation was not changed, as the project lacked a sharp focus in concept direction.

TARGET REQUIREMENTS

The requirements found in this section are inspired by the method of Ulrich and Eppinger (2008). Each need is listed with its relative importance from 6-to 1, where 6 is the highest rating and 1 is the lowest. The rating 6-4 is needs, which must be fulfilled, whereas 3-1 is considered as wishes to strive for.

Need No.	Metric	Unit	Value	Imp.	Source
1	Keep track of how much insulin there is in the equipment	ml	-	6	2.2
2	The user can control how much insulin there is being injected	Units	-	6	2.2
3	The needle should be replaceable	Binary	-	6	2.2
4	When the needle is not in use, the insulin output area must be protected	Binary	-	5	2.2
5	The injection should prevent the possibility to press so hard that you create a depression in the skin.	Binary	-	2	2.2
6	Keep track of the last time you injected insulin	Time	-	4	2.3
7	Keep track of how much insulin you took previous time	Units	-	4	2.3
8	A reusable insulin device	Binary	-	5	2.3
9	Inject half injections units.	Units	0,5 u	2	2.1
10	Able to enter carbonhydrates instead of units to adjust the insulin amount	Crabs	-	1	2.1
11	Contain more needles in the solution / reduce amount of external units like the needles	No.	-	2	2.1
12	The insulin pen must collaborate with the CGM sensor or the glycometer	Bluettoth / NFC	-	2	2.1
13	Make injection more invisible to the social evironment and for user	Binary	-	3	2.1
14	The device must be able to fit into a jacket/trousers/small bag	Binary	-	3	2.1
15	The user should have a feeling of control	Binary	-	3	2.1
16	The insulin injection can be done blindly	Binary	-	2	2.1
17	A known area to place your fingers to complete the injection	Binary	-	4	2.2
18	A grib/neutral area to hold/place the finger/hand (must be stable during injection)	Binary	-	3	2.2
19	The injection should be possible to due in a 90-degree angle with or without making a lifted skin fold.	Angle	90°	2	2.2
20	Need visual contact to the needle, when checking/pressing air bobbles out (doing safty check)	Binary	-	6	2.2
21	Decrease/reduce steps of injecting insulin	No.	-	1	2.2
22	The insulin injection can be made into a one-handed operation	Yes / No	-	2	2.2

INTERACTION AND VALUE

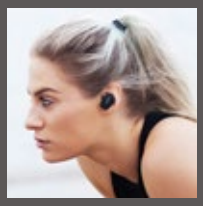
To describe the goal of the interaction and the value, which the user should gain from the solution, a need was seen to create an initial 'Interaction Vision' and 'Value Mission'. These are found on the next page. In the creation of these, a variant of the triangulation method by Tollestrup (2004) based on the Vision-based pyramid model by Lerdahl (2001) (see app. 0.1) is used, to create a common understanding of the meaning of each word, and thereby a common direction. However, as the framing was still open, the 'Interaction Vision' and 'Value Mission' were not formulated into one describing sentence at this stage in the project. The concepts were still pointing in different directions, to which 'Interaction Vision' and 'Value Mission' were kept in the description of a word with belonging metaphor and picture. Later in the process, these should be specified. The mind maps for choosing words and metaphors can be found in App. 2.22.

INTERACTION VISSION

TRUST

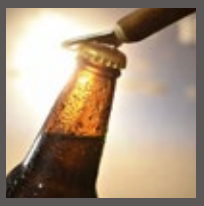
"Like the duvet as protection at night"

DISCREET



"Like stars in day-light"

FREEDOM



"Like being released from prison"

STATEMENT

"Like posting a picture of arm hair on social media"

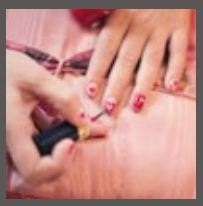
CONTROL

"Like eating with knife and fork"

ILL. 36

VALUE MISSION

PERSONALITY



"Like creating a build-a-bear teddy bear in the toyshop"

ACCEPT

"Like knowing that the earth is turning"

SEXY

"To make something out of yourself"

WARRIOR

"Like being behind in the race, but still completing"

ILL. 37

2.8 FEEDBACK FROM MILESTONE 2

The feedback at Milestone 2 contained many considerations regarding the project. First, the project was missing a market strategy concerning what the concepts would compete on and where they are limited in terms of other products on the market. Further, it was questioned what the sweet spot of personalization was, to which concept 1 (p. 37) was challenged as they seemed to be an extreme point of view, and they needed to be "calmed down" in the expression. It was added that if the solution needed to be personalized, the associations related to this were necessary to be shown and further explained. A note concerning this feedback was that the group presented the project wrongly. The focus was not on personalization but rather that the user should have opportunities to choose from different products. Concerning the scoping of the project, this needed to be clarified. Additionally, if the architecture of the insulin pen were changed, the group needed to show the blueprints of how the pen is today. Furthermore, it was questioned if the people with diabetes all use the same injection method, which the group did not clarify enough at the milestone. All the concepts were seen as features for a solution than actual concepts. (App. 2.23)

2.9 SUM-UP

ACQUIRED KNOWLEDGE

- An overview and insight into the users, their different experiences, and the development of feelings
- The overall scenario of a diabetes type-1 using insulin pens in everyday life, from morning to evening
- A mapping of the insulin pens development
- Three concepts focus on different user needs

FURTHER COURSE

- Insight from other stakeholders and mapping of stakeholders
- Map out the architecture of the insulin pen
- Understanding the users' everyday products
- Ideations and product development for a more precise direction
- Get insights into DS/EN standards for insulin products

Develop

The ‘Develop’ phase begins with an overview of the medical experts providing insights into the theme and the stakeholders. The group analyzed the users’ bags, personal belongings, and parallel universes with a broader knowledge base to inspire the ideation. This combined knowledge creates three ideations with three user tests, whereas the last one is ‘proof of concept’. Which presents a product architecture concept that is then further optimized to fit the users’ feedback.

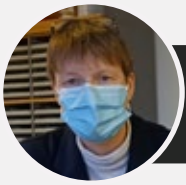
03

3.1 EXPERT INSIGHT AND STAKEHOLDERS

Despite the feedback from Milestone, there was a need to gather knowledge about the stakeholders impacting the users (section 2.1). Three expert interviews with a different focus in their field were conducted, leading to mapping the stakeholders within the project. One of the interviews was conducted in the 'Define' phase due to an iterative process.

EXPERTS IN DIABETES

Talking with experts has given great insight into what it means to have diabetes, what treatments there are in general, how it is to be young with diabetes, and how technology keeps getting better.



Anette Borre Hansen
Diabetes nurse since 1999
Department of Endocrinology, Aalborg

In the interview with Anette B. H. (see App. 3.1), she provided the group with general information about how it is to have diabetes, which products are often used, and the overall structure in Denmark (see Ill. 40). Anette mentioned that the current pens are cheap and easy and that everyone with diabetes needs to know how to use an insulin pen, even if they are equipped with a pump, as there is a risk of this failing. She highlighted that the new technology such as NFC and memory placed in the smartpens also benefit her as a diabetes nurse, and it helps in keeping track of her patient's health. With Anette's experience, she informed the group that many pump users think they are better regulated because the computer takes care of everything. But the truth is that they are not necessarily getting better regulated with a pump compared to when looking at the blood sugar regulation data. Anette also presented old and current available pens and their design and features throughout the years. The interview with Anette also led the group to deselect two requirements regarding injection angle and skin depression (section 2.2, p. 25). In addition, it should be noted that Anette was the first expert the group interviewed, and it already took place in the second phase, 'Define' (see section 2.1).

> *One should not underestimate that it is a huge job to have diabetes. Most of the time, it's all up to the person with diabetes, every single day, no vacation, 365 days a year, always.*
> *- Anette Borre H.*

Karina Kudahl Hansen
Diabetes Nurse since 2003
Steno Center, Aarhus

Karina's interview gave some of the same facts about equipment as Anette, but it was now clearer how the regions were different in Aalborg and Aarhus. There was also a difference in their specialty. Karina and her team in Aarhus work with young people from age 14 to 25, where they have run an experiment since 2018 about the specific needs and dialogue with young diabetics.

> *The transition from child to adult is per. definition from 12 - 24 years, where we like to follow them until they are between 23-25 years before being transferred to adult care in hospitals. However, this natural transition contradicts the way of running the hospital, as what they say you are "adult" already as an 18-year-old, which also means they come in another financial availability pool.*
> *- Karina K. H.*

Based on that, Karina explained the challenges young people have and what problem areas are worth noticing. Karina mentions the importance of the parent's role. When the patients are children, they are well regulated; it is not unusual for them to be measured 40-50 times a day due to the extra supervising parents. But as soon as the person with diabetes must take responsibility for themselves, they often become less well regulated. This transaction from child to adult is long and hard, and if not done, the child will probably neglect to talk about it and, in worst cases, not take their insulin.

The most problematic years are when they are teenagers, during school, breaks, later in afterschool, and social young party life. The nurses first see a change in behavior when the patient is about 25 and are focused on education and maybe creating a family. Karina and her team are very aware of the stigma and the diabetes stress that can strike in the young years (see section 1.4).

ILL. 38 Interview with Klavs W. H.

ILL. 39 Interview with Karina K. H.

> *It is most difficult for most young people when they are on their own two feet in the city. They want to be like their friends, and they start reflecting that it is not nice to have diabetes.*
>
> *- Karina K. H.*

Karina agrees with Anette that you don't necessarily get better regulated with a pump and adds, *"but you get more life quality."* They have noticed many people with diabetes go from pump to pen within their teenage years and then back to pump.

The group showed Karina the concepts from section 2.6, where she gave feedback on the features and added: *"I think invisibility is the most important"*. Besides, she mentioned: *"Recently, the Danish football player Kasper Dolberg was diagnosed with diabetes, influencing young people and being a role model. Certain equipment from some young people is also often requested; if, for example, Liv Marthine from "Den store bagedyst" shows off some of her diabetes equipment on her social media - it provides demand. So, I imagine that influencers also would strongly influence the young diabetic"*. See the full interview in App. 3.2. Karina was interviewed in the third phase, "Develop".

> *Young people are a complex group, and they do not want to be identified with diabetes... I think it's a lot about what the young people see on Social Media; for example, if Liv Martine from "The Great Baking Contest" shows some of her diabetes equipment on social media, there will subsequently be significant demand for what she has shown.*
>
> *- Karina K. H.*

Klavs Würgler Hansen
Clinical Professor, Chief Physician
Department of Endocrinology, Aarhus

At this time in the project, the group had selected working with insulin pens, so the interview was done to "see the other side of the coin". Klavs W. H. presented a deeper understanding of the pump equipment and why it is the future. The group wanted to know the good features and see if there were values to transfer into a new pen concept.

Klavs is Denmark's leading insulin pump specialist and got recommendations from Karina and the Diabetes society.

> *When it comes to diabetes technology, there are "two legs", one is insulin delivery, and the other is glucose measurement*
>
> *- Klavs W. H.*

Klavs presents insights into the benefits and challenges of the pumps. The knowledge gained around the pumps can be found in App. 3.3, as the group did not further use this in the process. Only the interaction features were considered to be used for further ideation.

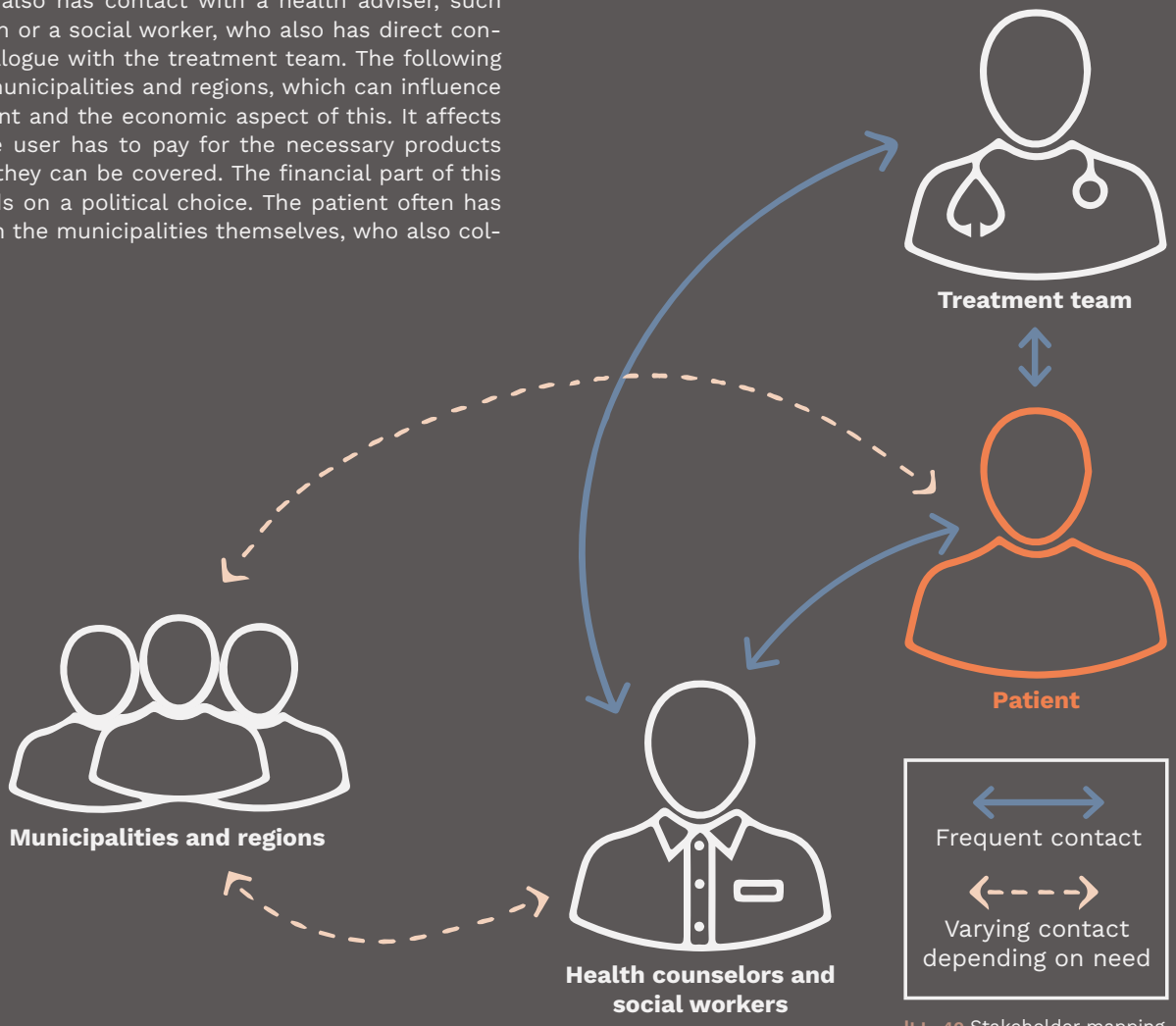
> *Visually impaired people "click" to the desired number of units on the insulin pen, therefore, this clicking sound may be important*
>
> *- Klavs W. H.*

MAPPING OF STAKEHOLDERS

Based on interviews and research, the group has mapped the stakeholders in the diabetes health care system (see App. 3.4).

It's roughly mapped out on Ill. 40 showing some of the factors that play a role for the person with diabetes.

The patient has contact with the treatment team, consisting of doctors and nurses. They assess the need and find the proper treatment for the diabetic (see some of the treatments in section 1.6, p. 14). In addition, if needed, the patient also has contact with a health adviser, such as a dietitian or a social worker, who also has direct contact and dialogue with the treatment team. The following link is the municipalities and regions, which can influence the treatment and the economic aspect of this. It affects whether the user has to pay for the necessary products or whether they can be covered. The financial part of this also depends on a political choice. The patient often has contact with the municipalities themselves, who also collect data and dialogue with the social workers, who receive their references from both the treatment team and the patient.
Anette and Karina highlighted one aspect in the interviews concerning the regions and municipalities' frameworks, where the complexity of the system was highlighted. It was pointed out that it varied depending on the residence of the diabetic. Karina also mentioned that they often use social workers as a helping hand in the complex system, both for the treatment team's understanding and for the patient.



ILL. 40 Stakeholder mapping

// EVALUATION

Talking with users gives a good understanding of the product in use and every challenge but talking with experts gives another perspective on the industry. They have a general overview and provide an objective opinion of products and features based on their years of experience and not being a patient. They confirmed that the teenage years could be difficult for many with diabetes. And how to use an insulin pen is necessary as every newly diagnosed must start their treatment with an insulin pen and learn to use it if other treatment options fail. Besides, it has been found that the diabetes market is convoluted to find its way around; whether you have diabetes or are a therapist and need to advise within this framework - there are many players and stakeholders. A need was seen that the next step would be to examine some of the already existing pens in more depth to understand the function better.

✕ The injection should be possible to due in a 90-degree angle with or without making a lifted skin fold.

✕ The injection should prevent the possibility to press so hard that you create a depression in the skin

3.2 ANALYSE OF INSULIN PRODUCTS

There was a need to examine some of the existing insulin pens and pumps to understand their function better. In addition, it also helps to understand the various elements that can potentially be changed and which ones should not be changed. This section analyzes existing solutions where the group can potentially transform some of these principles into the concept solution.

GET THE BASICS

By interviewing experts (see section 3.1), they donated both used and unused pens and pumps that the group could split apart to analyze. The products which the group analyzed was:

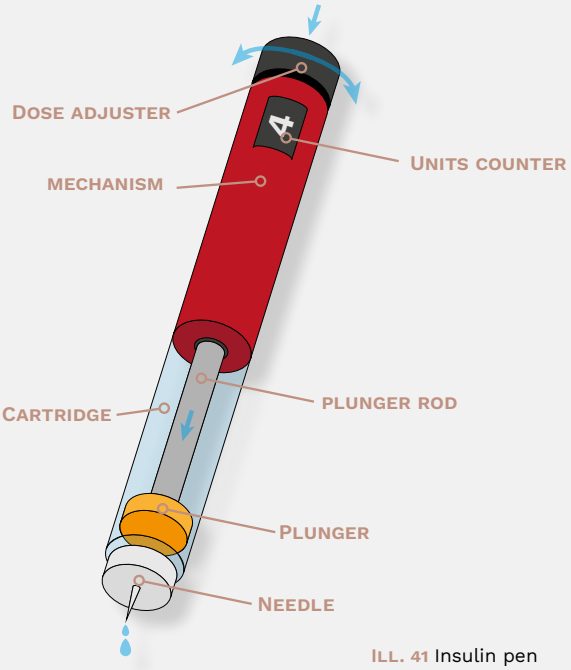
1. NovoRapid – FlexPen (Fast-acting insulin pen)
2. Novo Tresiba – FlexTouch (Slow-acting insulin pen)
3. Omnipod DASH (patch pump)
4. MiniMed 640G (tube pump)
5. NovoPen 4 (Insulin pen w. removable cartridge)
6. NovoPen Echo Plus (Insulin pen w. removable cartridge)

(see Ill. 42)

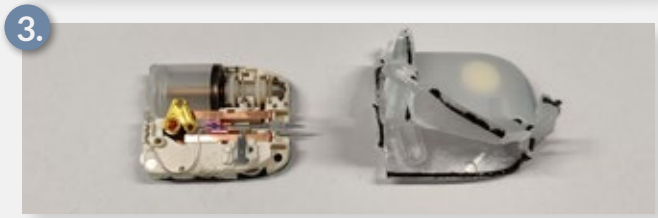
The different pens and pumps were separated into smaller parts to understand size ratios, various sub-elements, and overall functions. However, it should be noted that the functions have not been analyzed in-depth at this point in the project but were simply made overall to designate the various sub-elements. The sub-elements for a reusable pen are presented on the next page.

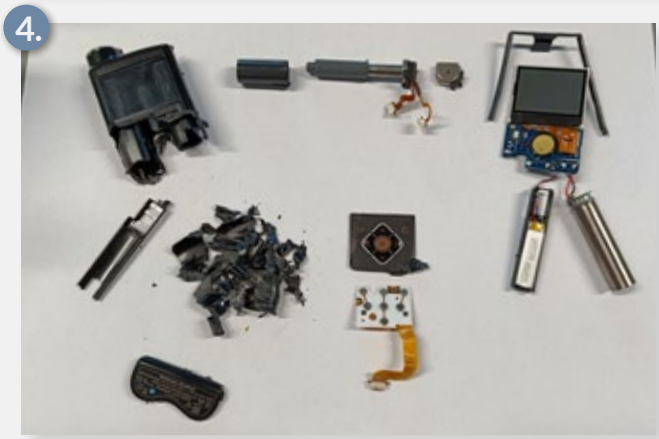
On Ill. 41 a simple representation of a reusable insulin pen, where interaction parts and feedback and feedforward indicators are highlighted. The 'dose adjuster' must be turned to adjust insulin units on the pen. The selected units can be seen on the 'unit counter', and the user is ready to inject by pushing down on the top of the 'dose adjuster'. Here the mechanism inside pushed the 'plunger rod' down toward the 'plunger' in the 'cartridge', pressing its insulin through the 'needle' and into the skin.

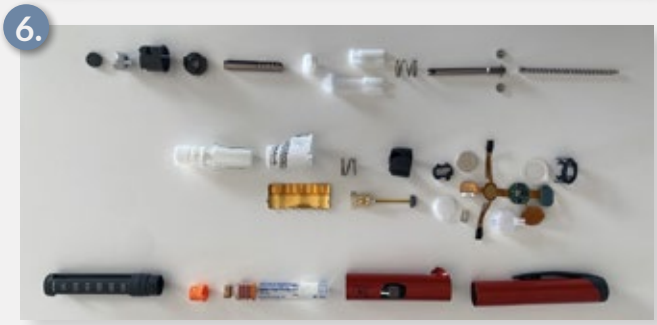
The pictures beneath showcase the exploded pens and pumps (App. 3.5). The pumps were analyzed to see if any features or constructions could help the upcoming ideations.



ILL. 41 Insulin pen



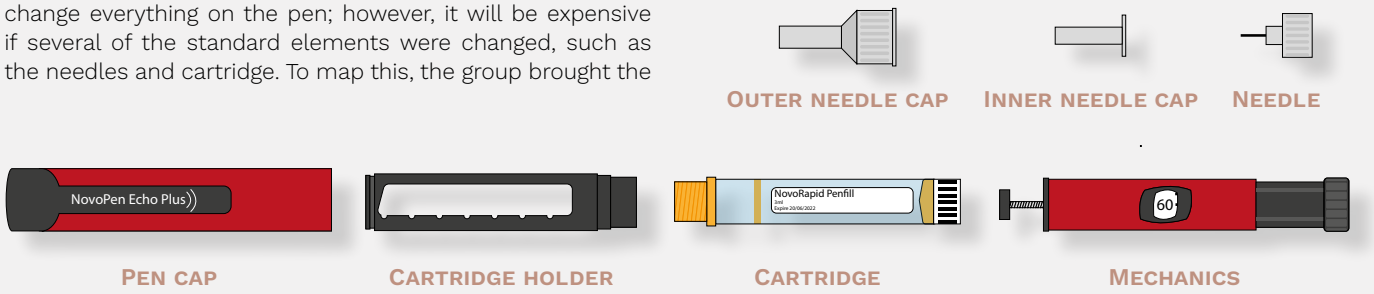




ILL. 42 exploded view of pens and pumps (App 3.5 + 3.12)

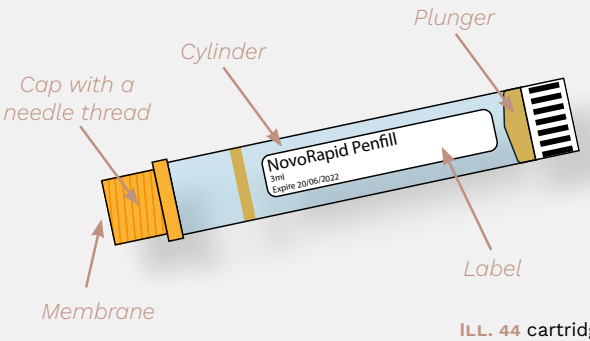
PRODUCT ARCHITECTURE

There was a need to map out the different parts of an insulin pen so that the group could better understand which parts would be possible to change in the concept solution. In addition, it is worth noticing that at this moment in the process, it was perceived by the group that they rotationally could change everything on the pen; however, it will be expensive if several of the standard elements were changed, such as the needles and cartridge. To map this, the group brought the learnings from the exploded views of the different pens and mapped them out in an overall product architecture based of the Novo Pen Echo Plus seen on Ill. 43 (see App. 3.5)



ILL. 43 pen arcitecture

To further explore the product architecture, the group wanted to understand what it would take to change the needle and cartridge, considered standard parts. Based on the interview with Karina (see App. 3.2), the group concluded that it would be expensive to change the needles and cartridges, as these were made after specific measurements fitting to the current pens on the market. However, not to limit the project, the group, later in the process, corresponded with Niels Skov Jørgensen from Stevanato Group, which makes cartridges for medical equipment (see App. 4.9). Based on his respondents, it was concluded that the cartridges could be made in different sizes if needed. However, this would also require changes to the cap, membrane, and plunger (see Ill. 44), which could affect the price of this and other parts in a concept. Note that this mail correspondence was conducted later in the process but is motioned here for consistency in this section.



ILL. 44 cartridge

! Potential for changing the cartridge size if necessary

// EVALUATION

The group obtained a deeper understanding of the potential sizing and changing of the different parts of an insulin device through analyses and mapping of the architectures on a reusable pen. It was concluded that there could be a potential for changing the sizing of the cartridge, depending on the concept. Therefore, this standard part did not limit the ideation of a concept.

3.3 SHOW US YOUR BAG

Parallel with the analysis of the pens, the group revisited some of the user data obtained former in the process to see if the group had overlooked potential possibilities concerning exploring the concept solution. Back then, the group had received pictures of the users' bags. This section explores what these bags contain and whether this could create inspiration both functionally and aesthetically.

WHAT'S INSIDE THE BAGS?

There was a need to revisit the users and investigate what diabetes equipment they bring with them on the go and whether there were other relevant products in addition to their diabetes equipment. This study of their bags started further back in the process after the interview with Rune S. J. (See App. 3.6), where he showed how full his pockets and bags were with the various things he used during the day related to diabetes. This discovery led to curiosity about whether the group's other users brought as much equipment. Another take on this was finding other products that the group could draw inspiration from for the aesthetic development of the concept solution. It took about a week to collect these photos from seven users (see more photos from users in App. 3.6).

The group observed that it was different which products the users carried with them in addition to their diabetes equipment. However, the primary recurrences were: Wallets, headphones, keys, mobiles, personal care (such as perfume or lipstick), and computer. In addition, various significant brands characterized the bags, such as the Appel, Bose, and Nike.
In these products related to the user scenario (see section 2.2), the group also became apparent that a focus for the concept solution was an "on the go" product, which must be considered both functionally and aesthetically.

THE TYPICAL DIABETES EQUIPMENT USERS BROUGHT WITH THEM WERE:

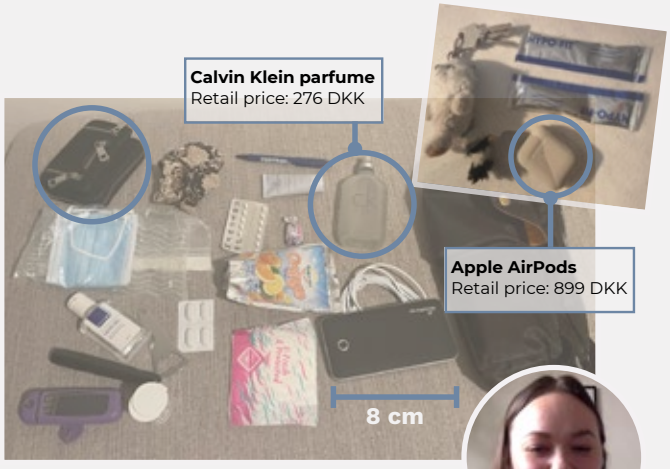
ILL. 45 Things from bags

OTHER PRODUCTS THE USERS HAD IN THEIR BAGS OR POCKETS:

After making clustering (Kolko, J., 2010) on the most typical products, each of the seven users had in their bags in addition to diabetes-related products. The group noted a need to dive even deeper into their bags, which will provide a deeper understanding of the products they spend money on and whether there are any size references.

PHOTO ETHNOGRAPHIC RESEARCH

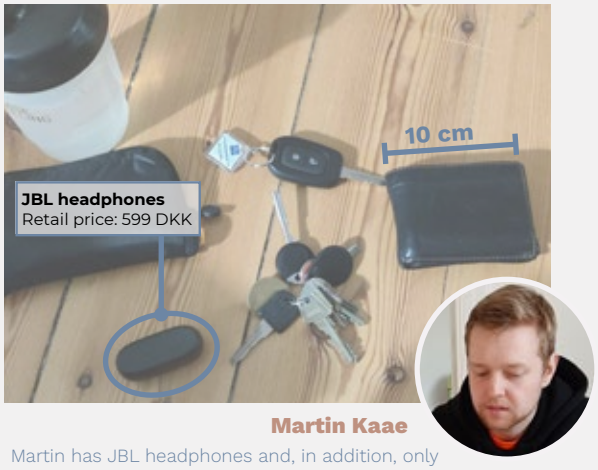
The collected images of seven users' bags and their contents allowed the group to conduct photo ethnographic research to analyze what types of products they consciously chose. In addition, this research can also provide a size reference for further development of the concepts.



Marthine Rose Jensen

Marthine has many more items for personal care, like her Calvin Klein perfume. In addition, she has chosen Appel AirPods headphones and a leather purse. The most prominent thing in her bag is no bigger than a mobile, which is the device for her pump seen in the picture.

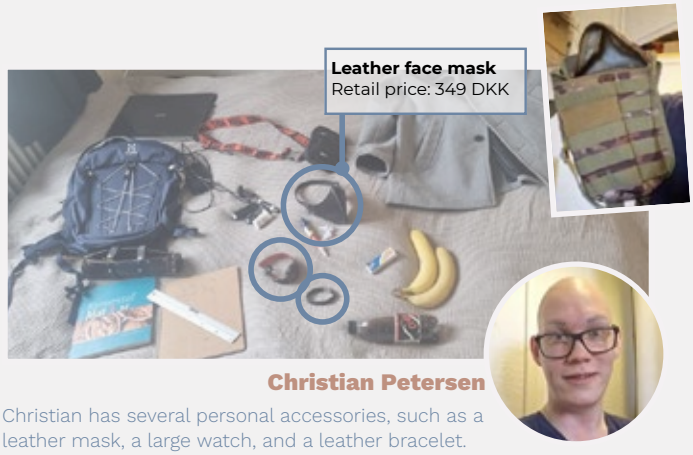
I have my insulin pen because it makes me feel good in my body and that I can survive. If there were a better and more functional solution, I would not speculate for a second on replacing it.
- Martin K. (App. 2.9)



Martin Kaae

Martin has JBL headphones and, in addition, only what is needed in his pockets, such as his wallet, keys, and mobile.

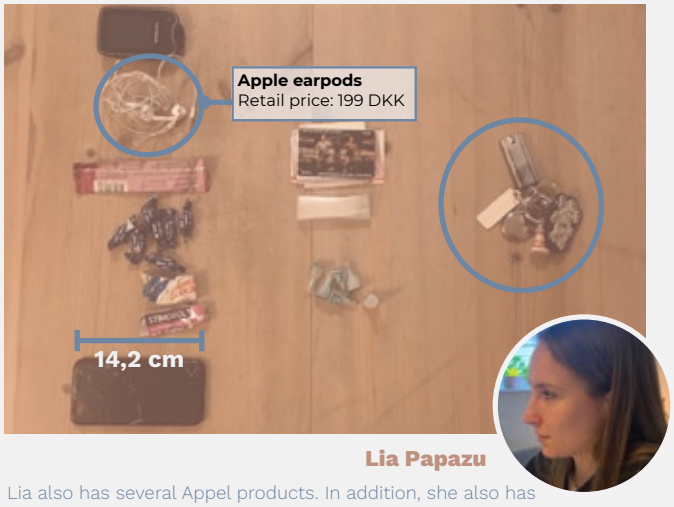
I would sometimes like my insulin pen to be more convenient to carry and use on the go
- Martin K. (App. 2.9)



Christian Petersen

Christian has several personal accessories, such as a leather mask, a large watch, and a leather bracelet.

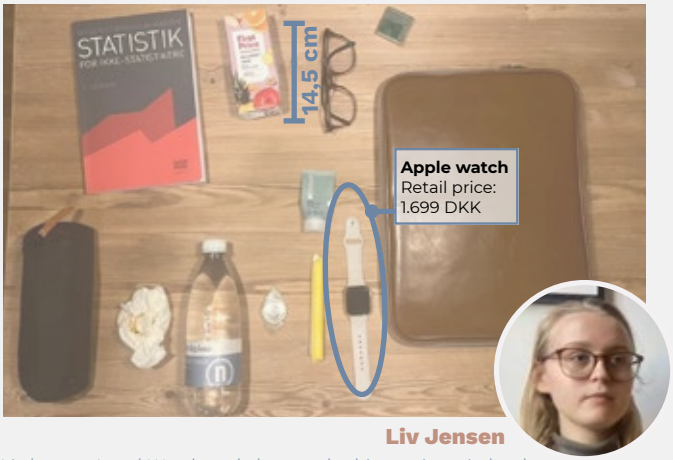
It [the pen] looks very hospital-like - but again, I also think it's because of the medical equipment that it should look like this
- Christian P. (App. 2.1)



Lia Papazu

Lia also has several Appel products. In addition, she also has several "decorative" pendants on her keys. The biggest item in her bag is her mobile.

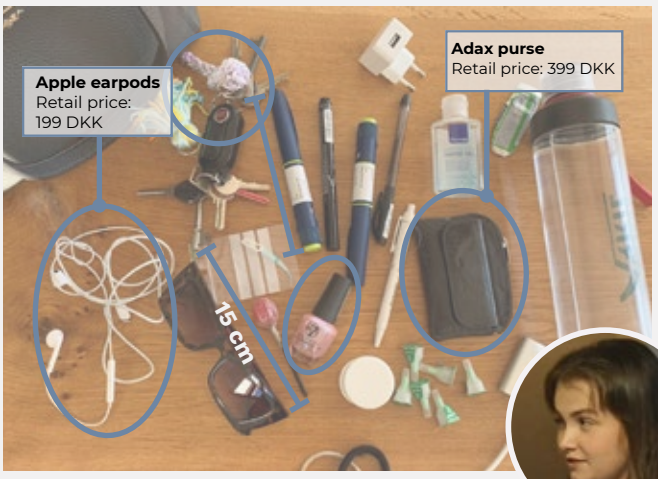
I feel a kind of relationship to the insulin itself but not really to the pen, as they are constantly being replaced. Maybe if I had a reusable pen, it would thus be more personal and more my own
- Lia P. (App. 2.8)



Liv Jensen

Liv has an Appel Watch and glasses, the biggest item in her bag.

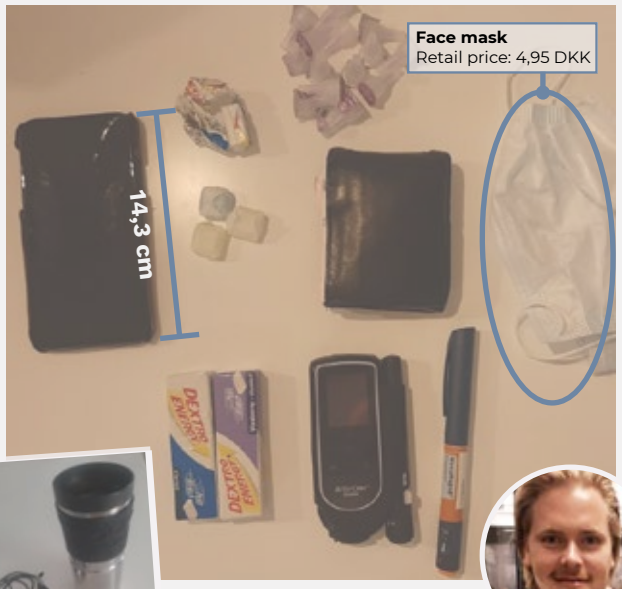
It will be so nice if the pen can get smaller. Not because I think it's too big, but the smaller the equipment, the nicer it will be to carry. On the other hand, I also know that there is a lot of technique in the pens we use, and that they are undoubtedly made as small as possible, so it is pure wishful thinking.
- Kathrine R. L. (App. 2.11)



Kathrine Randrup L.

Kathrine also has a lot in her bag, both personal care products and accessories such as sunglasses, which are the size of her insulin pens. In addition, she has chosen a leather purse, Appel headphones, and decorative hangers on her keys.

The disposable pen can only give me insulin. It works, but there is nothing fancy or luxurious about it
- Kathrine R. L (App. 2.11)



Rune Sejer J.

Rune has quite a few things in his pockets; however, the biggest product is his mobile besides his insulin pen, which is longer. In addition, Rune also has a Bodum thermo cup and a leather strap for his keys.

The group decided to consider the mobile phones as a reference point for the maximum size to have in the pocket. These are long and wide products, but not that thick. The largest mobile phone found from the users was an iPhone 10, which has the dimensions of 143,6 x 70,9 x 7,7 mm.

It has also been observed that users like to spend a little more money on identity-creating products, such as headphones and accessories. These often create a secondary user value with the associated brand in addition to the product's primary function.

These findings were used subconsciously during the previous iteration in section 2.6. However, there was still a need to dive into reference products to explore further and push the concept solution's aesthetic boundaries.

I actually feel it can be hard to hide an insulin pen as they are often reasonably long. Had they been a little shorter, it might have been easier.
- Katia M. R. (App. 2.10)

! The insulin device is an 'on the go' product

! The users want to spend a little more money on an identity-creating product

✓ The insulin device must not be longer than 140 mm

// EVALUATION

It gave an insight into the fact that it is different which products the users prioritize taking with them 'on the go' other than their diabetes equipment. Some essentials they bring are mobile, keys, and wallet, and others are frequently for entertainment or personal care. The group's users are willing to spend more money on identity marker products, such as Appel AirPods for 899 DKK or Appel Watch for 1.699 DKK. In comparison, more necessary things such as facemasks are more spread from low-price disposable mask to reusable masks, which become a more identity marker and has a higher price. In addition, mobile phones are a max size for what the users have in their pockets and give a requirement for the concept sizing. The next step is to investigate whether some of these products can provide more aesthetic direction and be used more directly in the concept solution.

3.4 UNIVERSES

Based on the obtained knowledge from the user bags, it was found necessary to investigate other product universes than the former conducted (see p. 35). It should provide further inspiration to influence the concept solution and potentially contribute to more identity. This section analyzes different product categories and related products, focusing on patterns and shapes. Note that not all universes investigated are based on the former section (3.3).

FIVE PRODUCT CATEGORIES

Based on the users from the previous section, it was found that 'on the go' products could be explored further to discover some character traits that the group could potentially put into perspective in the concept solution. However, the group also chose several product categories to analyze for patterns and shapes to explore even more. (See App. 3.7)

The product categories analyzed were: 1) headphones, small speakers, power banks, 2) watches, and 3) sports equipment. And to explore further, the group also selected 4) hiking equipment and 5) kitchen equipment.

HIKING

It looks practically, compact, and a gadget. Often use matte surfaces, metal, rubber, and fabric. Colors are often military colors with some strong detail colors.

WATCHES

It can look gadget, formel, feminine and masculine; here, the clock size matters. Materials are metal, leather, rubber, silver, and gold, and the colors can both be toned down and eye-catchy.

SPORT

The more extreme sport, the more aggressive colors, shapes, and aerodynamics appears. Soft colors and shapes are feminine, and aerodynamics is fast and performance. The materials are plastic, fabric, metal, and rubber for anti-slip.

ILL. 46
Product universes

KITCHEN

It is often metal and plastic with matte and/or shiny surfaces. The buttons and control areas are highlighted, big buttons give control, and smaller ones give fine adjustments. The curves are also showing some performance associations.

SPEAKER, HEADPHONES, AND POWER BANKS

It is simple shapes with fillets. The colors are neutral or dark with some strong detail colors. It takes inspiration from the interior and is often in metal, plastic, and some fabric or leather.

// EVALUATION

Examining different product categories and their universe gave different impressions of their expression. The group could take many materials, colors, and shapes further. The next step was to draw inspiration or directly bring some of the shapes over to the concept solution - this required several new sketch rounds.

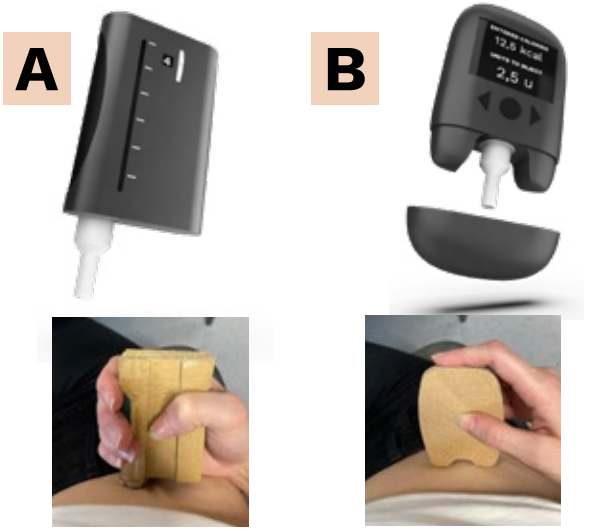
3.5 SECOND IDEATION

With the understating of identity markers made (section 3.3), and with the background of the deisgn universe (Section 3.4) the group started ideating on new solutions with the purpose of exploring potential concept ideas. This ideation took offset in Striim's ideation model (Striim, 2001).

INITIAL IDEATION

Initially, the group started in the 'Focusing' phase of Striim's ideation model (Striim, 2001). This was done based on the previous section 2.6 (p. 28). Here the group created three concepts and got written feedback from several diabetes users. These inputs were revisited after milestone 2, providing insight into how the group could explore more concept solutions. Hereafter the group moved into the 'idea creation' phase (Striim, 2001), trying to "think out of the box" with a method called "what if?" (Tollestrup, 2004).

Quick sketches were drawn in this method (see App. 3.8). However, the group quickly realized that there was a need to get the ideas out physically. A rapid prototyping session started, conducted in cardboard and 3D print, together with renders of the ideas. The ideas created are categorized and explained underneath. As some had the same intention of use, only a selection is shown underneath, whereas the rest can be found in App. 3.8.

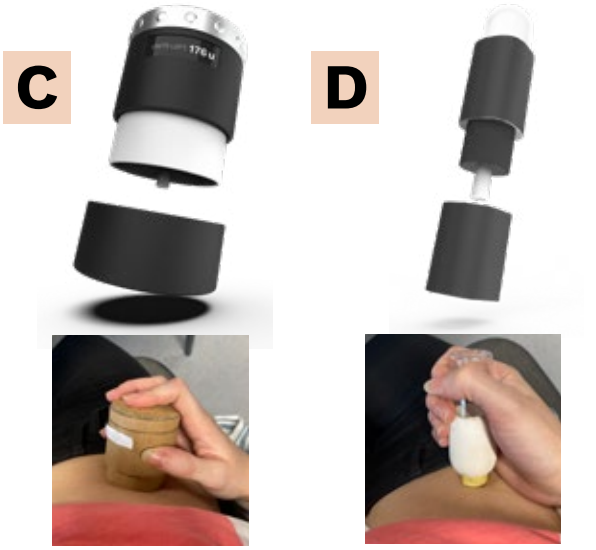


DIRECTION 1: PUMP / PEN

Both concepts combine the electronic functions of a pump with the injection of a pen. They both try to challenge the current pens' aesthetic and the interaction on 'how to inject'.

A: In this concept, insulin injection is done on the side using multiple fingers, mainly focusing on easing the injection. A material change tries to indicate where to grip and place the fingers.

B: This one is designed with a curvy shape for an ergonomic grip. The concept includes a screen for telling when and how much that was last injected. The insulin doses it set by entering calories instead of units.

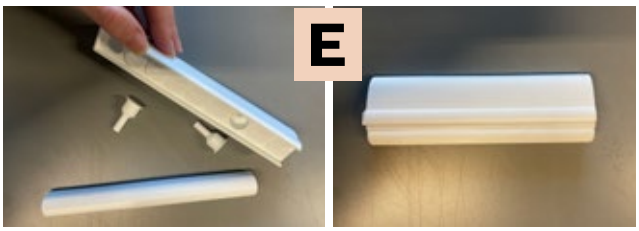


DIRECTION 2: NEEDLE HIDER

The main function of these concepts is the hiding of the needle when injecting. When the insulin device is pushed down, the part hiding the needle is withdrawn, ensuring the needle penetrates the skin.

C: This concept includes a screen telling the user their last dose. The unit is set by turning gripping on the steel surface, turning it into a big unit setting button. The injection is done by pushing down on the top.

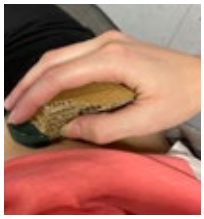
D: The following concept has the insulin cartridge placed on top. You turn on this for setting the dose, and afterward, push down for injecting.



DIRECTION 3: SLIDER

E: The concept with the slider holding the needle, presented at Milestone 2, was also mocked up in this ideation to get a feel of the concept. Here the pen slides on a needle container with 9 needles. The pen has the same length as the existing insulin pens and is used similarly.

F



G

DIRECTION 4: THE BLOBS

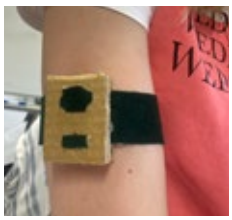
The concepts try to make injection interaction more like a gentle touch or an embrace on the body. Both concepts consider the ergonomics of having an insulin device for injection in hand.

F: This concept takes inspiration from the ergonomic interaction as with a computer mouse. Here the injection button for injecting insulin is placed in front, letting the user use their index finger and middle finger. The shape indicates a natural grip area to hold the fingers or hand.

G: Here, the bottom is a flat surface ensuring the needle can't penetrate further into the skin as intended. Here the aesthetics are in focus, trying to hide that the object is for diabetes treatment.

H

I



DIRECTION 5: BODY ATTCHEMENT

Both concepts focus on the users' needs for a more 'on the go' friendly version of their current insulin pen. Here the concepts try to be placed on the body, hiding their purpose of being for insulin injection.

H: This concept is considered a watch containing a computer, showing time, when, and how much insulin you last injected. The watch can be taken off, and the lid is removed, whereas the watch can be used for injecting.

I: This patch concept can be placed on a referable site on the body. It is with a strap making it easy to take on and off. The unit dose setting and injection button are placed in the front.

J

K

DIRECTION 6: KEYCHAIN

These concepts focus on the principle of 'on the go', where they are designed to be attached to the user's keys in a keychain-sized insulin device.

J: This concept is considered a smaller insulin pen with the aesthetics of a lipstick design. Therefore, selecting units and injecting insulin is done the same way as with the current pen. However, here the user is intended to use the index finger for injection rather than the tump.

K: This concept looks a lot like J; however, the shape, grip, and aesthetics are different, and the injection is done on the side and not at the end of the device.

// EVALUATION

Concerning the evaluation of the session, the group created a variety of ideas. The group decided to take each idea further for testing with users before an evaluation and protentional direction could be considered.

3.6 FIRST USER TEST

Many of the concepts pointed in different directions trying to solve different aspects, user needs, and requirements. However, the concept ideas were very broad, so the group needed a user test. The purpose was to gain feedback regarding the ideas and find a more focused concept direction. The group used the method 'The experiential learning cycle' by Kolb (McPheat, 2019) to gain new learning and develop further. All in-depth feedback from the test can be found in App. 3.9.

TEST CONDITIONS

The group did this test with two participants simultaneously, Rune Sejer Jakobsen and Jens Ulsøe.

- Rune is 30 years and has had diabetes for 26 years. He uses approximately 15-20 units and approx 4-6 needles pr. day.
- Jens is 27 years and has had diabetes for 2 years. He uses approximately 20 units and approx 4-5 needles pr. day.

The users have different relations to their diabetes. Rune has accepted his diabetes but does not want to show it, and Jens hides it as much as possible and unwillingly brings a bag with all his diabetes equipment. The two test persons discussed positive and negative thoughts concerning the concepts and the features. The group presented the concepts with cardboard, clay, 3D printed mock-ups, and additional renders, from the ideation round in section 3.5.

ILL. 47 Concept mock-ups

FEEDBACK:

The following explains the main feedback of the concepts. The concepts are presented on Ill. 47, with their represented letter (same as in section 3.5). The concepts disliked by the users have been marked with a cross in the Ill. 47.

Concepts A and B did not fit either of the users, as the design did not make diabetes more discrete. The concepts were both seen as clumsy and oversized. Using calories instead of units was not beneficial, as using units has become a habit.

Concepts C and D were also quickly discarded by the users due to the needle hiding function. The feature was intended for new users, as Jens; however, they both argued the hiding function would be like a blindfold, making the injection feel more violently due to the larger touching area.

Especially Rune saw a great value in concept E - the slider with a needle holder - as he could see this would help him get rid off all the loose needles in his pocket. However, both users thought the concept was too long.

Both Jens and Rune saw concepts F and G to be used more discretely, as it was possible to easily slide under the shirt and hide the skin when injecting. The disadvantage was the lack of view when injecting as the shapes overshadow it. Both concepts felt natural to hold in their hand, reminding them of a computer mouse. Rune highlighted that concept F only could be used by left-handed, and this problem was not seen with concept G. Additionally both liked the design and size of G.

For concept H (the watch), Rune mentioned that removing the issue of having much diabetes equipment in the pockets was solved with this idea, as it was not a pocket product. A concern from Jens with this concept was regarding the size of the amount of insulin it could contain, as this would influence how big the watch would look on the arm. Both mentioned that this concept should also function as a watch, as neither wants to wear two watches.

Both users rejected concept I, as it was too chunky, and the interaction and placement on the body would be difficult with most clothing.

The keychain feature in concepts J and K was a clever idea. However, concept K, felt wired in size and interaction and was not liked by the users.

Both Jens and Rune liked the anonymous, everyday friendly, pocket-sized, 'on the go' principle in concept J. Disguising it as lipstick had great value for both. Rune mentioned a drawback: "Trust is expensive; if it fails off just one time, you don't trust it again" – meaning the keychain should have a securement ensuing it would not fall off. Additionally, the size should not be smaller because it would affect the grip and use when injecting.

The reminder function of when and how much insulin they injected last time was included in concepts B, C, and H. It was seen as a valuable feature, ensuring that they wouldn't inject more insulin by mistake if they had forgotten their last intake.

Observation: None of the users understood the interaction areas where grip surfaces were included in concept A. Their interaction was more focused on the areas to select units and how to inject.

ILL. 48 User test

SUM UP OF FEEDBACK

The feedback showed which features to continue with for coming concepts and which features needed to be abandoned.

FEATURES & FUNCTIONS THAT WERE ABANDONED:

- Needle hiding function
- Choosing insulin dose with calories
- Using the function of the pump in a pen design
- Grip areas to place hand/fingers under injection

FEATURES & FUNCTIONS TO TAKE FURTHER:

- Screen telling the user their last injection (time and amount in unknit)
- Keychain solution
- Needle container to slide on the injection device
- Hiding in plain sight – 'on the go' size
- The computer mouse injection method
- Discreet design

// EVALUATION

The user testing gave the group four concepts to develop further on, which were E (slider concept with a container for the needles), G (the blob), H (the watch), and J (the lipstick keychain), as these was seen as being descreet. In the test, it was also found that users disagreed upon which concept they liked the best. Rune preferred having room for his needles, whereas Jens liked a more discrete design and did not see much value in combining the needles with an insulin device.

After the test, the group considered they potentially could have evaluated their concepts, only bringing a few for the user test, as many of the ideas had some of the same features. Further, the group did not actively use the universe (section 3.4) for inspiration, and these were intended to be used going into the next phase. The next step was to evaluate the four most interesting concepts.

✗ Able to enter calories instead of units to adjust the insulin amount (For new users)	✗ The insulin pen must collaborate with the CGM sensor or the glucometer
✗ Make injection more invisible to the social environment and for user	✓ The visual control of where you place the needle on your body
✗ The insulin injection can be done blindly	✓ The size must fit different hand sizes - must enable a comfortable user experience when injecting
✗ A grip/neutral area to hold/place the finger/ hand (must be stable during injection)	✓ Either it should be lightweight so it does not weigh much in the pocket / bag otherwise it should have more weight, so it feels of quality

3.7 CONCEPT EVALUATION

The first user test (see section 3.6) narrowed down the solution space and left the group with four concepts having potential. However, the group did not find a clarification on which to develop further on. To handle this, an evaluation of the four concept ideas was made to figure out which to develop further. The complete evaluation can be seen in App. 3.8 and 3.9.

Based on the feedback and observations from the user test, the group listed the pros and cons of each concept to handle the concept evaluation. To create transparency in the weighting of each pro and con, a tabel (see Table 3) was set up based on the user test instead of using specific requirements. Each pro and con were entered under a parameter, determining how well the concepts fulfilled this. The assessment of each pro and can in the diagram was summarized by a considered possibility of how good or bad it was to fulfill the parameter. More pros and cons could be placed under the parameter of each concept, determining the final weighting of how well the concept fulfilled the requirement. The transaction from pros and cons into the table and the weighting of each pro and con under each tables parameter can be found in App. 3.8 and 3.9. The underneath Table 3 shows the final weighting of each concept, whereas the parameters are described underneath the table.

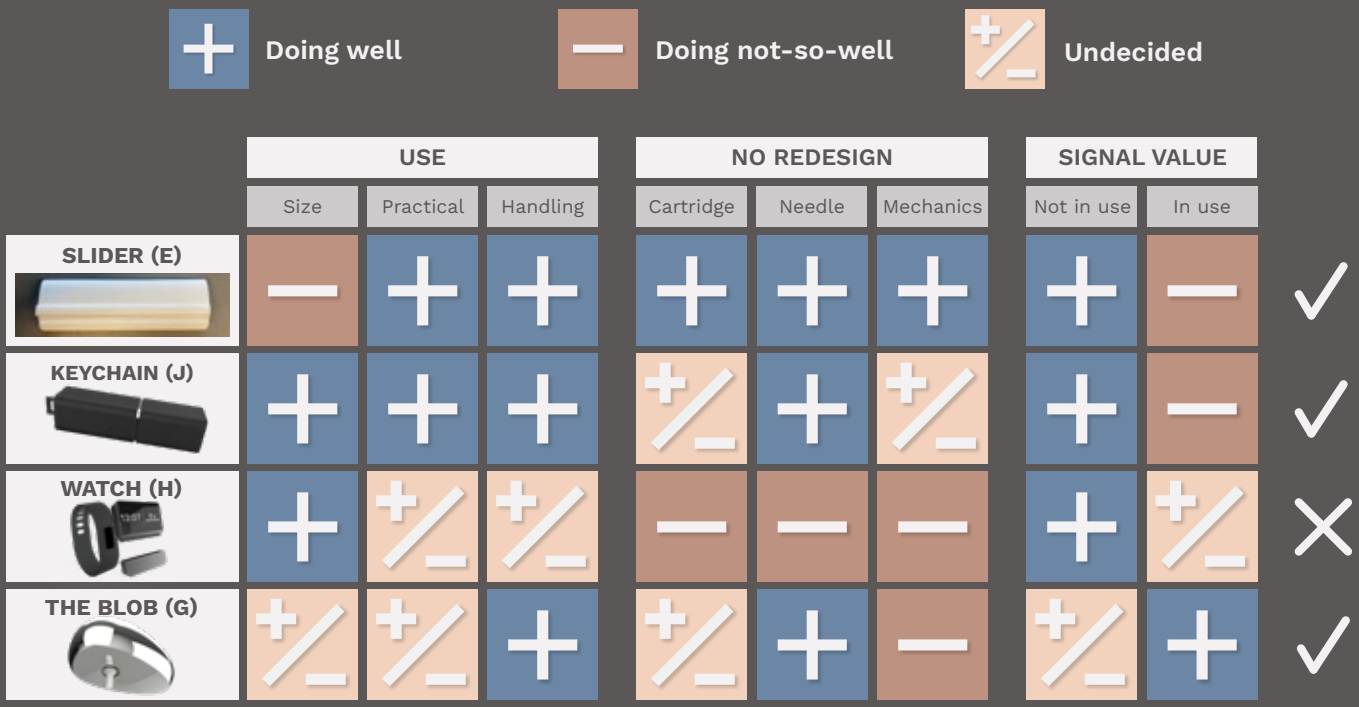


TABLE 3 concept evaluation

USE:
How well the concept ensures the security of a smaller size for 'on-the-go' use, easy injection handling (both replacement of needles and cartridges), and has a practical purpose or use.

NO REDESIGN:
How well the concept ensures standards (needles and cartridges) or existing solution (mechanics of pen or pump) can be implemented and does not need to be redesigned.

SIGNAL VALUE:
How well the concept hides being an insulin device either when in use (open) or not in use (closed).

// EVALUATION

As seen in the diagram, concept 3, the watch was not suitable for further development, mainly due to the redesign of different parts and the issue relating to handling problems, such as replacing needles or cartridges after finished use. Concept 1, slider, was seen as being too big; however, it is considered that merging it with the size of concept 2, lipstick/keychain, could be a possibility. Concept 4 still has issues, especially regarding the redesign of mechanics. However, the many undecided aspects of the concept lead to consider a further investigation of the concept possibilities. The next ideation of the concepts needs to incorporate dose adjustment, a maximum and a minimum number of units to choose from on the insulin device, and the possibility of having a screen that tells the user how much and when they last injected themself. Further, as much as possible, the design hides the medical parts, signaling it is for diabetes treatment.

3.8 THIRD IDEATION: DEVELOPING CONCEPTS

After the evaluation, a new ideation round started for developing further on the three concept directions. The ideation took offset in the third phase, 'Ideation' in Stiims ideation model (Striim, 2001). The group created initial sketches, taking inspiration from the 'show us your bag' (section 3.3), Universes (section 3.4), and considering how to select units and inject. The sketches are found in App. 3.10. The final ideas are represented underneath with renders and 3D printed mock-ups.

KEYCHAIN DEVELOPMENT

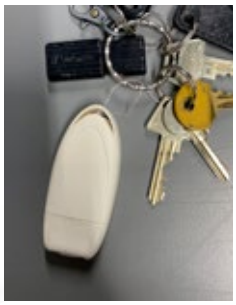
Three Keychain concept ideas were created. Each was focussing on being 'hide-in-plain-site' and making it fit being 'on the go'. The concept ideas were created using the same interaction as with the insulin pens.

CAR KEYS

Inspiration: Car keys (Show us your bag - section 3.3)

The 'Car Keys' was disguised as car keys, with the injection button placed at the bottom. A lock mechanism was placed on the front, ensuring the 'Car keys' would not fall off the keys. The shaping ensures a more stable injecting.

ILL. 49



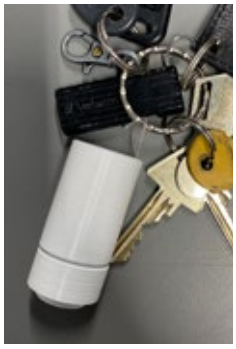
POWER BANK

Inspiration: Power banks (Show us your bag, section 3.3 and Universe section 3.4)

Feature: Has a screen showing when and how must there was last injected.

The 'Power Bank' keychain is wider and has a round design. Its length is short, making it fit better into a set of keys. The injection button with an incorporated screen is highlighted with a red color to indicate where to interact.

ILL. 50



LIPSTICK

Inspiration: Lipstick (Show us your bag, section 3.3, and Universe, section 2.5).

This 'Lipstick' keychain from the last ideation was further detailed (see section 3.5). The 'Lipstick' has incorporated the keychain in the lid and not the device, ensuring the injection device is not used with the keys when injecting.

ILL. 51

SLIDER DEVELOPMENT

In the Slider direction, three concepts were made. The concepts are different versions of ways to have a needle container attached to a smaller insulin pen. Aging the injection device uses the same interaction as the current pens. All concepts focus on fitting into a pocket or bag, whereas two out of three concepts try to disguise being for diabetes. Continues on next page.

LIPSTICK WITH HOLSTER

Inspiration: Lipstick (Show us your bag, section 3.3, and Universe, section 2.5).

Feature: Holster for containing the needles.

The 'Lipstick with holster' contains approx. 10-12 used/unused needles. The needles are turned the opposite way of each other in the holster. A lipstick-designed insulin device slides on the holster so that the insulin device can be used with or without the holster.

ILL. 52

WALLET

Inspiration: Wallets (Show us your bag, section 3.3)

Feature: Needle container w. 4 needles

The 'Wallet' is a smaller version of the former slider (section 3.5) containing four needles. It is rounded, making it fit better in hand. The insulin device and needle container are integrated when sliding them together, disguising it is for diabetes. The cartridge cap is protected when the concept is closed.

ILL. 53

SLIDER WITH VISIBLE NEEDLES

Feature: Needle container w. 5 needles. Hole to 'push' up needles.

The 'Slider with visible needles' has the same features as the 'Wallet', but the design shows it for diabetes. The holes in the needle container are made to make the needles easier to 'push' to gain better access to them. The concept contains five needles.

ILL. 54

THE BLOB DEVELOPMENT

Two concepts were made within the Blob concept direction. The concepts try to make the injection feel like a gentle touch as it is used as a computer mouse. Further, they enhance the injection easier to hide under a shirt, as they challenge the insulin pen length.

THE STONE

Feature: Injection with index finger

The 'Stone' is higher and thinner than the former Blob (section 3.5). The injection button is placed in front for injecting with the index finger. It has been made to fit both right- and left-handed.

ILL. 55

THE EGG

Feature: Injection with thump on the side

The 'Egg' is a re-design for the former Blob. The concept is made bigger and can be split apart to replace the cartridge. The injection button is placed on the side for injection with the thump. The dose adjuster and unit counter are placed at the bottom of the 'Egg'.

ILL. 56

// EVALUATION

The group developed eight potential concepts. The next step was to test the concept with users to find a potential concept to work further with. Evaluating the ideation, the group realized that the discretion and the transformation from open (in use) to closed (not in use) were interconnected. The current reusable pens show the unit counter in both cases, which communicates it is for diabetes. Hiding the unit counter in closed condition would make the device discrete and possible to hide-in-plain-site when not being used

! Insulin/diabetes signals are disguised in closed condition and visible in open.

3.9 SECOND USER TEST

A user test was carried out to get feedback on the eight concepts (see section 3.8) to find a concept or concept direction. The group went into a new loop of 'The Experimental Circle' by Kolb (McPheat, 2019).

TEST CONDITIONS

Again the group decided to bring all eight concept ideas, as each concept idea had different features addressing different user needs within its current concept direction. Two newly diagnosed users, Lia Papazu and Martin Kaae, were tested, each in their own home.

- Lia takes, in average 17-18 units a day, and uses 2-3 needles. The highest dose she has taken was 14 units
- Martins average insulin 15-20, using 3-5 needles a day. The highest dose he has taken was 18 units.

The purpose of using different users was to obtain other perspectives than from the previous users (section 3.6). The group presented the three concept directions staggered ('Stone' and 'Egg', Sliders, and Keychains). Within each direction presented, the belonging concepts ideas were shown together, making it possible for the users to compare features, size, interaction, and designs across the ideas within the current direction.

FEEDBACK

The feedback from the users on the Keychain and Slider direction was summed up in Tables 4 and 5. These are divided into pros and cons and who they came from. The 'Egg' and 'Stone' feedback can be seen on next page.

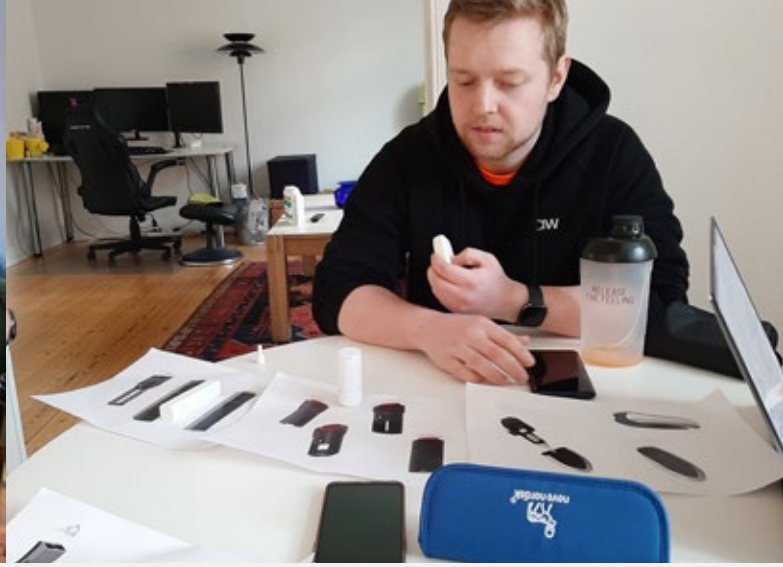
Further feedback from the test is found in App. 3.11. Overall, the users did not mind having lesser insulin in the concepts for all the concepts if the device could become smaller. However, under 1 ml or 100 units was considered to be too little.

Note that the users, in some cases, did not agree in terms of the concepts (see tabels 4 and 5).

> *"The idea of having the needles with you is brilliant!"*
> *– Martin Kaae*

KEYCHAINS	PROS	CONS
CAR KEYS 	**BOTH:** • Natural grip when injecting • Good travel version • Good pocket size • Great for small 'on the go' trips **MARTIN:** • Just as easy to remember as a normal car key **LIA:** • Felt more hiding in hand when injecting	**LIA:** • Keychain solution seemed careless dealing with vital medical equipment
POWER BANK 	**BOTH:** • Good pocket size • Great for small 'on the go' trips **LIA:** • Red design feature is nice • Good with screen showing last injection	**MARTIN:** • To big (wide) and felt cramp to use • Dislike red feature – make it less discrete • No value in the screen **LIA:** • Keychain solution seemed careless dealing with vital medical equipment • Unhandy shape in hand
LIPSTICK 	**BOTH:** • Squared shape on dose adjuster felt better when selecting units • Good pocket size • Great for small 'on the go' trips **MARTIN:** • Discrete deisgn • Hided an insulin device as something else **LIA:** • Liked it aesthetically	**LIA:** • Nervous that it could be hard to find in a bag – might feel like other similar products • Keychain solution seemed careless dealing with vital medical equipment • Insulin devise do not to be discrete if not a reusable device • The device should be recognisable

TABLE 4 Keychain feedback



ILL. 57 User test

SLIDERS	PROS	CONS
LIPSTICK WITH HOLSTER 	**BOTH:** • Good that it could contain many needles **MARTIN:** • Smart that the pen could be used both with and without the holster • Liked the function of hacing many needles	**BOTH:** • Not possible to distinguish between used and unused needles **MARTIN:** • Felt and looked to big • Overall squared shape felt uncomfortable in the hand **LIA:** • To slow to use, due to many part • No greater value having container for needles
WALLET 	**MARTIN:** • Liked the discrete and classic deisgn as it didn't symbolize diabetes • The overall round shape felt nicely in the hand • Fitted nicely into pockets • Liked the function room for needle **LIA:** • Could be nice in pink • Nice not to look for separate needle	**MARTIN:** • Four needles in the container were too few **LIA:** • No greater value in having container for needles
SLIDER WITH VISIBLE NEEDLES 	**BOTH:** • Best size of insulin device when injecting **MARTIN:** • Good with push functions to get needles out • Five needles in the needle container was good • Fitted nicely into a pocket • Liked the function room for needles	**MARTIN:** • Deisgn felt more medical **LIA:** • Dislike push function as the needles becomes visible • No greater value in having container for needles

TABLE 5 Slider feedback

ILL. 58

THE STONE AND EGG

Two essential key points made the group deselect the 'Stone' and 'Egg'. Lia mentioned both concepts made it difficult not to hit a blood vessel when injecting into the leg, as they hide the view of the injection. Additionally, it was impossible to see what type of insulin the cartridge contained (slow- or fast-acting). The comment made the group realize that it was not possible to see the amount of insulin left in the device. (See further feedback on the 'Stone' and 'Egg' in App. 3.11).

// DISCUSSION & EVALUATION

After the user test, the group deselected the 'Stone' and 'Egg' concepts. Based on the realization that the user could not see how much insulin there was left in the concept, creating a risk of leaving home without insulin in the device.

After speaking with Lia and Martin, a big topic was which concept and/or features to take further. As with the last test, the users seemed to have different likings (see pros and cons in tables 4 and 5).

The feedback did not result in the attempted purpose of finding a concept to work further with. Instead, it made the group unsure of which direction to go further with. As the confusion was at its highest, a supervision helped the group set fucus aging. The current pens have no variation in terms of use and design. They mainly focus on clinical aspects in their design languages (section 2.3), and often do not embrace the social or personal aspects. The social is all about the user's wish of fitting in, being normal, and fear of the stigma related to the products and being diabetic (section 2.1). They don't have a choice regarding variants and the context they had to fit into (section 3.3). Therefore, the users should have an option to decide which insulin device that fits best into their everyday. This fact led to considerations of creating a modular product platform, with a main unit fitting into different scenarios based on the various user needs.

Referring to the first user test (section 3.6 and App. 3.8) Rune and Jens also had different likings regarding the concepts presented then. For Jens, it was important the insulin device did not scream "I am a diabetes product!". He liked the 'Keychain Lipstick' (Idea J, p. 45) presented as it was discreet. Opposite, Rune valued the 'Slider' concept (idea E, p. 44) with the needle's container, as it created an overview of his needles and removed the mess from his pockets.

The two user tests also highlighted those aesthetics had significant importance. Lia and Martin disagreed. Lia needed her insulin device to be recognizable due to its vital importance. On the other hand, Martin wished it was hidden and discrete to avoid the stigma he felt from others towards his insulin pen. It became clear that the aesthetic should appeal to a broader spectrum and, at the same time, balance the span of being discrete and recognizable for the people with diabetes themselves. This realization opened the possibility of making different design languages, securing the users had a choice between different variants. Each user had different identities, product choices, and trends they felt connected to.

After the testing was done, the group also realized that none of the concepts tried to reduce the number of steps for injecting. Additionally, it was also found that users automatically use more than one hand when using insulin devices. The reason is the number of steps to prepare for injection (taking lids off, placing needles, etc.). It led to removing two requirements. See beneath.

This realization further added that a product platform would put users in focus. The next step was to mock up the platform concept and make a quick proof-of-concept test. The group further noted that users thought the minimum insulin amount shouldn't contain under 100 units of insulin (or 1 ml depending on the insulin type), as a smaller insulin device fitting in pockets and bags was valued high. That fact should be considered when designing the platform concept.

From the user test, some important point to consider for further development of the platform concept was found. These are listed beneath.

- ! Make a platform based concept that allows variants
- ! The insulin device should not be to squared, making it uncomfortable to hold in the hand.
- ! 5 needles were the golden number 'on the go'.
- ! A reduced amount of insulin would not be an issue (not under 100 unit /1 ml) if the deisgn becomes smaller and can fit in pockets/bags.
- ! The dose adjuster is easier to use when having a more squared shaping.
- ! Social aspect - decrete design to avoid stigma
- ! Positive that the insulin device can be hided-in-plane-site by appearing like something else.
- X The insulin injection can be made into a one-handed operation
- X Decrease/reduce steps of injection of insulin

3.10 FORTH IDEATION: PLATFORM

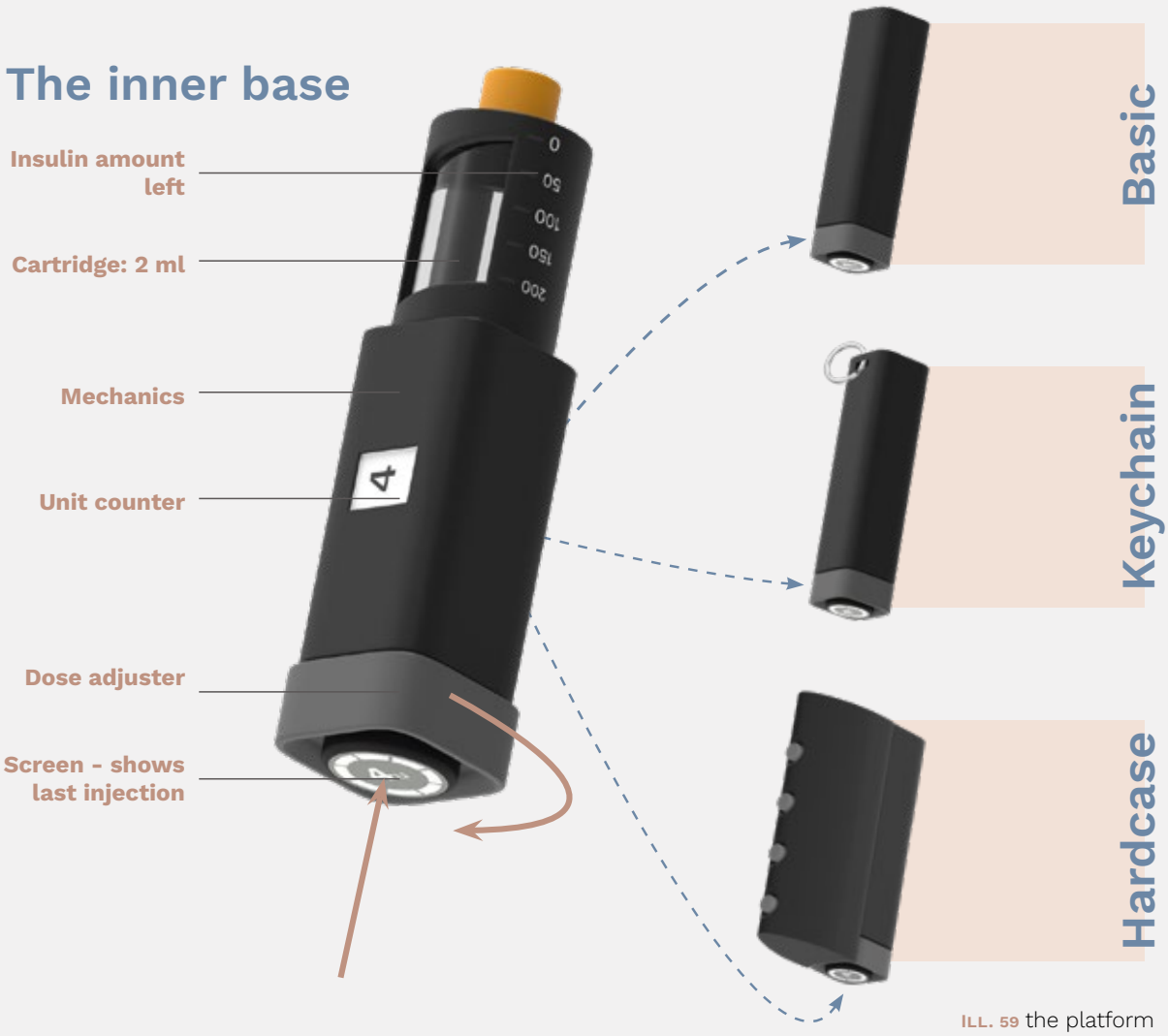
The group found that a platform design was the best option to embrace the user's diversity, different needs, and likings from the previous discussion and evaluation. The first draft of a platform design, later to be tested, was created in the following section. The considerations in combining different features for the platform design can be seen in App. 3.13.

After testing, the options of features, design, and interaction created the best foundation for a platform concept was discussed.

The group decided to combine the Lipstick concept inner base, make changeable lids and make it fit three user cases: 1) a Basic insulin device, 2) a Keychain concept, and 3) Hard case version with the needle container (see Ill. 59). The feature of the screen, telling the user when and how much insulin was injected last time, was added to the inner base and is included in all three versions. Further, the group set the number of needles to four. The group was still unsure if the needles should be visible or not. In the following, they are shown with visible needles. For the user test (next page), the group showed both versions with and without needles to the users.

The group choose the Lipstick base based on the feedback that the squared shape made the interaction of adjusting units better. Even though both users liked the interaction and design of the Car key concept (Ill. 49, p. 49), the shape and size were hard to connect to a needle's container. Further, the group also revisited the user test with Rune and Jens (section 3.6) where the lipstick-sized concept made diabetes look more elegant (App. 3.9).

The two user tests (section 3.6 and 3.9) showed that users value mobility and a smaller insulin device more than replacing a cartridge. Currently, all insulin pens contain a 3 ml cartridge. The unit amount in these cartridges depends on the insulin type. To delimit, Novo Nordisk's fast-acting insulin, NovoRapid, was used as a reference point. This insulin type has 100 units in 1 ml (Medicin.dk, n.d.). This concept insulin device reduces the insulin from the current pens of 3 ml to 1-2 ml. As the cartridge becomes shorter, it is assessed that it will decrease the length of the mechanism (the plunder rod (see section 3.2). For this concept, it was chosen to make a wider and shorter cartridge with room for 2 ml of insulin. Further, the unit dose setting is set to 30 units, as none of the users has injected over 18 units in one take (see section 3.6 and 3.9). The next step was to test the concept.



ILL. 59 the platform

3.11 THIRD USER TEST: PROOF OF CONCEPT

The next step was testing each of the three user variants, gathering feedback, and being able to confirm or deny the platform's concept (see App. 3.14). Based on the learnings from the former user test, the group went into a further loop in the 'The experiential learning cycle' by Kolb (McPheat, 2019). It was possible to gain access to two users, Rune Sejer Jakobsen, from an earlier test (section 3.6), and Kathrine Randrup Laursen, who had been used to gather user insight (section 2.1). The goal was to present the anticipated version fitted to each person and see their response. Afterward, the group showed the other versions and, at last, presented the whole platform concept. The wish was to get their full opinion on each version and the possibility of selecting the best personal match for them and see if it matched with the group's presumption.

Rune Sejer Jakobsen
Test person 1

ANSWER HIGHLIGHTS:

- It is very manageable and makes it easier to take things up from your pocket
- It looks innocent - It may have a psychological aspect to the aesthetics as you cannot see it is an insulin device when it is lying closed in front of you
- I liked it was shorter than the first I tested (section 3.6)
- Four needles are too few; five is better
- The slider seemed to lose
- The needles fell out – it was annoying
- Hard to get needles up with your fingers
- The push function to pop up the needles was better
- It's good with holes for needles, so it's possible to see how many there are left.
- There could also be a version for dextrose
- Annoys him that the slider function is hard to hit (missing a visible sliding direction)
- Solves the issue with needles lying loose

> *"The pockets are an eternity chamber, a Narnia - or maybe that is just men's pockets – this certainly also applies to needles. I always have more, so I never really know how many needles I have with me"*

- Afraid he will turn on the squared shape in his hand when injecting
- Annoyed if the base and lid would not align when closed

ILL. 60 User test

PLATFORM CONCEPT FEEDBACK

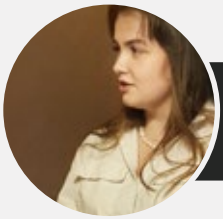
When presenting the Basic version and the Keychain version, Rune could see the possibilities in both versions. However, he did not find them suited for him. And again, he added the importance of securing the keychain lid.

When presenting the platform concept Rune said: "My first thought is that I think it is outstanding!" He saw many opportunities with this platform concept offered, but the group had only presented some from the platform. The fact of having a base fitting to different scenarios he found intriguing. As he explained, a child with no keys to the home would not get any good from the keychain solution; the child would maybe need the basic version. Whereas his friend Jens (tested in section 3.6), would like the one for the keys, as he often loses his lids. Rune explained:

> *"The diabetes world is somehow divided up into diabetes types. But it could also be divided into humans."*
> *- Rune S. J.*

The groups platform tried to embrace that form of viewpoint, not trying to make a one-size-fits-all, but instead providing options.

ILL. 61 User test



Kathrine Randrup Laursen
Test person 2

ANSWER HIGHLIGHTS:

- It looks like a lipstick
- I think about the size – how much insulin can it contain? 2 ml is okay
- I have an average insulin intake of approx 30-40 units a day
- The amount of insulin is a significant factor, as her insulin sensitivity is very high (she needs a lot of units) – fear of running out of insulin
- Replacing the ampul is not a problem
- The squared shape is fine, and it does not matter if it is squared or round.
- It is nice it is so small, also when I have to buy bags

> *I always choose my bags according to whether the pen can be in there*

- Consider that she will inject it the same way as with her present pen
- "I reuse my needles until they hurt. So the fact I can't have the lid on with a needle will make me take a new needle each time I have to inject wich will be good for me"
- Highest unit dose in one take: 25-30 units.
- The function of the screen is alpha omega for me
- It does not look dangerous

> *I'm a substitute teacher - and 2nd grade thinks it looks violent when I take out my pens. They will probably not think so with this one, as it does not look like a syringe.*

PLATFORM CONCEPT FEEDBACK

When presenting the Hard case and Keychain concept, Kathrine clarified that the Keychain would not do any good for her, as she often forgets her keys. However, she could see a value in the Hard case concept, for weekend trips or holidays. Kathrine reuses her needles so that the Slider concept wouldn't be the best-suited match for everyday use.

She liked that you should not deselect something. The purpose of having the possibility to purchase the different features was good, as she could expand to other options. As she mentioned, if she had to go on a vacation or a weekend trip, she could just bring the Hard case version instead of the Basic version. Then she does not have to bring a whole bag with needles. The function of pushing out the needles would suit her best. For her, it did not matter if the needles were visible.

REFLECTION

A note for the test was that the group presented the Hard case version with two types of needle containers (one with the push-out function of the needles and one where the container was closed) to get insight into which version was preferred. Both Kathrine and Rune liked the version where you push out the needles, as this was seen as most practical.
A note by Rune was that the Keychain version needed a securement, so the main base would not fall out from the lid when attached to the keys.

The presentation of the concepts to Rune was seen as a pilot test, as the group had tested with him before and knew his pre-ferred option. One source of error was that the group presented the Basic version before the Hard case, which was originally intended. Despite the mistake, Rune reacted positively and could see which one was designed concerning his needs, when the Hard case was presented.
Another source of error in the test with Kathrine was that the group did not know her in advance, besides some user insights from mail (App. 2.11). Hence, it was assumed which version suited best to her, although the group might not fit one-to-one. Verbally, she expressed that both the Basic and Hard case version suits her. Latent, the group concluded that due to her habit of reusing needles, the basic version would fit best into her everyday life. Habits are hard to change. As she expresses, the Hard case version could be used for weekend trips.

// EVALUATION

This proof-of-concept test showed that the platform worked, and the users had different product needs. Both users saw the benefits of choice, and even the possibility of choosing more versions, to fit different scenarios in their life. Even though the group didn't test the Keychain version, the group decided to go further with all three versions due to the feedback from former user tests. The users mentioned different interaction problems which need to be addressed and possibly tested. Based on the feedback, some requirements were set (see below).

- ✓ There should be a secure attachment in the interfaces, in the different combinations of the devices (Keychain Lid and needle container)
- ✓ The injection solution should contain between 1-2 ml of insulin
- ✓ The dose setting should be a maximum of 30 units
- ✓ The needle container version must have 5 needles (both used and unused)

3.12 PRODUCT ARCHITECTURE

After validating the concept platform, the group mapped out the different interfaces, interaction surfaces, and other essential parts of the concept. The overall intention was to consider which parts depended on each other and which could be replaced to create modularity for the three variants. Many of the following considerations have been made parallel when developing the concept platform, as the interfaces are dependent on each other and the interactions with the product. The coming pages are an overview of tests, considerations, and explorations of interfaces and interactions. For deeper insights, see App. 3.15.

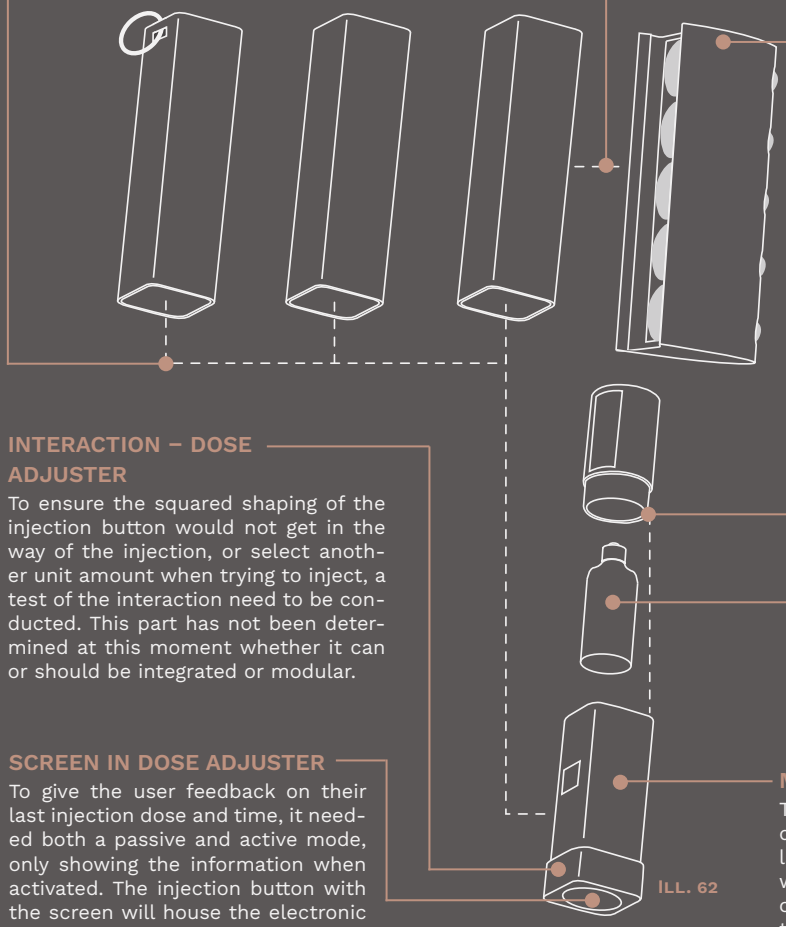
The envisioned product platform is now explored further. The initial platform consists of three lids sharing a common base for each version. The following provides an overview of the product's interfaces, modules, and interaction areas.

LID INTERFACES

The group needed an interface securing the lids attached to the base. Previous user tests clarified that the Keychain needed extra securement, so the base would not fall off without them noticing it. Furthermore, it was important to ensure that the lids and base would align when closed due to the squared shape. It was important to make the interface between the lids and base modular, securing the different variants fit to the base.

SLIDER AND LID CONNECTION

An interface between the lid and container with needles in the Hard case version needs to ensure that it is attached, not sliding off each other in the pocket by accident. Additionally, it requires a clear direction to ensure it does not slide together incorrectly. It is based on observations from the group sliding the parts wrongly together (see App. 3.15).



INTERACTION: ACCESS TO NEEDLES

It was important to ensure the needles were held in place when the container and lid of the Hard case version were slipped apart so that they wouldn't fall out. Likewise, it was important that the needles could be easily removed from the container. Thereby it was necessary to test the 'push-function' versus the container size with five needles, concerning whether the needles should be visible for practical purposes or not.

CARTRIDGE HOLDER

Ensure the cartridge can be held in place and not sit loose when the insulin device is in use. It must also make sure the cartridge can be replaced. An interface between the base and cartridge holder should be investigated. This part is determined by the cartridge containing insulin, and it must indicate to the user how much insulin is left in the cartridge. It is highly integrated with the mechanics in the base.

CARTRIDGE

The group considered that it could be possible to redesign the cartridge to fit the platform concept. However, it was perceived to strive after a standard or a minor reconfiguration here off. The group will explore this later.

INTERACTION – DOSE ADJUSTER

To ensure the squared shaping of the injection button would not get in the way of the injection, or select another unit amount when trying to inject, a test of the interaction need to be conducted. This part has not been determined at this moment whether it can or should be integrated or modular.

SCREEN IN DOSE ADJUSTER

To give the user feedback on their last injection dose and time, it needed both a passive and active mode, only showing the information when activated. The injection button with the screen will house the electronic components. The components, size, and battery capacity will be explored and calculated later. The electronic components are integrated into the base unit, as these are deepened on how much insulin the user injects, which they get data from during the injection.

ILL. 62

MECHANICS

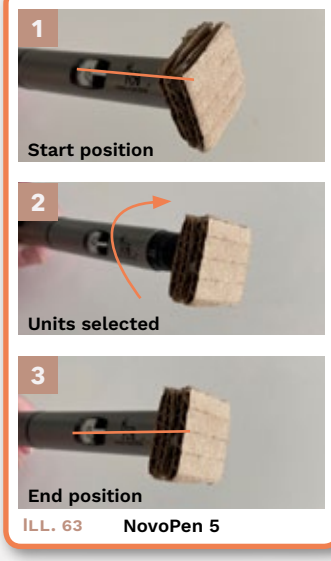
The base would house the mechanics, plunger rod, unit dose setting, etc. The size of the mechanics and calculations to ensure the right amount of insulin is injected when in use will be calculated and explored later. The size of the mechanics also depends on the sizing of the cartridge. This section of the platform is determined by its requirements to deliver insulin to the user and is integrated due to its relation to the cartridge and cartridge holder. It is the most expensive part due to the machines inside.

✓ The screen should only be activated when the user needs feedback on the last dose

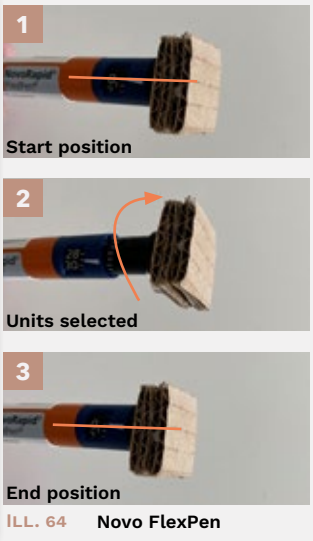
TEST OF SHAPE FOR DOSE ADJUSTER

A test was carried out to determine if the injection buttons square shape interfered with the injection, using two insulin pens, a disposable Novo Flexpen, and a reusable NovoPen 5. Using the Novo Flexpen, the button rotated back to its original position when injecting (Ill. 64). Here the squared shape affected the injection. When injecting the NovoPen 5, the button did not return to its start position but was pressed linear downwards (Ill. 63). The squared shape of the button did not interfere with the injection. It was chosen to work further with a squared shape using the linear injection function from NovoPen 5. Additionally, it was confirmed that gripping around a squared surface gave a better grip than with a round surface when setting unit dose amount. (see App. 3.15).

✓ The dose setting button should have squared shaping ensuring a better grip



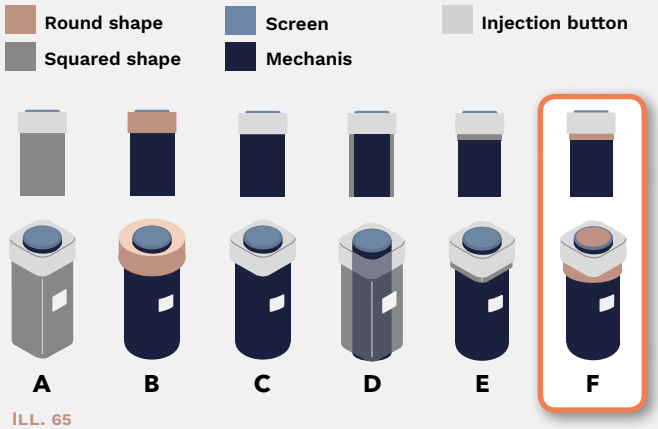
ILL. 63 NovoPen 5



ILL. 64 Novo FlexPen

LOCK AND ALIGN CONSIDERATIONS AND TEST

In testing the injection button, the group discovered that the button would not return to its starting point after selecting a dose amount and injecting with the NovoPen 5. This would result that when placing the lid back on, it would sit at an angle, and the shapes would not align. To explore how to secure the lid and base would align, the group conducted a diagram inspired by Tjalve's 'Struktur-variationmetode' (Tjalve, 1976) (see Ill. 65), showcasing different basic shapes that the group considered. Alternately, different lock mechanisms were evaluated parallel (see Ill. 66). The reason for exploring this parallel with each other was that this was integrated, but using the same solution on each lid would make it a more modular interface. Solving how to lock the lid would solve how the lid and base aligned. The importance of creating a secure lock was also due to the concern regarding the Keychain version (see former page 'Lid interfaces' p. 57).



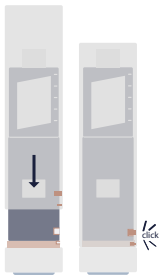
ILL. 65

Mock-up:
3. Twist and lock
- bottom of base

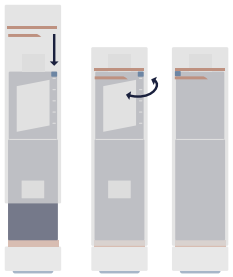
Mock-up:
2. Twist and lock
- top of base

ILL. 67

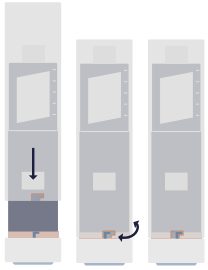
ILL. 66 Lockmechanisms



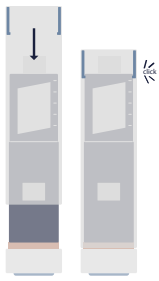
1. Click lock - bottom of base



2. Twist and lock - top of base



3. Twist and lock - bottom of base



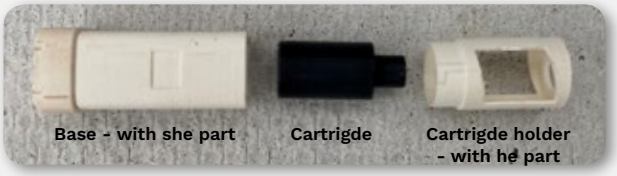
4. Click lock - top of base

Ill. 65 shows that the group chose the shaping of 'F'. It fitted well with the considerations of locks 2 and 3 (Ill. 66). It was seen as the click locks (1 and 4 on Ill. 66) were too easy to split apart. Therefore, the group decided to test the twist and lock mechanisms. These were afterward made in 3D, printed, and tested (Ill. 67). Here the group found '3. twist and lock' (Ill. 67), to be the best suited. It was based on the lid, and base could not be torn apart, the shapes aligned, and interaction came naturally (see App. 3.15).

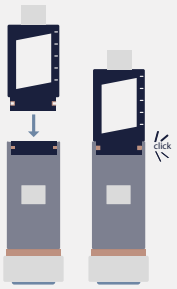
✓ Securement of lids (Twist and lock function in bottom)

TEST OF CARTRIDGE HOLDER INTERFACE

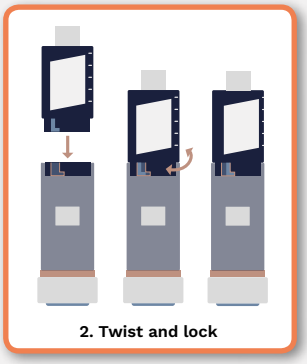
Trough out the ideation of the platform concept (see section 3.10), the interface between the cartridge holder and base was considered. Two major requirements needed to be addressed. Firstly, the cartridge should be locked in place and not sit loose when the product is in use, as this could result in the wrong amount of insulin being injected. Secondly, it needed to be easy to replace with a new cartridge when empty. The group considered two options. A clicking mechanism (see Ill. 68), and a twist and lock mechanism (see Ill. 69), are inspired by the current NovoPen 5. It was decided to 3D print the twist and lock mechanism (Ill. 70, 2. Twist and lock) as it was reviewed to suit the concept best. The click mechanism was too easy to rip apart, making it possible for the cartridge to fall out when the product was in use. The model was tested in exploring the platform concept (section 3.10), and function optimally. The group decided to go further with the twist and lock interface. (App. 3.15).



ILL. 70



ILL. 68 1. Click



ILL. 69 2. Twist and lock

✓ Securement of the cartridge (Twist and lock function between cartridge holder and base)

✓ Replaceable cartridge

TEST OF NEEDLE CONTAINER

The main concerns regarding the needle container were to avoid the needles falling out and that the user had easy access to take the needles. The group tested three options; 1) a closed version with no holes, 2) a version with holes for pushing the needle out to gain better access, and 3) a version with rubber hiding the holes to push the needles out. The pros and cons of each solution are shown to the right.

The group discovered that the needles were kept in place during testing and did not fall out in the version with holes. The reason was that the needles were pressed further down into the container. However, one issue was that it couldn't be assured that the users would press down the needles, so they got stuck. Therefore, it was considered to place rubber inside the holes to create a better grip around the needles, to ensure a long-term securement. The group did not explore this further at this point in the process.
Based on findings from the test (see ill. 71, 72, and 73), the choice fell on '2. needle container with holes'. (see App. 3.15).
Further, it was considered if the container could be used with different needles, as the people with diabetes use variant types. Three different needles were placed into the Mock-up, and the three-needle types could all fit in and did not fall out. (See App. 3.15). It confirmed working further with '2. needle container with holes' Ill. 72.

1. CLOSED NEEDLE CONTAINER
- ÷ Hard to get needle up
- ÷ Needles can fall out

ILL. 71

2. NEEDLE CONTAINER W. HOLES
- \+ Easy to push up needles
- \+ Needles do not fall out
- \+ Easy access to pick up the needles

ILL. 72

3. NEEDLE CONTAINER W. HOLES COVERED BY RUBBER
- ÷ Bindly seaching for where the needles are.
- ÷ Hard to puch up needles
- \+ Easy access to needles

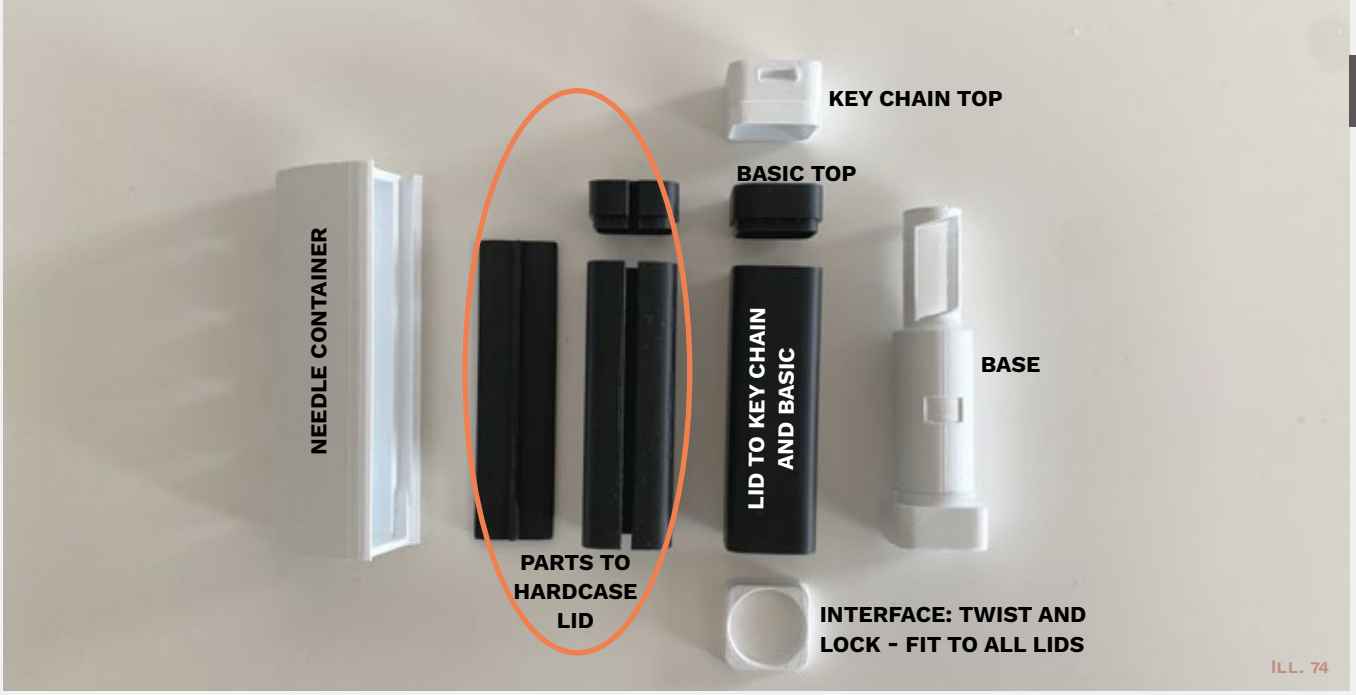
ILL. 73

✓ Easy to pick up needles from container

✓ Needles must not fall out

INTERFACE AND PART TESTING

To utilize the possibility of the variants, it was desired to make the platform concept as modular as possible but still focus on the three variants. The group assumed that by splitting the parts into smaller pieces, the complexity would be reduced. The intention was to let the base fit into each variant and thereby make it possible to shift between them, also form the user's perspective. It meant that the base unit, and dose adjuster with the screen, should be integrated and be the heart of the concept, whereas the lids and needles container should be possible to replace, depending on the need. The lids needed to have simple structures to create an easy transition between each part, so they would all fit into the base unit and make it possible to shift between variants. The group created simple tops and cylinders in 3D and printed each to test the principles and the simple interfaces. A big focus in this process was the production. It could easily be replaceable in production by making it as simple and with as few parts as possible. Based on this, the group assumed that the variation of the three concepts could be met and thereby reduce the pricing. The lids should be assembled before reaching the user, only making it possible for them to place the main base into the desired var-



ILL. 74

iant (Basic, Keychain, or Hard case). However, this was not calculated; it was just considerations and assumptions made in the current moment of the process. (See App. 3.15)

The tested modularity and parts can be seen in Ill. 74. Note that in creating the interface and modularity, the group also worked with the sizing of the cartridge and investigated standards sizes hereof. In this mock-up, the cartridge contains 1,5 ml insulin of NovoRapid. However, this will be explored in-depth and explained later.

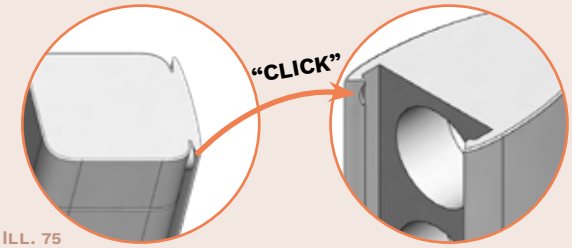
The group decided to go further with the created modularity. It was noticed that the interface between the needle container and its lid (see Ill. 74) needed to be reconsidered. The needle container could slide off the lid unintentionally with the current interface design. Therefore, this needed to be explored further.

HARD CASE SLIDER LOCK

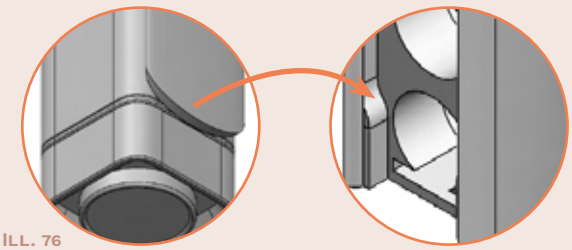
After prototyping the interfaces, the group reconsidered the needle container and lid interface. There were two main focuses in the test; creating a clear direction for the lid when sliding it on the needle container and a lock or click function, ensuring the two parts were secured together when being, e.g., placed in a pocket.

To do so, the group considered a linear click function shown in Ill. 75 A rounded end was suggested to create direction on the sliding function, seen Ill. 76. The principle was 3D printed and tested. (see App 3.15)

The group found from the test that the click function worked very well and had good auditive feedback when clicking down into the needle container. It was considered positive as the click sound would provide the user with the indication that the needle container and lid were secured. The rounded end also gave some direction for sliding the lid correctly on. (See App. 3.15). However, the group considered that the sliding direction needed a more visual feedforward than the current principle.



ILL. 75



ILL. 76

✓ Clear feedforward for placing lid and needle container together

✓ Lid and container must have a click function so they do not slip apart unintentionally

// EVALUATION

Based on the mock-ups, the group found to make the interfaces of the base and lids modular. However, the dose adjuster with the included screen was seen as an integrated part of the base with the mechanics.

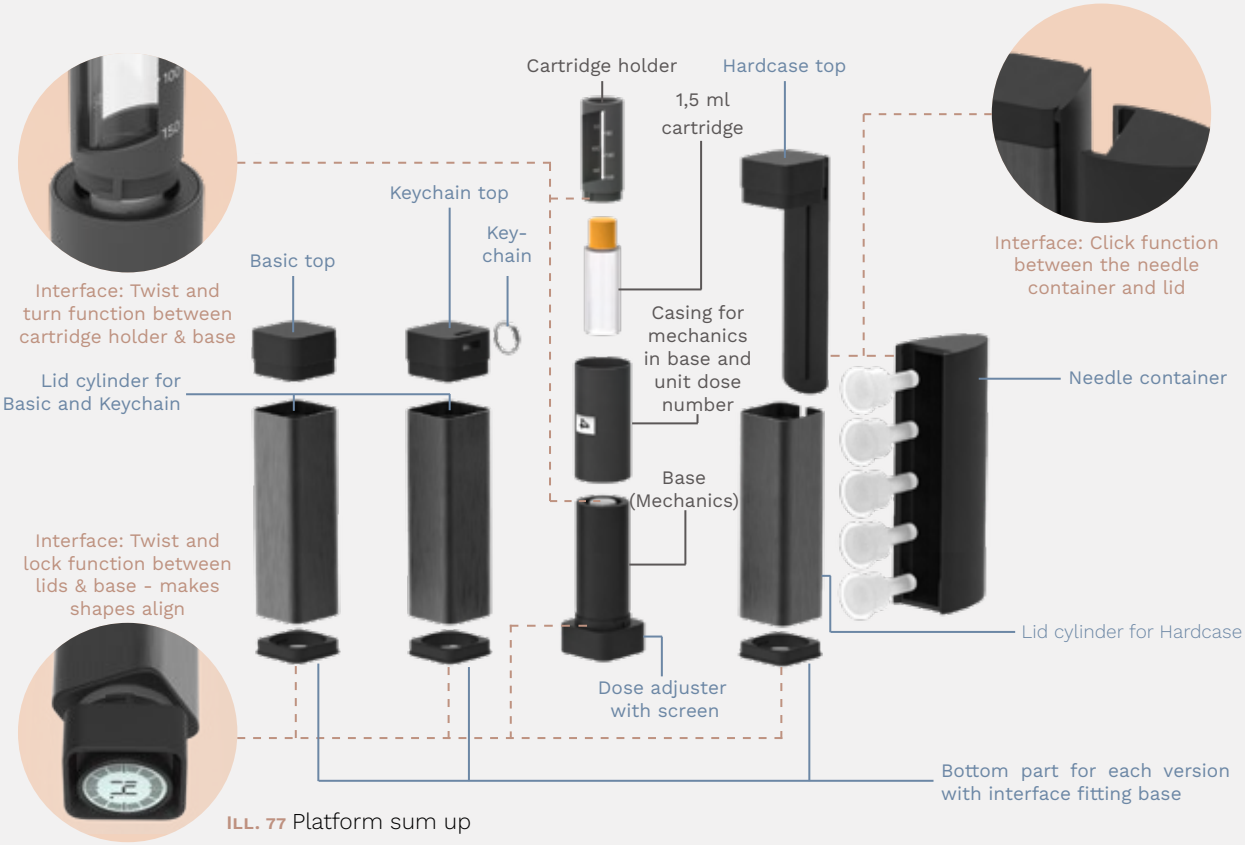
The group found different requirements and specifications while exploring the interfaces and interaction; these were listed ongoing with the exploration on the last four pages. Due to the parallel development of the interfaces, the group needs to get an overview of the entire platform concept at the current moment. It can be found on the next page.

3.13 PLATFORM CONCEPT SUM UP

The purpose of this is to summarize the current concept design, parts, and found interfaces of the concept to help the group highlight potential critical points or parts that need further investigation before detailing.

PARTS OVERVIEW AND INTERFACE MAPPING

Ill. 77 shows a sum-up overview of the parts and interfaces created for the concept. The modular parts that can change the shape but where the group must keep the interface are written in ***blue***. The parts that are locked in shape due to the requirements are written in ***grey***. The interface between parts is witting in ***light pink***.



ILL. 77 Platform sum up

PRODUCTION AND MATERIALS CONSIDERATIONS

In making the platform, the group started to consider the production and materials options to fit a product - and process architecture (Sanchez, 1999). Ill. 78 shows that the platform concept was divided into plastic parts, which were thought to be injection molded, and the cylinders of the lids, which should be extruded, and laser cut in metal. The production and materials of parts integrated into the base unit and optimization of the current pen's mechanics (section 3.2) were mainly seen as a black box until this point of the project.

ILL. 78

// EVALUATION

After summarizing the concept platform, the group had some concerns about how much variation, seen from a user perspec-tive, they were creating. The main difference in the concept was the change in use (the Basic, Keychain, and Hard case). The design did not seem to enhance and give the same value as the identity-creating products, as found in section 3.3. It was seen as a potential problem as it did not embrace personal differences, which was the intended purpose of the concept. A further investigation of the aesthetic design was needed. Additionally, the sliding direction on the needle container also needed a more precise indication of where to slide it on the case.

However, before going into detail, the next step was understanding the medical delivery products' requirements, which led the group to read the DS/EN ISO standard for a needle injection system.

! *A lack was seen in the variation of the design language*

3.14 DS/EN STANDARD

As the concept is a syringe, categorized as medical equipment, the group was conscious that the product had to meet several requirements. Therefore, there was a need to investigate which specific standards and requirements had to be met and could further be used to specify requirements for the concept. The Standards were investigated parallel with the last ideations.

NEEDLE-BASED INJECTION SYSTEM

Several Danish standards related to the concept, both for the associated needles and the cartridge (DA/EN ISO 11608-2 - Needles (Dansk Standard, 2012.a) and DA/EN ISO 11608-3 - Cartridge (Dansk Standard, 2012.b)). However, these standards have been delimited as these will be outsourced and the concept will be adapted to standards parts that are already on the market, or with few changes that do not affect the approvals. Therefore, it is up to the manufacturers of needles and cartridges to meet these standards. According to standard DS/EN ISO 11608-1: 2015 (Dansk Standard, 2015), the group's concept is a *needle-based injection system (NIS) for medical use, classified as a multi-dose container - a needle-based injection device with a replaceable container.*

To specify which sections of DS/EN ISO 11608-1: 2015 (Dansk Standard, 2015) could be most useful, the group reviewed the Novopen Echo Plus user manual to see which ones they comply with (Novo Nordisk A/S, n.d.). From this, it was confirmed by the product that the electronic in the device must comply with Directive 2014/52/EU, which is an assessment of the project's impact on the environment (Folketingets EU-Oplysning, 2014). However, the group will not go further in-depth with this. In addition, it must meet the specification limits for dosing precision (its performance) according to ISO 11608-1, 'Pen injections for medical use', where they refer to Part 1, 'Requirements and test methods'. Here, section 3 from the standard 'Terms and definition' has been used to rewrite the requirements of the concept, which leads to these (see the rewriting proces of the requirements in App. 3.12

- ✓ The container holder shall allow visibility of the insulin amount
- ✓ The injector must provide an indication of the insulin dose set to be injected by the user
- ✓ The injector must function with needles designed after DS/EN ISO 11608-2
- ✓ Keep track of how much insulin you took previous time
- ✓ The injector shall accurately deliver the entire labeled volume of the container
- ✓ When setting the insulin dose, there must be a visual and either tactile and/or audible feedback
- ✓ The insulin injector must at least visually indicate that it is ready for injection
- ✓ The insulin injector shall visually chance state from when it is ready to deliver a dose and when the dose has been delivered
- ✓ The insulin injector shall indicate the injection stroke has been completed either by visual, audible, or tactile feedback

The test

The group is aware that the concept must fulfill tests according to standards. However, the concept cannot be tested at present, as these tests require that the product is of the right materials and tolerances. Therefore, these tests are part of the final maturation process the product must undergo before being launched on the market.

ILL. 79

- ✓ The insulin injector must not allow a larger dose to be set by the user, than what is left in the container
- ✓ The dose accuracy shall be determined after DS/EN ISO 11608-1
- ✗ The group delimits itself from redesigning needles and cartridge according to fullfill the standards

// EVALUATION

Several requirements have been adjusted according to standard DS/EN ISO 11608-1, listed on the left. In addition, there is a limit to changing the associated needles and cartridges; therefore, these standards are disregarded. There are requirements for testing for a NIS; however, these cannot be performed with the resources available to the group, as these tests require a nearly finished matured product - but there is clarity that these tests are necessary before launching the product. The next step is to implement more of these design criteria and requirements in the concept solution.

3.15 FINAL DESIGN BRIEF

The final Design Brief has been updated since the 2nd phase, 'Define'. The Design Brief includes a new problem statement, value mission, interaction vision, feedback from Milestone 3, and a summary.

From user research from section 2.1, it was presented that just as people with diabetes are not the same, their forms of treatment also vary. The people interviewed with diabetes also had different relationships to their pens and associated needs. In addition, stigma from previous a deeper insight was achieved on p. 21 'Feeling curve', where individuals with diabetes emotion curves are presented from the time they were diagnosed with diabetes until now. Here the group observed that everyone had an emotional dive related to their illness. The curve is reversed when the person finds their appropriate treatment, where they often get a sense of "ownership" and accept that it is part of them. It is also where there is a potential for the concept to be able to soften this curve, where the person can hopefully embrace their illness faster and not feel embarrassed connected to their diabetes equipment. Additionally, it is also necessary from the scenario in section 2.2 that the product also embraces an 'on the go' product, because people with diabetes need to have their insulin pen treatment with them everywhere they go. From section 2.3, it is observed that it is primarily the technology that has been developed and not much on the aesthetic level.

These focal points have been underlying the entire ideration presented in phase 3 'Develop' but are first introduced here. With these new insights, the problem formulation was revisited and reformulated to:

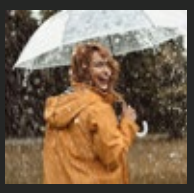
PROBLEM FORMULATION

How to design a needle-based injection system (NIS) for insulin that supports everyday life with diabetes and becomes a more neutral part of the user's individuality?

VALUE MISSION & INTERACTION VISION

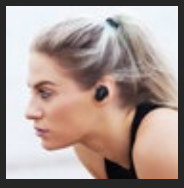
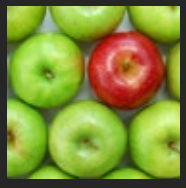
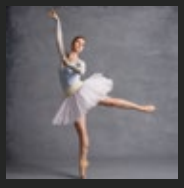
In the previous value mission and interaction vision (see p. 33), the group saw a need to re-evaluate and adapt to the new insight. It was done to become more precise and create a shared understanding of the chosen word among the group members. In addition, triangulate is based on these discoveries, which the concept should strive for.

VALUE MISSION

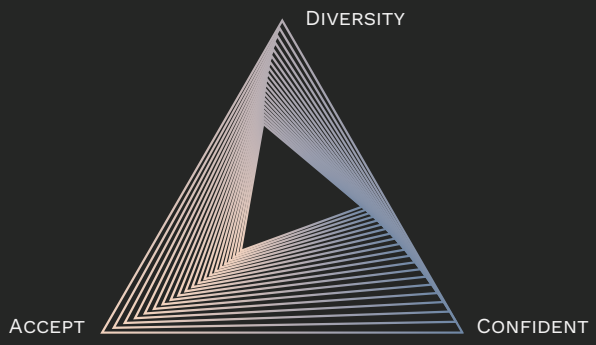
DIVERSITY	ACCEPT	CONFIDENT
		
"Like creating a build-a-bear in the toyshop"	*"Like knowing that the earth is turning"*	*"As when the support wheels are removed for the first time"*

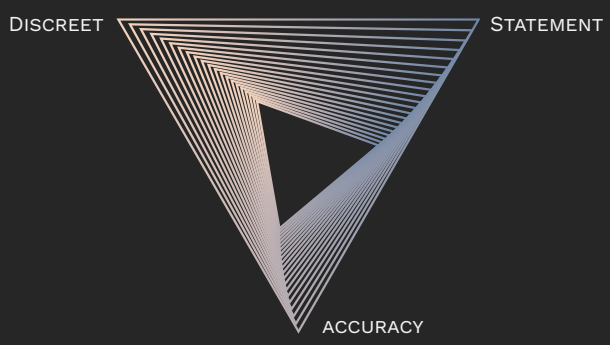
"Provides the opportunity to embrace diversity and establish a confident user who accepts the circumstances, likewise contributing to an acceptance from the surroundings"

INTERACTION VISION

DISCREET	STATEMENT	ACCURACY
		
"Like stars in daylight"	"Like choosing your outfit for the day"	"Like eating with knife and fork"

"Create a discreet solution that disguises having diabetes, which contributes to accurate handling, and embraces the statements of each person's values."





ILL. 80

ILL. 81

REQUIREMENTS

The requirements had to be updated after the found concept platform. It is done with inspiration from the method of Ulrich and Eppinger (2008), where the ranking is still carried on from previous Design Briefs (p. 32). It shall be noted that many requirements have been found, updated, and removed, creating an extensive list.

This resulted from the group's wish to embrace a vast amount of aspects when going into the ideation rounds in the 'Develop' phase.
Through the 3rd phase, 'Develop', some of the previous requirements have been rewritten or removed, and new ones have been added - these are marked with colors:

Changed requirement | Removed requirement | New requirement

Need No.	Metric	Unit	Value	Imp.	Source
1	The container holder shall allow visibility of the insulin amount	ml	-	6	2.2 + 3.13
2	The injector must provide an indication of the insulin dose set to be injected by the user	Units	-	6	2.2 + 3.13
3	The injector must function with needles designed after DS/EN ISO 11608-2	Binary	-	6	2.2 + 3.13
4	When the needle is not in use, the insulin output area must be protected	Binary	-	5	2.2
5	The injection should prevent the possibility to press so hard that you create a depression in the skin.	Binary	-	2	2.2
6	Keep track of the last time you injected insulin	Binary	-	4	2.3
7	Keep track of how much insulin you took previous time	Units	-	5	2.3 + 3.13
8	The injector shall be designed to function with a choosen standard cartridge deisgned after DS/EN ISO 11608-3.	Binary	-	5	2.3 + 3.13
9	Inject half injections units.	Units	0,5 u	2	2.1
10	Able to enter carbonhydrates instead of units to adjust the insulin amount	Crabs	-	1	2.1
11	Contain more needles in the solution / reduce amount of external units like the needles	No.	-	2	2.1
12	The insulin pen must collaborate with the CGM sensor or the glycometer	Bluettoth / NFC	-	2	2.1
13	Make injection more invisible to the social evironment and for user	Binary	-	3	2.1
14	The NIS must be no longer than 140 mm	mm	-	4	2.1 + 3.3
15	The user should have a feeling of control	Binary	-	3	2.1
16	The insulin injection can be done blindly	Binary	-	2	2.1
17	A known area to place your fingers to complete the injection	Binary	-	4	2.2
18	A grib/neutral area to hold/place the finger/hand (must be stable during injection)	Binary	-	3	2.2
19	The injection should be possible to due in a 90-degree angle with or without making a lifted skin fold.	Angle	90°	2	2.2
20	Need visual contact to the needle, when checking/pressing air bobbles out (doing safty check)	Binary	-	6	2.2
21	Decrease/reduce steps of injecting insulin	No.	-	1	2.2 + 3.8
22	The insulin injection can be made into a one-handed operation	Yes / No	-	2	2.2 + 3.8
24	The size must fit different hand sizes - must enable a comfortable user experience when injecting	Yes / no	-	3	3.5
25	Either it should be lightweight so it does not weigh much in the pocket / bag otherwise it should have more weight, so it feels of quality	Grams	-	1	3,5
26	The visual control of where you place the needle on your body	Binary	-	4	3.5
27	There should be a secure attachment in the interfaces, in the different combinations of the devices (Keychain Lid and needle container)	Binary	Binary	4	3.10 + 3.11
28	The injection solution should contain between 1-2 ml of insulin.	ml	1-2	6	3.10
29	The dose setting should be a maximum of 30 units	units	30	2	3.10
30	The needle container version must have space for 5 needles (both used and unused)	Amount	5	3	3.10
31	The screen should only be activated when the user needs feedback on the last dose	Binary	-	4	3.11

32	The dose setting button should have squared shaping ensuring a better grip	Yes / No	-	3	3.11
33	Securement of lids	Yes / no	-	5	3.11
34	Securement of the cartridge	Yes / no	-	6	3.11
35	Replaceable cartridge	Yes / no	-	6	3.11
36	Easy to pick up needles from the container	Yes / no	-	3	3.11
37	Needles must not fall out from the container	Yes / no	-	4	3.11
38	Clear feedforward for placing lid and needle container together	Yes / no	-	2	3.11
39	Lid and container must have a click function so they do not slip apart unintentionally	Yes / no	-	2	3.11
40	The injector shall accurately deliver the entire labeled volume of the container	ml	-	6	3.13
41	When setting the insulin dose, there must be a visual and either tactile and/or audible feedback	Binary	-	6	3.13
42	The insulin injector must at least visually indicate that it is ready for injection	Binary	-	6	3.13
43	The insulin injector shall visually chance state from when it is ready to deliver a dose and when the dose has been delivered	Binary	-	6	3.13
44	The insulin injector shall indicate the injection stroke has been completed either by visual, audible, or tactile feedback	Binary	-	6	3.13
45	The insulin injector must not allow a larger dose to be set by the user, than what is left in the container	Binary	-	6	3.13
46	The dose accuracy shall be determined after DS/EN ISO 11608-1	Binary	-	6	3.13

3.16 FEEDBACK FROM MILESTONE 3

The feedback at Milestone 3 contained some considerations regarding the project. First, the presentation was missing a more precise fly-in because it was not fully understood what the group were striving for with the project. The group needed to explain why the concept has variants and how these could fit in with the users and their everyday lives.

There were still questions about whether the group had researched the market enough. Some market-related information was missing regarding the product's Unique Selling Points and additional market strategies. Is there a desire for a startup or collaboration with one of the larger companies in the diabetes industry? The group lacked clarity on strategy and why some will potentially collaborate on the product - where the question was: "If I were Novo Nordisk, would I then invest?" One also assessed the pricing, and perspectives about the price point were shared: "Is it necessary to have the price in the middle of the market? or is it perhaps a more exclusive product and at the expensive end?"

A final emphasis was on the different variants and how modularity could create these. One perspective was that the concept was at the lower end of creating variety, where only the colors are changed, and whether the group could explore this further. (App. 3.16)

3.17 SUM-UP

ACQUIRED KNOWLEDGE

- Insights from experts and the stakeholders relation to the patient
- Examination of insulin devices and how they are constructed
- User insight into their personal belongings
- Feedback on several concept iterations and user test
- Created a product platform

FURTHER COURSE

- Explore aesthetics and variations
- Create style directions for concept
- Minimize the concept
- Finalize mechanics and needed components must be defined
- Define materials and production

Deliver

By now, the basic construction of the product is figured out; however, still a need to develop and explore further. The group uses aesthetic sessions and workshop methods to explore what different story designs will symbolize. The outcomes will then be combined with an identity exploration of style boards, leading to three concept variants. To finalize the product proposal, the current mechanics were examined and further improved to create a smaller product. The material and production choices and challenges will also be mentioned in this phase. Finally, the product architecture will also be presented and mapped.

04

4.1 EXPLORATION OF AESTHETICS: CARICATURES

From the milestone feedback, the variation in the concept had a low value expressively, and the platform design did not leverage in hitting different user segments or identities. Aesthetically exploration of the current platform concept was needed. A selection of two sketching sessions can be seen underneath (See App. 4.1). These were made in relation to the 'Idea Creation' phase based on Striim's ideation model (Striim, 2001).

CREATING 'CONCEPT-CARS'

Initiating the first two sketching sessions, this used the four phases of 'The experiential learning cycle' by Kolb (McPheat, 2019), within the first 'idea creation' phase of Striim (Striim, 2001). The experiment was set up using the sketching method 'Forced Relationship' (Tollestrup 2004, p. 284) to create a 'concept car' for each variant. Pictures of products were found and used in each session as a reference. Here the group sketched caricatures, transferring essential design features from the reference's pictures onto one of the variants. Each session is shown beneath, where all the sketches can be found in the appendixes, were Ill. 82 and 83 show examples.

SESSION 1 - INDENTY MARKERS

The first sketching session used products seen as identity markers, like a Motorbike, a NIKE football shoe, an old Gameboy, etc. (App. 4.1).

ILL. 82 Identity markers

SESSION 2 - 'ON THE GO'

In the second sketching, pictures of products used 'on-the-go', like coffee mugs, headphones, juice, make-up, etc., and two of the universes (watches and electronics in section 3.4), were used. (App. 4.1).

ILL. 83 'On the go'

// EVALUATION

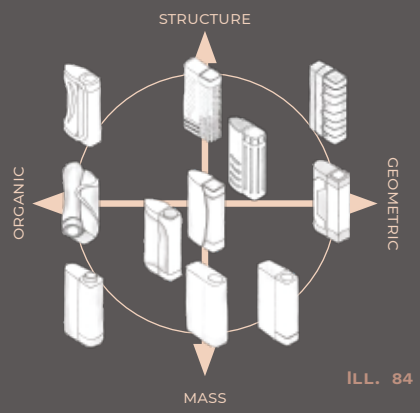
Evaluating the sessions, it became clear that the purpose of finding 'concept-cars' for the three variants did not give the intended result. In the attempt to draw for identity creative design, the sessions did not result in any specific direction, and the group could take only small details and elements further. To explore the design potential of the platform concept, a more systematic approach was needed.

4.2 THE SHAPE CIRCLE

After experimenting with caricature sketching, it was necessary to step back and find a new method for exploring the concept. The ideation approach was based on Striim's ideation model (Striim, 2001), by turning back to the 'Focusing' phase, the group needs to specify a more directional approach.

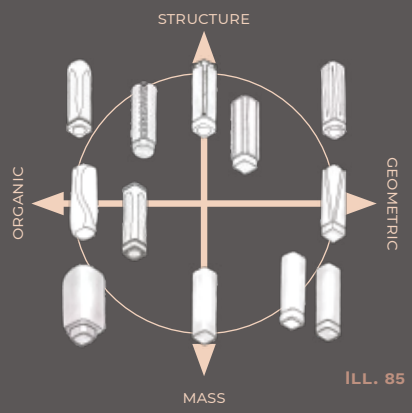
The sketching round needed a more academically approach, to investigate the shaping possibilities and boundaries of the concept platform.

To do this the book 'Formgiv/Givform' (Jaeger and Laursen, 2022) was used. The method takes a concept through the 'Shape circle', a shape and density scale, where the outer points of its opposites, mass vs. structure, and organic vs. geometric, are explored. The intention is to help designers clarify decisions, see the pros and cons, etc., for a concept. Further, the book also considers the details and transitions when different shapes meet. (Jaeger and Laursen, 2022). Illustrations 84, 85, and 86 show the sketches for each variant placed in the 'Shape Circle'. In App. 4.2 sketches from the whole session, including details and transition sketches, can be found.



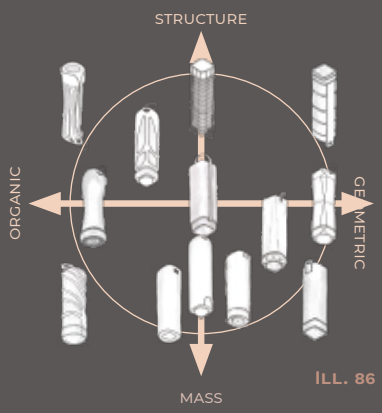
ILL. 84

HARDCASE



ILL. 85

BASIC

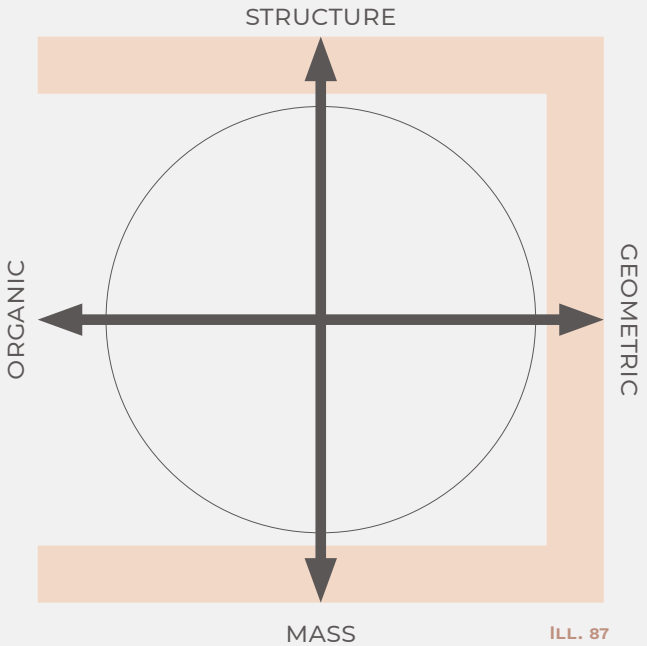


ILL. 86

KEYCHAIN

Through this method, the group found some aesthetic boundaries. Ill. 87 highlights the preferred areas the concept variants should navigate within in the 'shape circle', and the causes are described underneath.

- **STRUCTURE:** The lids and base shapes must not get too structured. It can create holes in the surfaces, resulting in dirt entering the mechanics and the insulin in the worst case. The damage can potentially be life-threading.
- **GEOMETRY:** The group clarified that the edges could not be too geometric based on the previous user test (section 3.6 and 3.9). It would make it uncomfortable to hold in hand and store in pockets.
- **MASS:** As the concept is placed in trousers and jacket pockets or small bags, it can not be too mass, both regarding the size and the user's visual perception hereof.



ILL. 87

// EVALUATION

Evaluation of the shape circle gave some clear boundaries for the design, however, there were still no identity-creating directions. Again, the group could use some potential details and elements in further explorations. The knowledge obtained is transferred and implemented into a more direction defined design exploration.

! Boundaries for the shaping of the concept platform variants where found based on the shape 'shape circle' – see Ill. 87.

4.3 IDENTITY EXPLORATION OF THE VARIANTS

Multiple rounds were conducted to determine the aesthetic expression of the three variants in the concept. The group used Striim's ideation model (Striim, 2001) in combination with Kolb's experiential learning cycle (McPheat, 2019). The following pages go through the steps of exploring the design expression of the three variants trough style boards, sketches, and ending with a user test.

STEP 1: STYLEBOARDS

The first step before going into sketching centered around the first phase in Striims ideation: 'Focusing' (Striim, 2001). Here, the group created directions to explore the aesthetics through different style boards for each platform variant. The inspiration was drawn from the identity markers in section 3.3, from the three users, Christian, Rune, and Kathrine (see the products of inspiration in App. 4.3). The group chose these to create the most difference in the design languages for each platform variant. It is essential to distinguish that the style boards do not directly define the three users they are inspired by. These should be seen as style personas. The style boards have been more mainstream to target a larger group or identity styles, incorporating product trends and lifestyle inspiration from social media. See style boards and description underneath on ill. 88.

Different considerations led to this aesthetic exploration. Firstly, the users preferred having a discrete product not directly signaling it was for diabetes treatment (sections 3.6 and 3.9). Secondly, it was found in the user insights and feeling curve analysis (section 2.1, p. 21) that accepting being a diabatic related to their view on themselves and identity and how they feel others look at them. Here the signal value from the insulin pen did not help, as they felt people sent judgmental looks. Embracing the differences in the individual's identity, and giving the insulin devices other interpretations in design, was seen to help to soften the feeling curve and make the acceptance of their diabetes more bearable.

CLASSIC (BASIC AND ELEGANT)

- Simple shapes, not challenged with many interruptions.
- The materiality is toned down, and not many different compositions.
- The coloring has an exclusive feel (shiny silver, matte finish, or no eye-catching colors)
- Contrasts are highlighted with dark and light colors (black and white/silver)
- Materialization of the lines, determine the alignment
- Few fractures in the overlays (lines in the surfaces)
- Mixtures of curvature (Georg Jensen) and tangent (Apple)

INSTAGRAM (TRENDY AND FEMININE)

- Simple with few materiality meetings.
- More rounded and soft edges.
- Toned down and gentle colors (bay colors).
- Matte surface dominating. Shinny surfaces as details (often silver or gold).
- Flat/tangent surface meets round/curvature surface (Apple).
- Curvature is the most dominant shape.
- Lines define the edges, and the lines are determined by the materiality

OUTDOOR (PRACTICAL AND TOUGH)

- Defined by serval rough product (military hard cases) Sharp edges, occasionally encounter roundings.
- Materiality corresponds to each other, matte and glossy surfaces.
- Clarer division of diffrent parts (clear meetings)
- The material is often metal, plastic, or rubber.
- Earth tones and dark colors, with a contrasting color for details (not pervasive).
- Several lines, both on the edges and on the surfaces defined by the materiality
- Primarily positional relationships, with few combinations of tangent lines.

ILL. 88 Style boards

STEP 2: COMBINING SKETCHES

The second step jumps into the third phase in Striims ideation: 'Ideation' (Striim, 2001). Here the group wanted to use 'Combinatorial sketching' (Tollestrup, 2019, s. 34-38), combining sketches from the caricature drawing (App. 4.1) and the details and shaping from the 'shape circle' (App. 4.1), to create a span where the group could unfold the designs of the variants. (App. 4.3). Ill. 89, 92, and 95 show the drawings found from the forced relationship. The sketches used to combine them can be found in App. 4.3.

STEP 3: LEVELS OF SHAPES & DETAILS

In step three, the group evaluated the sketches, and afterward, details and shapes were gathered from them by 'Combinatorial sketching' (Tollestrup, 2019, s. 34-38) to create a synthesis. The group gradually developed the expressions to find the most suitable design fitting to each universe (ill. 90, and 93). Four drawings within each universe were decided to take further into a user test (see Ill. 91, 94, and 96), to validate and assess which drawings or detail within each universe to take further (App. 4.4). The levels are marked from A to D, where A is the simplest version within the universe. The test is described on the next page.

Classic

ILL. 89

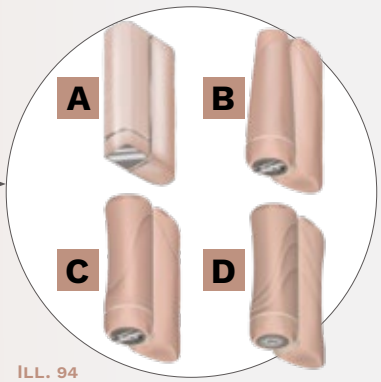
ILL. 90

ILL. 91

Instagram

ILL. 92

ILL. 93

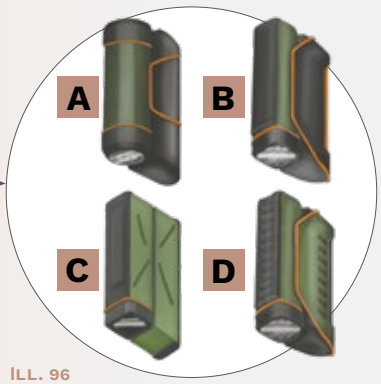


ILL. 94

Outdoor

ILL. 95

The sketches made here was transferred directly to the test



ILL. 96

During the drawing sessions, the group realized that product families within each style board could be created for all three variants (see Ill. 102 on p. 73). Therefore, the group decided to draw mainly on the Hardcase variant. It was seen as the most difficult to solve, as the transition between the lid and needle container required much design investigation.

STEP 4: SHAPE CIRCLE OF LEVELS

The fourth step focused on the 'idea evaluation' in Striim's ideation model (Striim, 2001). Before going into the user test, the group placed the four sketches for each universe in the shape circle to ensure that they were shaped according to the found boundaries (Ill. 87, p. 68). As a result of this evaluation, as seen on Ill. 97, the sketches were kept inside the boundaries. (App. 4.4).

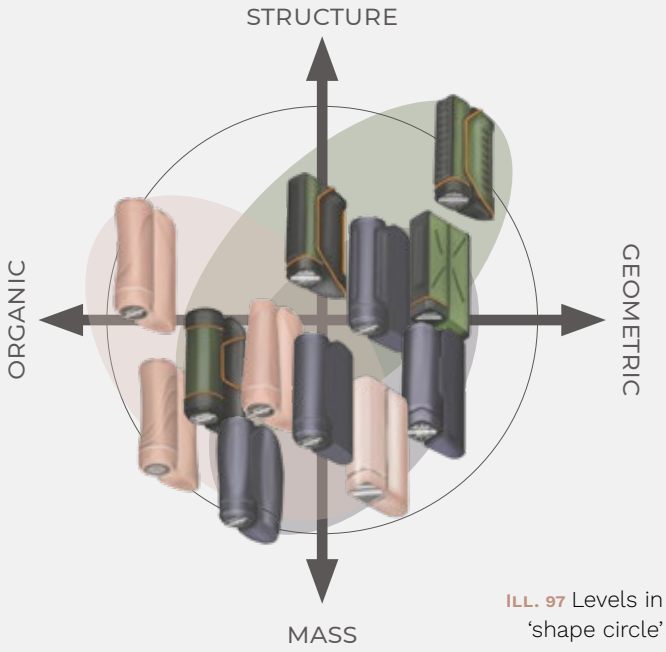
STEP 5: AESTHETICS TEST

Investigating which of the four sketches (Ill. 91, 94, and 96), was best within each three style board directions they were intended for, a test with six persons was carried out. The intention was to determine which level of detail and shape best belonged to its reference style board. The test was carried out by showing the persons a model for size reference, and then were presented to each style board and the four sketches accompanying them. They were asked which sketch of the four best fitted into the style board universe and why.
The six persons had difficulty expressing what they thought fitted best and couldn't always distance themselves from what they preferred. However, personal likings were disregarded, and instead, the group listened to the descriptive words they used on each sketch. In-depth feedback can be found in App. 4.5.

In the 'Classic' style board drawing (Ill. 88, p. 69), the test persons overall explained A and B with words such as: simple, boring, and discrete. Opposite C was described as a gadget, but classic style and one test person described D as a dildo. Based on the feedback, the simple shapes from A and B, but adding smaller details on the surfaces, which made it more interesting and not boring, were considered to work further.

For the 'Instagram' style board (Ill. 88, p. 69), A was referred to as a make-up case and simple, whereas B, C, and D were described as something resembling intimate, weird, and or that could be dildoes. Further, the pink colors did not seem to be liked by any test persons. Based on the feedback, the group decided to work further on A and reconsider the coloring of the concept.

Overall, C and D were viewed as the best matching for the 'Outdoor' style board (Ill. 88, p. 69). D was seen as tough-looking and more outdoor feeling. A and B were pointed out as too toned down in sharp edges and details. One test person noticed the design was more niched-based. The group saw D as the fit to work further on based on the feedback. To make the version less niche, it could be considered to tone it a little down to hit a wider group.



ILL. 97 Levels in 'shape circle'

ILL. 98 Test

// EVALUATION

Overall the user test did not give the group a one-to-one design choice for the variants. Evaluating the many explorations of the aesthetes, sketching steps, and the test, one thing has been noted afterward. It was to ensure the design got challenged for each variation. The group tried not to limit the interaction and interface test made in section 3.12. Therefore, many concept drawings are round even though the group found that the base dose adjuster should have a more squared shaping (test section 3.12 p. 58). Therefore, some sketches can be discarded, and instead, the details, materialization, and some colors can be taken further.
The three created style boards will be used as a reference point for further exploration of the variant's designs. In the next step, the group needed to figure out which variant, Basic, Keychain, and Hardcase, to detail further on, aesthetically in one of the three style board directions.

4.4 AESTHETICS & PRODUCT FAMILIES

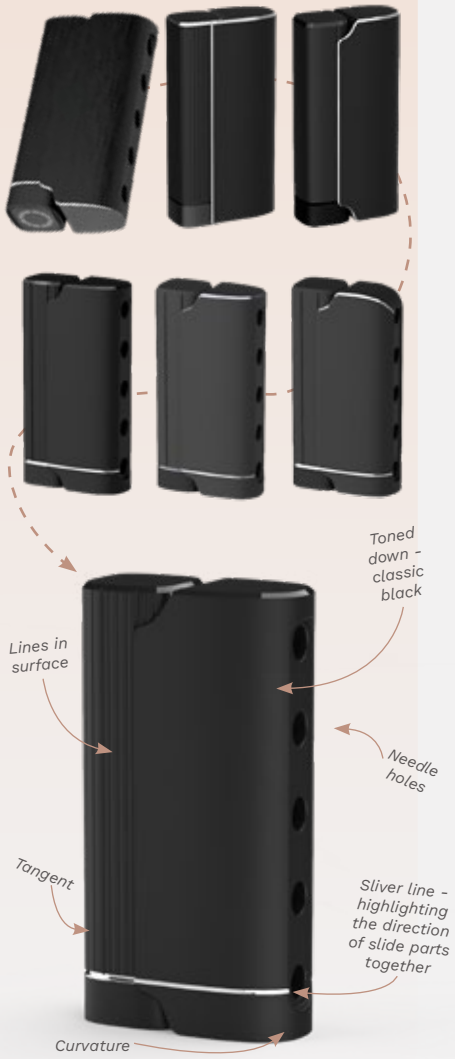
To determine the expression of the final variants and possibilities of the product family's extension, the group needed to move the exploration into 3D drawings. The learnings from the previous design exploration were considered when moving into 3D, together with the found boundaries from the 'shape circle' p. 68. In relation, the group transferred the known interfaces, shaping, and test from section 3.12 into the designs of the three variants. The approach of this design session was going back and forth in the two last phases of Striim's ideation model (Striim, 2001); 'ideation' and 'idea evaluation'.

STYLES AND DESIGN DEVELOPMENT

When going into 3D, the group decided to match one style board direction with one variant each. However, it was still considered that product families could be made, where one style board could be used to create all three variants (see ill. 102 on next page). Underneath is the match of style board direction and variant explained and explored in 3D. The group can find further exploration illustrations of each variant in App. 4.6.

CLASSIC STYLE BOARD X HARDCASE VARIANT:

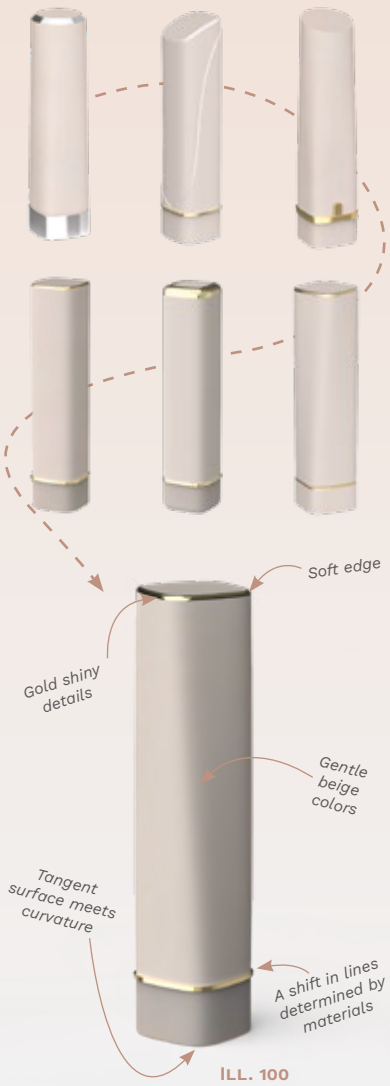
This Hardcase variant is mixed with the 'Classic' style board, based on users, like Rune and Martin. These persona's identity was seen as persons seeking order and overview, valuing complete and practical solutions. The design should be and must fit into pockets and bags. Details from the style board are highlighted in the final design Ill. 99.



Ill. 99

INSTAGRAM STYLE BOARD X BASIC VARIANT:

Based on the user, like Kathrine and Lia, the Basic variant is mixed with the 'Instagram' style board. These personas are much about personal and product image. They would consider a small, disguised size fitting into stylish bags, ensuring no compromises are made on design and style. The detail from the style board is highlighted in the final design Ill. 100.



Ill. 100

OUTDOOR STYLE BOARD X KEYCHAIN VARIANT:

Fitted for persons like Christian, the Keychain solution is matched with the gadget and outdoor style board. These personas' identities are practical, like gadgets, and things that can handle an active life. It is important that the product is easy to bring and cannot be forgotten, so they feel secure. Ill. 101 shows the final design with highlighted details from the style board.

Ill. 101

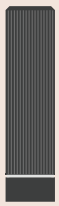
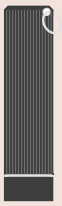
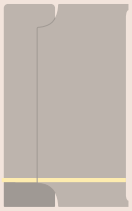
VERSITY PRODUCT FAMILIES

Through the development of the aesthetics, the group became aware of being able to create product families within each style board universe direction. Ill. 88 exemplifies the possibilities of each product family. Here the final name of the platform was defined and was named Versity. The three that have been detailed are highlighted with a darker background.

Initially, the idea was to keep the three use variants (Basic, Hanger, and Case) within the three style universes.

Nevertheless, the group realized that possibilities of variant additions within each style universe could be added. An example could be holders for the users' cartridges or the dextrose they eat to gain higher blood sugars. Further new styles could be designed to target groups, such as children or older people.

! Note that the previous presented changed to to the final product names in this section

	Basic	Hanger	Case	Variant ?
Classic				?
Instergram				?
Gadget / Outdoor				?
Style universe ?	?	?	?	?

ILL. 102 Product families, matrix

// EVALUATION

The final aesthetics were found, as seen on the last page. The group used the style universe for each variant in the product platform, and families were found. In the following sections, aspects such as electronic components, mechanics, and materials, will be elaborated further. These parts have been done parallel with the exploration of aesthetics.
Through the drawing session, it was also found to place a sliver line in the Case variants' bottom, indicating the direction of sliding parts together.

✓ Case: Indication line at the bottom for placing parts together.

4.5 COMPONENTS

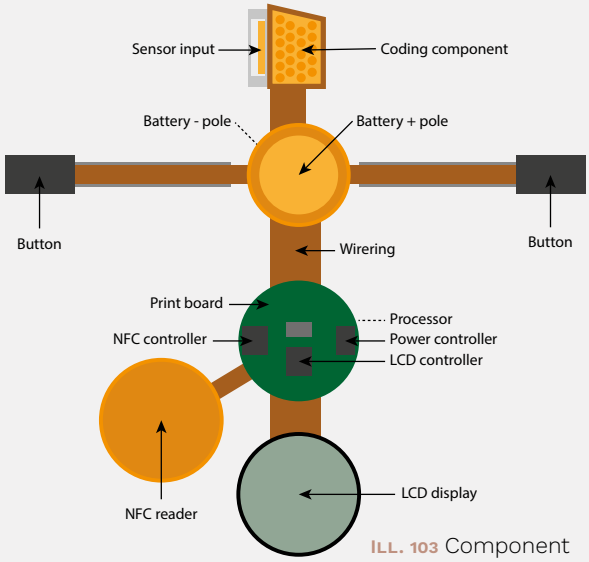
Parallel with the development of the aesthetics, the group analyzed components to ensure that the users wished to see how much insulin they took and when. The analysis can be seen in App. 4.7.

COMPONENTS

The previous section 3.2 shows how the group examined several insulin products, including NovoPen Echo Plus. Using this as a reference point, the group considered Versity's component specifications. An analysis of the NovoPen Echo plus (Ill. 103), laid the foundation for choosing components for Versity. In App. 3.5 and 4.7 the found components and considerations can be found. Through the analysis and user test, and expert interviews (sections 3.1, 3.2, 3.9, and 3.11), the following features have been focus points to implement:

- Tracking of how much insulin you injected and when
- Visual feedback of last injected dose and time
- Able to transmit data to the nurses to track their diabetes behavior and supervise accordingly.

It is known that the NovoPen Echo Plus claims to have a battery life of 5 years; therefore, it would be the potential battery lifetime to strive for.



ILL. 103 Component structure

USE SCEANRIOS

Based on the intended use of the screen, the following scenarios are listed. These must estimate how often the product is in use to calculate the battery life further. In App. 4.7, a flowchart describes how the found components communicate.

Scenario 1
Check data

When the user presses down the turning button to see 'how much insulin they injected and when' (visible for 12 sec.)

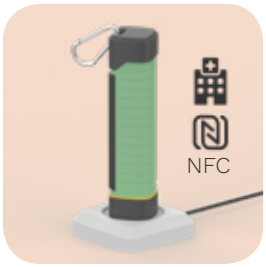
Average of 6 times a day (User Kathrine)

Scenario 2
Adjust unit for injection

When the user pulls up the turning button and adjust the number of units needed to complete an injection

Average 5 times a day (User Rune)

Scenario 3
Visits nurses at hospitals



The user transmit data from Versity trough a NFC. Helps diabetes nurse in supervission meeting. It is considred that 2 cm is enough distance. Average 2 times a year (Expert, Anette)

Scenario 4
Standby time

When the user does nothing, and the software is in standby

365 days a year

ILL. 104 Scenarios

BATTERY

With all 4 scenarios considered, the battery calculations result in 574 hours (See App. 4.7), which means 3 weeks. The group acknowledged that this is not realistic because of missing power data and knowledge about how long time specific components use to transmit. Some components can use 1 sec to transmit or 1 nano-sec, which impacts the calculations. To solve this, the group needs to contact a software/technical engineer and get them to construct the proper circuit.

// EVALUATION

The group found that the diabetes nurse could transmit the diabetic's data through NFC. Further, the potential use scenarios and requirements for the screen were found, and these are listed underneath. Additionally, the group found that the battery lifetime calculated was not realistic, which potentially requires help from software engineers.

- ✓ Visual feedback of last injection dose and time trough LCD screen on 0,5'' inches.
- ✓ The transmitting range of NFC must be 2 cm
- ✓ Memory storing of last unit dose injection and time
- ✓ Battery lifetime must be a least 5 years

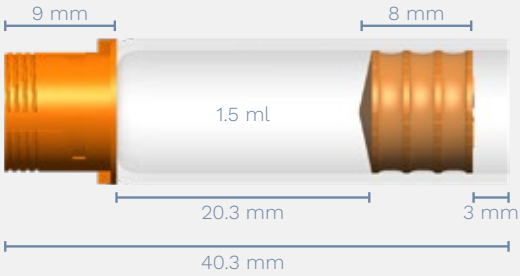
4.6 MECHANICS

Parallel with the aesthetic development; the group examined how the needle-based injection system (NIS) could be smaller than the current solutions. Therefore, the cartridge and mechanism needed improvements by examining several insulin pens, including NovoPen Echo Plus (see App. 4.8).

CARTRIDGES

Based on the previous user feedback, they all, in summary, didn't mind changing the cartridge more often if they got a smaller NIS. Therefore, it was necessary to look at the cartridge, making it smaller as its length will affect the overall size and mechanism. The group needed to know the minimum volume of insulin pressed out to do this. According to section 3.10 based on the insulin type NovoRapid, it contains 3 ml = 300 units.

To understand the possibilities with cartridges, the group contacted Stevanato Group (see App. 4.9) and watched their production video (Stevanato Group, n.d.a; Stevanato Group, n.d.b). They produce standard cartridges in the needed volume, but the concept requires other dimensions. From the production video, the group found that cartridges could be made in shorter lengths, with the same diameter as the current standards (Stevanato Group, n.d.b). Therefore, the cartridges had to be made shorter. The cap and plungers could be maintained as standards, thereby not changing the manufacturing process as long as it follows the guidelines in the standard DS/EN ISO 11608 (DS/EN ISO 11608-1, 2015). The most appropriate dimension to fit the current solutions were a cartridge containing 1.5 ml - between the users' advised volumes of 1-2 ml. The cartridge calculations can be found in App. 4.10, and Ill. 105 shows the final size.

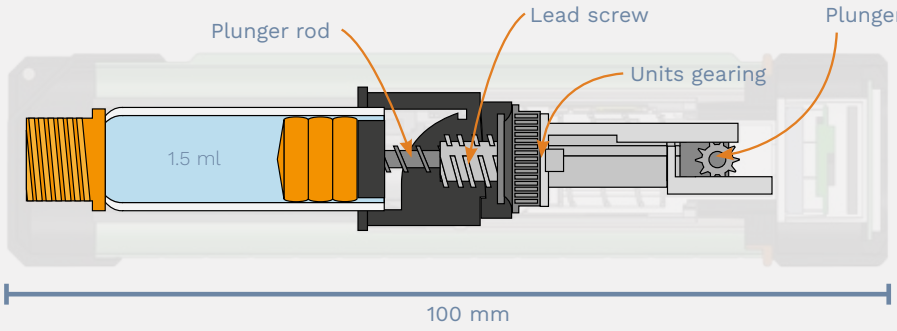


ILL. 105 Improved cartridge

✓ Compatible with 1,5 ml insulin cartridge

UNIT ADJUSTMENT MECHANICS

To ensure that the product could give the correct volume of insulin, the group examined multiple insulin injection systems (App. 3.5). To further understand the mechanics, the group examined the Novo Pen Echo Plus further to figure out the construction and mechanics (App. 4.10). With the combined knowledge, the group designed a new and smaller concept (Ill. 106), which has a length of 100 mm (compared to the NovoPen length at 160 mm), adjusted to a 1.5 ml cartridge and a range between 0.5 - 30 units delivered in one injection.

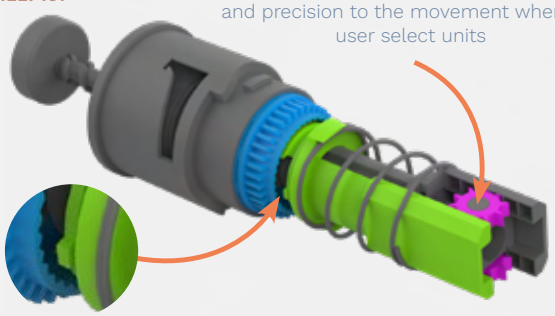


ILL. 106 Improved mechanism

✓ Maximun length of all three variants are 100 mm

On the illustrations 107 and 108, the dictating mechanics activated when choosing units and injecting on the dose adjuster, Forare highlighted and explained. How this works in ensuring the insulin is injected is explained in the section 'How it works' on the next page.

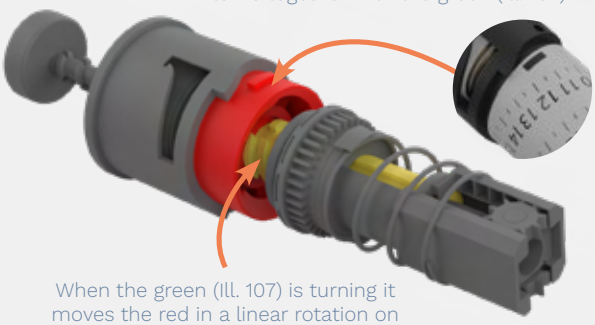
ILL. 107



Gears act as linear slider to add stability and precision to the movement when the user select units

The blue and green are attached to each other and is the gearing that controls the dose setting when the user adjust. It it the inner gear that is important.

ILL. 108



Controlles the visual units counter which turns together with the green (Ill. 107)

When the green (Ill. 107) is turning it moves the red in a linear rotation on the yellow lead screw.

ILL. 109

1. The user turns the dose adjuster to set the wanted units

HOW IT WORKS

The following illustrations shows how the concept injects insulin. It is a visual presentation of how the user interacts from the outside and what happens mechanically on the inside. It starts with the user turning the dose adjuster as seen on Ill. 109. This turning action is then passed on to the inside mechanics on ill. 110, 111, and 112.

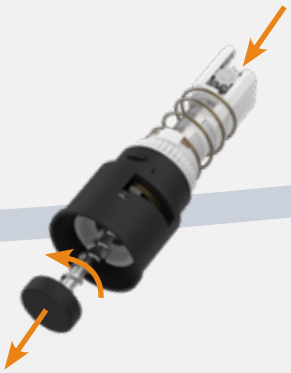
After the steps in Ill. 109 - 112, the plunger rod will stay in the last linear position until the cartridge is empty or the user reset it by themselves.

ILL. 110

2. When the dose adjuster are turning, the gearing turns and moves linearly up.

ILL. 111

3. The dose adjuster will also turn and move linear up, so the user knows the dose is set and the user press down to inject.



ILL. 112

4. Pressing down the dose adjuster will press down the plunger rod, which pushes the insulin out of the cartridge. The hole mechanism will return to the original position in the same movement besides the plunger rod.

CALCULATIONS ON THREADS

To ensure the right amount of insulin corresponding to ½ unit, the group had to calculate the amount of insulin that the plunger rod should push. Insulin volume for ½ unit was found to be 0.005 ml equals 5 mm^3, together with the cartridge's dimensions, it gave a displacement of 0.06766 mm for the plunger rod to move ½ unit. (see calculation i App. 4.10)

To ensure this within the mechanism, the group had to find the optimal lead/pitch for the lead screw (see Ill. 106). The group examined 1, 2, and 3 number of starts on the lead screw (yellow Ill. 108), in a combination of how many steps the gearing should have on a full rotation (Blue Ill. 107). The group found this to be 0.093 mm between the pitches on the lead screw with 36 teeth within the gearing. In addition, it was also chosen to proceed with a lead screw with 2 number of starts. These calculations give a total displacement of the plungerrod at 5.6 mm for 30 units (see calculations in App 4.10). Applying this into the mechanism resulted in a full concept length of 100 mm (Ill. 106), which also fits the 'case' concept containing 5 needles.

FURTHER OPTIMIZATION

If there was more time, there could be examined the following optimizations to achieve a wish about making the concept even smaller (see details in App. 4.11).

- Since the users take an average of 15 units pr. injection (see user test section 3.6 and 3.9), the total available unit injection of 30 could be reduced to 20 and minimize the linear movement.
- The thread screw could have 3 starts instead of 2, which could reduce the linear movement from 5,6 to 3,75 mm
- By increasing the diameter of the gearing (blue Ill. 107) from ø16 to ø20 mm, with the same distance bewteen the teeth the steps would change from 36 to 50 steps and reduce the linear movement.
- Change dimensions on the cartridge diameter, which could make it shorter with the same volume of 1,5 ml and thereby reducing the linear movement of the plunger rod, which affects everything.

✓ Inject half units

✓ Maximum of 30 units for dose setting

4.7 MATERIAL AND PRODUCTION

Developing the concepts directions, the groop took into consideration which types of materials the parts should be produced of. As the concept is a medical device, it needed to live up to those requirements. Through the process, the group has made a spectrometer analysis of one of the current pens (see App. 4.12), and used this as a foundation for finding materials and production methods for the NIS and platform. All the found materials are pointed out in Ill. 113, and color-indicated to be able to distinguish between them.

MATERIALS

As a starting point, the group made a reverse engineering of the Novo Pen 4, by analyzing the plastic materials through a spectrometer (see App. 4.12). A rule of thumb noted by the group's technical supervisor was that if the analysis of the materials gave an 80% match or over, it could be considered pure material. However, there were potentially additives added to the material if it was under. All the analyzed materials were, on average, 50 %, indicating they all had additives added. Therefore, this spectrometer analysis was used as a starting point in choosing materials. All the considerations can be found in App. 4.12.

INNER MECHANICAL PLAST PARTS:
POM + PTEF W. PIGMENTS

Construction of the 'Unit dose gear' used to adjust unit amount setting need to have been able to handle long-term wear due to several uses each day. Therefore, POM is chosen. POM is known to have high stiffness, low coefficient of friction, excellent abrasion resistance, and hardness and is often used in pen injectors. The low coefficient of friction makes it ideal to use in gears and bearings, and its property makes it optimal in parts exposed to long-term wear and abrasion. It is important as it must maintain medical performance, and thereby it helps to reduce the maintenance and extends the life of the products. To ensure the parts has a higher wear resistance, it is considered to add PTFE. PTFE also helps to reduce the friction of the parts. Other parts e.g., the 'cartridge holder', has identical requirements, as it needs to handle the friction when replacing the cartridge. Here it is considered to add black pigments to these parts due to its contact with the users and make it easier to distinguish from each other when assembling. Alternative materials for these parts could be polyamide (PA), which is much stronger for the same weight and has equal stiffens. However, POM is chosen (with additives of PTFE) as it is less expensive. (Thompson et al., 2017; Sastri, 2014)

LEAD SCREW PLUNGER ROD ETC.
STAINLESS STEEL ALLOY 304

The concept is a reusable NIS; therefore, the 'plunger rod', 'lead screw', 'gears', and 'plunger rod controller' must handle the pressure when injection several times a day. To solve this, stainless steel was chosen, due to the usage of precision-important threads, ensuring a correct insulin injection (bj-gear, n.d.). Stainless steel is also chosen because of its corrosion resistance and load pressing strength when injecting (kloeckner Metals, 2021). Stainless alloy ASIS 303/EN4305 and alloy AISI 304/EN4301 were considered as these both can be applied in medical devices (Thompson et al., 2017; Azo Materials, 2012) (see App. 4.12). ASIS 303/EN4305 was thought to be fitting as it is often used in gearing and screws; however, it has high corrosion resistance as alloy AISI 304/EN4301. Therefore, alloy AISI 304/EN4301 was chosen due to its high corrosion resistance, good formability, and ease of fabrication, even though it is a little more expensive. (Doherty, 2020; Atlantic Stainless, 2019)

LID SHELL, CASE, AND DOSE ADJUSTER
PC/ABS BLEND W. PIGMENTS

For the 'unit counter' showing the number for the users, and the 'shell lids', case, and 'dose adjuster', PMMA and PC were considered (see WS85) as they both can be used in medical devices. The group chose PC instead of PMMA because PMMA is more brittle and due to PC superior impact strength, toughness, and rigidity. It is considered
to use PC as a blend with ABS is added to make the material better suited for molding complex thin-walled parts due to its lower viscosity when heated. Additionally, a PC/ABS is often used as housing, making it suited for the 'shell lids' and 'dose adjuster'. Further, the blend also lowers the cost instead of using pure PC. PC also has a high resistance to chemical as greases and soaps, which is preferable for an everyday, everywhere product. (Thompson et al., 2017; Sastri, 2014;).

TRANSPARENT SCREENS
PMMA W. PIGMENTS

It was considered to use PMMA, PC, or glass for transparent material use. PMMA was chosen instead of glass due to the broader design freedom and is greater resistance to impact. The advantages of using PMMA are that it is hard, is scratch-resistant, has high strength and stiffness, is resistant to weathering, and is transparent. However, it is also brittle. Therefore, the group considered PC instead; even though PC has much higher impact resistance, PMMA has a better light transmission and scratch resistance (Thompson et al., 2017). It is preferred because the NIS will be placed in pockets, bags, etc., where possible things can impact the PMMA surface.

GRIP SIDE ON KEYCHAIN VERSION AND SCREEN RIM
THERMOPLASTIC ELASTOMER (TPE)

The group wanted a rubber-like material to make the grip on the side, where Polysiloxane, silicone, Fluoropolymer, and TPE were considered. They all share some of the same features and can be used for medical equipment. The group chose TPE due to its cost and injection molding capability with rubber-plastic properties. There are two types of TPE: polyether and polyester. Polyester THPU is chosen due to its superior abrasion resistance and is less affected by oils and chemicals such as grease (Thompson et al., 2017).

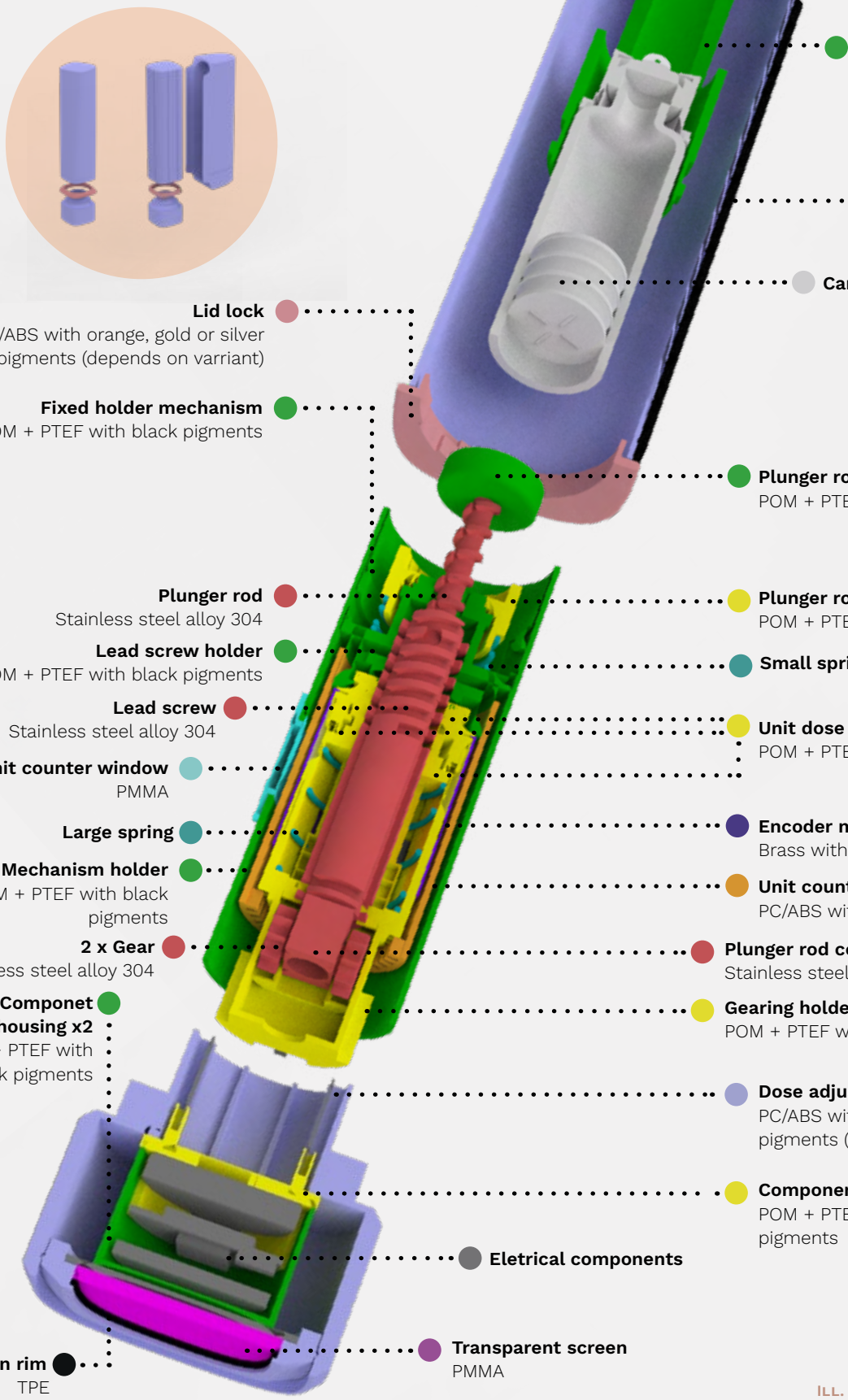
OTHER ELEMENTS OF THE NIS:

The mechanism needs two separate springs with ø10mm x h0.8mm and h1.2mm. This element is not specified since it would be bought externally.

This element is a brass sheet covered with kapton tape. It is done for the rotary encoder (section 4.5) to have high and low static surfaces to register input when adjusting units.

The electrical components will be bought by a supplier and are not specified. The list can be found in App. 4.7.

The cartridge consists of glass, metal, plastics, and a rubber membrane. This element would be bought by an external company, see more details in section 4.6.



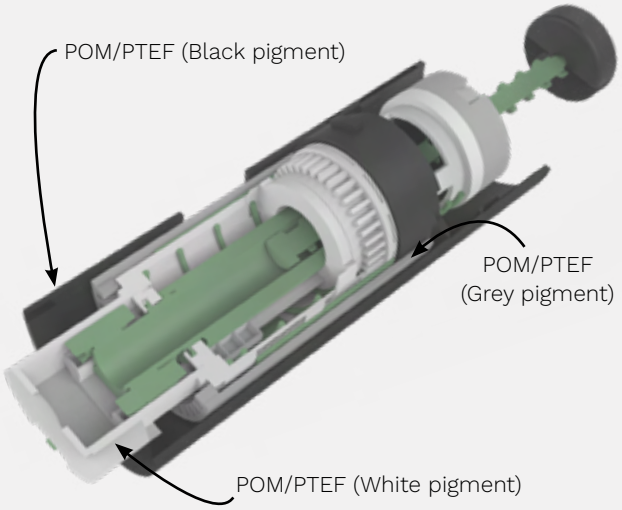
ILL. 113 Parts and materials

PRODUCTION

This section describes how the production is chosen based on the concept and the medical requirements for precious insulin injections.

Injection molding

All the parts made of the PC/ABS blends (see previous Ill. 113) and POM/PTEF blends are injection molded. Some of the bigger parts, like the lids, could be made by extrusion. But many of the parts have mechanical purposes, and therefore the possible tight tolerances of injection molding are ideal. Molding is also excellent for rapid production and offers a good surface finish and fine reproduction of details (Thompson, 2007). To account for this, it is optimal to consult with the manufacturers because of the need for tight tolerances. However, as the parts are very small (ill. 118 is 1.6g), most of the parts would be considered to use a multi-cavity mold, and for the shell part (ill. 119), multishot injection molding is required due to more materials within one mold (Thompson, 2007). The part is with different pigmentation due to classify use within the product and to optimize assembly (See more in App. 4.12).

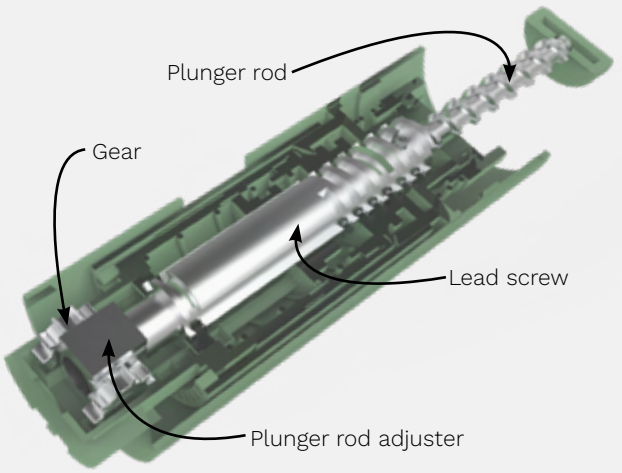


ILL. 114 Injection molded plastic

MIM and CNC machining

Within the mechanical parts, there are two small gears. These parts require tight tolerances to ensure the NIS can achieve the correct dose of insulin for the user. Therefore, it is chosen to use metal injection molding (MIM), which is suitable for producing small metal parts up to 100 g in large volumes. CNC machining could also be considered; however, the amount of gears makes MIM more suitable. Casting could also be considered, as it offers great tolerances and intricacy of features, but is also more expensive. The tooling cost and cycle time are like injection molding, and the advantages of good surface finish, fine reproduction of detail, and good repeatability (Thompson, 2007).

The rest of the mechanical parts are the plunger rod, lead screw, and metal mechanism. These parts are chosen to be produced by CNC machining (Sansmachining, 2021). It is done to create the internal thread in the plunger rod adjuster and the external threads on the lead screw and plunger rod. Further CNC lathe turning (Pioneer Service Inc., 2016). CNC machining is optimal as it can produce high-quality parts and has close tolerances, which is important to give accurate insulin doses set by the user. (See more in App. 4.12).



ILL. 115 Metal gearing

Laser cutting and multi-injection molding

Two parts of the product use PMMA to show numbers (Ill. 116) or computer information (Ill. 117), which needs protection. The first is produced by laser cutting from a plastic sheet, and the other is multishot injection and then glued to the product (Thompson, 2007). (See more in App. 4.12).

ILL. 116 PMMA (black and white

ILL. 117 PMMA screen

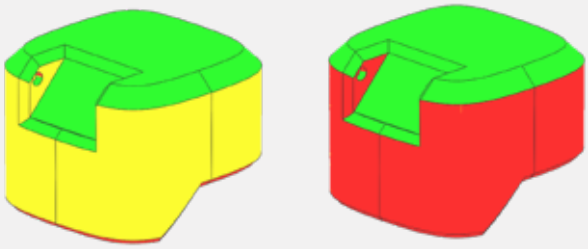
Sterilization

As the product is a medical device, it is considered if all the parts must be sterilized. There are three types: EtO, steam and gamma, and e-beam radiation. As the parts never have contact with the insulin or any fluids or penetrate the skin, the importance of sterilization is questioned. Therefore, it should be considered to consult manufacturers for medical devices and validate if the sterilization process must be added to each of the parts (Hand, 2018). (See more in App. 4.12).

PRODUCTION CHALLENGES

Draft analysis

Designing for injection molding is important and involves engineers, material experts, toolmakers, molders, and designers. To avoid the stress build-up within the retraction of the cores, there is a need for draft angles, so it would leave the form, which should be at least 0.5° (Thompson, 2007). The parts within the product are small, so there are only a few parts like the long shell (Ill. 119), which is above 0.5°. The group made a draft analysis of all the parts to ensure this. The positive mold is green, and the negative is red (red is not a bad thing), shown on 'Cap top' (Ill. 118). The analysis shows in yellow which surfaces need draft angles.

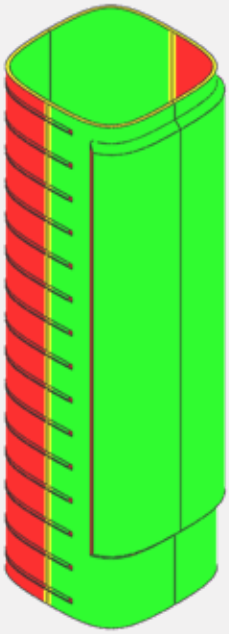


ILL. 118 Draft analysis of 'cap top'

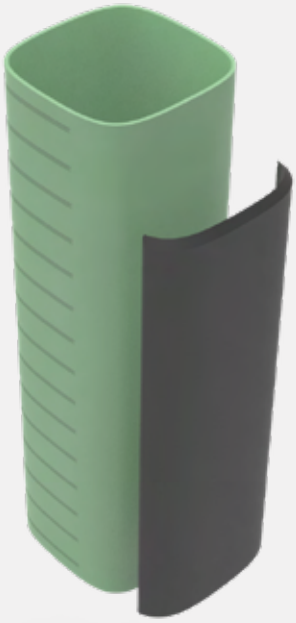
Multi injection with multiple cores

The multi-shot injection can be a challenge with different materials. In the case of the shell element, PC and TPE requires different temperatures. Therefore, the runner system for the PC must be heated with oil and the TPE heated with cooled water (Thompson, 2007).

This element (Ill. 119) has a tricky shape, which requires a 4-side core and center-core pull to be produced. Due to this complexity, it might not be possible, which needs expert validation or re-design.



ILL. 119 Draft analysis of shell element

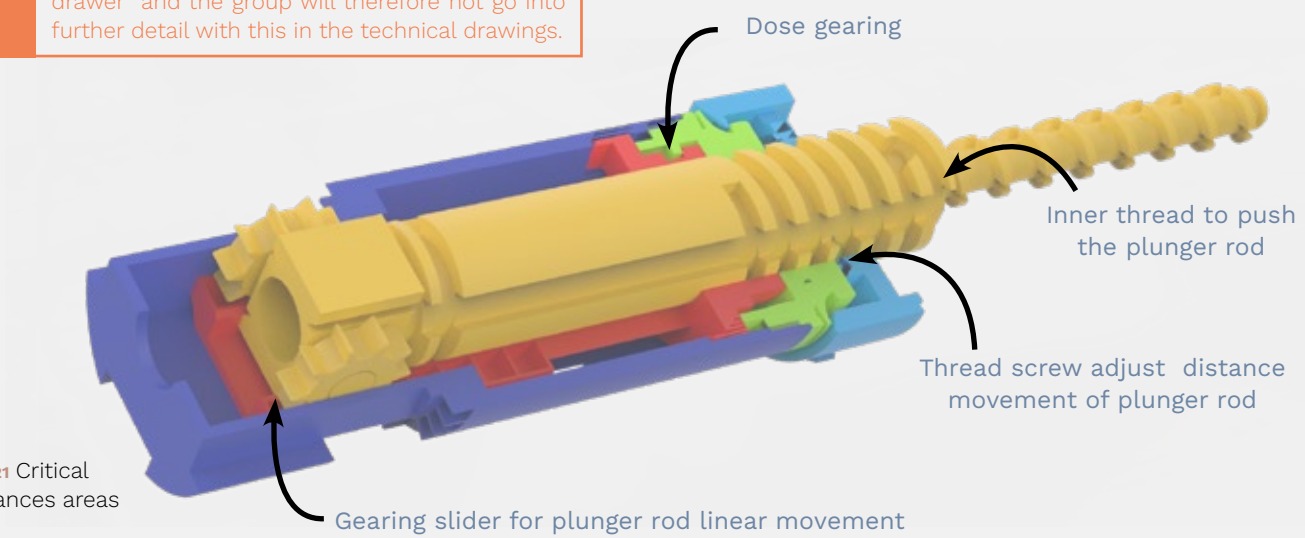


ILL. 120 PC/ABS plast and TPE

Important tolerance areas

Developing a part for medical use is often small and needs to be precise in its actions, which means strict tolerances and regulations (ill. 121 show the critical tolerance areas). These demands for NIS products are described in the DS/EN ISO 11608 standard (Dansk Standard, 2015). The standard describes multiple rules to follow and achieve a medical dose accuracy of 95%, which all impact the tolerances of the mechanical parts (see details p. 75). It should be defined by GD&T (Geometric Dimensions and Tolerancing), which helps engineers and manufacturers to achieve the best result for the parts (Formlabs, n.d).

! The process of adding correct tolerances and fulfill GD&T guidelines, would need a technical drawer and the group will therefore not go into further detail with this in the technical drawings.



ILL. 121 Critical tolerances areas

4.8 PRODUCT ARCHITECTURE

After defining the styling and identity, electronic components, construction, production and mechanism of the concept for insulin injection, there could be made product platforms architecture.

PARTS THAT DIFFIRENIATE

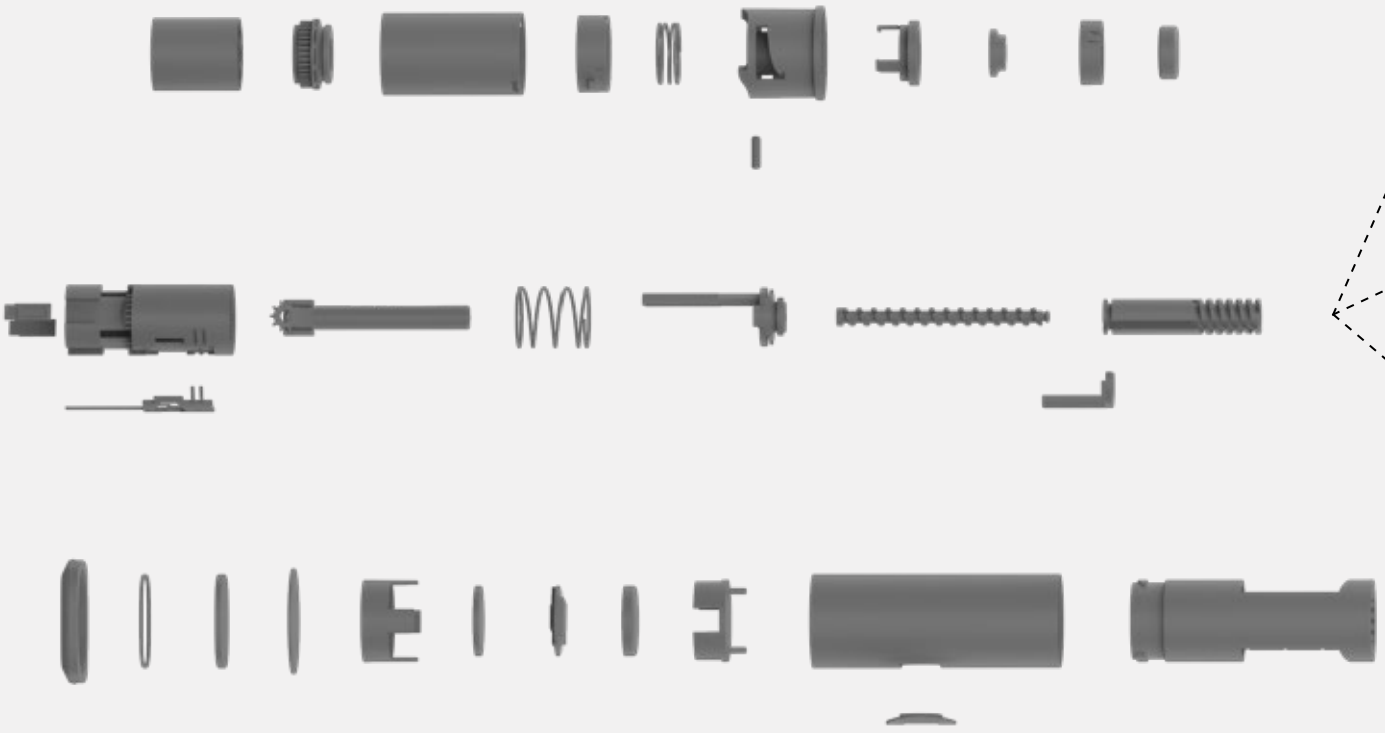
As the needle-based injection system (NIS) is the heart of the platform, this must fulfill the requirements of being able to deliver the insulin. All the 33 base parts for accomplishing this are repeated across all three variants (see Ill. 122 below). The changeable options mainly modify the coloring of the materials visible to the user, depending on the styling of variants. It has ensured a high diversity in the design and identity across the three variants, as approximately 65 % of the parts are reused across the variants (see Ill. 122 below). The result is that only 18 more parts must be produced to create diversity in the three design variants (case, basic, and hanger). This approach, creates a product- and process architecture (Sanchez, 1999), that makes the production economically affordable, while while still embracing the diversity of the different diabetes patients. All three variants use the same production methods and materials (see section 4.7), making it possible to lower different cost-efficient finishing methods.

All three variants are assembled at the manufacturers, with the dose adjuster attached, ensuring the electronic components work and are held in place. However, if the products families within each universe were created (see Ill. 102, p. 73), the NIS/base, including the dose adjuster, could be placed into the different user variants, e.g., by removing the Basic lid and placing the NIS/base in the Case variant. Additionally, having the NIS as the 'heart' of the platform makes it possible to reduce process development and upgrading cost when targeting other segments and leverage further (Meyer, 1997), when additional add-ons or other design identities.

✓ Base must be compatible with alle three varriants

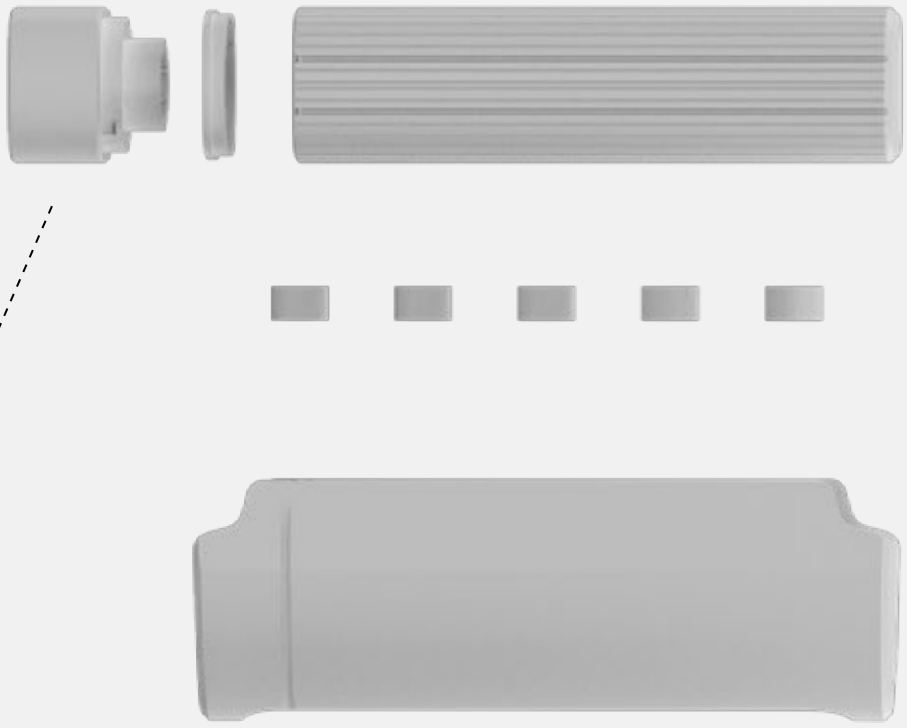
COMPONENTS SHARED AMONG THE VARIANTS

DIVERSE COMPONENTS BETWEEN THE THREE VARIANTS



Base
64,7 %
33 parts

ILL. 122 Product architecture



Case
17,6 %
9 parts

Basic
5,9 %
3 parts

Hanger
11,7 %
6 parts

4.9 DESIGN SPECIFICATION

The last phases of 'Develop' and 'Deliver', resulted in product specification, which is sum-up underneath. These specifications can be traced back to the requirements on p. 64 by 'need no.'. Additional specifications have been added due to the detailing in the 'Deliver' phase. Note that the changed or added specifications are also mentioned by 'source'. The specifications are arranged in sections based on which parts of the product proposal they belong.

Spec. no.	Need. no.	Metric	Unit	Value	Imp.	Souce	
1	28	Compateble with 1,5 ml insulin cartrigde	ml	1,5	6	4.6	CARTRIGDE
2	8	Must be function with cartrigde deisgned after DS/EN ISO 11608-3	-	Yes / no	5	-	
3	1	Visual indication on cartigde holder of left insuiln	ml	0 - 1,5	6	-	
4	34, 35	Securement of replaceble inuslin cartrigde	-	Yes / no	6	-	
5	3	Must function with needles designed after DS/EN ISO 11608-2	-	Yes / no	6	-	NEEDLE - INJECTION
6	15, 20	Visual view of needle when pressing air bobles and insulin out for safty check.	-	Yes / no	6	-	
7	15, 26	Visual view of needle when penetrating skin for injection	-	Yes / no	4	-	
8	4	Protection of insulin output area when no needles is acctched	-	Yes / no	5	-	
9	9	Inject half units	units	0,5	2	4.6	BASE - INJECTION
10	29	Maximum of 30 units for dose setting	units	0,5 - 30	2	4.6	
11	41	Visual, tactile and audible indication when selecting unit dose.	-	Yes / no	6	-	
12	2	Visual indication of the insulin dose seleceted	-	Yes / no	6	-	
13	24, 32	Squread shapping of unit dose adjustment button for better grip	-	Yes / no	3	-	
14	15, 17, 42	Must provide visual indication when ready for injection	-	Yes / no	6	-	
15	43	Must visually change state from being ready for injection and when the dose have been injected.	-	Yes / no	6	-	
16	44	Visual, audible and tactile feedback of completed injection	-	Yes / no	6	-	
17	45	No larger unit dose must be able to be selected, than what is left in the insulin cartrigde.	-	Yes / no	6	-	
18	40	Must accurately deliver entire labeled volume in the cartrigde.	-	Yes / no	6	-	
19	46	Unit dose accuracy must be determined after DS/EN ISO 11608-1	-	Yes / no	6	-	
20	6, 7	Memory storing of last unit dose injection and time	memory	-	5	-	BASE - SCREEN
21	31	Visual feeback of last injection dose and time: LCD screen	ich.	0,5"	4	-	
22	-	Battery lifetime must be a least 5 years	years	5	3	4.5	
23	-	Transmitting range of NFC	cm	2	1	4.5	
24	14, 24, 25	Maximun length of all three variants must be 100 mm	mm	100	5	4.6	VARRIANTS
25	27	Base must be compatible with all three varriants	-	Yes / no	6	4.8	
26	33	Securement of lid	-	Yes / no	5	-	
27	11, 30	Needle container must provide space for 5 needles	amount	5	4	-	CASE VARRIANT
28	36	Easy access to needles in needle container	-	Yes / no	4	-	
29	37	Needles must not fall out of needle conatiner	-	Yes / no	4	-	
30	38	Indication line in bottom for placing parts toegther.	-	Yes / no	4	-	
31	39	Click function ensuring needle conatiner do not slide off	-	Yes / no	4	-	

4.10 FEEDBACK FROM MILESTONE 4

The focus of the presentation at Milestone 4 was on the aesthetical development. However, the communication from the group was not clear, which led to many misunderstandings regarding the product proposal. There was a lack of information regarding the needs from the users, as well as the focus of the concept was developing a platform to create variants. Additionally, a lack of presenting the product architecture of the platform led to many misunderstandings. Due to the big misunderstandings, the group needed to get an overview over there
unique selling point.

4.11 SUM-UP

ACQUIRED KNOWLEDGE

- Sketching session to provoke different design languages
- Explored form circle by a workshop on the concept
- Made force relationship between form circle and chosen user segments
- Created a smaller device and made it ready for production by choosing materials and production methods

FURTHER COURSE

- Calculate production cost
- Investigate market strategies
- Create a launch plan for the product and estimate its final cost

Implement

This phase starts with a step back to map out where the final project should strive toward and what values should be prioritized.

Now that the product proposal, Versity, is presented, it's time to distribute it to the market. This phase examines business opportunities, strategies, sales channels, and launch plans. And together with the knowledge of regulations, it is estimated what the product would cost both in production and for the users to buy.

05

ILL. 123

5.1 THE PROJECT STRIVE MAP

There was a need to get an overview of the project and map its approaches and where the requirements for concept solutions provide value. In addition, a cross felt will also be presented through a Venn Diagram, where the desired positioning of the concept solution is also mapped herein.

There are three main areas this project strives for, which are presented below. See also further classifications and associated influence these have in the next section.

THE HOSPITAL

CLINICAL

The clinical is assessed by the treatment team at the hospitals (doctors and nurses)
What the group's concept solution will strive for and contribute to in this area is:

- Assistive technology (reminder through the screen)
- Can inject insulin in half units
- Avoid situations without access to insulin (stigma related + keychain principle)
- Better hygiene (lid deprives of the possibility of reusing a needle)

This also provides some necessary requirements from the treatment team and that the product must meet requirements from Standard DS/EN ISO 11608-1

REGIONS & MUNICIPALITIES

POLITICAL/ ECONOMIC

This is a more complex area where it has a political influence on which economic spans field the product should be aimed at. It is primarily the municipalities and regions that are involved in determining and classifying diabetes products (see next section).
What the group's concept solution will strive for and contribute to in this field is:

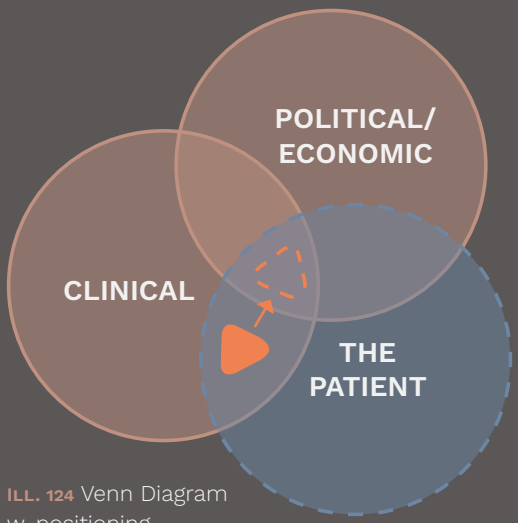
- Utilizes existing treatment (for fast-acting insulin (based on NovoRapid))
- Reusable (more than disposable pens)
- Can be used with already existing needles + cartridges
- Less insulin wastes

THE PATIENT

THE PATIENT

This area is not so affected by the current diabetes products on the market. This is where the group's concept solution stands out by bringing the patient into focus and giving them part of the choice in their process of finding the diabetes products that suit them.
What the group's concept solution will strive for and contribute to in this area is:

- Social acceptance
- Stigma
- Safety (keychain can help remember insulin + extra needles)
- Practical (extra needles, storage)
- Strives for "The normal life"
- Anticlinical design
  - Possibility to select variants



ILL. 124 Venn Diagram w. positioning

INTERSECTION OF AREAS

These three presented areas 1) clinical, 2) political/economic and 3) the patient also influence each other. A Venn Diagram (Lucidchart, n.d.) is presented to the left on Ill. 124. The two beige circles (Clinical and political/economic) are the two intersections that the current insulin pens on the market primarily affect. Here is a desire to bring the patient more into focus. At present, the concept solution is located between a cross field, which provides value in the cross field between the clinical and the patient (marked in orange in Ill. 124). Here, a future desire will be to move the concept solution more towards the center and include more of the economic aspect too (see the dotted orange marking on Ill. 124) The reason is that these political/economic demands can be difficult to regulate and therefore the entrance to the free market for the concept solution must be further explored.

// EVALUATION

The concept solution affected on these three presented areas 1) clinical, 2) political/economic and 3) the patient. However, it is necessary to dive deeper into the regulations and the connection between the various stakeholders and their influence on diabetes products and classifications. In addition, the product's positioning in the market must also be examined in more detail.

5.2 REGULATIONS

Different regulations control diabetes products and medicine. Further mapping was needed to understand which type of regulations exist more in-depth than presented in section 3.1, p. 37. (App. 5.2).

To get an overview of the regulations applying to the different diabetes products, Chief Physicians Sanne Fisker, Steen Højer, and Social workers associated with Aarhus Steno Diabetes centers, were contacted. Concerning rules and regulations, paragraphs §100 and §112 from the Danish service law and additional websites to understand the rights and support under which diabetes products are applied were read. (Aarhus Kommune, 2021; Bekendtgørelse af lov om social service, Serviceloven §100 and §112; Danske Love, n.d.a; Danske Love, n.d.b; Diabetes foreningen, n.d.b)

Table 6 summarizes the three types of categories within diabetes treatment by medicine and products and which stakeholder impacts the possibilities of the products subsidized for the patient. Note that the users themselves make the orders for the needed medication and equipment (App. 5.2).

	Medicine	AID's	Treatment equipment
Stakeholders deciding treatment	Collaboration between treatment team (Doctor and nurse) and patient	Collaboration between treatment team (Doctor and nurse) and patient. Paintent can ask/whish for specific AID's	Collaboration between treatment team (Doctor and nurse) and patient
Stakeholders applying for public subsidies & appropriations	Patient is responsible for applying. Help can be gained from social worker at diabetes outpatient clinic, and from doctors, or nurses if any special reasons. Some Insulin types only needs prescription, to get subsidies.	Patient is responsible for applying. Help can be gained from social worker at diabetes outpatient clinic, and from doctors, or nurses if any special reasons.	Treatment equipment are allocated by the outpatient clinic/region. It should be recommended by the doctor, and no applications is needed.
Stakeholder paying expenses	Over 18 – additional expenses over 6.888 DKK are covered by municipalities Under 18 - additional expenses over 5.207 are covered by municipalities	Municipalities covers. Unless painted want specific AID's, then they need to cover the more-expenses or buy it themselves.	Region covers.
Product examples	Insulin types like NovoRapid or Fisap and diet products like dextrose	Blood glucose meter and strips, device for ketones, reusable pens and strips, syringes, needles, etc.	Pump and associated gear and glucose sensors

Note: *Products in the category of AID's and treatment equipment can vary depending on the region and municipalities, but this overview covers the most common division.*

TABLE 6 Regulations

> *You can buy reusable pens yourself. There are regular reusable pens, which are also approved by most municipalities. Smart pens have also recently arrived. Our impression is that the municipalities will not grant them, but patients can buy them themselves (approx. DKK 400 with a 4-year guarantee). Some diabetes wards also grant these pens if there is an indication for it. The use of these smart pens is likely to increase. Most reusable insulin ampoules are generally subsidized.*
> *- Sanne Fisker, Chief Physician (App. 5.2)*

// EVALUATION

Versity belongs in the aid category, making it accessible to be bought without applying for it. The user can also be granted only to buy the more expenses for insulin devices. In addition, changing from a disposable pen to a reusable insulin device does not seem to be a problem since the insulin type is the same.

5.3 BUSSINESS STRATEGIES

The core value of Versity, is that it combines the need for insulin with a high-end design unique for both the preferred 'on-the-go' use and aesthetics, creating options for people with diabetes not seen before. However, creating a new product that mixes identity and healthcare in a regulated market requires understanding potential ways to enter the fileld on diabetes health care treatment. During so, insights of key competitors and potential business partners and approaches are needed. It means that a discussion of pros and cons within observed business strategies has been made.

CONSIDERABLE BUSINESS PLANS

Three potential business plan strategies (listed below) have been considered for entering the diabetes treatment market in Denmark and worldwide.

SELLING IP-RIGHTS

PROS:

- No major investment risk (the buying company takes the risk)
- Payment upfront for the group and/or possibilities of negotiating royalties

CONS:

- Possibility of one-time payment (if no royalty agreement is made)
- No control over design changes and potential extensions
- Buying companies get credits if the product(s) get successful

COLLABORATION

PROS:

- Help with operational channels of materials, logistics, production, and gaining access to insulin markets and sales channels
- Sharing investment with collaborating company
- Access to the know-how on approval as CE, US standards, DS/EN ISO, etc., and facilities for testing.
- Using the company's insulin in Versity.

CONS:

- Smaller investment risk for the group
- It is time-consuming and hard to make an agreement the partners are willing to approve.
- The bureaucracy in the company can slow down the process, and potential design changes and add-ons.

START-UP

PROS:

- Full ownership over the design
- All profits go to own pocket or reinvestments
- Fitting the design to other insulin types and cartridges, widening the market opportunities
- Possibilities of smaller collaborations with other firms, gaining access to other insulin types

CONS:

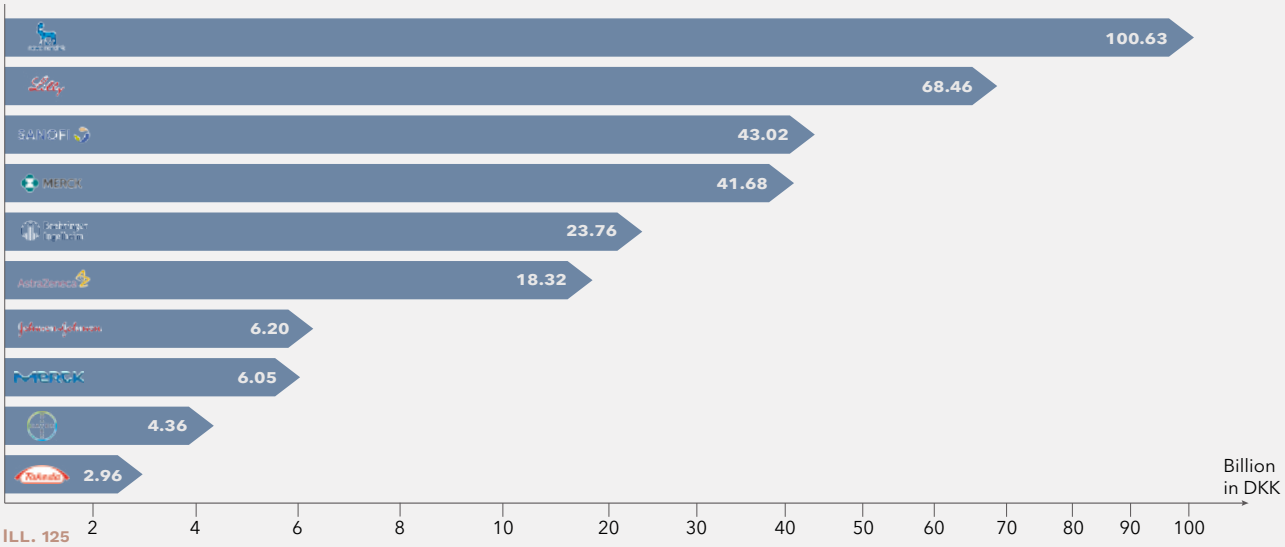
- Finding operational channels having the right approvals for manufacturing of medical equipment
- Small company with a new name, making it hard to gain access to the insulin market and sales channels
- Big investment risk - longtime for breakeven
- Using time and money on getting knowhow and approval like CE, US standards, DS/EN ISO, etc.

PARTIAL EVALUATION

As the diabetes market is highly regulated, the group decided to find a key partner to make a collaboration with. It would result in a faster maturation process, using their know-how for approvals and regulations that Versity must live up to. Additionally, it would provide easier entry to the market, as the key partner potentially know and have the authorization for selling insulin and treatment product in Denmark and other parts of the world. It would also provide insights into potential suppliers that are approved for producing the manufacturing of medical equipment.

POTENTIAL PARTNERS

The 10 biggest medical companies in the diabetes industry in the world have been listed on Ill. 125 (App. 5.1). It has been done to get an overview of key competitors worldwide and potential partners for making a collaboration. Three of the listed companies are key actors in the Danish insulin market (App. 5.1), and these are considered for collaboration (see underneath).



ILL. 125

The Danish company, Novo Nordisk is viewed as a potential partner as it has a long history of making diabetes treatment products and medicals and strives to create change for defeating diabetes (Novo Nordisk, 2022.b; Novo Nordisk, 2022.c; Wikipedia, 2022.a).

Novo Nordisk has the biggest market share in Denmark for type-1 diabetes treated with insulin. (App. 5.1.) Utilizing their logo and reputable brand value directly on Versity, would create high reliability and potentially a faster and stronger place on the Danish market.

On the other hand, as the company already has different versions of the Novo Pens, Versity would be a potential thread and competing for product to their current pen.

The American company Eli Lilly is seen as a potential partner due to its purpose of striving to make life better and meet the diverse needs of people with diabetes (Lilly, 2022.a; Lilly, 2022.b; Wikipedia, 2022.c).

Eli Lilly is the second largest company worldwide but has a small market share in Denmark, with no current reusable insulin pens available (App. 5.1). Insulin and required pens are adapted to each other, where the treatment team makes the prescription for an insulin type (p. 87), making it hard to enter the Danish market, where Novo Nordisk is the biggest.

However, as they have no current reusable insulin devices on the DK market, making a collaboration help in striving for a bigger market share with an aggressive business strategy.

Sanofi A.S. is a French company, leading in both insulin treatment and insulin pens, trying to pioneer the possibilities to help people living with diabetes live and manage their condition without emotional burden (Sanofi, 2022.a; Sanofi, 2022.b; Wikipedia, 2022.b).

Sanofi is the third-largest firm worldwide but only has a small share of the Danish market. However, the company has a larger range of reusable insulins pens available to purchase. (App. 5.1)

As Sanofi has a market share of reusable pens in Denmark, utilizing its brand reputation would create an easier entry into the market. However, adding another insulin pen could make them their competitor.

ILL. 126

// EVALUATION

As Eli Lilly is the second-largest company in the world, meaning its biggest competitor is Novo Nordisk. Since they currently have a no reusable insulin pen on the Danish market, a collaboration could help gain a larger share. It makes Eli Lilly a key partner, helping gain access to municipalities and regions on the Danish market and getting Versity out into the world.

5.4 SALES CHANNELS

Concerning the discussion on the market strategy, it was necessary to look at the sales channels to reach the customer segment of young type-1 diabetics. Two different strategies of selling Versity through different channels are explained here. In relation, a promotion strategy is suggested.

SALES CHANNELS

Versity is a diabetes treatment product targeting a particular customer segment. Here three different options for sales channels are considered for entering the Danish diabetes market.

B2B: PHARMACIES

Patients order their medical products (section 5.2), either at the local or at online pharmacies such as Mitliv.dk, Apoteket.dk, mediqdanmark.dk, etc. These are key actors for gaining access to the customers and are a vital B2B channel.
The drawback with these B2B strategies is that the group earns less money on the product because of the middleman between the company and the customer. however, it can also provide access to more potential customers.

B2B: PRODUCT SAMPLES

Current reusable pens are presented for the users at the diabetes outpatient clinics in the hospitals under treatment sessions. Therefore, it requires selling product samples in a B2B strategy to the clinics, ensuring the users is offered Versity as a treatment option. As Eli Lilly already sells disposable pens on the Danish B2B market (Medicin.dk, 2022.a; Medicin.dk, 2022.b), the collaboration would facilitate easier entry to the clinics.

B2C: WEBSITE

Versity is viewed as a high-end smart insulin device, which welcomes the diversity of the users. Selling Versity on its website would contribute to embracing the high-end value of the product. This is possible as no application for buying reusable insulin pens is needed (section 5.2. Cutting out the retailers cuts out their margin, and instead adds to companies' contribution margin. Selling Versity on its website could potentially create additional sales of the variants. A downside is that the group needs to facilitate sales themselves and invest in a website.

ILL. 127

PROMOTION

The opportunity in a B2C sales channel is the promotion of Versity. Earlier, the group found that people mistakenly view diabetes type 1, as being diabetes type 2 (section 1.4). Therefore, combining a B2C website with an aggressive marketing strategy could create a community around diabetes, making awareness of the difference in diabetes types.

Versity's value proposition is to be an identity marker for persons with diabetes, which is essential to highlight. Product placement using influencers having diabetes type-1, such as the Danish football Kasper Dolberg and or Liv Martine from 'Den Store Bagedyst' (Lage, 2021; Svenningsen, 2018), is thus considered.

As told by diabetes nurse Karina (section 3.1), her patients notice when the idols stage their diabetes publicly. Using influencers as promoters could higher the value proposition and create a trend around diabetes. Additionally, marketing Versity on social media such as Instagram would meet the target group on their "home field".

// EVALUATION

The group viewed that both strategies would contribute to the sales of Versity. The next step was to consider the launch plan.

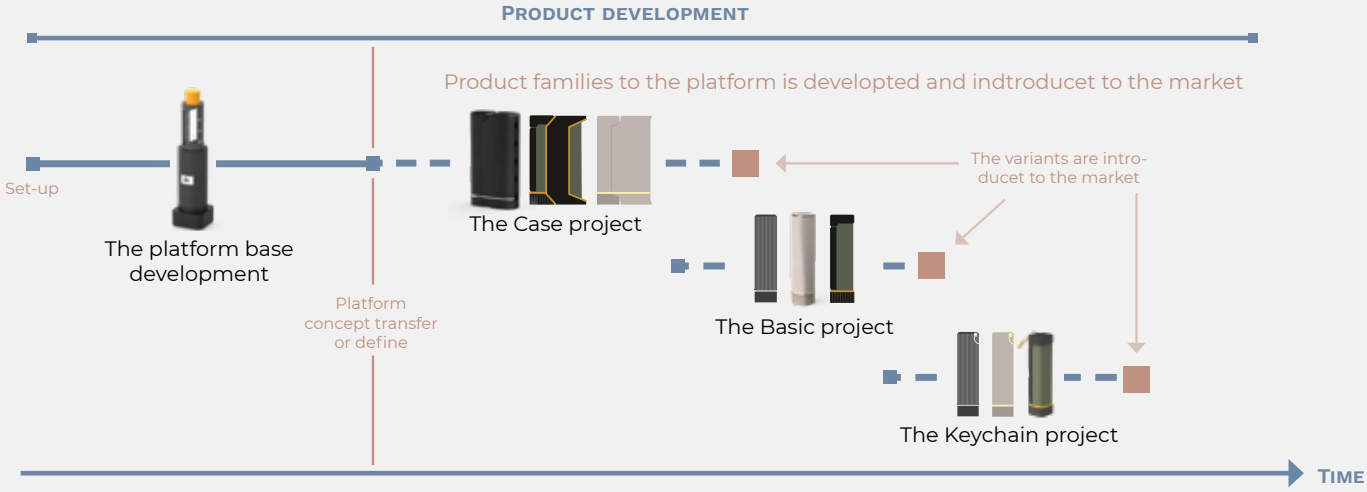
ILL. 128 Dolberg

ILL. 129 Liv Martine

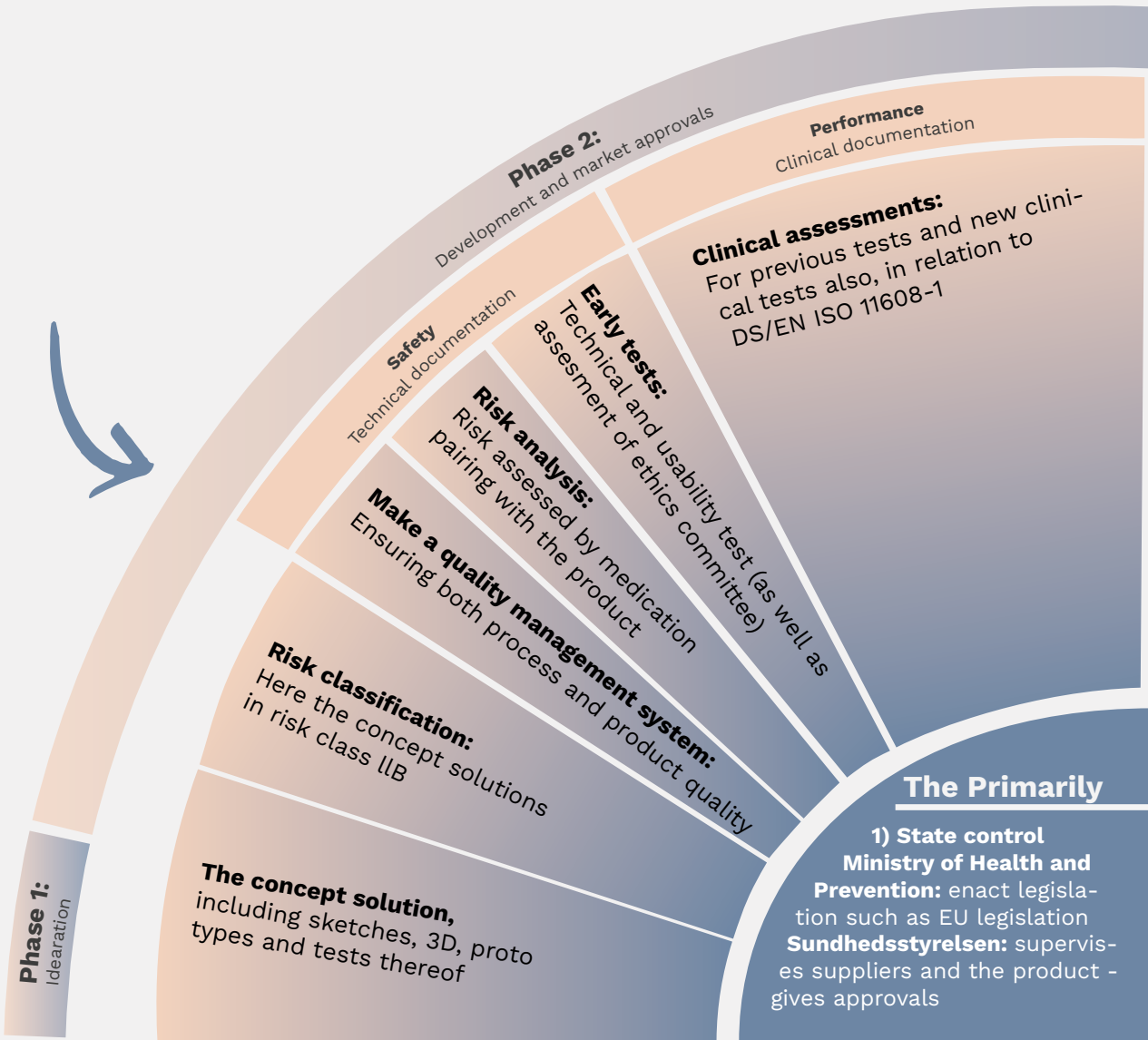
5.5 LAUNCH PLAN

There was a need to assess different launching plans for the different variants of the concept solution (see App. 5.3). Besides there was also a necessity to figure out a moderation plan for the concept solution and how it could get approved before launching.

Several launch plans have been examined (see App. 5.3), inspired by Haraland, et al. (2018, p. 4) where the model tells a potential in stagger the launch of product families.
Here it has been chosen that the base of the platform itself must be developed first, after which the various sub-elements are developed and launched to the market staggered (see Ill. 130). The variations of the three style universes are first launched as the Case concept solution, as this is considered to have the most news value and create functional added value for the users. Then the Basic concept solution was expanded and finally Kay chain solutions. In addition, there have also been thoughts about package solutions and that some of the parts, such as the lids, can be purchased as needed afterwards.



ILL. 130 Lanch plan inspired by Haraland, et al. (2018, p. 4)



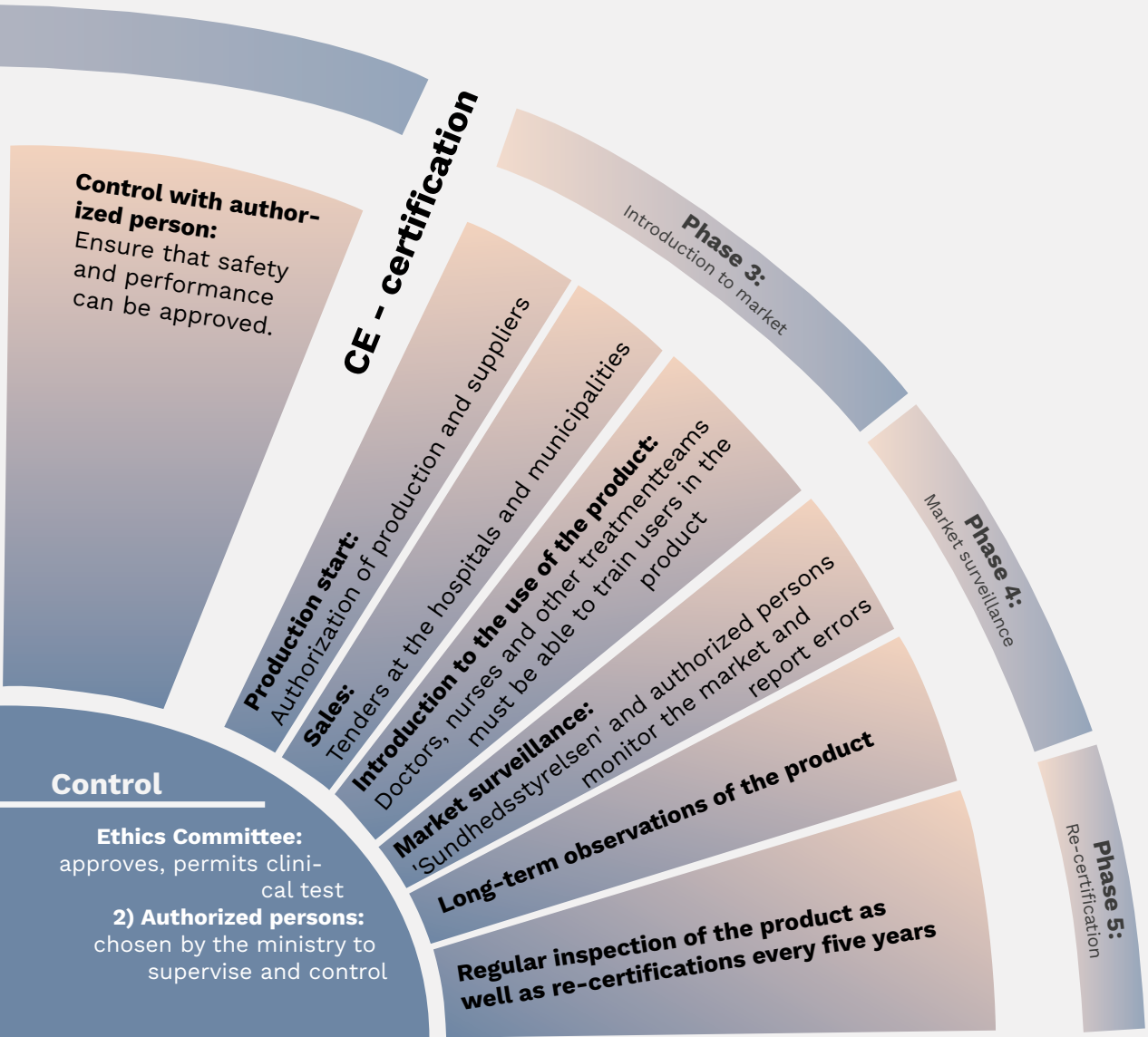
ILL. 131 Maturation plan for risk classification IIB

Maturation

The group is noted that medicine and equipment take a long time before it has the right approvals and markets. A rule of thumb in medicine is said to take 8 -10 years before it is ready to enter the market (Lægemiddelstyrelsen, Danish Medicines Agency, 2020.a). The group's product does not make the medicine itself (insulin), but only the equipment for this, therefore the approvals can go faster. In the case of medical devices, it is classified into four risk classes. The insulin pen is at the higher end of the risk scale below Class llB (see App. 5.3). When it is of a higher class, an authorized person must assess whether the product's documentation on safety and performance is good enough and can thus be CE marked. In addition, even after the product has been launched, inspections will be carried out to ensure no safety errors or incorrect handling and that these are rectified. (Lægemiddelstyrelsen, Danisk Medicines Agency, 2020.b)
A maturation plan for the concept solution will follow the different steps in each phase as required for risk class llB, based on the model from (Medico Industrien, n.d.). At present, the concept solution is only at the beginning of this long chain of tests, inspections and approvals (see blue arrow) (Ill. 131).

// EVALUATION

A proposal for a launching plan and maturation of the product is given. An operational value chain can further be examined.



5.6 OPERATIONAL VALUE CHAIN

There was a need to map a possible operation value chain to the concept solution. In this section, the group will give a proposal for an operation value chain with a view to production and a possible collaboration with Eli Lilly (section 5.3).

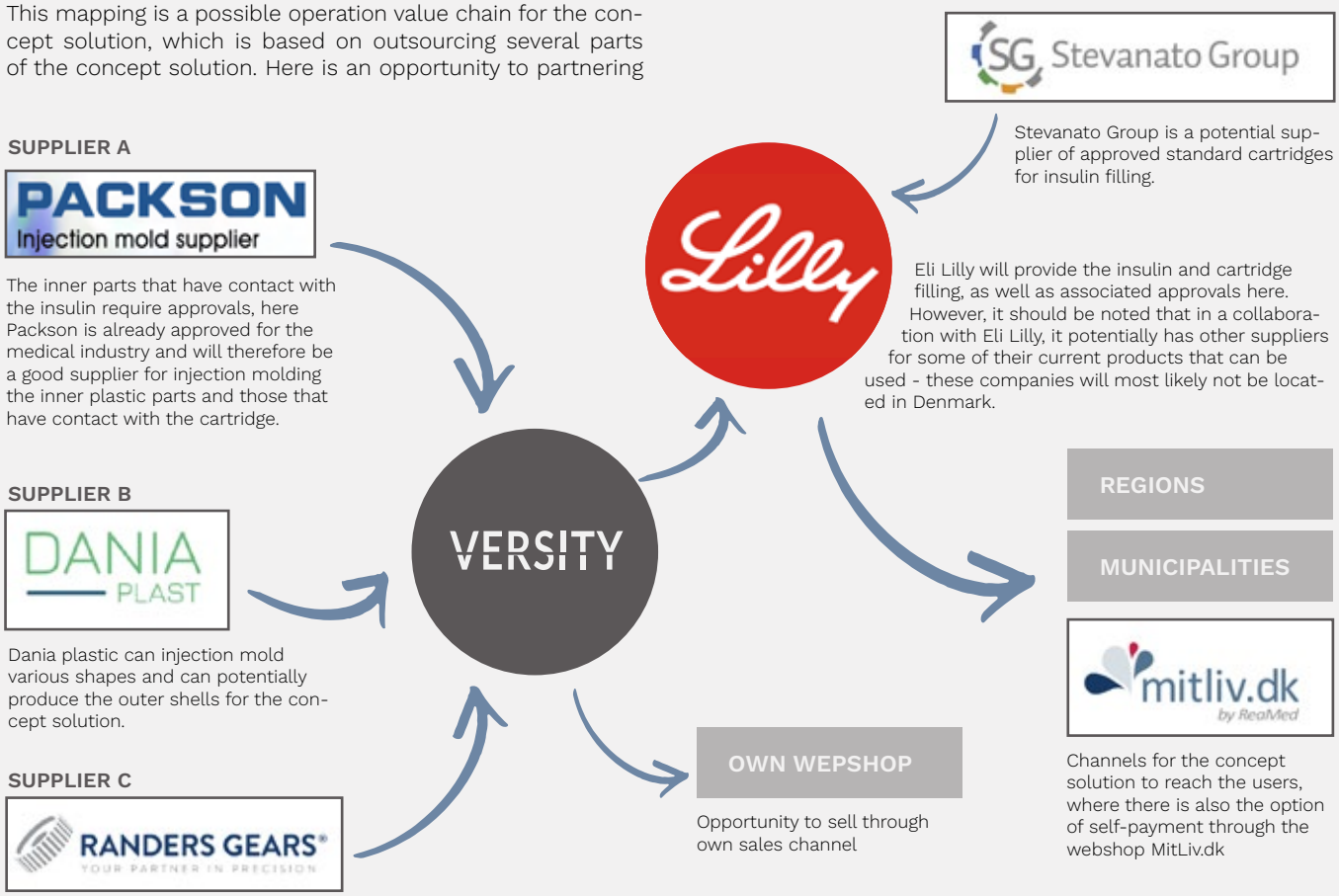
A manufacturing process is mapped, to get an overview of the primary manufacturing process, and where the concept solution primarily focuses and must interact.

No focus Focus Less focus

INSULIN FORMULATION | MANUFACTURING PRODUCT PARTS | INSULIN FILLING | ASSEMBLY | APPROVALS | PACKAGING

ORIGINAL EQUIPMENT MANUFACTURER

In this section, the group will give a proposal for an operation value chain with a view to production and a possible collaboration with Eli Lilly (section 5.3). The insulin itself and its filling will not affect the concept solution, however, it must be reserved and adapted to the filled cartridges and additional needles on the market.
This mapping is a possible operation value chain for the concept solution, which is based on outsourcing several parts of the concept solution. Here is an opportunity to partnering with Original Equipment Manufacturer (OEM), where they produce several of the parts, which are subsequently integrated into the system. This solution means that more of the parts can be produced cheaper as they will be responsible for the production facilities. (IBM Services, 2019)



When several elements are outsourced, it is important to have several possible suppliers who can overlap each other's work if problems arise, in this way the value chain can be adjusted more quickly so that it all does not break if one link in the supply chain suddenly cannot delivers as promised.

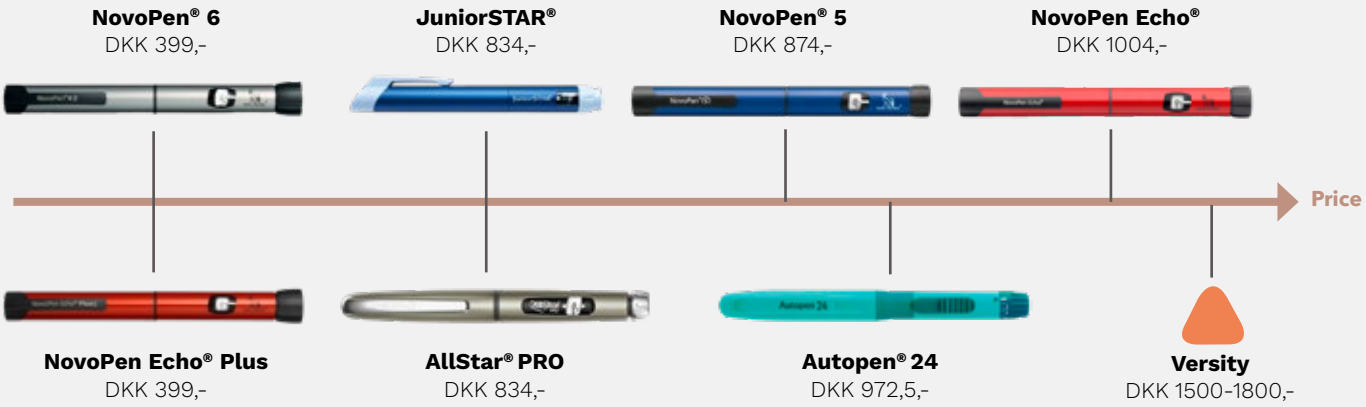
ILL. 132

// EVALUATION

Here, potential OEMs were mapped, however knowing that if a collaboration with Eli Lilly or another major manufacturer in the industry, their partners will be used as the right approvals. The next step is to estimate a price and thereby see when a potential revenue can be achieved.

5.7 PRODUCT COST

There is a need to calculate the price of the product to estimate a possible break-even and see if there is a business case that can give profit. The calculations consider the launching plan (Section 5.5) and the three variations.



ILL. 133 Prices

PRODUCTION COST AND PRICE

The production calculations include all components and parts in the base and the three variants presented on Ill. 133 (see App. 5.4). Here, the total production price is 1552,16 DKK for all three variants. Assessment of product pricing was re-visited from previously presented to Milestone 3 (See App. 3.16), where the group priced the concept solution to a medium price. Based on previous research of users' bags (section 3.3) and their identity-marker products, the group assessed that they would often like to pay a little extra for these. Therefore, the group considered that this concept solution could also have a higher price. Accordingly, the Basic is priced at 1500 DKK, which approximately gives a profit of 66%. Keychain is priced at 1600 DKK, which approximately gives a profit of 69%. And the Case is priced at 1800 DKK and gives roughly a profit of 71%. It also means that the product will be in a higher price range than the current insulin pens on the market (see Ill. 133).
The investments are also estimated concerning imagined tooling costs and labor in the form of development, production, quality assurance and approvals, and marketing, which requires monthly salaries depending on the work required. Here it should be noted that all tooling costs are calculated with the same estimated mold price, which the group knows does not cost the same in the actual production direction.

In addition, it is also included that some of the labor may need to be expanded continuously in parallel with more variants being developed, produced, and marketed. It is estimated that the investment will run up to approximately 31,4 million DKK in the 5 years included in the calculations on Ill. 133 (see App. 5.4).

BUSINESS CASE

The product is intended to start on the Danish market; therefore, the numbers are based on this. Where approx. 27.614 have type-1 diabetes in Denmark, and approx. 70% have an insulin pen, so a possible initial sale could be 25% of these, approx. 4800 units. Therefore, the first sale of the Case concept solution is estimated to be 4800 units. After which, the market will hopefully be boosted with the intended promotion plan (p. 90), where sales will potentially increase by 25% and in subsequent years by 10 % and 5%. In the second year, the basic is developed, which will increase sales by 10% and subsequently 5%. And finally, the keychain solution will be developed and marketed. Combined with current investments and salaries, these estimates will be breakeven after four years (see Ill 137).

PRODUCTION COST

	Cost (DKK)
Basic	517,18
Keychain	517,16
Case	517,82
Total:	**1552,16 DKK**

ILL. 134 Production cost

UNIT PRICE

	Price (DKK)
Basic sales price	1.500
Constribution margin Basic	982,82
Keychain sales price	1.600
Constribution margin Keychain	1.082,84
Case sales price	1.800
Constribution margin Case	1.282,18

ILL. 135 Unit price

INVESTMENT

Project/ activity	Price (DKK)	Quantity	Total (DKK)
Tooling	542.084,8	1	542.084,8
Developer salary (monthly)	39.000	165	6.435.000
Software engineer salary (monthly)	42.000	12	504.000
Mechanical Engineer salary (monthly)	45.000	55	2.475.000
Production worker salary (monthly)	25.700	374	9.611.800
Marketing salary (monthly)	27.600	407	11.233.200
CE-certification (1 year, 2 employee):	28.000	22	616.000
		Total:	31.417.085,8 DKK

ILL. 136 Investment

BUSINESS CASE

			25%	*10%*	*5%*	
Budget - Case	**Year 1**	**Year 2**	**Year 3**	**Year 4**	**Year 5**	**Total**
Units sold	0	4.800	6.000	6.600	6.930	24.330 DKK
Sales price (factory) (DKK)	1.800	1.800	1.800	1.800	1.800	
Product cost (DKK)	-517,82	-517,82	-517,82	-517,82	-517,82	

				10%	*5%*	
Budget - Basic	**Year 1**	**Year 2**	**Year 3**	**Year 4**	**Year 5**	**Total**
Units sold	0	0	3.000	3.300	3.465	9.765 DKK
Sales price (factory) (DKK)	1.500	1.500	1.500	1.500	1.500	
Product cost (DKK)	-517,18	-517,18	-517,18	-517,18	-517,18	

					10%	
Budget - Keychain	**Year 1**	**Year 2**	**Year 3**	**Year 4**	**Year 5**	**Total**
Units sold	0	0	0	3.000	3.300	6.450 DKK
Sales price (factory) (DKK)	1.600	1.600	1.600	1.600	1.600	
Product cost (DKK)	-517,16	-517,16	-517,16	-517,16	-517,16	

Turnover (DKK)	0	8.640.000	15.300.000	21.630.000	22.951.500	68.521.500
Variable cost (DKK)	0	-2.485.536	-4.658.460	-6.675.786	-7.087.149,3	-20.906.931,3
Constribution margin (DKK)	0	6.154.464	10.641.540	14.954.214	15.864.350,7	47.614.568,7

Return					
Investment (DKK)	-8.306.615,9	-11.835.599,3	-13.791.480	-11.299.166,4	-9.875.615,7
Constribution (DKK)	0	6.154.464	10.641.540	14.954.214	13.885.450,7
Remaining (DKK)	-8.306.615,9	-5.681.135,3	-3.149.940,4	3.655.047,6	4.009.835

ILL. 137 Break even

Epilog

The last phase is where the group concludes the whole process and reflects on what could be done differently or what to do next. Lastly, there are listed reference and illustration sources.

06

6.1 CONCLUSION

The group set this master thesis to challenge the existing insulin pens marked for diabetes type-1. It was done through several user interviews, who presented the group with discomforts, stigmatizations, and general product problems such as forgetfulness and loose needles. By interviewing medical experts in the field, it became clear that many young diabetics experience a discomforting moment in their lives, where they must find their identity as themselves and as diabetics. This insight was clear by mapping the users' experiences through a 'feeling curve'. They mapped how they felt about their disease through the years, likewise with those who got the disease later in life. This combined knowledge shows an identity problem within the young years with diabetes.

Therefore, the problem was framed as 'the users' experience with diabetic products, in the young years'. By stating this, it was developed through the first iterations, several concepts, and mock-ups. That proved that; the users' experience did not relate to only form or function but also the expression. Together with user-requested features and own ideas developed along the way, a product platform was created that uses the same base but is visualized in different designs. The design was scaled down in size to accommodate the users' needs for an 'on the go' solution in an even smaller version than the current available. The product gave a 'proof of concept', which was validated by the users to create a new product value with known technology.

As a result of this, this thesis presents a product variation platform, shown in three concept proposals. Overall, the variants share the same main base that delivers the insulin. The design of interfaces has made it possible to create variants fitting individual users' preferences, needs, and identities. In this way, the product focuses more on the user than just being a piece of medical equipment in everyday life.

6.2 REFLECTION

Looking back at the project, the group chose to challenge a medical design that has been the same for approximately 30 years. And the found problem is something related to personal opinions and taste, which has shown to be a tricky area to design for through user tests. It means setting up curtain boundaries and precise demands for the product variants. This task has turned out to be very challenging because it's about people and what they feel an attachment to, not only the function it offers them. The group will describe some of the reflective areas to improve on in the following.

PROCESS

This section reflects upon the overall process of the project. Here, the group will consider different aspects and considerations of the process within different process models, which will be reflected on.
Several methods have been used throughout the project when going through the different stages of the project. The overall project started with a fussy front (Koen et.al., 2002), which resulted in research on diabetes being postponed, and the group scaled down the research phase in time. The fussy front end affected the knowledge gained from users and experts. These were broad later in the process, creating a wide and unstructured search for a project frame, as the group initially considered redesigning the insulin pump. Additionally, it is also visual throughout the Design Brief and requirements, revised and reformulated several times. However, the potential was that the group initially explored a broader view of possible product concepts.

The overall project process has been conducted through the four phases of Double Diamond (Design Council, 2005), with a mixture of Striims ideation model (Striim,2001) and the 'Experimental circle' by Klob (McPheat, 2019). Taking the process into retrospect, it has mainly been converging, which resulted in some broad iterations and explorations of potential concept ideas, solutions, and designs. In contrast, some diverging phases have been neglected, which is visible in the vast number of requirements and presented solutions for users when testing. Reflecting on this, it has been clear that the group quickly moved across the diverging phase, where considerations of concept ideas and requirements could have been compared. It might have impacted the time used on some parts of the concept as the screen and some potential time to gain feedback on the final product platform proposal.

Within the overall phases of the Double Dimond, Striims ideation model was used as a leading method in the sketching session. Multiple ideas were created, evaluated, and improved within the idea creation phase, summary, ideation, and idea evaluation. Considering this in retrospect, the group could have been more consequent when evaluating the ideas, as many of the ideas have many aspects just in different design and shaping. Many of the individual design features could have been merged into more precise concept ideas when presented to users. It could potentially have resulted in more staid ideation, thereby making room for further exploring the interaction parts of the concepts.

The group used the 'Experimental Circle' by Klob (McPheat, 2019) through the three ideations and user testing in the development phase. The group did each user testing by setting up a concrete experience for testing, collecting data, and reflecting and learning for the next iteration and user test. This approach gave valuable insight into the project, as it became clear through each phase that users wanted different things. Thereby the group found it to create the product platform.
Even though the group's final design proposals, interaction surfaces, and construction were much like the existing solutions, through the many iterations and user testing, it became clear that users mainly reacted positively to updated and optimized versions of the current solution when considering the features and interaction. It made it hard to explore outside the current function and use of the existing solution.

As mentioned, designing a product for different people has been challenging. It took some user tests and iterations to get the project's focus. And when the group had the focus, there were many troubles communicating it to the outside because the users wanted different things. This affected the group's milestone feedback and the process.

The group's process is characterized by the fact that the group have not been good at collapsing the requirements and reconsidering them. This can be vaguely seen in the group iterations. Precise requirements could have provided more clear iterations and perhaps reduced the number of concepts chosen to be developed and made more specific. It also resulted in many repetitive requirements and not all equally evaluated.

USERS

This section considers the users of the different users throughout the project and their impact on the project. Within the iterations with the users and their feedback, it became clear that the problem was not with the insulin pen itself, the interaction or fear of needles. The problem lay with the perception of the product and how it was visualized to the social environment around the user.

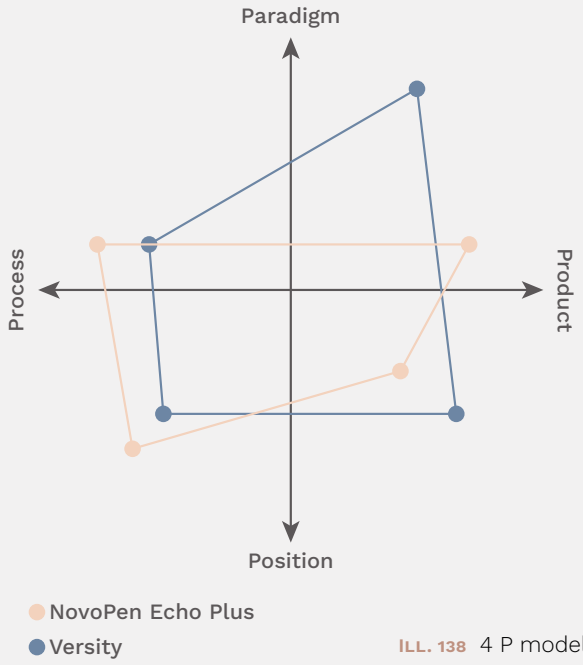
Interviewing that number of different users was challenging and complex to navigate because of their different opinions on diabetes and the equipment related to that. Some were proud to say they had diabetes, and others hid it away as much as possible. It affected the process and the concept but was rewarding in knowing how 'people are different' and need different solutions. In addition to this pride or not, there might be some misleading facts in the user research. A couple of the ask users were currently comfortable with their diabetes, creating misleading data.

Nevertheless, some had experienced some of the same issues regarding accepting their illness and the feelings of stigmatization. More young users who feel discomfort about their disease could have helped understand the user needs more clearly. However, this might also be why they are hard to reach. To further validate the 'proof of concept', it could have been considered to reach out to the users again to get feedback on the chosen concept. Furthermore, if the group had been given more time, it could have been beneficial to present it to Eli Lilly or Novo Nordisk to get their professional opinion and advice.

PRODUCT

This section of the reflection cover consideration regarding the found concept platform. Reflection regarding fulfillment of specifications, innovation level, feasibility, and overall considerations has been made.
Fulfillment of specifications When considering the proposed platform, it must meet many design specifications. On the next page are the specification listed. Here, it is considered whether the requirements are fulfilled or not or if the proposal needs testing to ensure the specifications are achieved.
Considering the specification, it becomes clear that many of the requirements related to the base that must provide the injection are still to be tested. Due to the many aspects, such as the tight tolerances in the parts, specific materials, constructions, and the clinical testing with the correct cartridge and needles. It has not been possible to test these parts as the group does not have the equipment or investment to create the needed testing facilities and parts to do so. If the product proposal was to be sold to a company or needs to be matured, these aspects must be some of the next steps to conduct.

Concerning the product platform proposal, this section aims to identify the innovation level by using the 4P model by Hansen et.al (2014) (see the method in App. 0.1). Here the group compared the current product proposal with the NovoPen Echo plus, as it has been the major reference point for the product.



ILL. 138 4 P model

By looking at the proposed concept solution, Versity, it is seen that a shift in the paradigm/product is made. It is a result of many aspects, but the leading reason is that the product sets the users' need to disguise their diabetes high and tries to embrace their individuality on different levels. Through variants, the users do not only have a choice in design liking but also the use case that fits their everyday life (Case, Hanger, and Basic). Many of the other aspects are likely to be the same as the current NovoPen Echo Plus, as the interaction of use, production, construction, etc. haven't been further innovated.
A notable consideration radaring the product platform design is the diverse differences in variant creation on the aesthetics level. As Novo Nordisk has different Novo Pens on the market, they all seem identical aesthetically. It is not the case with the product platform proposal. Here the group has deicide to focus on the design and signal value from the user's perspective, ensuring a choice for their liking can be made.

Concerning the proposal's feasibility, some aspects need to be reflected upon. Some important features to improve within the technical aspect can be pinpointed. When having a small complex element for injection molding, it would be optimal to review the design with a specialist since there are elements like the caps, which could be a challenge to mold due to their length and decorations. These elements potentially require re-designing and sparing with specialists to reach this.
It is also noticed that the battery calculations are unrealistic. It can potentially be because the required components aren't available to find online, making it hard to create a precise estimate. However, considering this, these electrical components would be ordered from a supplier, knowing how to choose and develop the hardware and software fitting to the design proposal. The same goes for the production cost mentioned in the report to be estimated. Likewise, this requires an expert to validate the production cost of such elements.
In retrospect, some aesthetic features within the concept are hard to make production-wise. Further detailed exploration in combination with production considerations could be examined to avoid this, making these parts fit for production.

Having a product platform could open an exploration upon which other medical universes this product could belong. The 'vision' of making everyday medical equipment more personal. It could be applied to other products within the medical industry, such as inhalers, apnea sleeping masks, and oxygen treatment in the home. In addition, it could also be expanded to other user segments and create this personal identity marker for children or older people.

FULFILLMENT OF SPECIFICATIONS

Spec. no.	Need. no.	Metric	Unit	Value	Imp.	Meeting requirement	
1	28	Compateble with 1,5 ml insulin cartrigde	ml	1,5	6	Yes	CARTRIGDE
2	8	Must be function with cartrigde deisgned after DS/EN ISO 11608-3	-	Yes / no	5	Yes (outsourced manufacturing)	
3	1	Visual indication on cartigde holder of left insuiln	ml	0 - 1,5	6	Yes	
4	34, 35	Securement of replaceble inuslin cartrigde	-	Yes / no	6	Yes (test needed)	
5	3	Must function with needles designed after DS/EN ISO 11608-2	-	Yes / no	6	Yes (outsourced manufacturing)	NEEDLE - INJECTION
6	15, 20	Visual view of needle when pressing air bobles and insulin out for safty check.	-	Yes / no	6	Yes	
7	15, 26	Visual view of needle when penetrating skin for injection	-	Yes / no	4	Yes	
8	4	Protection of insulin output area when no needles is acctched	-	Yes / no	5	Yes	
9	9	Inject half units	units	0,5	2	Yes	
10	29	Maximum of 30 units for dose setting	units	0,5 - 30	2	Yes	
11	41	Visual, tactile and audible indication when selecting unit dose.	-	Yes / no	6	Yes (test needed)	
12	2	Visual indication of the insulin dose seleceted	-	Yes / no	6	Yes	
13	24, 32	Squread shapping of unit dose adjustment button for better grip	-	Yes / no	3	Yes	
14	15, 17, 42	Must provide visual indication when ready for injection	-	Yes / no	6	Yes (test needed)	
15	43	Must visually change state from being ready for injection and when the dose have been injected.	-	Yes / no	6	Yes (test needed)	
16	44	Visual, audible and tactile feedback of completed injection	-	Yes / no	6	Yes (test needed)	
17	45	No larger unit dose must be able to be selected, than what is left in the insulin cartrigde.	-	Yes / no	6	Yes (test needed)	
18	40	Must accurately deliver entire labeled volume in the cartrigde.	-	Yes / no	6	Yes (test needed)	
19	46	Unit dose accuracy must be determined after DS/EN ISO 11608-1	-	Yes / no	6	Yes/no (needs external tests)	
20	6, 7	Memory storing of last unit dose injection and time	memory	-	5	Yes/no (needs tests)	BASE - SCREEN
21	31	Visual feeback of last injection dose and time: LCD screen	ich.	0,5”	4	Yes/no (needs tests)	
22	-	Battery lifetime must be a least 5 years	years	5	3	Yes/no (needs tests)	
23	-	Transmitting range of NFC	cm	2	1	Yes/no (needs tests)	
24	14, 24, 25	Maximun length of all three variants must be 100 mm	mm	100	5	Yes	VARRIANTS
25	27	Base must be compatible with all three varriants	-	Yes / no	6	Yes (needs tests)	
26	33	Securement of lid	-	Yes / no	5	Yes (needs tests)	
27	11, 30	Needle container must provide space for 5 needles	amount	5	4	Yes	CASE VARRIANT
28	36	Easy access to needles in needle container	-	Yes / no	4	Yes	
29	37	Needles must not fall out of needle conatiner	-	Yes / no	4	Yes/no (needs tests)	
30	38	Indication line in bottom for placing parts toegther.	-	Yes / no	4	Yes (needs tests)	
31	39	Click function ensuring needle conatiner do not slide off	-	Yes / no	4	Yes (needs tests)	

* note that ‘Yes (needs test)’ has been tested on previous concepts but has not been tested on the final concept solution

6.3 REFERENCES

The reference list contains references for the product as well, and are listed in the end.

A

Aarhus Kommune, 2021. Diabeteshjælpemidler. [online] (last updated: 31.05.2021) Available at: https://www.aarhus.dk/borger/personlig-hjaelp-og-stoette/hjaelpemidler/personlige-hjaelpemidler/eksempler-paa-personlige-hjaelpemidler-som-du-kan-soege-om/diabeteshjaelpemidler/ [Accessed 10.05.2022]

Almdal, T., 2019. Insulinbehandling ved type 1-diabetes. [online] (10.10.2019) Available at: https://www.sundhed.dk/borger/patienthaandbogen/hormoner-og-stofskifte/sygdomme/diabetes-type-1-behandling/insulinbehandling-ved-type-1-diabetes/ [Accessed: 17.03.2022]

Anderson R. J., , B., Freedland K.E., Clouse, R.E., Lustman, P.J., 2001. The Prevalence of Comorbid Depression in Adults With Diabetes: A meta-analysis. Diabetes Care, 01 06.

B

Bagger, K. & Sperschneider, W., 2003. "Ethnographic Fieldwork Under Industrial Constraints: Towards Design-in-Context", EBSCO Publishing.

Bekendtgørelse af lov om social service, LBK nr. 1117 af 26/09/2007.

bj-gear, n.d. Tre ting du bør overveje, når du skal vælge det rigtige gear. [online] Available at: https://www.bj-gear.dk/om-bj-gear/informationscenter/teknisk-videnbase/vaelg-det-rigtige-gear [Accessed 12.05.2022]

D

Danske Love, n.d.a. Serviceloven § 100. [online] Available at: https://danskelove.dk/serviceloven/100 [Accessed 10.05.2022]

Danske Love, n.d.b. Serviceloven § 112. [online] Available at: https://danskelove.dk/serviceloven/112 [Accessed 10.05.2022]

Dansk Standard, 2012.a. DS/EN ISO 11608-2, Needle-based injection systems for medical use – Requirements and test methods – Part 2: Needles. Kollegievej 6 DK-2920 Charlottenlund. Avaible through: Dansk Standard website https://webshop.ds.dk/standard/M250907/ds-en-iso-11608-2-2012 [Accessed 22.05.2022]

Dansk Standard, 2012.b. DS/EN ISO 11608-3, Needle-based injection systems for medical use – Requirements and test methods – Part 3: Finished containers. Kollegievej 6 DK-2920 Charlottenlund. Avaible through: Dansk Standard website https://webshop.ds.dk/standard/M251955/ds-en-iso-11608-3-2012 [Accessed 22.05.2022]

Dansk Standard, 2015. DS/EN ISO 11608-1, Needle-based injection systems for medical use – Requirements and test methods – Part1: Needle-based injection systems. Göteborg Plads 1 DK-2150 Nordhavn. Avaible through: Dansk Standard website https://webshop.ds.dk/standard/M283807/ds-en-iso-11608-1-2015 [Accessed 22.05.2022]

Design Sprints, n.d.a. Crazy 8's. [online] Available at: https://designsprintkit.withgoogle.com/methodology/phase3-sketch/crazy-8s [Accessed 31.03.22]

Design Council, 2005. A study of the design process. [pdf]. Available at: https://www.designcouncil.org.uk/sites/default/files/asset/document/ElevenLessons_Design_Council%20(2).pdf [Accessed: 08.05.2022].

Diabetes foreningen, n.d.a. Diabetes i Danmark. [online] Available at: https://diabetes.dk/forskning/viden-om-diabetes/diabetes-i-danmark [Accessed: 17.03.2022]

Diabetes foreningen, n.d.b Hjælp og støtte fra det offentlige. [Online] Availabla at: https://diabetes.dk/radgivning/stotte-og-rettigheder/hjaelp-og-stotte#anchor-id-hjaelp-og-stoette-a-til-aa-merudgifter-til-boern--servicelovens--41 [Accessed 10.05.2022]

Diabetes foreningen, n.d.c. Diabetes.dk [online] Available at: https://diabetes.dk/diabetes-1/fakta-om-type-1/blodsukker-og-maling/insulinchok [Accessed: [12.05.2022].

Diabetes foreningen, n.d.d. diabetes.dk. [Online] Available at: https://diabetes.dk/diabetes-1/fakta-om-type-1/behandling/insulinbehandling#anchor-id-vaerd-at-vide-om-at-bruge-insulinpumpe-fordele-og-ulemper-ved-insulinpumpe [Assessed: 13.05.2022].

F

Fonden, P., n.d. Psykiatrifonden.dk. [Online] Available at: https://psykiatrifonden.dk/viden/temaer/tabu-stigmatisering [Accessed: 17.03.2022]

Formlabs, n.d. GD&T: The Basics of Geometric Dimensioning and Tolerancing. [online]. Available at: https://formlabs.com/blog/gdt-geometric-dimensioning-and-tolerancing/ [Accessed 15.05.2022]

G

Groot, M. d., Golden, S. H. & Wagner, J., 2016. Psychological Conditions in Adults With Diabetes. Am Psychol, 12 10.

H

Hand, S., 2018. How to Choose the Best Medical Device Sterilization Method. [online] Available at: https://xtalks.com/how-to-choose-the-best-medical-device-sterilization-method/ [Accessed: 13.05.2022]

Hansen, P. H. K., Berg, P., Mabogunje, A., 2014. Adding To Product Development Theory – A language Perspective. In M.Laakso, & K. Ekman (Eds.), Proceedings of Norddesign 2014 Conference (pp. 470-479). Design Society. Available at: https://vbn.aau.dk/ws/portalfiles/portal/207630779/Hansen_Berg_Mabogunje_2014_Adding_To_Product_Development_Theory_A_Language_Perspective.pdf?fbclid=IwAR1ulDs6z-zq2KurAbCX85-ZShSE0FbbuT7a2jDBcnE0V4d0GoMXt-2CuZkk [Accessed: 20.05.2022]

Hansen, U. M., Olelsen, K., and Willa, I., 2020. Diabetes stigma and its association with diabetes outcomes: a cross-sectional study of adults with type 1 diabetes. Scandinavian Journal of Public Health. [e-journal] 48 (8), p.855-861. Available at: https://doi.org/10.1177/1403494819862941 [Accessed 08.03.2022]

I

IBM Services, 2019. IBM. [Online] Available at: https://www.ibm.com/dk-en/services/technology-support/multivendor-it/oem [Accessed 11.05.2022]

IDF Diabetes Atlas, 2022. Diabetes around the world in 2021. [online] Available at: https://diabetesatlas.org/ [Accessed 17.03.2022]
International Diabetes Federation, 2021. IDF Diabetes Atlas 10th edition. [PDF]. The International Diabetes Federation. Available at: https://diabetesatlas.org/idfawp/resource-files/2021/07/IDF_Atlas_10th_Edition_2021.pdf [Accessed: 17.03.2022]

J

Jaeger, T. A., Laursen, L. N., 2022. Fomgiv Givform. 1st edition. Aalborg, Department of Architecture, Design & Media Technology, Aalborg University

K

kloeckner Metals, 2021. When to use aluminum vs stainless steel. [online] Availble at: https://www.kloecknermetals.com/blog/when-to-use-aluminum-vs-stainless-steel/ [Accessed 12.05.2022]

Koen, P., A., Ajamian, G., M., Boyce, S., Clamen, A., Fisher, E., Fountoulakis, S., Johnson, A., Puri, P., Seibert, R., 2002. Fuzzy front end: Effective methods, tools and techniques. In Belliveau, P., Griffin, A., Somermeyer, S., Product Development & Management Association (Eds.), 2002. The PDMA toolbook for new product development. John Wiley & Sons, Inc, New York.
Kolko, J., 2010. Exposing the Magic of Design: A Practitioner's, Guide to the Methods and Theory of Synthesis. Avilible at: https://oxford-universitypressscholarship-com.zorac.aub.aau.dk/view/10.1093/acprof:oso/9780199744336.001.0001/acprof-9780199744336-chapter-7 [Accessed 23.05.2022]

Krohn, C., 2021. Stigma forbundet med Diabetes Mellitus Type 1 og Type 2: konsekvenser og medierende faktorer, s.l.: Aalborg Universitet.

L

Lage, J.N., 2021. Dolberg har diabetes. Tv2-Sport. [online] Available at: https://sport.tv2.dk/fodbold/2021-11-08-dolberg-har-diabetes [Accessed 11.05.2022]

Lerdahl, E., Norges tekniske høgskole, 2001. Staging for creative collaboration in design teams: models, tools and methods. Norwegian University of Science and technology, Dept. of Product Design Engineering, Trondheim, Norvège.

Lilly, 2022.a. About Lilly [online] Available at: https://www.lilly.com/who-we-are/about-lilly [Accessed 11.05.2022]

Lilly, 2022.b. Diabetes. [online] Available at: https://www.lilly.com/disease-areas/diabetes [Accessed 11.05.2022]

Lægehåndbogen, 2021. sundhed.dk. [Online] Available at: https://www.sundhed.dk/sundhedsfaglig/laegehaandbogen/endokrinologi/tilstande-og-sygdomme/diabetes-mellitus/type-1-diabetes/ [Assessed: 13.05.2022].

Lægemiddelstyrelsen, Danish Medicines Agency, 2020.a. Laegemiddelstyrelsen.dk. [Online] Available at: https://laegemiddelstyrelsen.dk/da/godkendelse/godkendelse-af-medicin/?fbclid=IwAR2-Eh-w3YTJoA0LntSFz3VkhPBpTfaXC1grZxiLbqyXmubYBZRLnoU40yE [Accessed: 11.05.2022]

Lægemiddelstyrelsen, Danisk Medicines Agency, 2020.b. Laegemiddelstyrelsen.dk. [Online] Available at: https://laegemiddelstyrelsen.dk/da/udstyr/ [Accessed: 11.05.2022]

M

McPheat, S., 2019. What Are KOLB's Learning Styles And What Do They Mean? [online] Skillshub. Available at: https://www.skillshub.com/what-are-kolbs-learning-styles/ [Accessed 09.06.2022]

Medicin.dk, 2022.a. Humulin® NPH. [online] Available at: https://pro.medicin.dk/Medicin/Praeparater/1585 [Accessed 11.05.2022]

Medicin.dk, 2022.b. Humalog®. [online] Available at: https://min.medicin.dk/medicin/praeparater/1962 [Accessed 11.05.2022]

Medicin.dk, n.d. NovoRapid®. [online] Available at: https://pro.medicin.dk/Medicin/Praeparater/2605 [Accessed 03.05.2022]

Medico Industrien, n.d. Medicinsk udstyrs lange vej fra idé til patient. [Online] Available at: https://medicoindustrien.dk/sites/default/files/plakat_godkendelse_af_medicinsk_udstyr_1.pdf?fbclid=IwAR0W-3dbw0Lo9Q5kQxzPORTITqpg4IWt8jbUS_vbv73l6iRoSZ9BSHPiQdM [Accessed: 11.05.2022]

N

Nielsen, K. A. & Golubovic, S., 2019. Livet med diabetes, Rapport 2019, Glostrup: Diabetes Foreningen, pp. 46

Nordisk, N., n.d. https://www.novonordisk.com/. [Online] Available at: https://www.novonordisk.com/content/dam/nncorp/global/en/our-products/pdf/novopen-echo/NovoPen-Echo-generic-injection-guide.pdf [Accessed: 31.03.2022]

Novo Nordisk A/S, n.d. Indlægsseddel: Information til brugeren. [Online] Available at: http://xnet.dkma.dk/indlaegsseddel/PdfFileServlet?formulationid=228&lang=da [Accessed: 23.03.2022]

Novo Nordisk, 2022.a. Smart pens. Smarter care. [online] Available at: https://www.novonordisk.com/our-products/smart-pens/novopen-6.html [Accessed 25.04.2022]

Novo Nordisk, 2022.b. What we do. [online] Available at: https://www.novonordisk.com/about/what-we-do.html [Accessed 11.05.2022]

Novo Nordisk, 2022.c. Who we are [Online] Available at: https://www.novonordisk.com/about/who-we-are.html [Accessed 11.05.2022]

P

Pioneer Service Inc., 2016. What is CNC Turning? [online] Available: https://pioneerserviceinc.com/blog/what-is-cnc-turning/ [Accessed 13.05.2022]

R

Reersted, T. M., 2020. 5 hurtige om diabetes. [online] (Date of update: 08.12.2020) Available at: https://min.medicin.dk/artikler/artikel/47 [Accessed 08.03.2022]

Richter, C., 2022. Adgangen til ny teknologi begrænses af forældet kassetænkning [online]. Pentia A/S. Available at: https://diabetes.dk/nyheder/2022/adgangen-til-ny-teknologi-begraenses-af-foraeldet-kassetaenkning/ [accessed 3.27.2022].

S

Sanofi, 2022.a. Diabetes your type. [online] Available at: https://www.sanofi.com/en/about-us/our-stories/diabetes-your-type [Accessed 11.05.2022]

Sanofi, 2022.b. Your health - diabetes and cardiovascular diseases: We are pioneering possibilities [online] Available at: https://www.sanofi.com/en/your-health/diabetes-and-cardiovascular-diseases [Accessed 11.05.2022]

Sansmachining, 2021. Introduction And Advantages Of Thread Milling Cutter. [online] Available at: https://www.sansmachining.com/introduction-and-advantages-of-thread-milling-cutter/ [Accessed 13.05.2022]

Sastri, V.R., 2014. Plastics in Medical Devices Properties, Requirements and Applications. 2nd ed.

Sortsø, C., Green, A., Jensen, P. B., and Emneus, M., 2016. Societal costs of diabetes mellitus in Denmark. Diabetic Medicine, [e-journal] 33(7), 877–885. https://doi.org/10.1111/dme.12965

Stevanato Group, n.d.a. Glass Cartridge System [online]. Available at: https://www.stevanatogroup.com/en/offering/drug-containment-solutions/cartridge-systems/ [Accessed 22.05.2022]

Stevanato Group, n.d.b. Cartridge forming lines. [online] Avablibe at: https://www.stevanatogroup.com/en/offering/glass-converting/cartridge-forming-lines/ [accessed 22.05.2022]

Striim, O., 2001. Kreativ problemløsning og Praktisk Idéudvikling. 2. end. Aarhus: Academica, pp. 49-62, 72-79

Sundhed.dk, 2020. Diabetesmedicin. [online] (05.03.2020) Available at: https://www.sundhed.dk/borger/patienthaandbogen/hormoner-og-stofskifte/illustrationer/animationer/diabetesmedicin/ [Accessed: 17.03.2022]

Svenningsen, M., 2018. Liv Martine har diabetes: "Det er en kronisk sygdom, som jeg ikke kan gøre for". Tv2Nord. [online] Available at: https://www.tv2nord.dk/nordjylland/liv-martine-har-diabetes-det-er-en-kronisk-sygdom-som-jeg-ikke-kan-gore [Accessed 11.05.2022]

Sørensen, M. H. & Jensen, H., 2019. Socialstyrelsen, Vidensportalen på det sociale område. [Online] Available at: https://vidensportal.dk/voksne/prostitution/stigma-og-dobbeltliv [Accessed 17.03.2022]

T

Thompson, R., 2007. Manufacturing processes for design professionals. Thames & Hudson, New York.

Thompson, R., Thompson, M., Burgess, N., 2017. The materials sourcebook for design professionals. Thames & Hudson, New York.
Tjalve, E. 1976, Systematisk udformning af industriprodukter: værktøjer for konstruktøren

Tollestrup, C., 2004. Value and Vision-based Methodology in Integrated Design. Ph D. Thesis. Aalborg Universitetsforlag, Department of Architecture & Design. Aalborg University. http://www.aod.aau.dk/forskning/publikationer/2004.htm. Pp. 283-291

Tollestrup, C., 2019. Integreret produktudvikling – Koncept Systematisk idé- og konceptudvikling. DAI440003L Integreret produktudvikling – Koncept. [PowerPoint presentation via internal VLE], Aalborg University. Available at: https://www.moodle.aau.dk/pluginfile.php/1435481/mod_resource/content/2/IPU%20kursusgang%2004%20F2019.pdf [Accessed 08.05.2022]

U

Ulrich, K.T., Eppinger, S., 2008. Product Design and Development, McGraw-Hill 5th edition

V

Videncenter for Diabetes, 2022. Videncenter for Diabetes. [Online] Available at: https://videncenterfordiabetes.dk/viden-om-diabetes/diabetes-og-psyken/diabetes-distress#sociale-sammenhaenge-7d [Accessed: 17.03.2022]

Videncenter for diabetes, 2021a. Kort om diabetes. [online] (Date of update: 23.08.2021) Available at: https://videncenterfordiabetes.dk/viden-om-diabetes/generelt-om-diabetes/kort-om-diabetes [Accessed 08.03.2022]

Videncenter for diabetes, 2021b. Hvad er type 1-diabetes?. [online] (Date of update: 05.08.2021) Available at: https://videncenterfordiabetes.dk/viden-om-diabetes/type-1-diabetes/hvad-er-type-1-diabetes [Accessed 08.03.2022]

Videncenter for diabetes, 2021c. Hvad er type 2-diabetes?. [online] (Date of update: 23.12.2021) Available at: https://videncenterfordiabetes.dk/viden-om-diabetes/type-2-diabetes/hvad-er-type-2-diabetes [Accessed 08.03.2022]

Videncenter for diabetes, 2021d. Injektion af insulin [Online] Available at: https://videncenterfordiabetes.dk/viden-om-diabetes/type-1-diabetes/behandling/insulin/injektion-af-insulin [Accessed: 31.03.2022]

Videncenter for Diabetes, 2020. Diabetes i tal. [online] (10.12.2020) Available at: https://videncenterfordiabetes.dk/viden-om-diabetes/generelt-om-diabetes/diabetes-i-tal [Accessed: 17.03.2022]

Videncenter for diabetes, n.d. Andre typer diabetes. [online] Available at: https://videncenterfordiabetes.dk/viden-om-diabetes/andre-typer-diabetes [Accessed 08.03.2022]

W

Wikipedia, 2022.a. Novo Nordisk. [online] (Last updated: 11.03.2002) Available at: https://da.wikipedia.org/wiki/Novo_Nordisk [Accessed 11.05.2022]

Wikipedia, 2022.b. Sanofi. [online] (Last updated: 30.04.2002) Available at: https://en.wikipedia.org/wiki/Sanofi [Accessed 11.05.2022]

Wikipedia, 2022.c. Eli Lilly and Company. [online] (Last updated: 10.05.2002) Available at: https://en.wikipedia.org/wiki/Eli_Lilly_and_Company [Accessed 11.05.2022]

Willanig, I. & Sjøgren, K., 2020. Sciencenews.dk. [Online] Available at: https://sciencenews.dk/da/personer-med-type-1-diabetes-oplever-ogsaa-i-danmark-at-blive-stigmatiseret [Accessed: 17.03.2022]

Y

Yan, K., 2022. diaTribe Learn, Making sense of diabetes. [Online] Available at: https://diatribe.org/diabetes-stigma-everywhere-you-can-do-something-about-it [Accessed: 17.03.2022]

REFERENCE LIST: PRODUCT REPORT

***Nielsen, K. A. & Golubovic, S., 2019.** Livet med diabetes, Rapport 2019, Glostrup: Diabetes Foreningen, pp. 46

***Videncenter for Diabetes, 2020.** Diabetes i tal. [online] (10.12.2020) Available at: https://videncenterfordiabetes.dk/viden-om-diabetes/generelt-om-diabetes/diabetes-i-tal [Accessed: 17.03.2022]

***Willanig, I. & Sjøgren, K., 2020.** Sciencenews.dk. [Online] Available at: https://sciencenews.dk/da/personer-med-type-1-diabetes-oplever-ogsaa-i-danmark-at-blive-stigmatiseret [Accessed: 17.03.2022]

6.4 ILLUSTRATIONS

All illustration numbers not mentioned in this list are own illustrations

Ill. 2: Discover: https://blog.flowing.com.br/como-aplicar-insulina/
Ill. 4: World map illustration: https://diabetesatlas.org/
Ill. 5: Map over Denmark: https://foliegejl.dk/webshop/79-vis-alle-stickers/2348-danmarkskort/
Ill. 6: Picture of syringe and insulin: https://forskning.no/diabetes/diabetes-type-2-lovende-resultater-med-insulin-som-varer-i-en-uke/1850661
Ill. 10: Cosy picture: https://www.freestylelibre.co.uk/libre/?fbclid=IwAR0AFzyT0_KLv-h43akUoSxdnnR4bfPrMGRF08tYetbiQ8mRSe8TjGFtFD8
Ill. 15:

1. Novopen Echo Plus: https://www.novonordisk.com/our-products/smart-pens/novopen-6.html
2. 780G Pump: https://www.medtronic-diabetes.com/da-DK/insulinpumpe/minimed-780g-systemet
3. Accu-Chek: https://hcp.accu-chek.com/products/guide-meter
4. Accu-Chek Mobile: https://www.accu-chek.dk/blodsukkerapparater/mobile
5. Accu-Chek Solo: https://www.accu-chek.dk/dk/microsites/solo/index.html
6. FreeStyle Libre: https://www.freestyle.abbott/dk-da/freestyle-libre-system.html
7. Emergency Medicine Kit: https://www.businesswire.com/news/home/20200205005106/en/Fresenius-Kabi-Introduces-Glucagon-Emergency-Medicine-Kit-to-Treat-Life-Threatening-Episodes-of-Low-Blood-Sugar
8. Accu-Chek2: https://www.accu-chek.com/lancing
9. Minimed 670G: https://www.medtronic-diabetes-mena.com/en/insulin-pump-therapy/minimed-670g-system
10. Novo Nordisk: https://www.novomedlink.com/diabetes/products/training/insulin-pen-training.html
11. https://www.medtronic-diabetes.se/insulinpumpsbehandling/minimed-670g-systemet

Ill. 16:

1. Accu-Chek Spirit Blå hund: https://www.mitliv.dk/accu-chek-spirit-bla-hund-etui-til-born
2. Accu-Chek Spirit: https://www.mitliv.dk/accu-chek-spirit-til-baeltet-blue-jeans
3. MiniMed® Pumps: https://shop.medtronic-diabetes.co.uk/en/accessories/Comfort/Diabete-ezyComfyBeltPouch
4. FreeStyle Libre Tigermotiv: https://www.mitliv.dk/freestyle-libre-klistermaerke-saet-til-sensor-og-scanner-tiger/
5. Freestyle Libre armbånd: https://www.mitliv.dk/choupinou-armbaand-til-freestyle-libre-sensor/
6. FRIO Lifestyle køletaske: https://www.mitliv.dk/frio-lifestyle-koeletaske-til-2-insulinpenne/
7. Håndlavet Funder: https://www.mitliv.dk/funder-diabetestaske-laeder-brun/
8. Klistermærke til Dexcom G6: https://www.mitliv.dk/dexcom-g6-sensor-klistermaerker-planter/
9. Lenny® Silicon Skin https://shop.medtronic-diabetes.ch/en/Accessories/kids/Lennysiliconskin
10. Lenny® The Lion Plush: https://shop.medtronic-diabetes.co.uk/en/accessories/kids/lennySmall
11. Myabetic Cherise diabetestaske: https://www.mitliv.dk/myabetic-cherise-diabetes-haandtaske/
12. Myabetic diabetestasker: https://www.mitliv.dk/myabetic-diabetes-unicorn/dinosaur-taske/
13. Taske til diabetesudstyr: https://www.mitliv.dk/elite-bags-diastaske-til-barn-med-isotermisk-effekt/

Ill. 17: Person sticking herself with glucometer: https://www.diabetesselfmanagement.com/diabetes-resources/definitions/somogyi-effect/?fbclid=IwAR1i04DTgPIRCLMTNjiv4sE6jTS9823JnBiHe3NEhowng3rk1AQkLBs_NuM

Ill. 29 + 30: Insulin pens + timeline:

1. https://starship.org.nz/guidelines/diabetes-insulin-treatment-of-hospitalised-patients-with-diabetes-mellitus/
2. https://i.pinimg.com/originals/46/ff/4f/46ff4f400fa54c08e08da50423e1ffd5.jpg
3. https://europepmc.org/article/med/23732369
4. https://docplayer.dk/1023052-Device-manufacturing-sourcing.html
5. https://www.amazon.co.uk/Lilly-HumaPen-Luxura-Burgundy-pen/dp/B00TOL5QB4
6. https://americanhistory.si.edu/collections/object-groups/insulin-and-diabetes-management/insulin-injection
7. https://www.novonordisk.co.in/content/dam/Denmark/HQ/aboutus/documents/HistoryBook_DK.pdf
8. https://www.indiamart.com/proddetail/lemevir-insulin-pens-9046420412.html
9. https://www.diabeteswhatsnext.com/dk/da/insulin-100.html
10. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3063658/
11. https://www.indiegogo.com/projects/timesulin-making-your-insulin-pen-smarter#/
12. https://www.pharmaceutical-technology.com/projects/chartres/
13. https://www.novonordisk.co.nz/about/insulin-100-years.html
14. https://investor.lilly.com/news-releases/news-release-details/lilly-introduces-worlds-first-digital-insulin-pen-memory

Ill. 32: Product universes

1. Philips Norelco OneBlade: https://www.amazon.com/dp/B01D328DH8?asc_campaign=&asc_source=&asc_refurl=https%3A%2F%2Fwww.gq.com%2Fstory%2Fbest-electric-shavers-for-avoiding-razor-burn&tag=gqgensqua-20&ascsubtag=5b33a647b8d0e16cfcf66eb8
2. Axe Deospray Apollo: https://gpris.dk/axe-deospray-apollo-150ml.html
3. Babyliss: https://www.osfrisorartikler.dk/7649-babyliss-pro-foilfx02-4artists-shaver
4. Clarins Gentle: https://nicehair.dk/clarins-gentle-care-roll-on-deodorant-50ml-596106.html
5. Dodson: https://www.harpersbazaar.com/beauty/skin-care/g38238570/best-electric-razor-for-women/
6. Dove: http://www.luxplus.dk/produkt/dove-pomegranate-roll-on-deo-50-ml
7. Giorgio Armani https://nicehair.dk/giorgio-armani-acqua-di-gio-deo-stick-pour-homme-75-g.html
8. Immortal Hair Wax: https://immortalwax.com/home/26-immortal-hair-wax-crazy-aqua-gel-150-ml.html
9. Kaos: https://www.fleggaard.dk/pi/Kaos-for-Women-Deospray-150-ml-_1210033_40584.aspx
10. Nish Man: https://billigvoks.dk/nish-man-07-hair-styling-wax-gold-one-150-ml
11. L'Oréal Paris: https://nicehair.dk/loreal-men-expert-thermic-resist-48h-anti-perspirant-deodorant-150-ml.html
12. Maybelline: https://www.bangerhead.dk/maybelline-lash-sensational-mascara-intense-black-
13. Melau: https://melaucare.dk/vare/melau-haarvoks/
14. Moisturizer: https://nicehair.dk/clinique-superdefense-night-recovery-moisturizer-combination-oily-to-oily-34-50-ml.html
15. Ladyshaver https://www.matas.dk/philips-hp634100-ladyshaver
16. Philips S5050: https://www.appliancesonline.com.au/andoo/product/philips-s5050-aquatouch-wet-dry-electric-shaver
17. Philips Shaver AT620/14: https://ekram.dk/produkt/philips-shaver-at620-14-aqua-touch/
18. Rudolph: https://salling.dk/skoenhed/dufte/deodorant/acai-deo-roll-on-50-ml/p-28972/
19. Swan: https://www.gucca.dk/swan-barbermaskine-til-kvinder-all-in-one-ultimate-p489992
20. Epilator: https://www.walmart.com/ip/Women-s-Painless-Hair-Remover-for-Leg-Women-Epilator-Hair-Removal-Electric-Shaver-for-Women-s-Legs-Face-Lips-Bikini-As-Seen-On-TV-Rose-Gold-nbsp/545993757 (accessed 4.10.22).
21. Yves: https://www.boozt.com/dk/da/yves-saint-laurent/rouge-pur-couture_15725331/15725334?gclid=Cj0KCQiA09eQBhCxARIsAAYRiyk5ag54HKe6c7--CNXMq8YkU4qAJxWMYhAzG-9gOO-nFS1jc8XKHUIYaAgdoEALw_wcB&localLanguage=1

Ill. 36: Interaction vision

1. Trust: https://pixabay.com/vectors/insurance-protection-safety-care-5798050/?download
2. Discreet: https://hardwired.pbtech.co.nz/article/1423/Best-in-Wireless-Running-Headphones
3. Freedom: https://www.istockphoto.com/photo/beer-bottle-opening-gm1161693474-318397659
4. Statement: https://da.depositphotos.com/stock-photos/colorful-woman.html?qview=56961147
5. Control: https://eugeneballet.org/dancer-of-the-week-sarah-kosterman/

Ill. 37: Value mission

1. Personality: https://pixabay.com/photos/painting-finger-

nails-nail-polish-635261/
2. Accept: https://www.blog.motifphotos.com/dont-let-a-few-rain-clouds-stop-you-with-these-rain-photography-tips/
3. Sexy: https://www.barebulbcoffee.org/wp-content/uploads/2016/10/Getting-Ready-For-The-Night-Out.jpg
4. Warrior: https://www.farmandfleet.com/blog/teach-kid-ride-bike/

Ill. 46: Product universes
Watches
1. Damme ur skagen: https://www.zalando.dk/skagen-connected-hybrid-ure-black-ska51m00h-q11.html?size=One%20Size&allophones=0&wmc=SEM450_NB_GO._7584348957_702712754_134454114891.&opc=2211&mpp=google|v1||pla-1444512004456||9048902||g|c||555056355021||pla|SKA51M00H-Q110ONE000|1444512004456|1|&gclsrc=aw.ds&gclid=CjwKCAiAjoeRBhAJEiwAYY3nDG0r41Ga-to49LOgq7c-Zy3FDqCG8gktMDpeHHDPZeW87ej6KG0DrBoClzAQAvD_BwE
2. Daniel wellingtomn dame ur: https://buytime.dk/produkt/daniel-wellington-dameur-iconic-link-36-mm-silver-white/
3. AJ dame ur: https://hjem.dk/shop/730-dameur/22938-arne-jacobsen-armbaandsur-roman-34mm-guld-laenke-guldhvid/
4. gamin dame ur: https://www.sport24.dk/garmin-fenix-6s-pro-solar-pulsur.html?c=1560892&gclid=CjwKCAiAjoeRBhAJEiwAYY3nDIAcZq8akKhskoYFdHEaU7YoxvNyxPZZJ2lc9PeRrr7i-qUj6PzetRBoCSFgQAvD_BwE&gclsrc=aw.ds&s=1961
5. Garmin here ur: https://www.intersport.dk/damer/tilbehor-og-udstyr/elektronik/instinct-solar/garmin.010_02293_00.ncc.0753759235895.html?gclid=CjwKCAiAjoeRBhAJEiwAYY3nDMxK29Clb3B0GwbQ_3Y41tnKtid2QTS5dwnXTeys8E-Z8zZC3HUNVRoCr84QAvD_BwE&gclsrc=aw.ds
6. Kvinde appel wacth: https://www.apple.com/shop/buy-watch/apple-watch-se/40mm-gps-gold-aluminum-starlight-sport-band-sm-ml-se
7. Braun digital ur: https://priisma.dk/da/ure-armbandsure/alle-ure-armbandsure/braun-prestige-digital-steel/
8. Casio digital ur (herre og dame): https://www.zalando.dk/casio-digitalure-gold-colouredblack-c1554m00l-f11.html?-size=One%20Size&allophones=0&wmc=SEM450_NB_GO._7584348957_702712754_134454114891.&opc=2211&mpp=google|v1||pla-1444512004456||9048902||g|c||555056355021||pla|C1554M00L-F110ONE000|1444512004456|1|&gclsrc=aw.ds&gclid=CjwKCAiAjoeRBhAJEiwAYY3nDFspNUFNiIlz-GKlEyzAsQ2PFkHP5WYRIbo-G70lgc0Smqurjnr7InBoCebQQAvD_BwE
9. Rosendahl Ambåndsur: https://www.allbuy.dk/products/rosendahl-watch-2-digital-sort-23x37mm?currency=DKK&variant=31646114742359&gclid=CjwKCAiAjoeRBhAJEiwAYY3n-DEsN3SmjzX5pUS1HyuuuCt9ORw7boqaVdR4n5xQoAznYa-zyuqYmcaBoC7p0QAvD_BwE
10. Nye here ur 1: https://swisstime.dk/rolex-cosmograph-daytona-1

Ourdoor:
1. https://www.eventyrsport.dk/sandberg-survivor-power-bank-20100-3012100006.html?c=282350&s=18502
2. https://www.eventyrsport.dk/garmin-inreach-mini-0502000030.html?c=265313&s=18502
3. https://www.eventyrsport.dk/intensity-370-hand-torch-battery-0722103544.html?c=304306&s=18502
4. https://www.made-in-china.com/showroom/kellyhumtto/product-detailWZQmkOxdZDVg/China-Humtto-Outdoor-Hiking-Boots-Men-Climbing-Shoes-Tactical-Hunting-Camping-Trekking-Mountain-Sports-Cushioning-Sneakers-Big-Size.html
5. https://www.anglingdirect.co.uk/penn-surfblaster-long-cast-reel?gclid=CjwKCAiAjoeRBhAJEiwAYY3nDEX8i2l-ytFQ8A-nyKM2FMD3oESVYfMTO2fEUCehK7aTw0ShkHka9vhoCC9YQAvD_BwE
6. https://www.eventyrsport.dk/flash-2-0-0321800748.html?dfw_tracker=73472-0321800748-133&ab_version=B&gclid=CjwKCAiAjoeRBhAJEiwAYY3nDPGfsyG9pyJ1b6x1NQ2clJK2M7m6-g_rYny-8JtumJnm1-f3Uusk7BxoCTRcQAvD_BwE&c=201437&s=18502
7. https://www.aliexpress.com/item/32955755561.html?dp=292296-172240.20819283&aff_fcid=a1205bb-125c84a7eb5ff5f310b6366ad-1646385330447-04285&aff_fsk&aff_platform=api-new-product-detail&sk&aff_trace_key=a1205bb125c84a7eb5ff5f310b6366ad-1646385330447-04285&terminal_id=e21b1336ea8c466ab4c4d68f474f64a5&afSmartRedirect=y

Sport
1. Nike sko: https://static.nike.com/a/images/t_PDP_1280_v1/f_auto,q_auto:eco/77c0a529-8fe0-4dcb-a122-ba2b63e18d95/zoomfly-4-mens-road-running-shoes-dw6jzQ.png
2. Cykelhjelm: https://cykelshoppen.dk/racerhjelme/met-road-vinci-mips-cykelhjelm-red?optionId=50154&gclid=CjwKCAiAjoeRBhAJEiwAYY3nDPWgUQNJr4uCTC-msare4XmMDXFlktoTjxedyNMWJtHbmW5tx1F5FRoCi-EQAvD_BwE
3. Vægt 5 kg: https://www.fysiosupplies.dk/vinyl-dumbbells
4. Yoga måtte kork: https://www.loebeshop.dk/flowlife-flow-mat-kork.html
5. Orange youga måtte: https://www.fitshop.dk/taurus-tpe-yoga-maatte-tf-asl881
6. Nike fodbold støvle: https://www.nike.com/dk/t/mercurial-superfly-8-elite-km-ag-fodboldstovler-kunstgraes-0cSnGX
7. Rulleskøjte vild: https://www.lirumlarumleg.dk/products/impala-rulleskojter-til-born-pastel-fade-str-34-40
8. Inliners: https://www.sport247.dk/shop/rezo-oahu-in-line-142859p.html

Electronics:
1. Gaming Headset:https://www.avxperten.dk/gaming-headset/logitech-gaming-headset-7-1-surround-g432.asp
2. Baige headphones: https://skalhuset.dk/da/hovedtelefoner/horetelefoner-los-angeles-sand-gold/?gclid=CjwKCAiAjoeRBhAJEiwAYY3nDCyujlPY5R7glD-LgwO-ppFTbzT8llrGRCdkGjhXIlIKVM-JawhkRMxoCBnIQAvD_BwE#fo_c=4060&fo_k=16d66034c1c3b-8d5a65085f351975489&fo_s=gpladk
3. Jabra in ear: https://www.jabra.dk/bluetooth-headsets/jabra-elite-3
4. TWS headphone: https://www.kentfaith.com/GW01.0419_tws-bluetooth-headphones-stereo-true-wireless-headset-earbuds-in-ear-handsfree-earphones-ear-buds-for-mobile-phone-white
5. Pink in ear: https://www.logitech.com/da-dk/products/headsets/zone-true-wireless-earbuds.985-001082.html
6. JBL speaker: https://dk.jbl.com/bluetooth-speakers/JBL+BOOMBOX.html
7. B&O speaker: https://www.hifiklubben.dk/bang--olufsen-beosound-a1-2nd-gen-traadloes-hoejtaler/boa1g2pi/?dfw_tracker=102491-BOA1G2PI&gclid=CjwKCAiAjoeRBhAJEiwAYY3nDGv2Pby2vI_-gMHhl1Q-XTFFg-dR9RvwSNassXajFt9kKy512wqwmhRoCuq0QAvD_BwE
8. Powerbank:- https://freshnrebel.com/power-bank-18000-mah/2pb18000sg/

Kitchenware:
1. Kicthen aid rørmaskine: https://www.kitchenaid.dk/koekkenmaskiner/859702301230/koekkenmaskine-med-vippehoved-4-8-l-artisan-5ksm185ps-roed-metallic
2. Matteo rørmaskine: https://www.punkt1.dk/koekkenredskaber/koekkenmaskiner/koekkenmaskiner/chef-matteo-cmkm134-chef-pastry-koekkenmaskine-sort/p-1174691/
3. Stelton emma: https://www.imerco.dk/stelton-emma-elkedel?id=100363011
4. Witt kettle: https://coffeejoy.dk/vare/witt-premium-kettle-1-7l-ss/?gclid=CjwKCAiAjoeRBhAJEiwAYY3nDDFZPFwyRja-JV76n6vgXQ6K-r-ED97ki9dxZvNRSzurtGYNut_WmLxoCIjkQAvD_BwE
5. Teddy-varimixer-black: https://www.jyskestorkokken.dk/rore-maskine-bjorn-5l-teddy-sort.html
6. Russel Hobbs foodprocesser: https://www.helsebixen.dk/shop/russell-hobbs-retro-food-processor-red.html
7. Kenwood foodprocessor: https://www.coolshop.dk/produkt/kenwood-fdp65-640wh-multipro-express-foodprocessor/236FA9/
8. Smeg kaffe: https://www.kai-berntsen.dk/shop/smeg-dcf02p-geu-kaffemaskine-8730p.html?CookieConsentChanged=1
9. Wilfa kaffemaksine: https://kaffeexpressen.dk/vare/wilfa-classic-kaffemaskine-mat-sort/
10. Lyserød nespresso: https://www.avxperten.dk/kapselmaskiner/delonghi-en510-lattissima-one-nespresso-kapselmaskine-hvid.asp

Ill. 80: Valuemission:
1. https://all2day.dk/offer/179179/500+gram+bland-selv-slik
2. https://www.blog.motifphotos.com/dont-let-a-few-rain-clouds-stop-you-with-these-rain-photography-tips/
3. https://approachableleadership.com/gaining-trust/

Ill. 81: Interactionvision:
1. https://hardwired.pbtech.co.nz/article/1423/Best-in-Wireless-Running-Headphones
2. https://pixers.dk/fototapeter/sta-ud-fra-mangden-15106192
3. https://eugeneballet.org/dancer-of-the-week-sarah-kosterman/

Ill. 82:
1. Nike football boot: https://www.nike.com/dk/t/phantom-gt2-elite-fg-fodboldstovle-graes-R5X4vR/CZ9890-167
2. Lamborghini Huracan STO: https://www.carwale.com/lamborgh-

ini-cars/huracan-sto/
3. Bike: https://www.lasylife.top/products.aspx?cname=kawasaki+h2r+2021&cid=25
4. Christian Louboutin shoe: https://costume.dk/mode/nye-rode-saler-til-christian-louboutin-stiletter

Ill. 83:
1. Pink earplugs: https://www.logitech.com/da-dk/products/headsets/zone-true-wireless-earbuds.985-001082.html
2. Garmin venues watch: https://dealicious.dk/smartwatch-og-sportsure/1652-garmin-venu-sports-fitness-ur-rosa-guld-gra-0753759227890.html
3. Eastpack bag: https://www.boozt.com/dk/da/eastpak/buddy_30503616/224642842?position=3&group=related
4. Juice: https://www.bilkatogo.dk/produkt/Salling-%C3%98KO-Appelsinjuice-fra-koncentrat-%C3%B8ko/39099/

Ill. 88:
Pictures sources - classic
1. Knife: https://cateringinventar.dk/produkter/redskaber-toej-service/knive-strygestaal-knivsliber-mv/knive-knive-strygestaal-knivsliber-mv-redskaber-toej-service/kokkekniv-knive-knive-strygestaal-knivsliber-mv-redskaber-toej-service/kokkekniv-255-cm-yaxell-ran/
2. Iphone: https://i.pinimg.com/564x/b4/4e/20/b44e2073e51a672156a45b75244393b2.jpg
3. beoshape: https://i.pinimg.com/564x/59/a4/de/59a4de11f2982df4207f423c0886b647.jpg
4. Gerorg jensen: https://royaldesign.dk/alfredo-kokkenrulleholder
5. Watch: https://www.danielwellington.com/dk/mens-watches/
6. Cover: https://i.pinimg.com/564x/cb/17/e3/cb17e32a62030f149cbde7a85a4795ba.jpg
7. Jacket: https://onug.dk/1/img-2021-nye-vinter-ulden-kludfrakke-herre-enkelt-knap_13716/pic.jpeg
8. Bag: https://img01.ztat.net/article/spp-media-p1/4346f308a4683f98b0cf3fa306f6e333/b49275c9046e45688d18c5f6ec20e5fe.jpg?imwidth=1800
9. Sport: https://i.pinimg.com/564x/04/32/74/04327402d846af8ec86b1abdf5410366.jpg

Pictures sources - Instagram
1. Sunglasses: https://hairstylesbeauty.tumblr.com/post/618495850713382912
2. Ringe: https://www.pinterest.jp/pin/324470348155012129/
3. Nail polish: https://glamorable.com/my-moms-zoya-haul-part-ii-neutrals/
4. Watch: https://overclassy.tumblr.com/image/628350194545754112
5. Flower cover: https://www.insnic.com/products/insnic-flowers-phone-case-for-iphone-1?variant=42215878164717
6. Mirror: https://nordal.dk/skylark-stort-spejl-i-jern-200x100-cm-sort
7. bogO: https://www.hifiklubben.dk/bang--olufsen-beosound-a1-2nd-gen-traadloes-hoejtaler/boa1g2go/
8. Stelton cup: https://hjem.dk/shop/492-rejsekrus/34110-stelton-to-go-click-04-l-rust/?gclid=CjwKCAjw6dmSBhBkEiwA_W-EoLCaeMC_33uEX2EJy0_mmkKE3vCXT8RjBvlk4-MaZJ4d8HtoOoJOEBoCvFkQAvD_BwE
9. Lipstick: https://www.dior.com/en_dk/products/beauty-Y0222004-

Picture sources – outdoor:
1. Cover Phone: https://www.amazon.in/TheGiftKart-Neo-Hybrid-Outstanding-Protection-Shockproof/dp/B08BCS3M6P?th=1
2. Army computerhttps: https://www.pinterest.com/pin/829999406336029101/
3. Speaker: https://www.pinterest.dk/pin/265501340516869515/
4. Buckles: https://i.pinimg.com/564x/10/bf/b7/10bfb7fe1bb-02b299c969c939279202e.jpg
5. Bracelet: https://www.dealcrafty.com/products/fashion-male-jewelry-braided-leather-bracelet-handmade-bracelet-black-stainless-steel-magnetic-clasps-men-wrist-band-gifts?variant=17860729-669a-4214-80e1-630ae2fd217e&epik=dj0yJnU9ejQzc2NyOUxFRW10RVpKeVJnN3E4R0Y2ZEduaWx6ZW8mcD0wJm49alVwOVF1LVRtdDFQelRac0NmMWlwZyZ0PUFBQUFBR0pXYzFF
6. Man with watch: https://www.watchnation.com/product/luminox-bear-grylls-xb-3729/
7. Bag: https://cdna.lystit.com/photos/xhibition/65923b16/human-made-Navy-Military-Backpack.jpeg

Ill. 123: Implement: https://www.pharmazeutische-zeitung.de/laesst-sich-ein-insulin-pen-recyceln-125819/

Ill. 125: Potential partners 5.3
1. Novo Nordisk: https://download.logo.wine/logo/Novo_Nordisk/Novo_Nordisk-Logo.wine.png
2. Eli Lilly and Company: https://download.logo.wine/logo/Eli_Lilly_and_Company/Eli_Lilly_and_Company-Logo.wine.png
3. Sanofi S.A.: https://cdn.contactcenterworld.com/images/company/sanofi-s.a.-1200px-logo.png
4. Merck & co.: https://logowik.com/merck-pharmaceuticals-vector-logo-6833.html
5. Boehringer Ingelheim: https://logos-download.com/11561-boehringer-ingelheim-logo-download.html
6. AstraZeneca PLC: https://www.astrazeneca.com/content/dam/az/homepage/AZ_RGB_H_COL_1200x630.jpg
7. Johnson & Johnson: https://logos-world.net/johnson-johnson-logo/
8. Merck KGaA: https://da.wikipedia.org/wiki/Fil:Logo_Merck_KGaA_2015.svg
9. Bayer: https://commons.wikimedia.org/wiki/File:Logo_Bayer.svg
10. Takeda Pharmaceutical Company Limited: https://commons.wikimedia.org/wiki/File:Logo_Takeda.svg

Ill. 126: Logo 5.3
1. Picture/Logo source: Novo Nordisk: https://download.logo.wine/logo/Novo_Nordisk/Novo_Nordisk-Logo.wine.png
2. Picture/logo source: Sanofi S.A.: https://cdn.contactcenterworld.com/images/company/sanofi-s.a.-1200px-logo.png
3. Picture/logo source: Eli Lilly and Company: https://download.logo.wine/logo/Eli_Lilly_and_Company/Eli_Lilly_and_Company-Logo.wine.png

Ill. 127: Sales channels: 5.4
1. Mitliv.dk: https://www.naeve.dk/wp-content/uploads/Mit-Liv-Logo.png
2. Website logo: https://in.pinterest.com/pin/671740100661393045/
3. Aalborg universistet hospital: https://aalborguh.rn.dk/-/media/Designfiler-og-ikoner/Logo/Print/Aalborg-Universitetshospital_Sort110.ashx?mw=600
4. Steno Diabetes Center Aarhus: https://media-exp1.licdn.com/dms/image/C4E12AQEOfYzSNzsQ1g/article-cover_image-shrink_600_2000/0/1525465320516?e=2147483647&v=beta&t=b7h-m5oaTWGccAU7GD7b_Is--HzNWChm5NLQGV5mqfS8
5. Apotek.dk: https://www.apoteket.dk/brug-af-cookies
6. Mediq: https://mediqdanmark.dk/formular/erhvervnyhedsbrev/

Ill. 128: Kasper Dolberg: https://ronaldo.com/dk/fodboldnyheder/medie-dolberg-naermer-sig-skifte-for-150-millioner-kroner/

Ill. 129: Liv Martine: https://www.dr.dk/nyheder/kultur/bagedyst-vinder-mobbet-paa-nettet-nu-svarer-hun-igen-jeg-naegter-tilfredsstille-jer

Ill. 132: value chain
1. Stevanato logo: https://www.stevanatogroup.com/en/
2. Mitliv logo: https://www.mitliv.dk/diabetes/
3. Eli Lilly Logo: https://logos-download.com/11523-lilly-logo-download.html
4. Packson logo: https://www.packson-mould.com/products/medical-plastic-injection-molding/?gclid=Cj0KCQjwmuiTBhDoARIsAPiv6L_Rz5ZG1EE2v2gYL22eozfm5dxQUp4zFbLPfWyOE78bNzf25BXAC1UaAtnuEALw_wcB
5. Randers gear logo: https://www.randersgears.dk/
6. Dania logo: https://dania.dk/

Ill. 133: Andre penne på markedet
7. Allstar: https://www.mitliv.dk/allstar-pro-soelv-pen1/
8. NovoPen echo plus: https://www.mitliv.dk/novo-pen-echo-plus-elektronisk-flergangsinsulinpen-roed/
9. NovoPen 6: https://www.mitliv.dk/novopen-6-elektronisk-flergangsinsulinpen-soelv/
10. NovoPen Echo: https://multicare-centrum.nl/da/diabetes/forskellige-diabetes-forsyninger/insulin-pen/12503-novo-pen-echo-insulin-pen-rod-8718692270435.html
11. Sanofi: https://www.blood-glucose-monitoring.com/en/insulin-pens/64-autopen-24-for-sanofi-aventis-insulin-3-1-green-04108935.html
12. JuniorStar: https://medicinemarketplace.com/juniorstar-3-0ml-0-5-unit-insulin-pen-blue/
13. NovoPen 5: https://www.diabetiker.info/novopen-5-der-insulin-pen-mit-verstand/

VERSITY

Technical Drawings

Master Thesis in Industrial Design
Aalborg University - Ma4-id4, June 2022
01.02.22 - 25.05.22

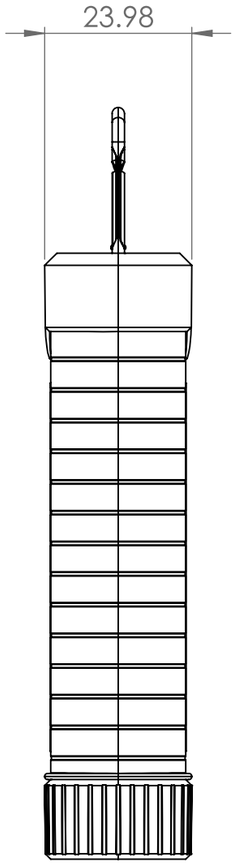
Benjamin Liboriussen
Emma Rosendal Jensen
Katrine Timmermann

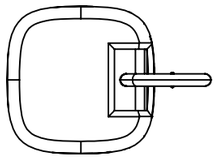
Technical Drawings

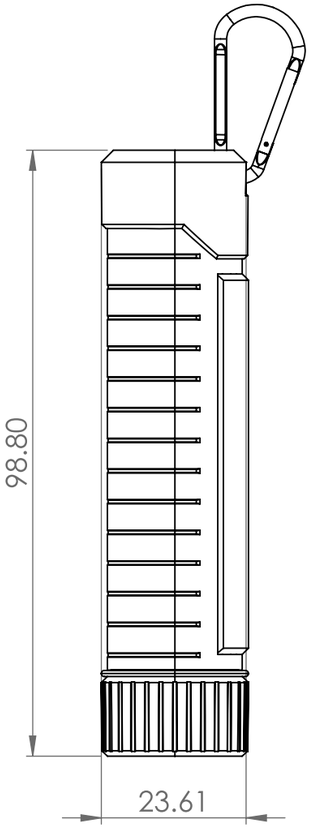
CONTENT

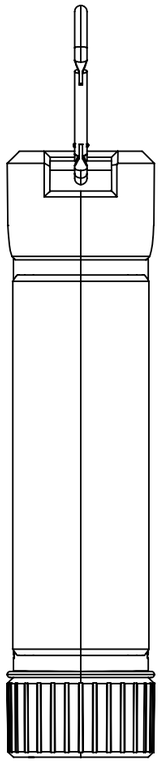
This technical drawings folder is divided into three sections:

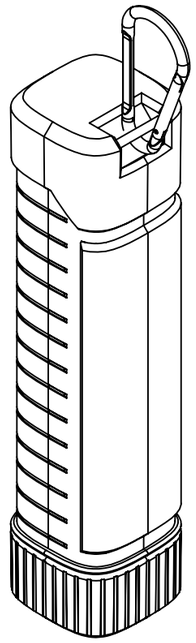
Note: The Base presented in the first section (Base & Hanger) fits into the other two sections (Case & Basic).

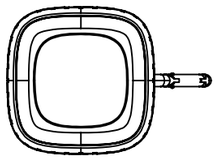




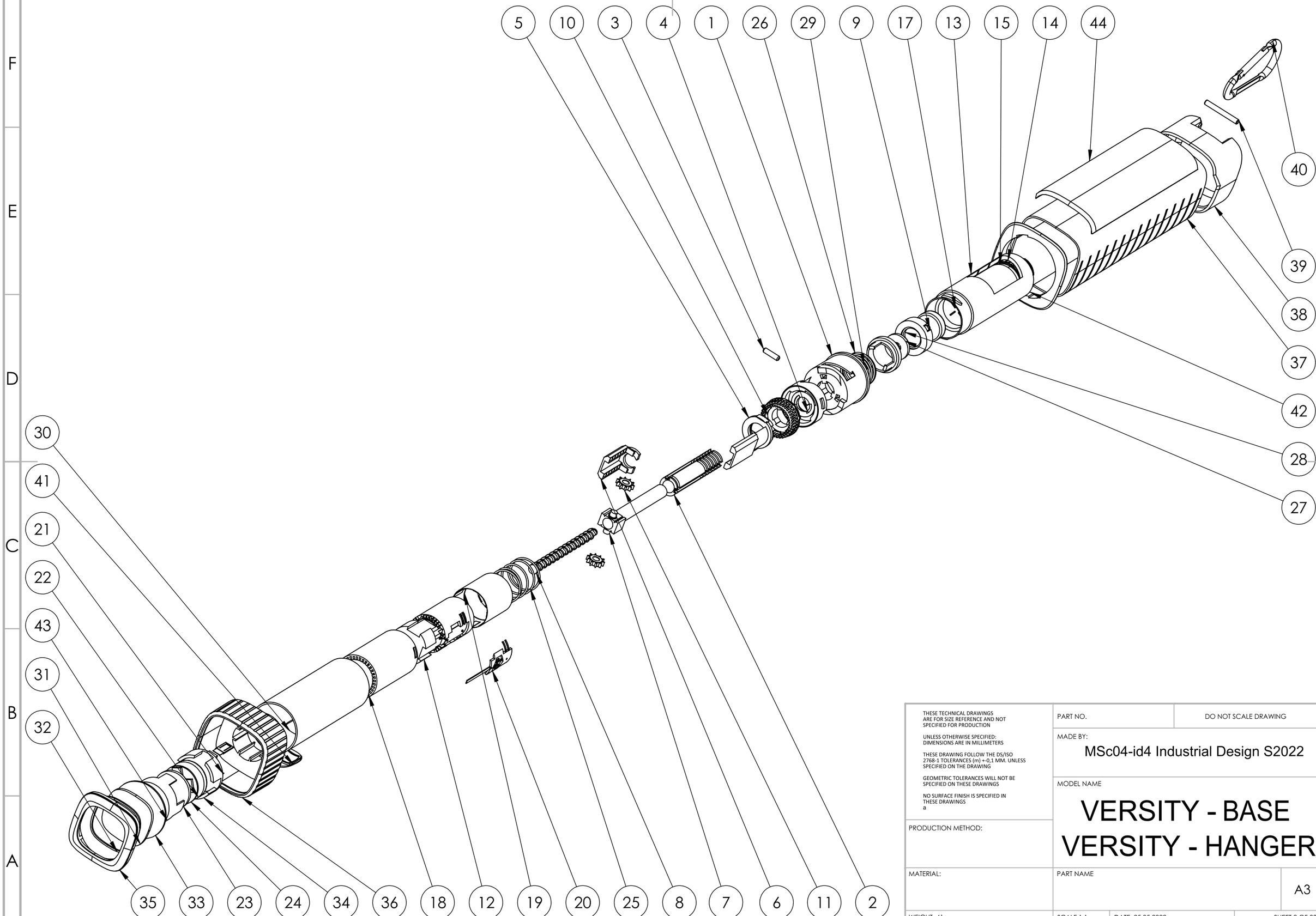








THESE TECHNICAL DRAWINGS ARE FOR SIZE REFERENCE AND NOT SPECIFIED FOR PRODUCTION UNLESS OTHERWISE SPECIFIED: DIMENSIONS ARE IN MILLIMETERS THESE DRAWING FOLLOW THE DS/ISO 2768-1 TOLERANCES (m) +-0,1 MM. UNLESS SPECIFIED ON THE DRAWING GEOMETRIC TOLERANCES WILL NOT BE SPECIFIED ON THESE DRAWINGS NO SURFACE FINISH IS SPECIFIED IN THESE DRAWINGS	PART NO.	DO NOT SCALE DRAWING
	MADE BY: MSc04-id4 Industrial Design S2022	
PRODUCTION METHOD:	MODEL NAME: VERSITY - BASE VERSITY - HANGER	
MATERIAL:	PART NAME	A3
WEIGHT: 41g	SCALE:1:1 / DATE: 25.05.2022	SHEET 1 OF 33



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	MADE BY: MSc04-id4 Industrial Design S2022		
PRODUCTION METHOD:	MODEL NAME VERSITY - BASE VERSITY - HANGER		
MATERIAL:	PART NAME		A3
WEIGHT: 41g	SCALE:1:1	DATE: 25.05.2022	SHEET 2 OF 33

ITEM NO.	PART NUMBER	Part nr.	QTY.
1	Fixed holder mechanism	1	1
2	Lead screw	2	1
3	Center plastic_Pin	Bought externally and cut	1
4	Lead screw holder	4	1
5	Plastic Gearing_Adjuster	5	1
6	Plastic_Adjust_short	6	1
7	Plunger rod controller	7	1
8	Plunger rod	8	1
9	Plunger Rod End	9	1
10	Unit dose gearing	10	1
11	Gear	11	2
12	Gearing holder	12	1
13	Cartridge holder	13	1
14	Cartridge Top screw	Bought externally	1
15	Glass	Bought externally	1
16	Glass metal cap	Bought externally	1
17	Plunger	Bought externally	1
18	Unit counter	18	1
19	Encoder metal	19	1
20	Encoder sensor	Bought externally	1
21	Side button	Bought externally	2
22	Battery	Bought externally	1

ITEM NO.	PART NUMBER	Part nr.	QTY.
23	NFC reader	Bought externally	1
24	Chip board	Bought externally	1
25	Large spring	Bought externally	1
26	Small spring	Bought externally	1
27	Rod holder 2	27	1
28	Plunger Rod holder	28	1
29	Rod holder 3	29	1
30	Mechanism holder	30	1
31	Transparent_Screen	31	1
32	Screen rim	Bought externally	1
33	LCD Screen	Bought externally	1
34	Component housing_bottom	34	1
35	Screen holder_Hanger	35	1
36	Dose adjuster	36	1
37	Lid_Shell_Hanger	37	1
38	Lid_Top_Hanger	38	1
39	Lid_Pin_Hanger	39	1
40	Carbin_Hanger	Bought externally	1
41	Unit counter window	41	1
42	Lid_Lock_Hanger	42	1
43	Component housing_Top	43	1
44	Lid_Grip side_Hanger	37	1

THESE TECHNICAL DRAWINGS ARE FOR SIZE REFERENCE AND NOT SPECIFIED FOR PRODUCTION

UNLESS OTHERWISE SPECIFIED: DIMENSIONS ARE IN MILLIMETERS

THESE DRAWING FOLLOW THE DS/ISO 2768-1 TOLERANCES (m) +-0,1 MM. UNLESS SPECIFIED ON THE DRAWING

GEOMETRIC TOLERANCES WILL NOT BE SPECIFIED ON THESE DRAWINGS

NO SURFACE FINISH IS SPECIFIED IN THESE DRAWINGS

PRODUCTION METHOD:

PART NO.

DO NOT SCALE DRAWING

MADE BY:

MSc04-id4 Industrial Design S2022

MODEL NAME

VERSITY - BASE
VERSITY - HANGER

MATERIAL:

PART NAME

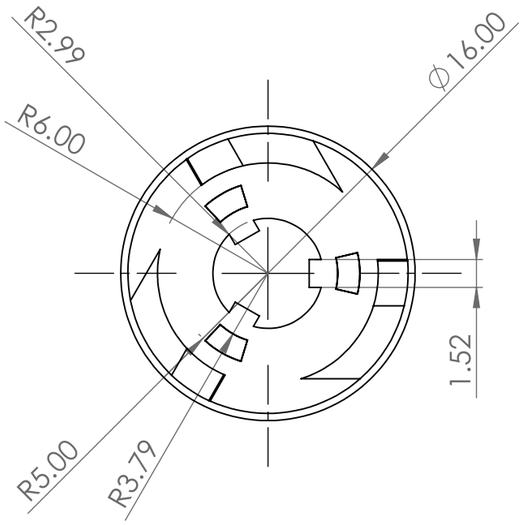
A3

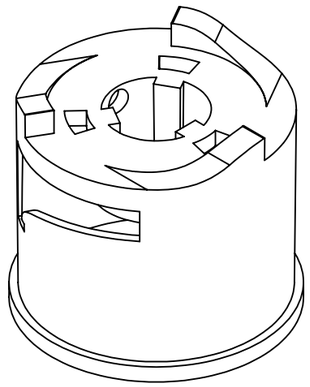
WEIGHT:

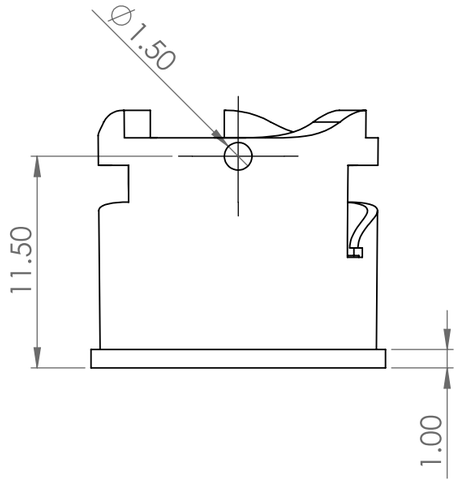
SCALE:

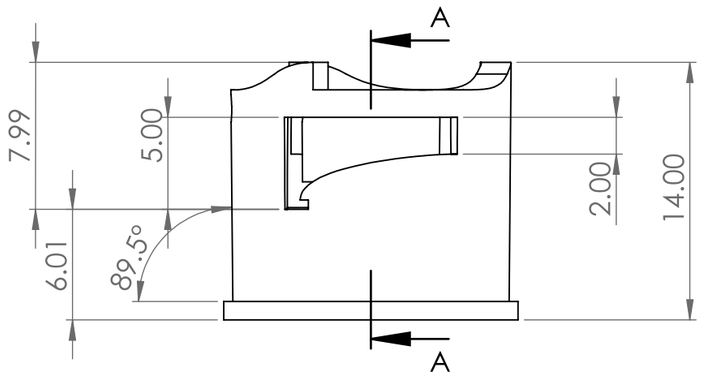
DATE: 25.05.2022

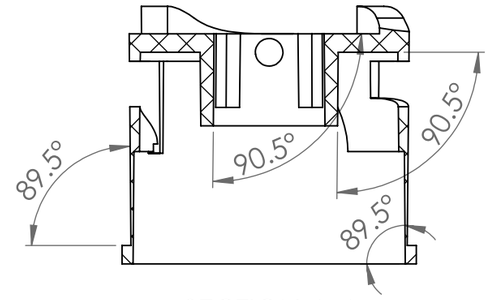
SHEET 3 OF 33



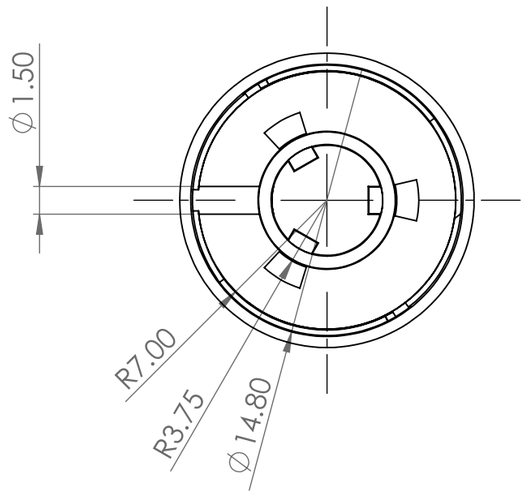








SECTION A-A
SCALE 3 : 1



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UNLESS OTHERWISE SPECIFIED: DIMENSIONS ARE IN MILLIMETERS

THESE DRAWING FOLLOW THE DS/ISO 2768-1 TOLERANCES (m) +-0,1 MM. UNLESS SPECIFIED ON THE DRAWING

GEOMETRIC TOLERANCES WILL NOT BE SPECIFIED ON THESE DRAWINGS

NO SURFACE FINISH IS SPECIFIED IN THESE DRAWINGS

PRODUCTION METHOD: Injection molding

MATERIAL: POM + PTEF (black pigment)

WEIGHT: 0.53g

PART NO. 1

DO NOT SCALE DRAWING

MADE BY: MSc04-id4 Industrial Design S2022

MODEL NAME

VERSITY - BASE

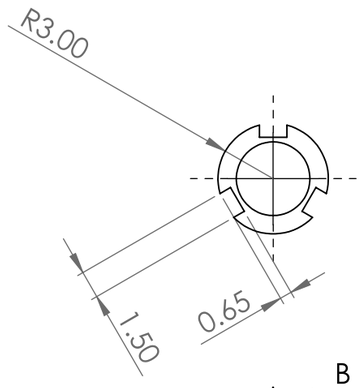
PART NAME: Fixed holder mechanism

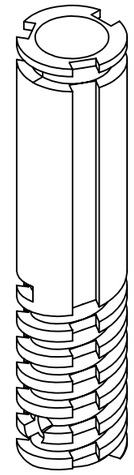
A3

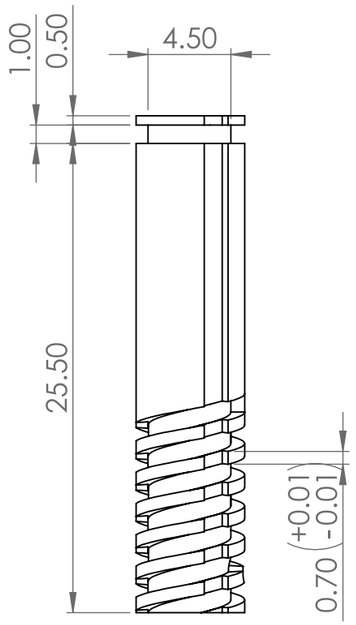
SCALE: 3:1

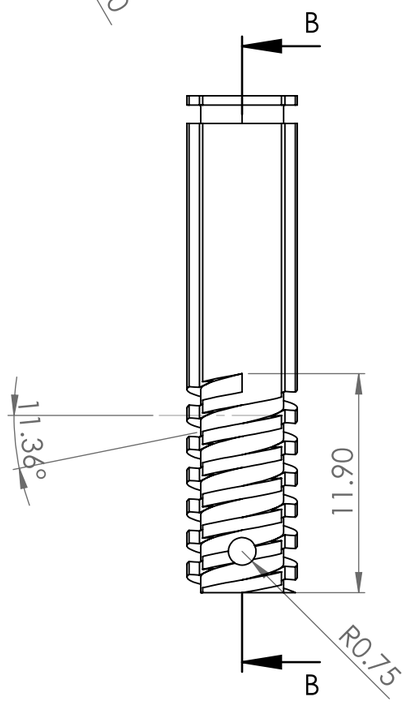
DATE: 25.05.2022

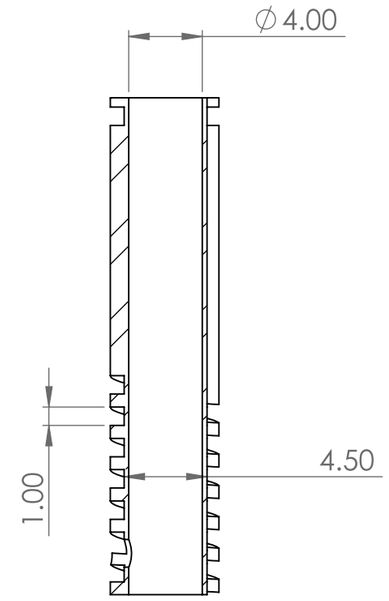
SHEET 4 OF 33



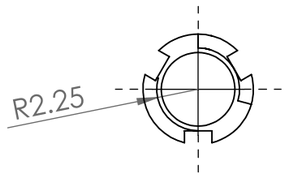








SECTION B-B
SCALE 3 : 1



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UNLESS OTHERWISE SPECIFIED: DIMENSIONS ARE IN MILLIMETERS

THESE DRAWING FOLLOW THE DS/ISO 2768-1 TOLERANCES (m) +-0,1 MM. UNLESS SPECIFIED ON THE DRAWING

GEOMETRIC TOLERANCES WILL NOT BE SPECIFIED ON THESE DRAWINGS

NO SURFACE FINISH IS SPECIFIED IN THESE DRAWINGS

PRODUCTION METHOD:
CNC milling

MATERIAL:
Stainless steel alloy 304

WEIGHT: 2.12g

PART NO. 2

DO NOT SCALE DRAWING

MADE BY:
MSc04-id4 Industrial Design S2022

MODEL NAME

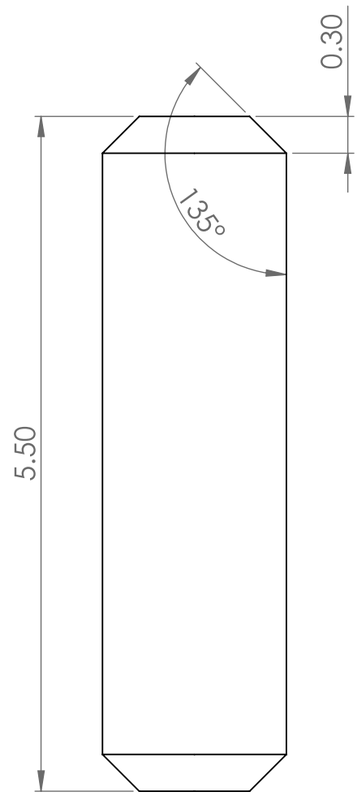
VERSITY - BASE

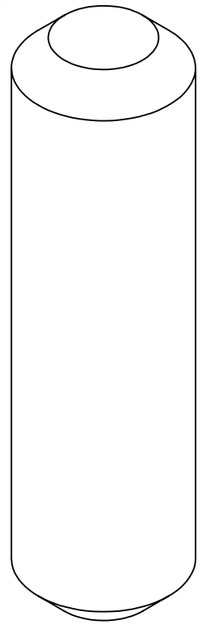
PART NAME
Lead screw

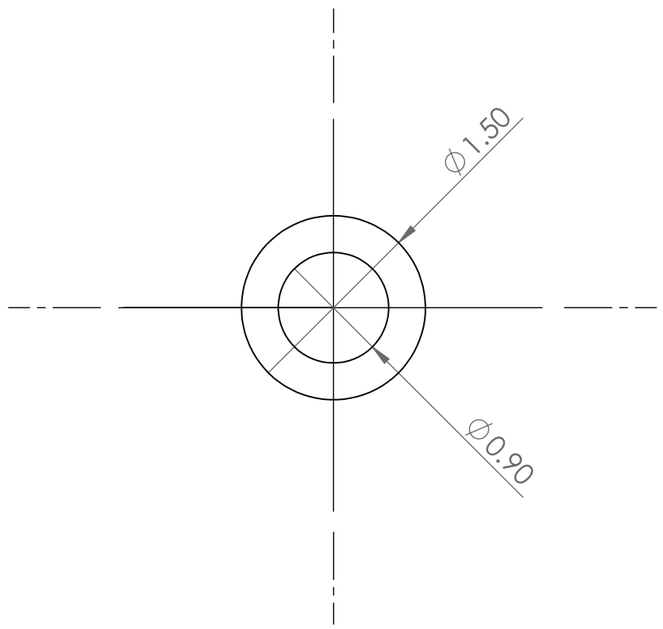
A3

SCALE: 3:1

DATE: 25.05.2022







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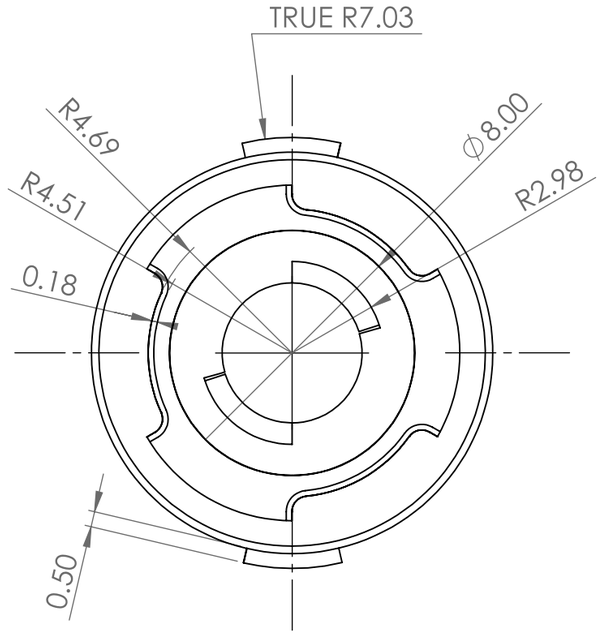
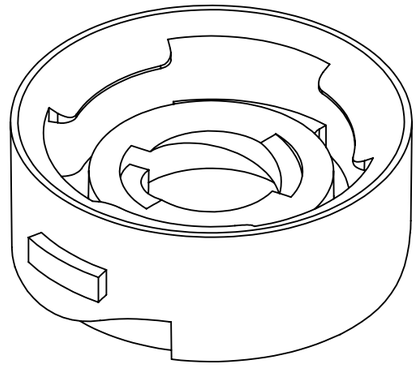
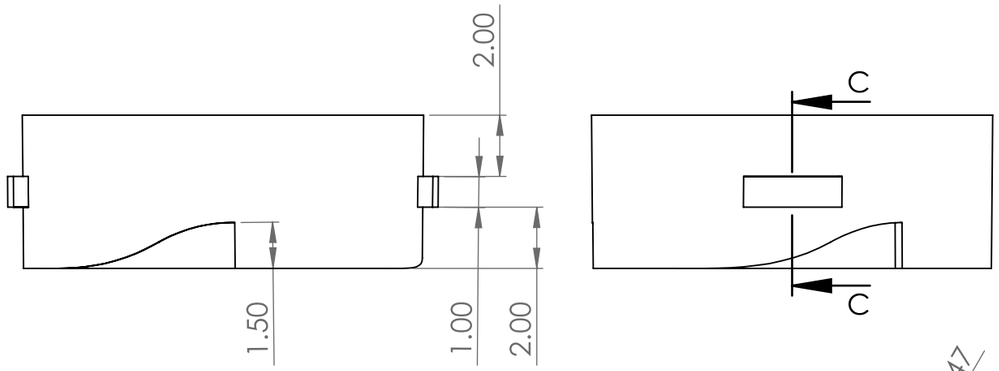
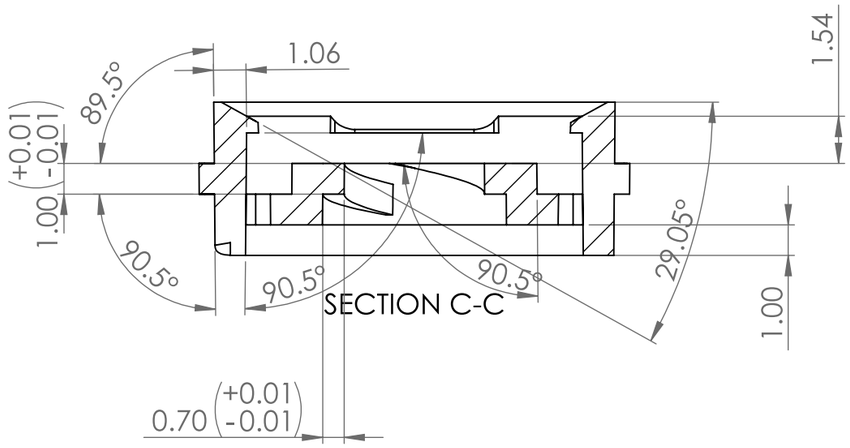
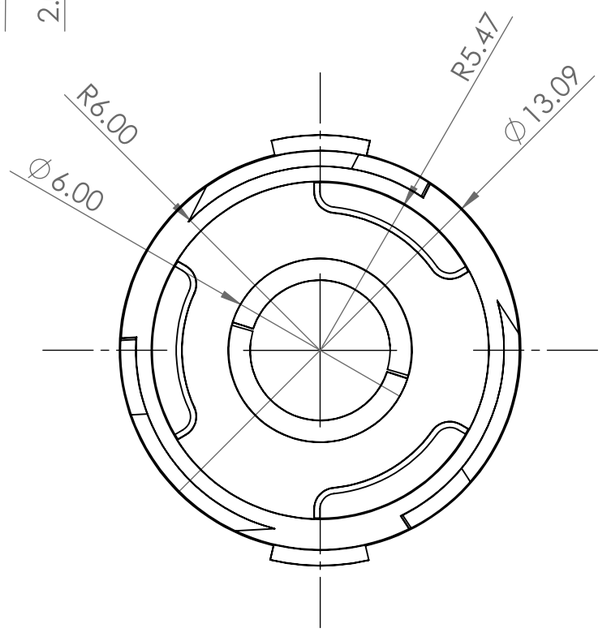
	MADE BY: MSc04-id4 Industrial Design S2022		
	MODEL NAME: VERSITY - BASE		
PRODUCTION METHOD: Bought externally and cut			
MATERIAL: Stainless steel alloy 304	PART NAME: Center plastic_Pin		A3
WEIGHT: 0.07g	SCALE:20:1	DATE: 25.05.2022	SHEET 6 OF 33











THESE TECHNICAL DRAWINGS ARE FOR SIZE REFERENCE AND NOT SPECIFIED FOR PRODUCTION

UNLESS OTHERWISE SPECIFIED: DIMENSIONS ARE IN MILLIMETERS

THESE DRAWING FOLLOW THE DS/ISO 2768-1 TOLERANCES (m) +-0,1 MM. UNLESS SPECIFIED ON THE DRAWING

GEOMETRIC TOLERANCES WILL NOT BE SPECIFIED ON THESE DRAWINGS

NO SURFACE FINISH IS SPECIFIED IN THESE DRAWINGS

PRODUCTION METHOD: Injection molding

MATERIAL: POM + PTEF (black pigment)

WEIGHT: 0.37g

PART NO. 4

DO NOT SCALE DRAWING

MADE BY: MSc04-id4 Industrial Design S2022

MODEL NAME

VERSITY - BASE

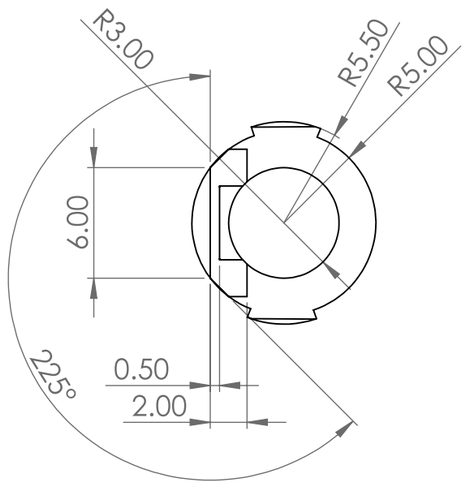
PART NAME: Lead screw holder

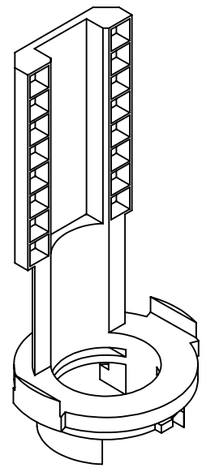
A3

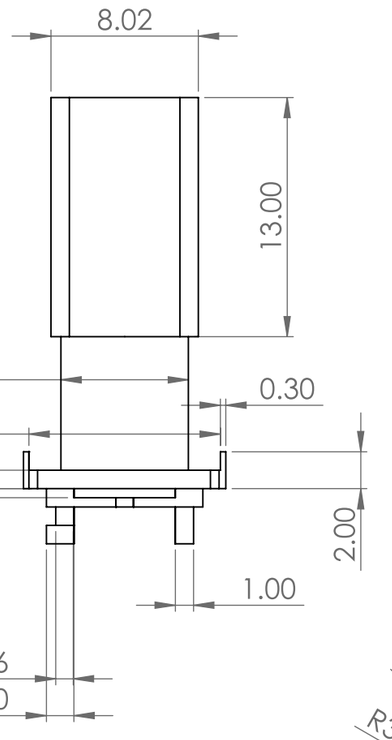
SCALE:5:1

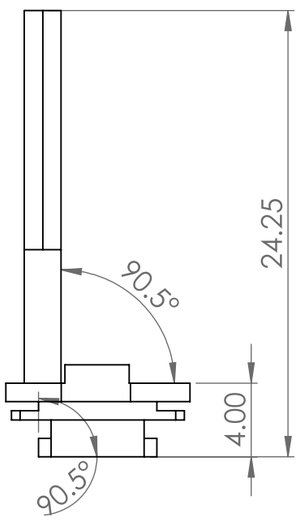
DATE: 25.05.2022

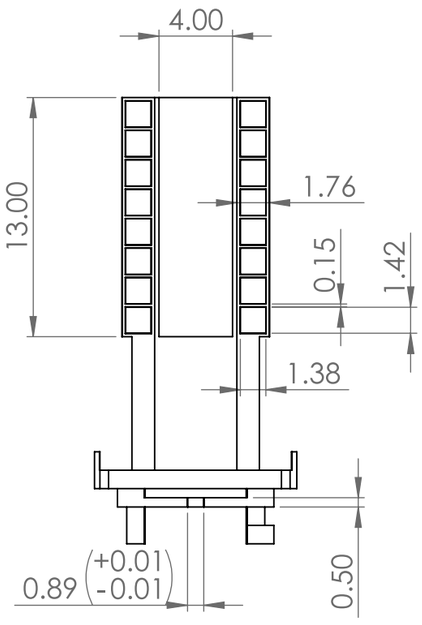
SHEET 7 OF 33

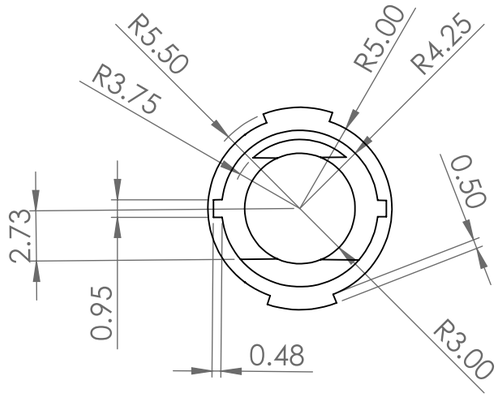












THESE TECHNICAL DRAWINGS ARE FOR SIZE REFERENCE AND NOT SPECIFIED FOR PRODUCTION

UNLESS OTHERWISE SPECIFIED: DIMENSIONS ARE IN MILLIMETERS

THESE DRAWING FOLLOW THE DS/ISO 2768-1 TOLERANCES (m) +-0,1 MM. UNLESS SPECIFIED ON THE DRAWING

GEOMETRIC TOLERANCES WILL NOT BE SPECIFIED ON THESE DRAWINGS

NO SURFACE FINISH IS SPECIFIED IN THESE DRAWINGS

PRODUCTION METHOD: Injection molding

MATERIAL: POM + PTEF (milky white)

WEIGHT: 0.31g

PART NO. 5

DO NOT SCALE DRAWING

MADE BY: MSc04-id4 Industrial Design S2022

MODEL NAME

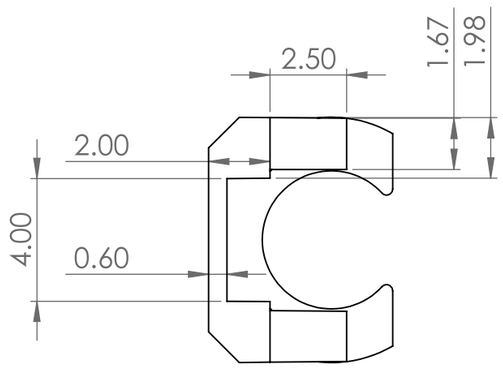
VERSITY - BASE

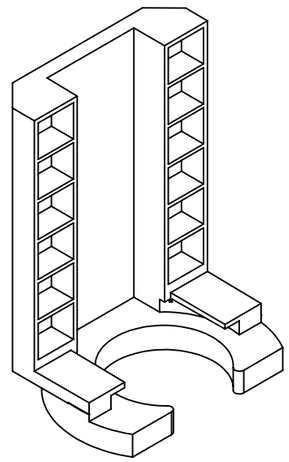
PART NAME: Plastic Gearing_Adjuster

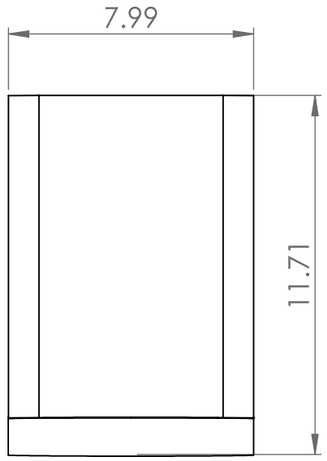
A3

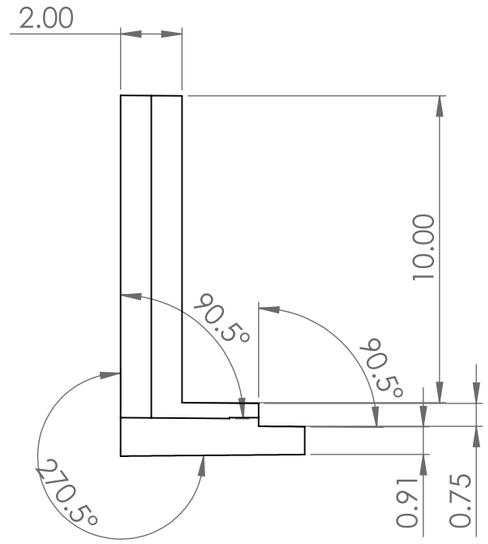
SCALE: 3:1

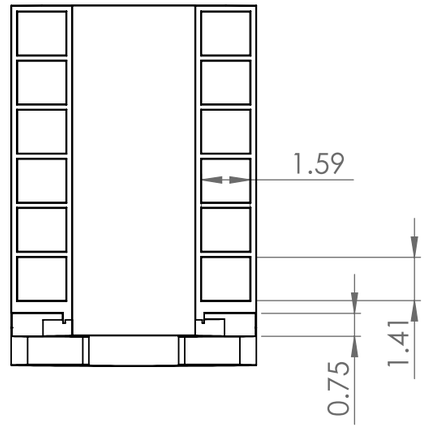
DATE: 25.05.2022

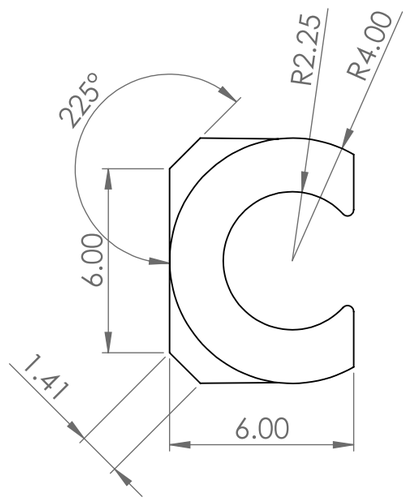












THESE TECHNICAL DRAWINGS ARE FOR SIZE REFERENCE AND NOT SPECIFIED FOR PRODUCTION

UNLESS OTHERWISE SPECIFIED: DIMENSIONS ARE IN MILLIMETERS

THESE DRAWING FOLLOW THE DS/ISO 2768-1 TOLERANCES (m) +-0,1 MM. UNLESS SPECIFIED ON THE DRAWING

GEOMETRIC TOLERANCES WILL NOT BE SPECIFIED ON THESE DRAWINGS

NO SURFACE FINISH IS SPECIFIED IN THESE DRAWINGS

PRODUCTION METHOD:
Injection molding

MATERIAL:
POM + PTEF (milky white)

WEIGHT: 0.14g

PART NO. 6

DO NOT SCALE DRAWING

MADE BY:
MSc04-id4 Industrial Design S2022

MODEL NAME

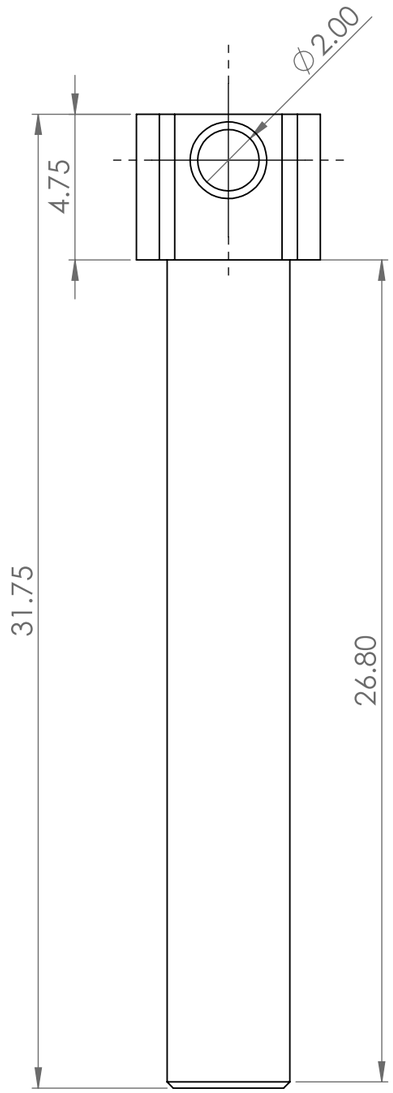
VERSITY - BASE

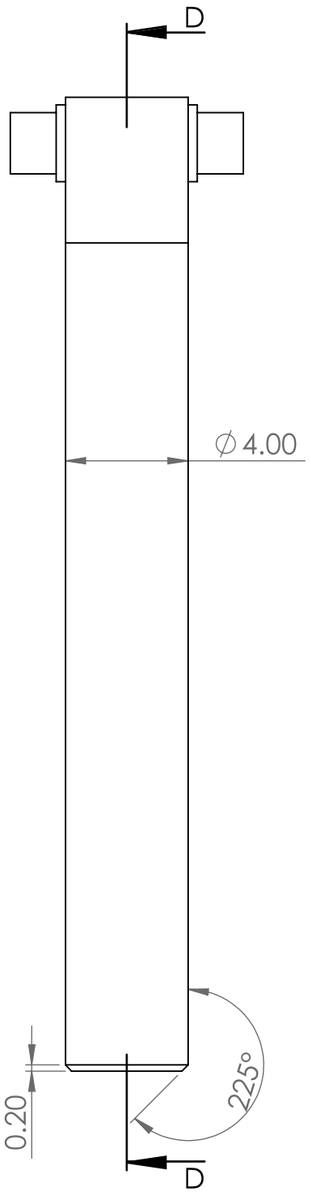
PART NAME
Plastic_Adjust_short

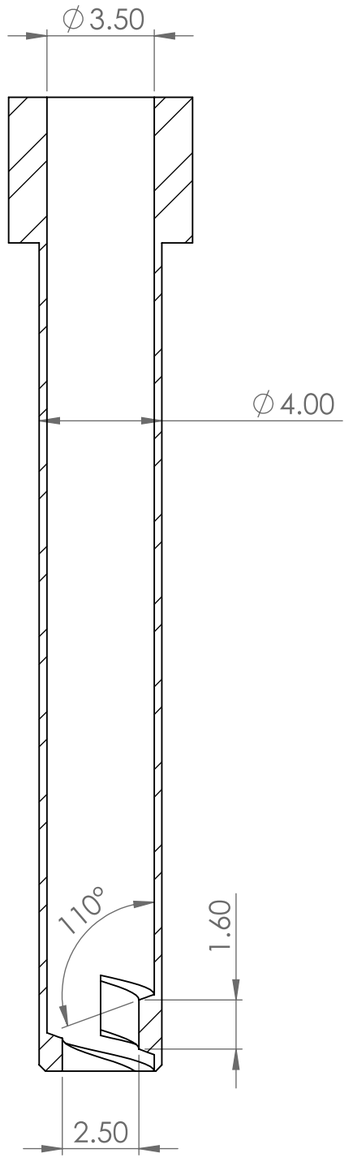
A3

SCALE:5:1

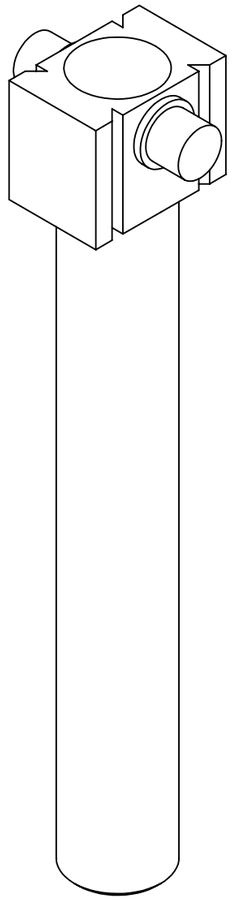
DATE: 25.05.2022

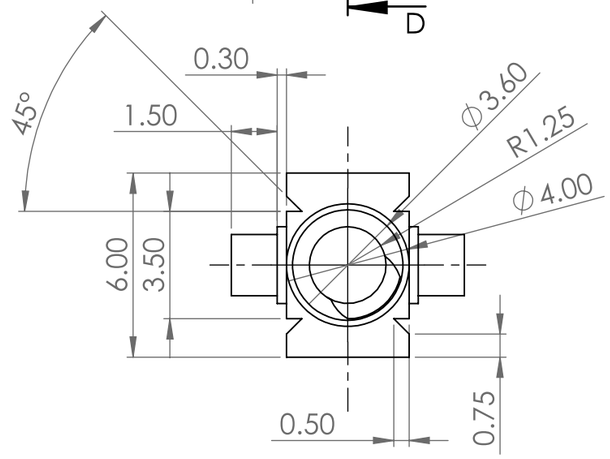






SECTION D-D
SCALE 5 : 1





THESE TECHNICAL DRAWINGS ARE FOR SIZE REFERENCE AND NOT SPECIFIED FOR PRODUCTION

UNLESS OTHERWISE SPECIFIED: DIMENSIONS ARE IN MILLIMETERS

THESE DRAWING FOLLOW THE DS/ISO 2768-1 TOLERANCES (m) +-0,1 MM. UNLESS SPECIFIED ON THE DRAWING

GEOMETRIC TOLERANCES WILL NOT BE SPECIFIED ON THESE DRAWINGS

NO SURFACE FINISH IS SPECIFIED IN THESE DRAWINGS

PRODUCTION METHOD:
CNC milling

MATERIAL:
Stainless steel alloy 304

WEIGHT: 1.32g

PART NO. 7

DO NOT SCALE DRAWING

MADE BY:
MSc04-id4 Industrial Design S2022

MODEL NAME

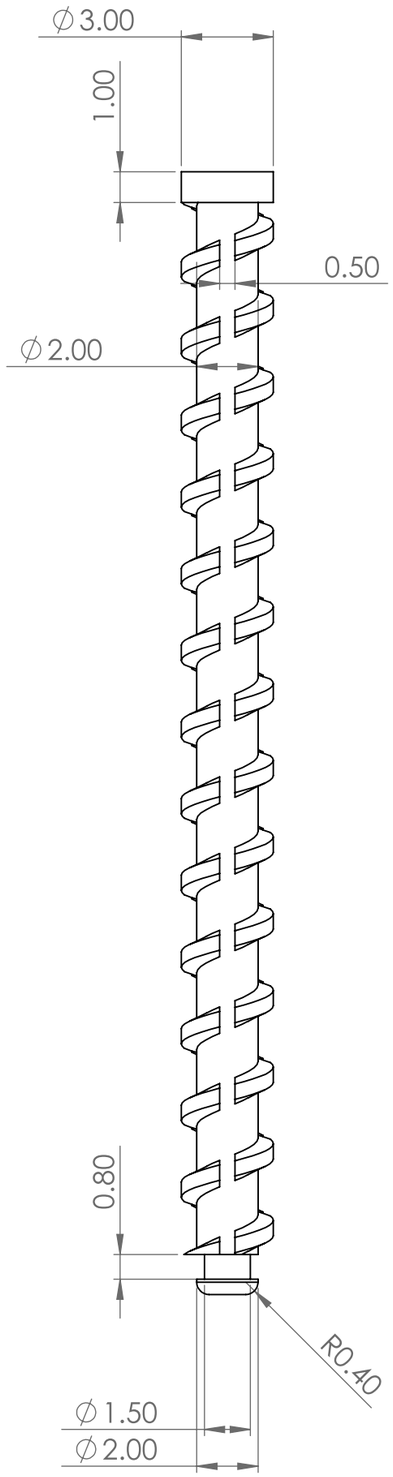
VERSITY - BASE

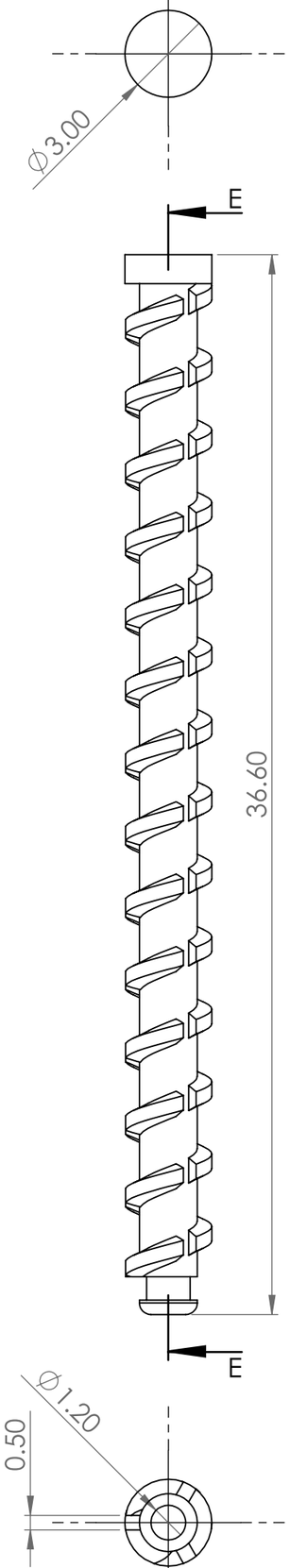
PART NAME
Plunger rod controller

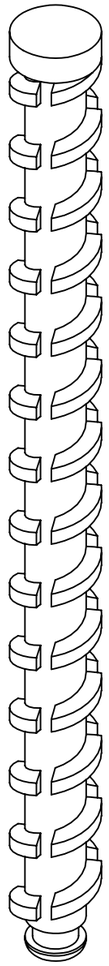
A3

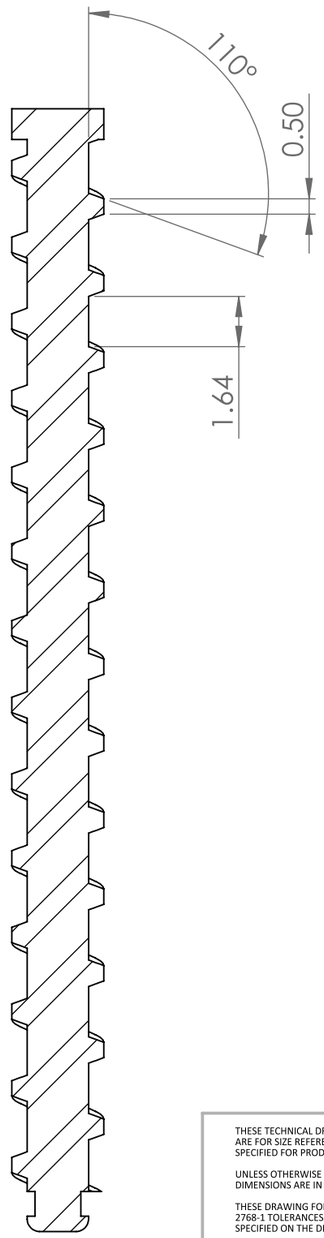
SCALE:2:1

DATE: 25.05.2022









SECTION E-E
SCALE 5 : 1

THESE TECHNICAL DRAWINGS ARE FOR SIZE REFERENCE AND NOT SPECIFIED FOR PRODUCTION

UNLESS OTHERWISE SPECIFIED: DIMENSIONS ARE IN MILLIMETERS

THESE DRAWING FOLLOW THE DS/ISO 2768-1 TOLERANCES (m) +-0,1 MM. UNLESS SPECIFIED ON THE DRAWING

GEOMETRIC TOLERANCES WILL NOT BE SPECIFIED ON THESE DRAWINGS

NO SURFACE FINISH IS SPECIFIED IN THESE DRAWINGS

PRODUCTION METHOD:
CNC milling

MATERIAL:
Stainless steel alloy 304

WEIGHT: 1.17g

PART NO. 8

DO NOT SCALE DRAWING

MADE BY:
MSc04-id4 Industrial Design S2022

MODEL NAME
VERSITY - BASE

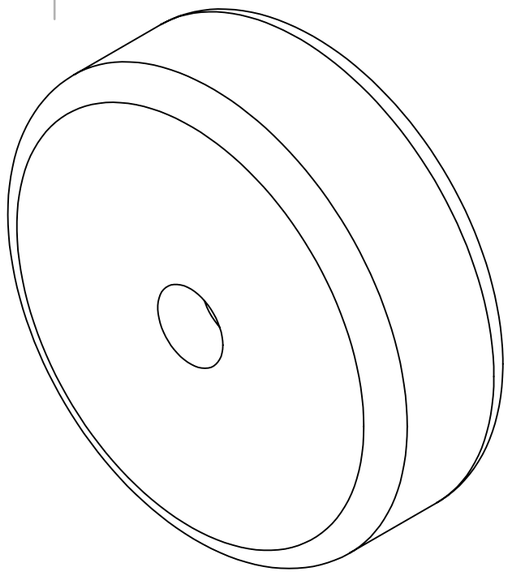
PART NAME
Plunger rod

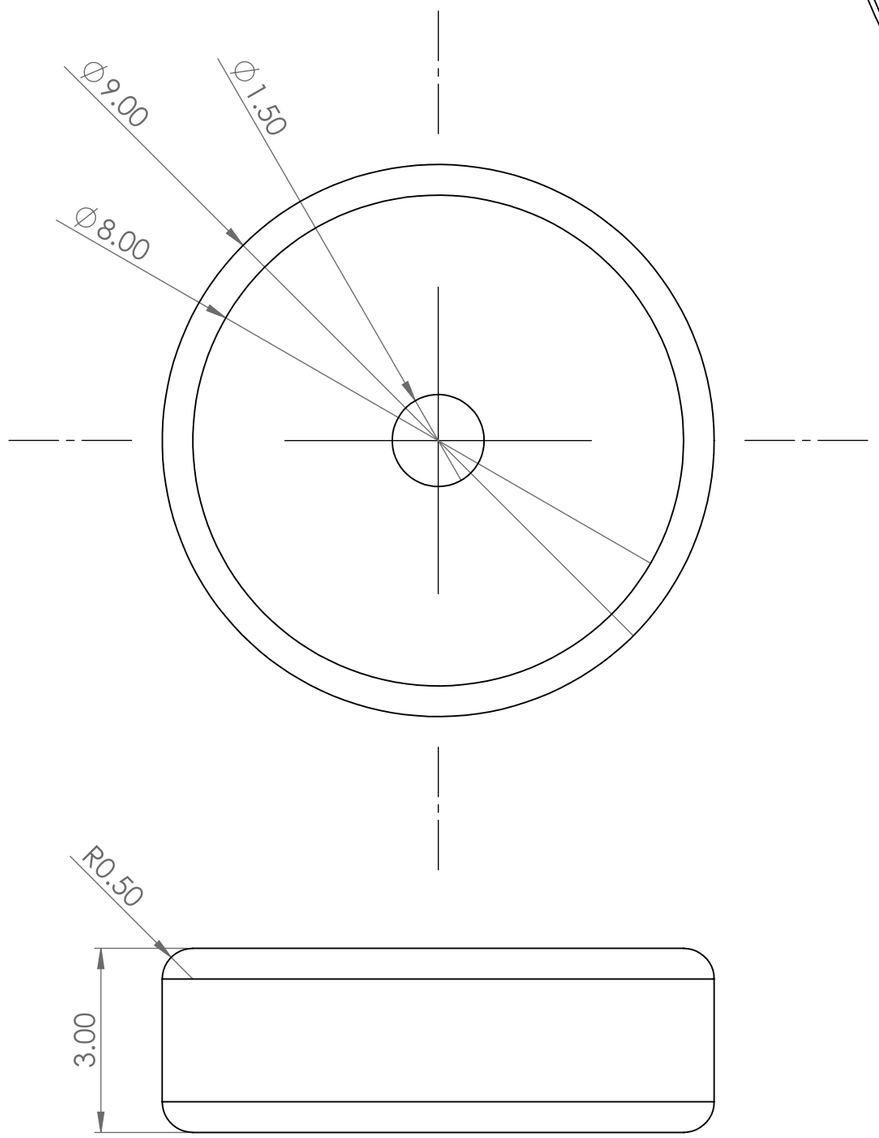
A3

SCALE:2:1

DATE: 25.05.2022

SHEET 11 OF 33





THESE TECHNICAL DRAWINGS ARE FOR SIZE REFERENCE AND NOT SPECIFIED FOR PRODUCTION

UNLESS OTHERWISE SPECIFIED: DIMENSIONS ARE IN MILLIMETERS

THESE DRAWING FOLLOW THE DS/ISO 2768-1 TOLERANCES (m) +-0,1 MM. UNLESS SPECIFIED ON THE DRAWING

GEOMETRIC TOLERANCES WILL NOT BE SPECIFIED ON THESE DRAWINGS

NO SURFACE FINISH IS SPECIFIED IN THESE DRAWINGS

PRODUCTION METHOD:
Injection molding

MATERIAL:
POM + PTEF (black pigment)

WEIGHT: 0.21g

PART NO. 9

DO NOT SCALE DRAWING

MADE BY:
MSc04-id4 Industrial Design S2022

MODEL NAME
VERSITY - BASE

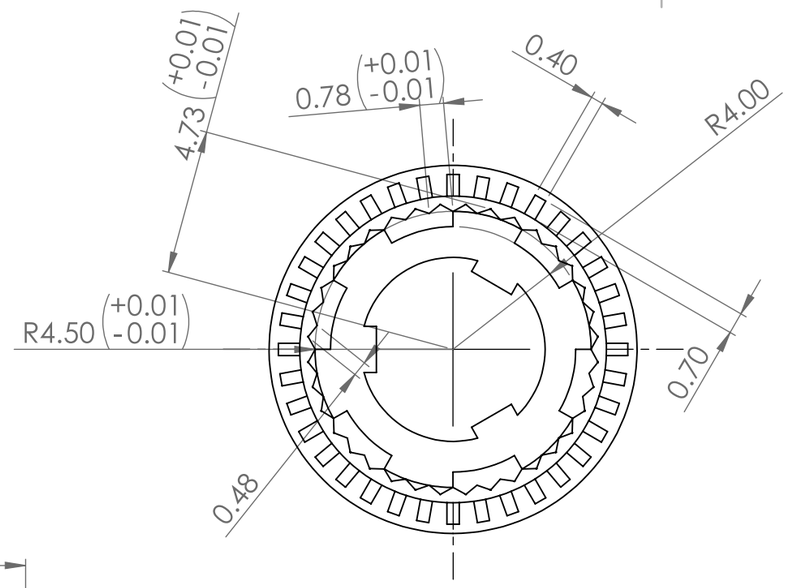
PART NAME
Plunger Rod End

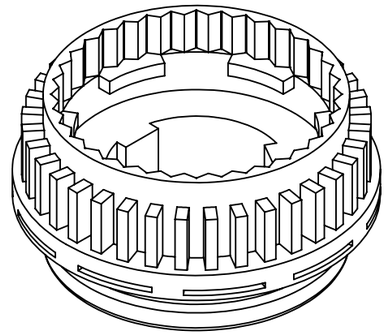
A3

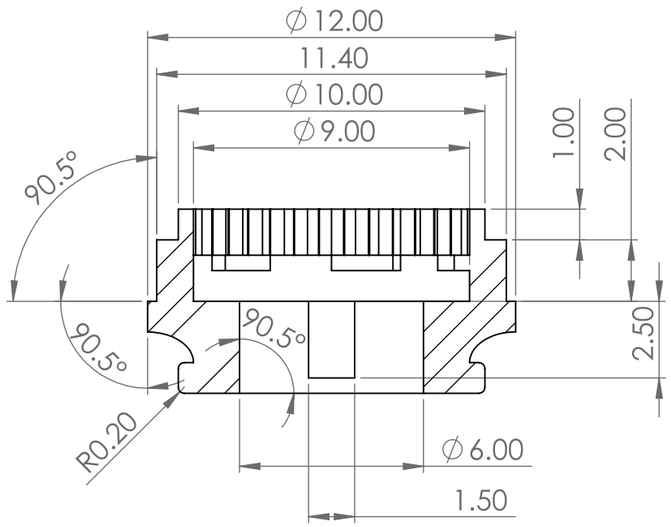
SCALE:10:1

DATE: 25.05.2022

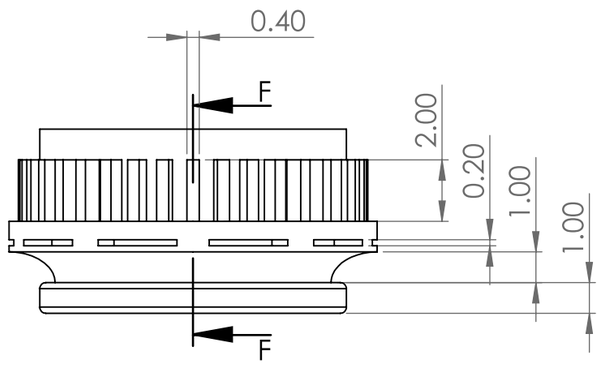
SHEET 12 OF 33

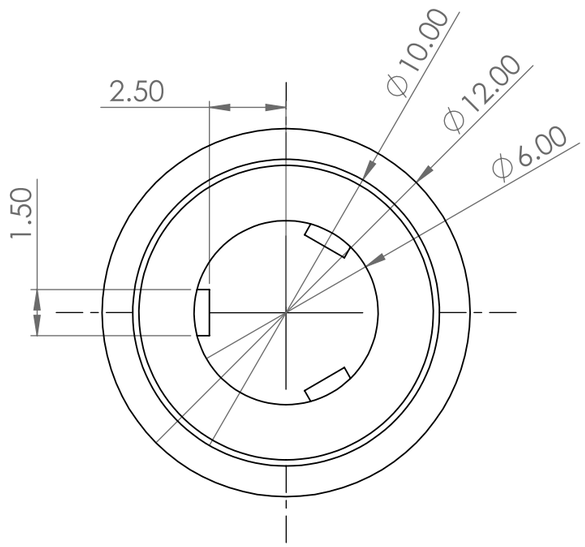






SECTION F-F





THESE TECHNICAL DRAWINGS ARE FOR SIZE REFERENCE AND NOT SPECIFIED FOR PRODUCTION

UNLESS OTHERWISE SPECIFIED: DIMENSIONS ARE IN MILLIMETERS

THESE DRAWING FOLLOW THE DS/ISO 2768-1 TOLERANCES (m) +-0,1 MM. UNLESS SPECIFIED ON THE DRAWING

GEOMETRIC TOLERANCES WILL NOT BE SPECIFIED ON THESE DRAWINGS

NO SURFACE FINISH IS SPECIFIED IN THESE DRAWINGS

PRODUCTION METHOD: Injection molding

MATERIAL: POM + PTEF (milky white)

WEIGHT: 0.34g

PART NO. 10

DO NOT SCALE DRAWING

MADE BY: MSc04-id4 Industrial Design S2022

MODEL NAME

VERSITY - BASE

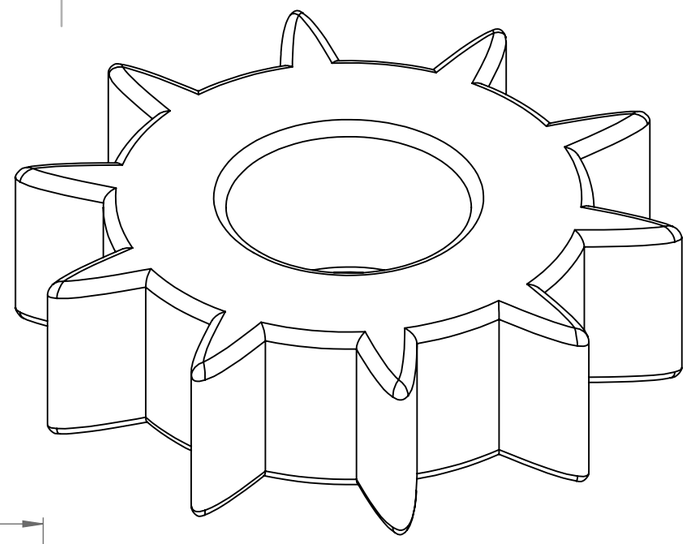
PART NAME: Unit dose gearing

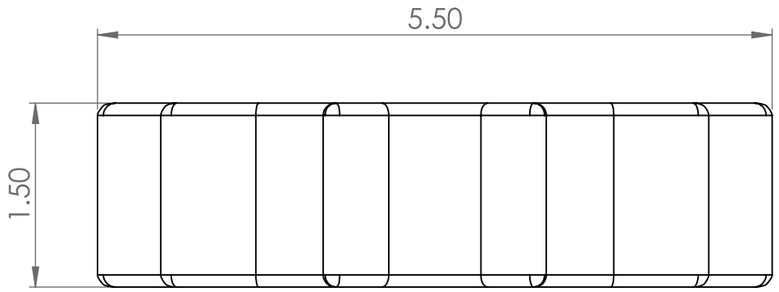
A3

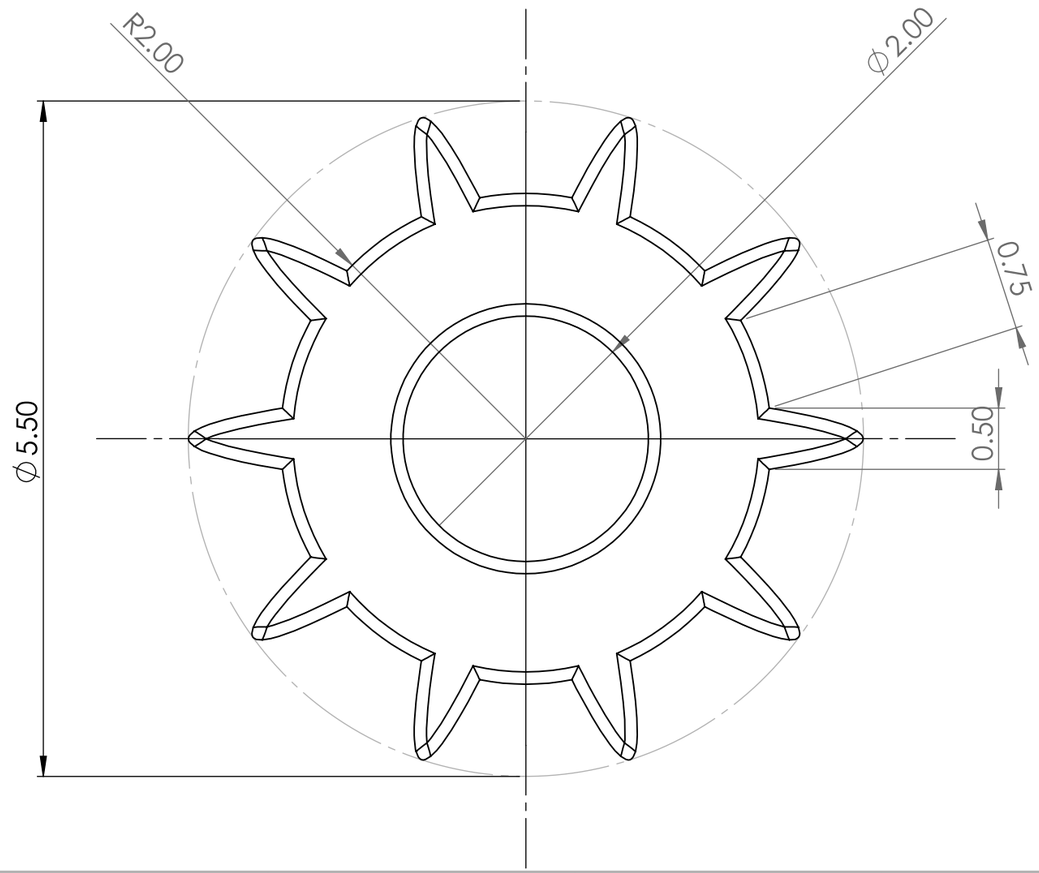
SCALE:5:1

DATE: 25.05.2022

SHEET 13 OF 33







Tolerances on this part is fine = -+ 0,05

THESE TECHNICAL DRAWINGS ARE FOR SIZE REFERENCE AND NOT SPECIFIED FOR PRODUCTION

UNLESS OTHERWISE SPECIFIED: DIMENSIONS ARE IN MILLIMETERS

THESE DRAWING FOLLOW THE DS/ISO 2768-1 TOLERANCES (m) +-0,1 MM. UNLESS SPECIFIED ON THE DRAWING

GEOMETRIC TOLERANCES WILL NOT BE SPECIFIED ON THESE DRAWINGS

NO SURFACE FINISH IS SPECIFIED IN THESE DRAWINGS

PART NO. 11

DO NOT SCALE DRAWING

MADE BY:

MSc04-id4 Industrial Design S2022

MODEL NAME

VERSITY - BASE

PRODUCTION METHOD:

MIM (Metal injection molding)

MATERIAL:

Stainless steel alloy 304

PART NAME

Gear

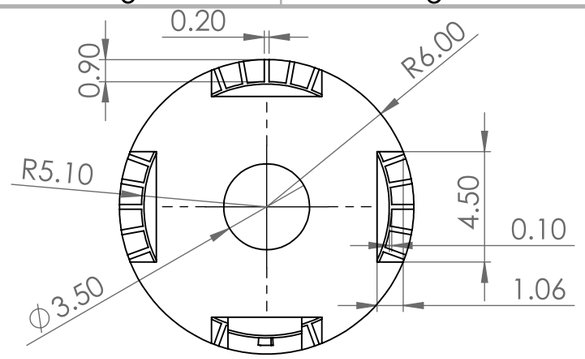
A3

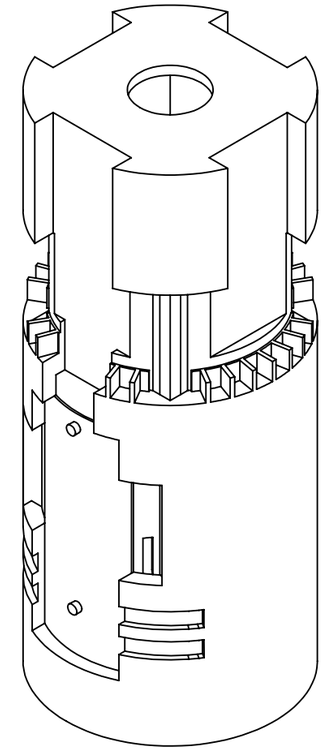
WEIGHT: 0.14g

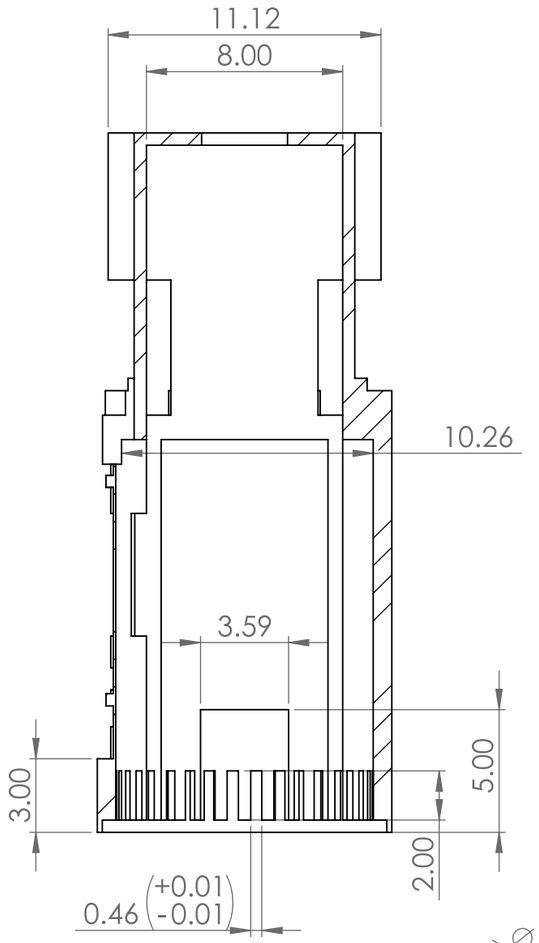
SCALE:20:1

DATE: 25.05.2022

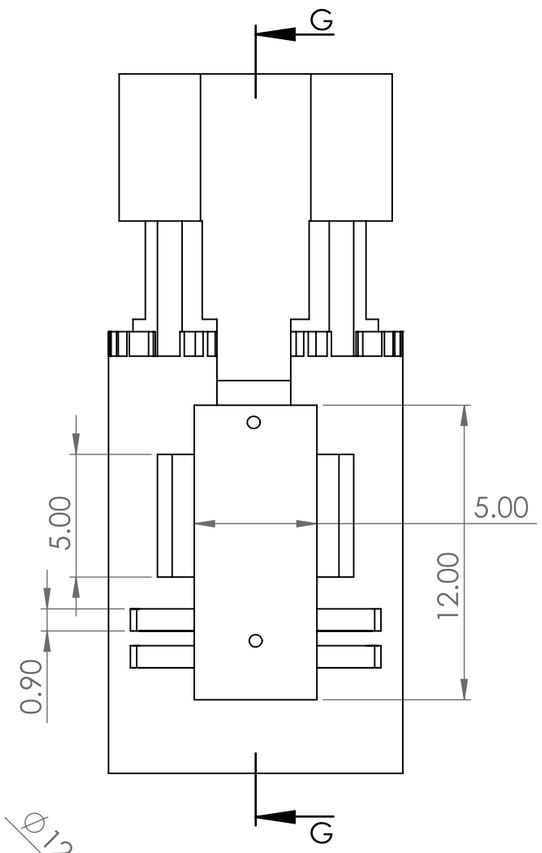
SHEET 14 OF 33

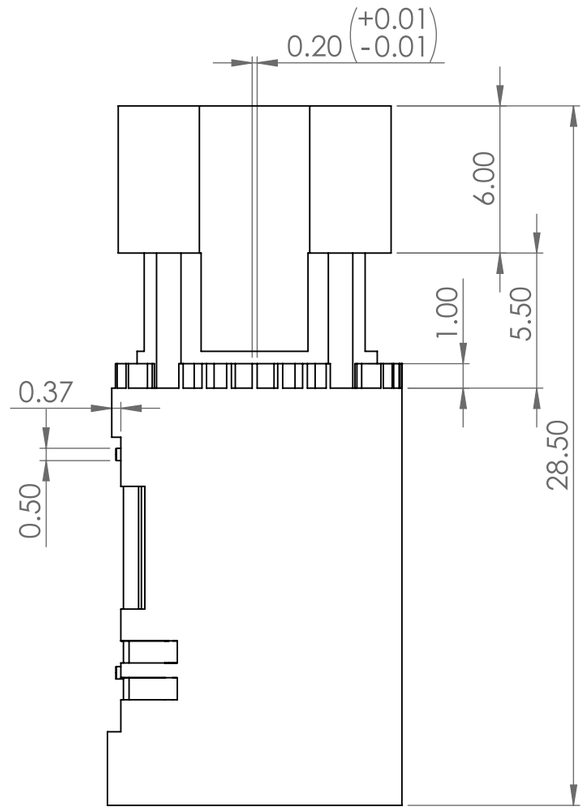


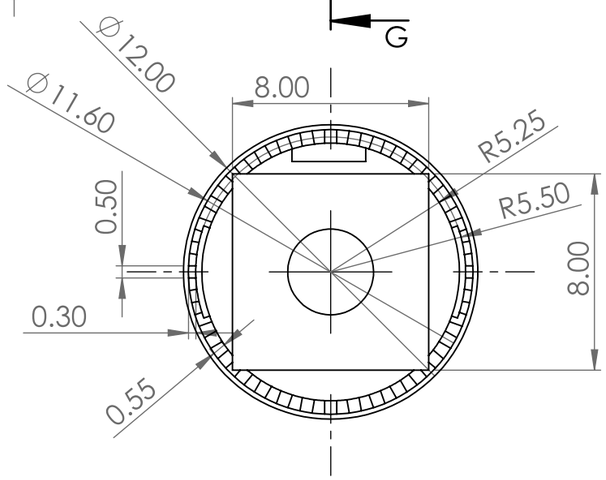




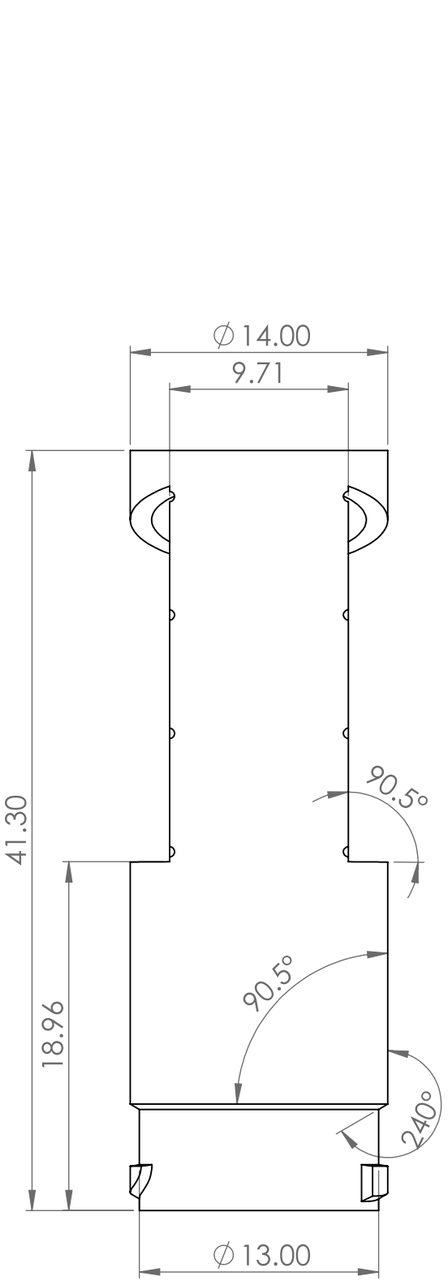
SECTION G-G
SCALE 4 : 1

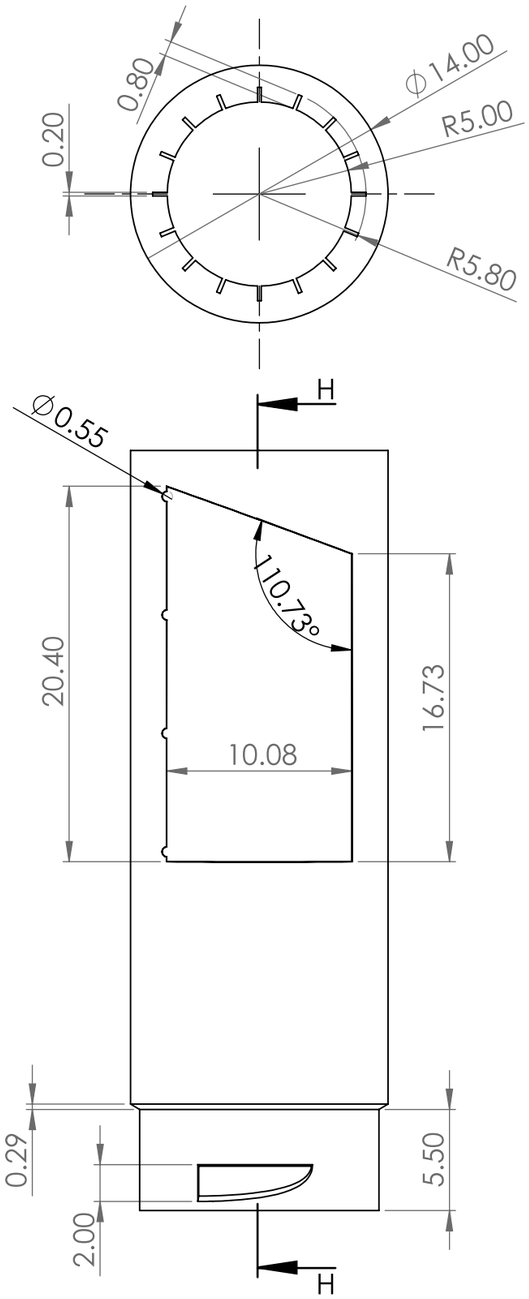


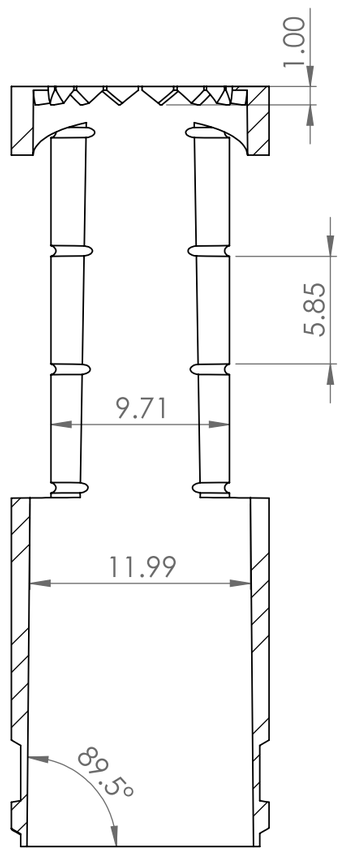




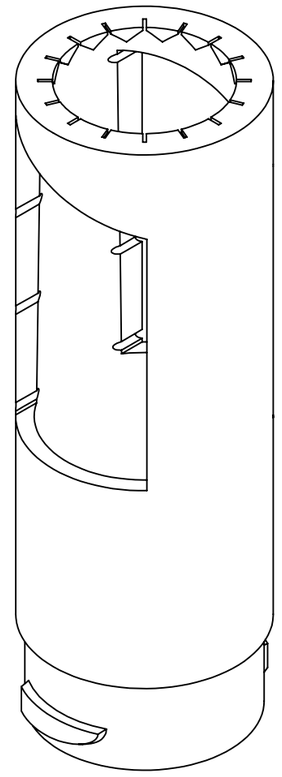
THESE TECHNICAL DRAWINGS ARE FOR SIZE REFERENCE AND NOT SPECIFIED FOR PRODUCTION UNLESS OTHERWISE SPECIFIED: DIMENSIONS ARE IN MILLIMETERS THESE DRAWING FOLLOW THE DS/ISO 2768-1 TOLERANCES (m) +-0,1 MM. UNLESS SPECIFIED ON THE DRAWING GEOMETRIC TOLERANCES WILL NOT BE SPECIFIED ON THESE DRAWINGS NO SURFACE FINISH IS SPECIFIED IN THESE DRAWINGS	PART NO. 12	DO NOT SCALE DRAWING
	MADE BY: MSc04-id4 Industrial Design S2022	
	MODEL NAME: VERSITY - BASE	
PRODUCTION METHOD: Injection molding		
MATERIAL: POM + PTEF (milky white)	PART NAME: Gearing holder	A3
WEIGHT: 0.85g	SCALE: 4:1 DATE: 25.05.2022	SHEET 15 OF 33

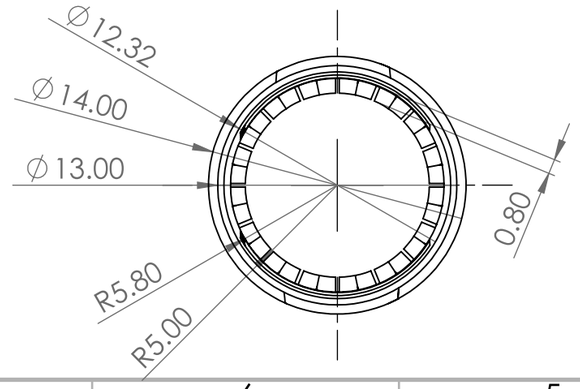






SECTION H-H
SCALE 3 : 1





THESE TECHNICAL DRAWINGS ARE FOR SIZE REFERENCE AND NOT SPECIFIED FOR PRODUCTION

UNLESS OTHERWISE SPECIFIED: DIMENSIONS ARE IN MILLIMETERS

THESE DRAWING FOLLOW THE DS/ISO 2768-1 TOLERANCES (m) +-0,1 MM. UNLESS SPECIFIED ON THE DRAWING

GEOMETRIC TOLERANCES WILL NOT BE SPECIFIED ON THESE DRAWINGS

NO SURFACE FINISH IS SPECIFIED IN THESE DRAWINGS

PRODUCTION METHOD: Injection molding

MATERIAL: POM + PTEF (black pigment)

WEIGHT: 1.6g

PART NO. 13

DO NOT SCALE DRAWING

MADE BY: MSc04-id4 Industrial Design S2022

MODEL NAME

VERSITY - BASE

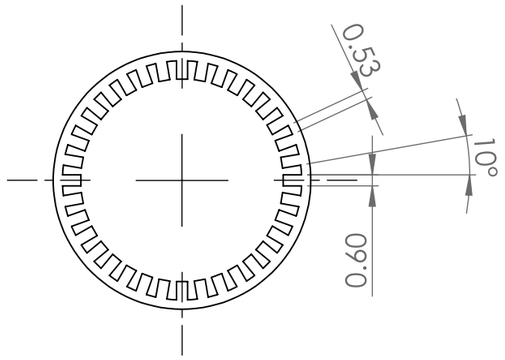
PART NAME: Cartridge holder

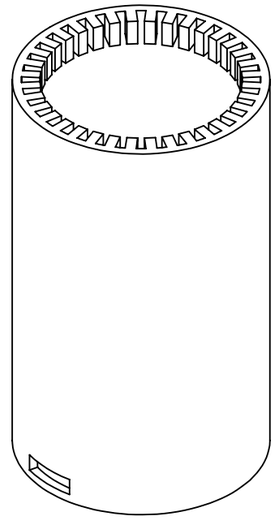
A3

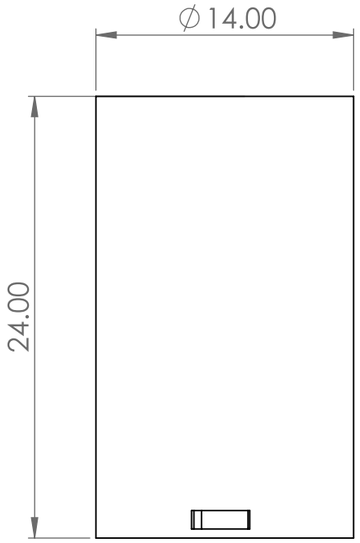
SCALE:2:1

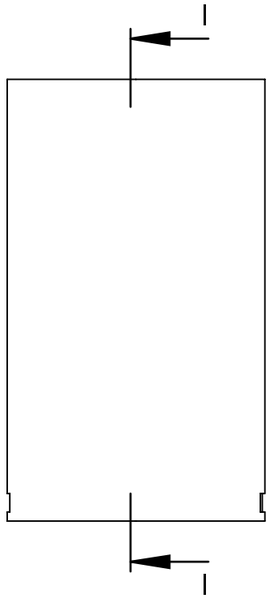
DATE: 25.05.2022

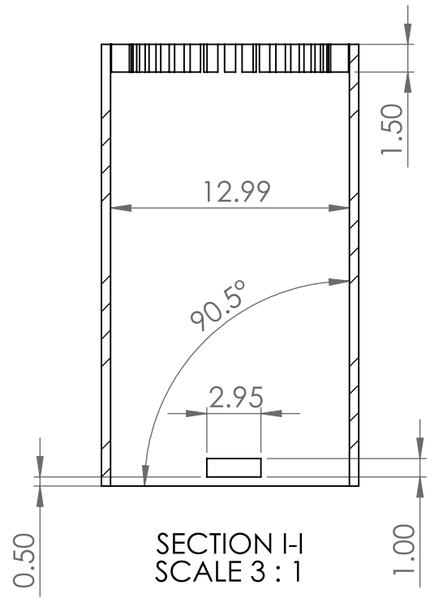
SHEET 16 OF 33

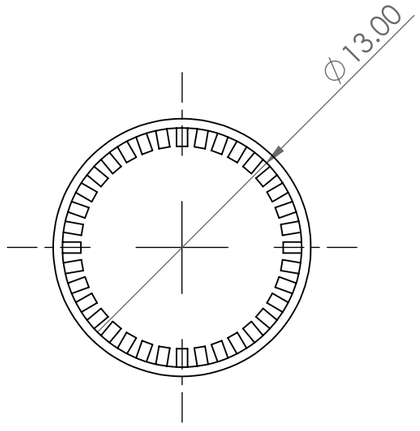












THESE TECHNICAL DRAWINGS ARE FOR SIZE REFERENCE AND NOT SPECIFIED FOR PRODUCTION

UNLESS OTHERWISE SPECIFIED: DIMENSIONS ARE IN MILLIMETERS

THESE DRAWING FOLLOW THE DS/ISO 2768-1 TOLERANCES (m) +-0,1 MM. UNLESS SPECIFIED ON THE DRAWING

GEOMETRIC TOLERANCES WILL NOT BE SPECIFIED ON THESE DRAWINGS

NO SURFACE FINISH IS SPECIFIED IN THESE DRAWINGS

PRODUCTION METHOD: Injection molding

MATERIAL: PC / ABS blend (white pigment)

WEIGHT: 0.64g

PART NO. 18

DO NOT SCALE DRAWING

MADE BY: MSc04-id4 Industrial Design S2022

MODEL NAME

VERSITY - BASE

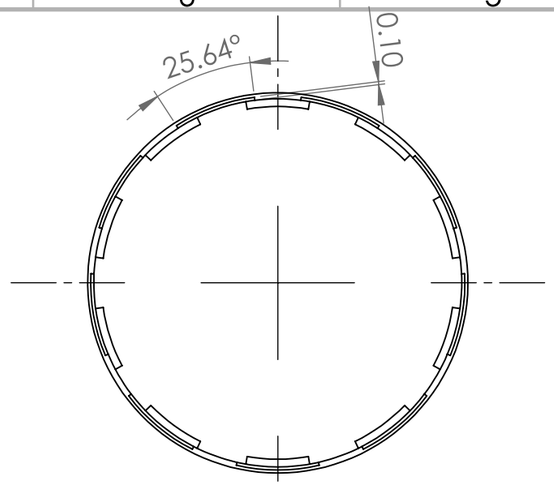
PART NAME: Unit counter

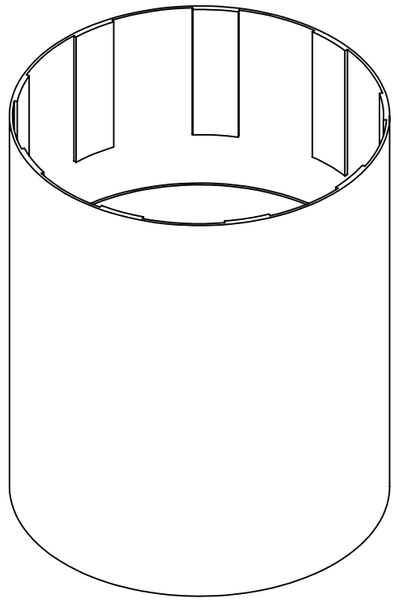
A3

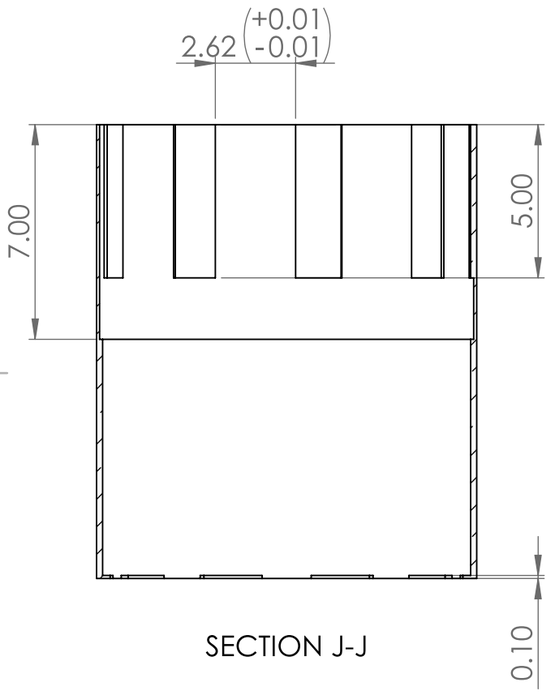
SCALE: 3:1

DATE: 25.05.2022

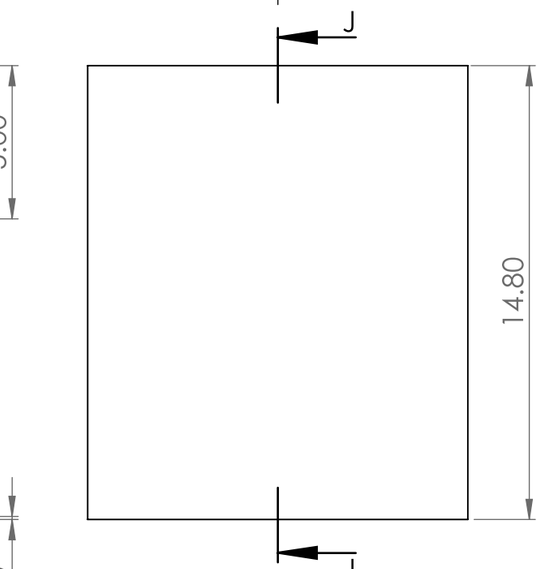
SHEET 17 OF 33

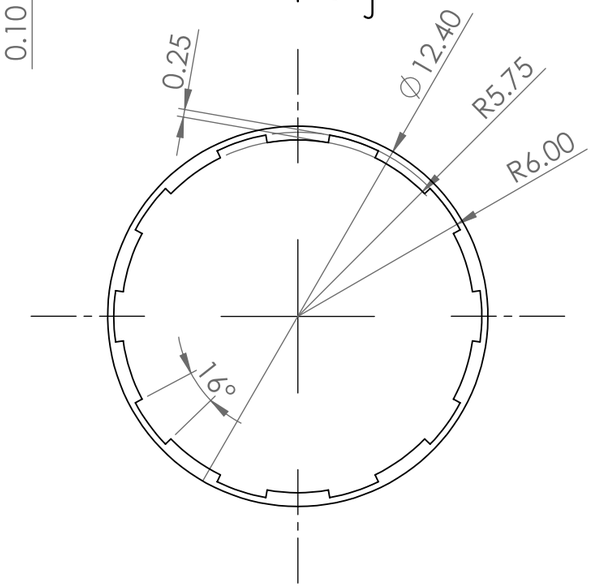






SECTION J-J





THESE TECHNICAL DRAWINGS ARE FOR SIZE REFERENCE AND NOT SPECIFIED FOR PRODUCTION

UNLESS OTHERWISE SPECIFIED: DIMENSIONS ARE IN MILLIMETERS

THESE DRAWING FOLLOW THE DS/ISO 2768-1 TOLERANCES (m) +-0,1 MM. UNLESS SPECIFIED ON THE DRAWING

GEOMETRIC TOLERANCES WILL NOT BE SPECIFIED ON THESE DRAWINGS

NO SURFACE FINISH IS SPECIFIED IN THESE DRAWINGS

PRODUCTION METHOD:
Bought externally

MATERIAL:
Brass w. kepton coding

WEIGHT: 0.8g

PART NO. 19

DO NOT SCALE DRAWING

MADE BY:
MSc04-id4 Industrial Design S2022

MODEL NAME
VERSITY - BASE

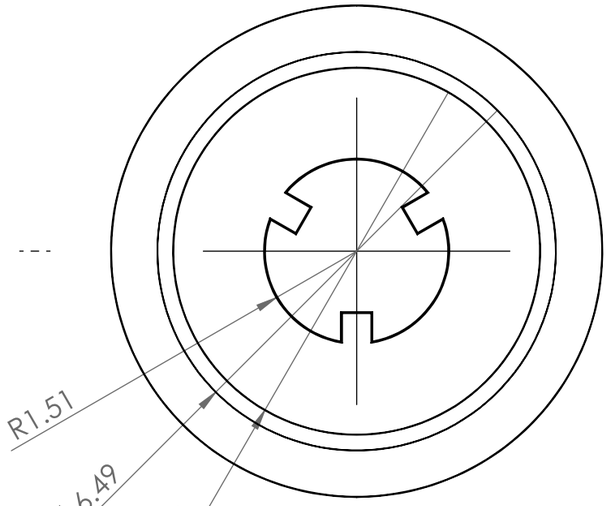
PART NAME
Encoder metal

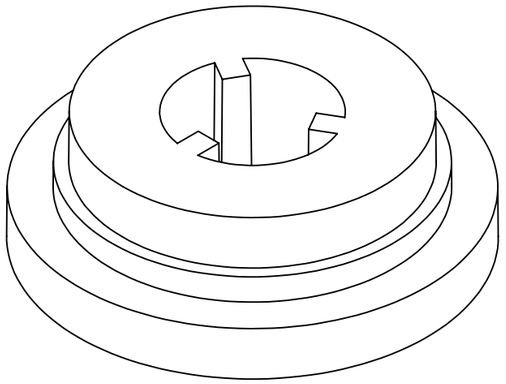
A3

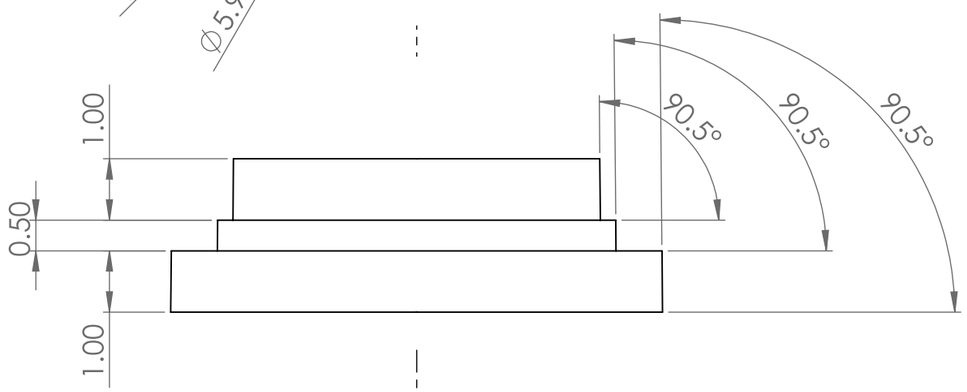
SCALE:5:1

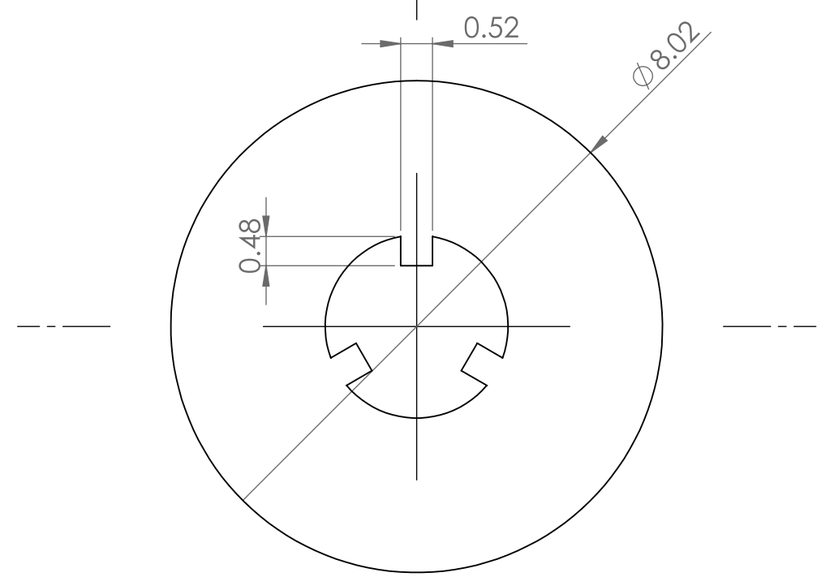
DATE: 25.05.2022

SHEET 18 OF 33

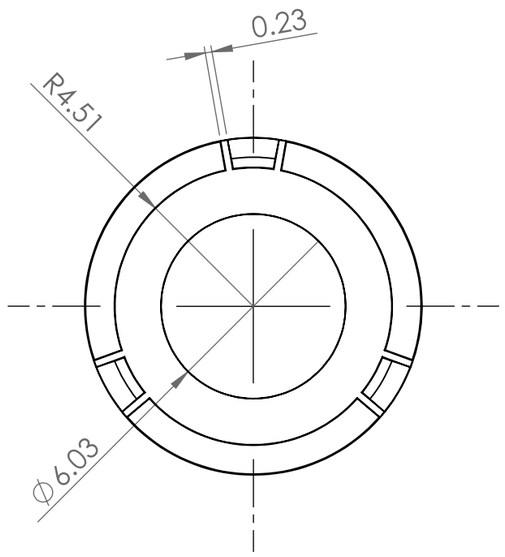


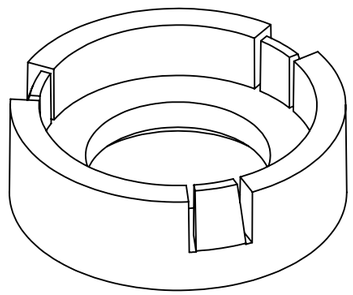


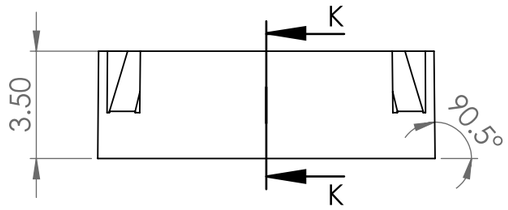


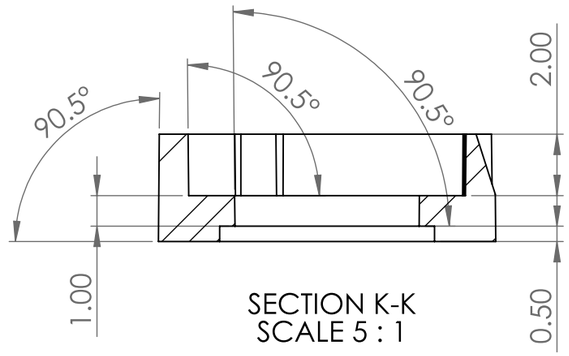


THESE TECHNICAL DRAWINGS ARE FOR SIZE REFERENCE AND NOT SPECIFIED FOR PRODUCTION UNLESS OTHERWISE SPECIFIED: DIMENSIONS ARE IN MILLIMETERS THESE DRAWING FOLLOW THE DS/ISO 2768-1 TOLERANCES (m) +-0,1 MM. UNLESS SPECIFIED ON THE DRAWING GEOMETRIC TOLERANCES WILL NOT BE SPECIFIED ON THESE DRAWINGS NO SURFACE FINISH IS SPECIFIED IN THESE DRAWINGS	PART NO. 27	DO NOT SCALE DRAWING
	MADE BY: MSc04-id4 Industrial Design S2022	
	MODEL NAME: VERSITY - BASE	
PRODUCTION METHOD: Injection molding		
MATERIAL: POM + PTEF (black pigment)	PART NAME: Rod holder 2	A3
WEIGHT: 0.11g	SCALE:10:1 / DATE: 25.05.2022	SHEET 19 OF 33

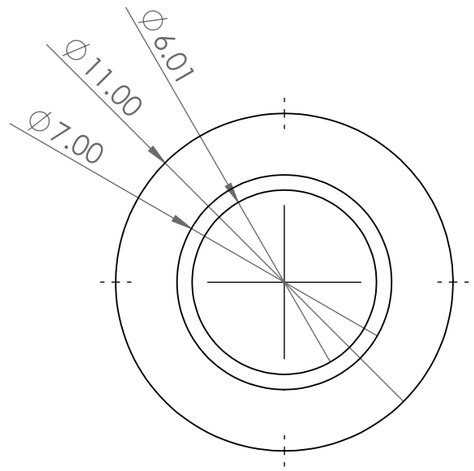








SECTION K-K
SCALE 5 : 1



THESE TECHNICAL DRAWINGS ARE FOR SIZE REFERENCE AND NOT SPECIFIED FOR PRODUCTION

UNLESS OTHERWISE SPECIFIED: DIMENSIONS ARE IN MILLIMETERS

THESE DRAWING FOLLOW THE DS/ISO 2768-1 TOLERANCES (m) +-0,1 MM. UNLESS SPECIFIED ON THE DRAWING

GEOMETRIC TOLERANCES WILL NOT BE SPECIFIED ON THESE DRAWINGS

NO SURFACE FINISH IS SPECIFIED IN THESE DRAWINGS

PRODUCTION METHOD:
Injection molding

MATERIAL:
POM + PTEF (milky white + pigment)

WEIGHT: 0.21g

PART NO. 28

DO NOT SCALE DRAWING

MADE BY:
MSc04-id4 Industrial Design S2022

MODEL NAME
VERSITY - BASE

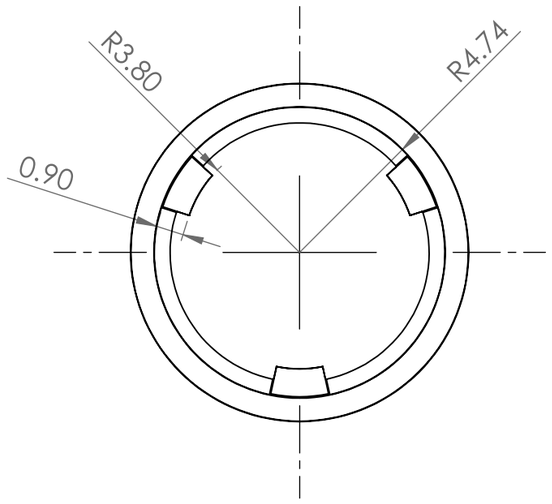
PART NAME
Plunger Rod holder

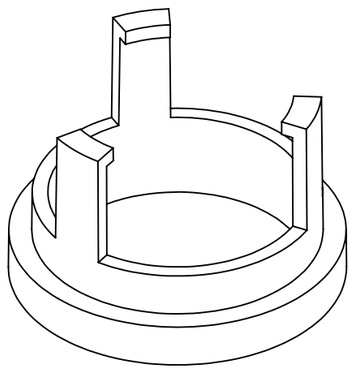
A3

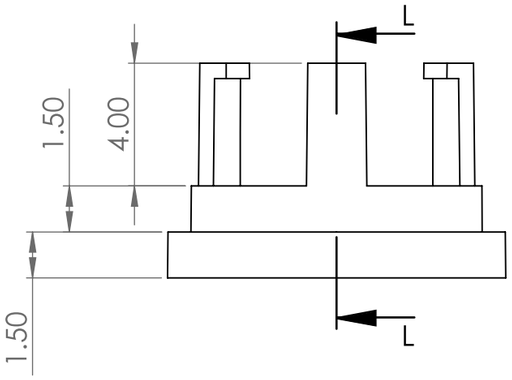
SCALE:10:1

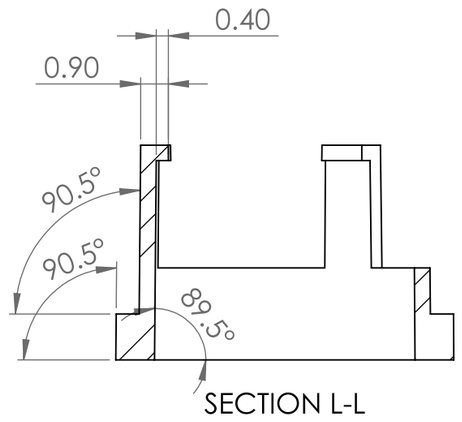
DATE: 25.05.2022

SHEET 20 OF 33

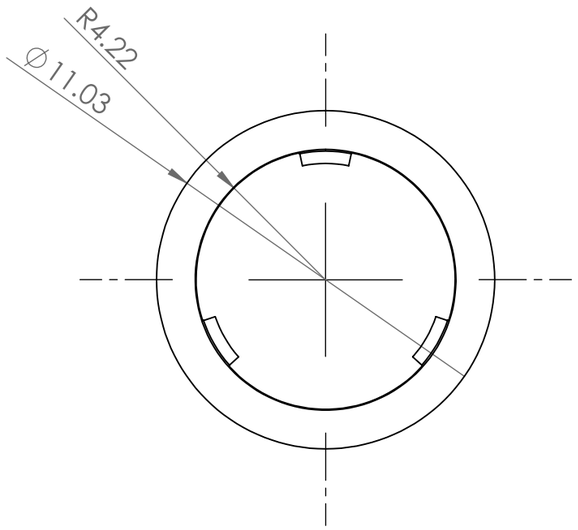








SECTION L-L



THESE TECHNICAL DRAWINGS ARE FOR SIZE REFERENCE AND NOT SPECIFIED FOR PRODUCTION

UNLESS OTHERWISE SPECIFIED: DIMENSIONS ARE IN MILLIMETERS

THESE DRAWING FOLLOW THE DS/ISO 2768-1 TOLERANCES (m) +-0,1 MM. UNLESS SPECIFIED ON THE DRAWING

GEOMETRIC TOLERANCES WILL NOT BE SPECIFIED ON THESE DRAWINGS

NO SURFACE FINISH IS SPECIFIED IN THESE DRAWINGS

PRODUCTION METHOD: Injection molding

MATERIAL: POM + PTEF (milky white)

WEIGHT: 0.13

PART NO. 29

DO NOT SCALE DRAWING

MADE BY: MSc04-id4 Industrial Design S2022

MODEL NAME

VERSITY - BASE

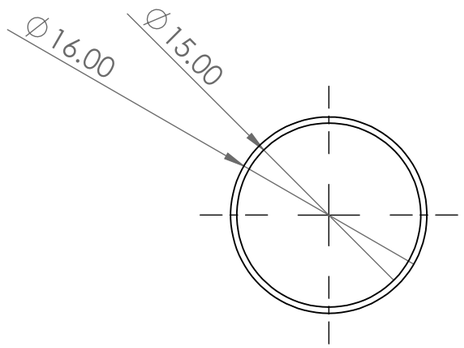
PART NAME: Rod holder 3

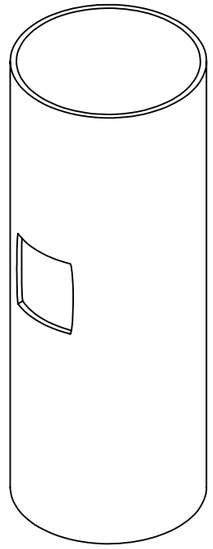
A3

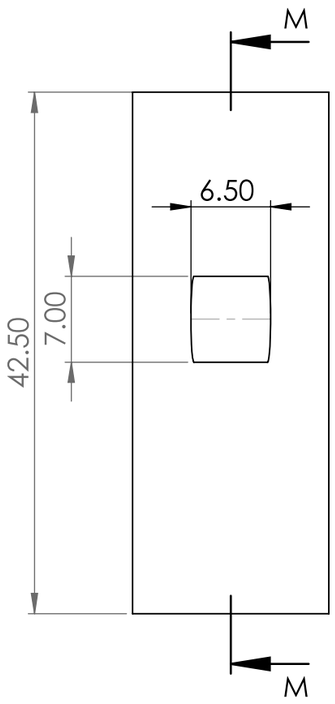
SCALE:5:1

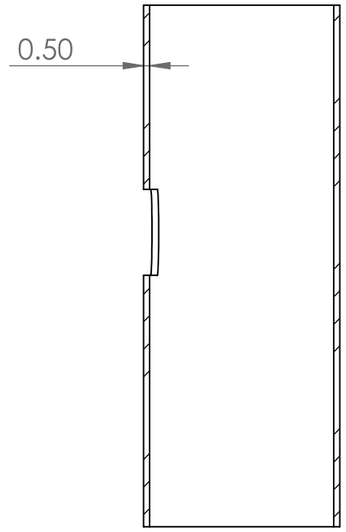
DATE: 25.05.2022

SHEET 21 OF 33









SECTION M-M

THESE TECHNICAL DRAWINGS ARE FOR SIZE REFERENCE AND NOT SPECIFIED FOR PRODUCTION

UNLESS OTHERWISE SPECIFIED: DIMENSIONS ARE IN MILLIMETERS

THESE DRAWING FOLLOW THE DS/ISO 2768-1 TOLERANCES (m) +-0,1 MM. UNLESS SPECIFIED ON THE DRAWING

GEOMETRIC TOLERANCES WILL NOT BE SPECIFIED ON THESE DRAWINGS

NO SURFACE FINISH IS SPECIFIED IN THESE DRAWINGS

PRODUCTION METHOD:
Injection molding

MATERIAL:
POM + PTEF (black pigment)

PART NO. 30

DO NOT SCALE DRAWING

MADE BY:
MSc04-id4 Industrial Design S2022

MODEL NAME
VERSITY - BASE

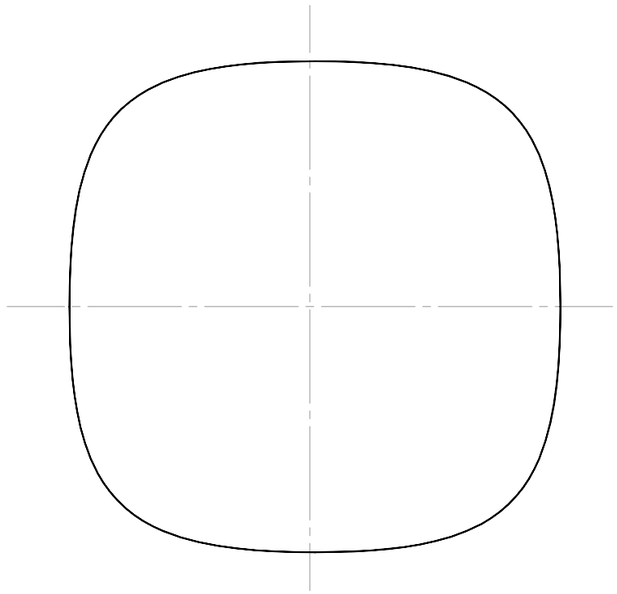
PART NAME
Mechanism holder

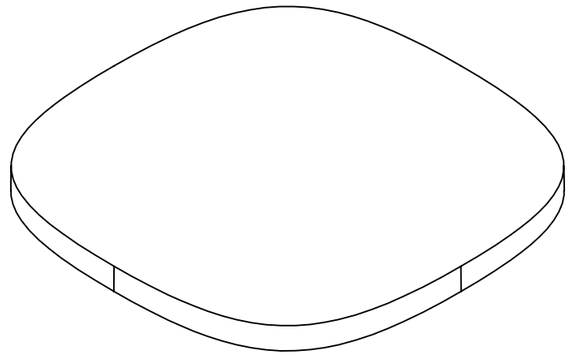
A3

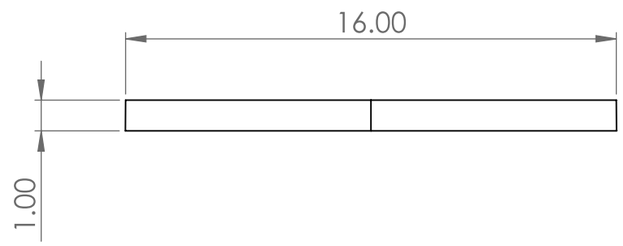
WEIGHT: 1.41g

SCALE:2:1

DATE: 25.05.2022







THESE TECHNICAL DRAWINGS ARE FOR SIZE REFERENCE AND NOT SPECIFIED FOR PRODUCTION

UNLESS OTHERWISE SPECIFIED: DIMENSIONS ARE IN MILLIMETERS

THESE DRAWING FOLLOW THE DS/ISO 2768-1 TOLERANCES (m) +-0,1 MM. UNLESS SPECIFIED ON THE DRAWING

GEOMETRIC TOLERANCES WILL NOT BE SPECIFIED ON THESE DRAWINGS

NO SURFACE FINISH IS SPECIFIED IN THESE DRAWINGS

PRODUCTION METHOD: Laser cut

MATERIAL: PMMA (trans)

PART NO. 31

DO NOT SCALE DRAWING

MADE BY: MSc04-id4 Industrial Design S2022

MODEL NAME

VERSITY - BASE

PART NAME Transparent_Screen

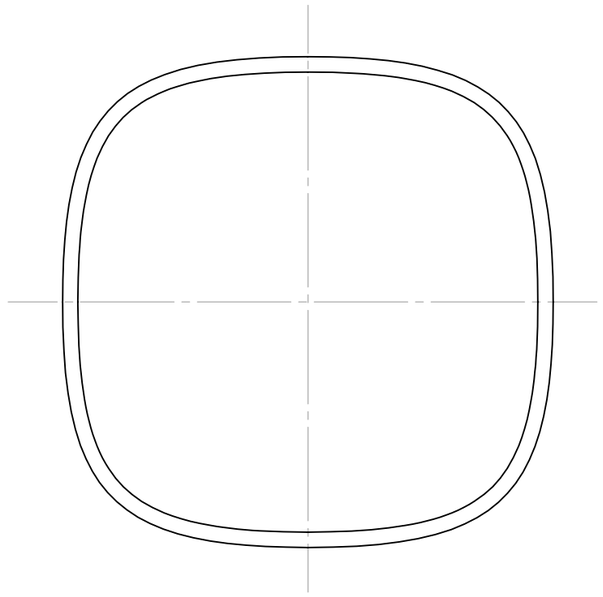
A3

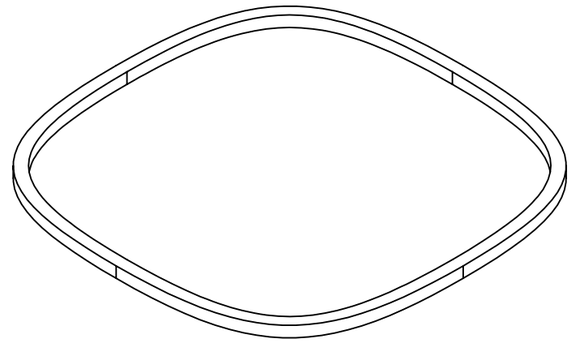
WEIGHT: 0.27g

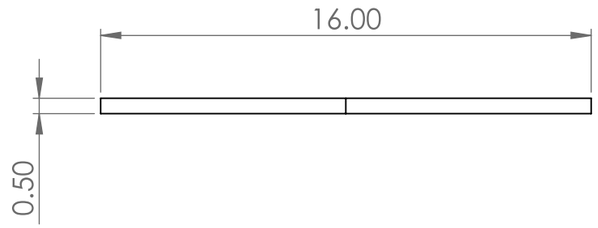
SCALE:5:1

DATE: 25.05.2022

SHEET 23 OF 33







THESE TECHNICAL DRAWINGS ARE FOR SIZE REFERENCE AND NOT SPECIFIED FOR PRODUCTION

UNLESS OTHERWISE SPECIFIED: DIMENSIONS ARE IN MILLIMETERS

THESE DRAWING FOLLOW THE DS/ISO 2768-1 TOLERANCES (m) +-0,1 MM. UNLESS SPECIFIED ON THE DRAWING

GEOMETRIC TOLERANCES WILL NOT BE SPECIFIED ON THESE DRAWINGS

NO SURFACE FINISH IS SPECIFIED IN THESE DRAWINGS

PRODUCTION METHOD:
Bought externally

MATERIAL:
Thermoplastic elastomer (TPE)

WEIGHT: 0.02g

PART NO. 32

DO NOT SCALE DRAWING

MADE BY:
MSc04-id4 Industrial Design S2022

MODEL NAME
VERSITY - BASE

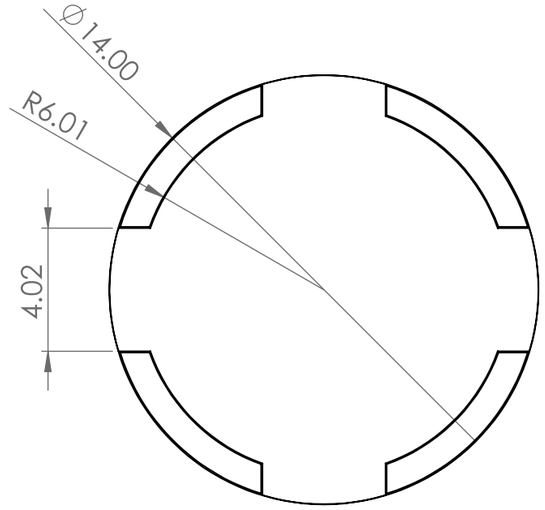
PART NAME
Screen rim

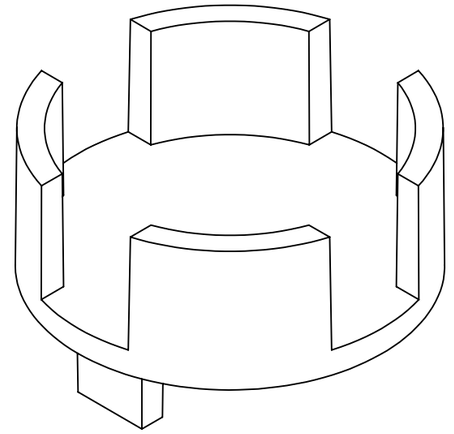
A3

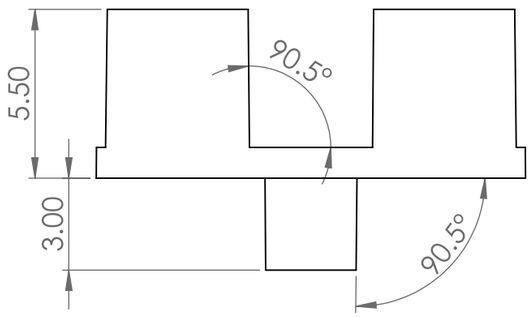
SCALE:5:1

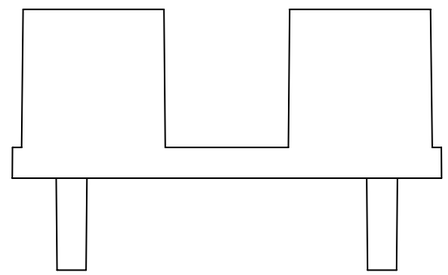
DATE: 25.05.2022

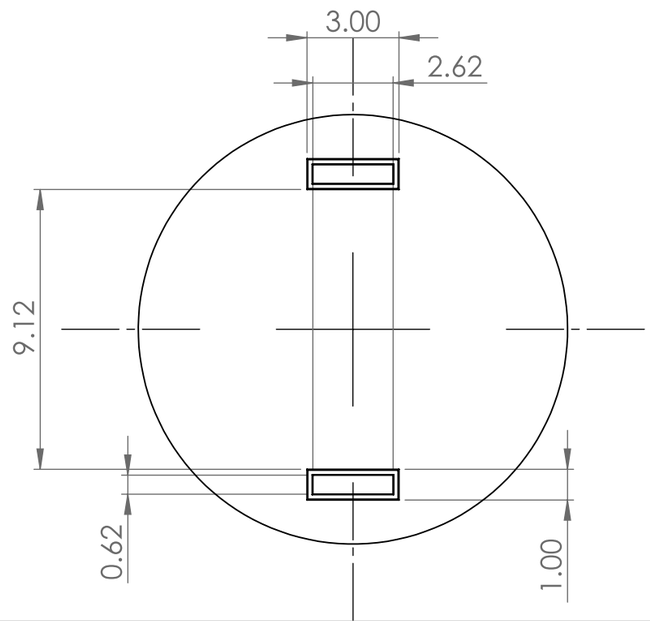
SHEET 24 OF 33



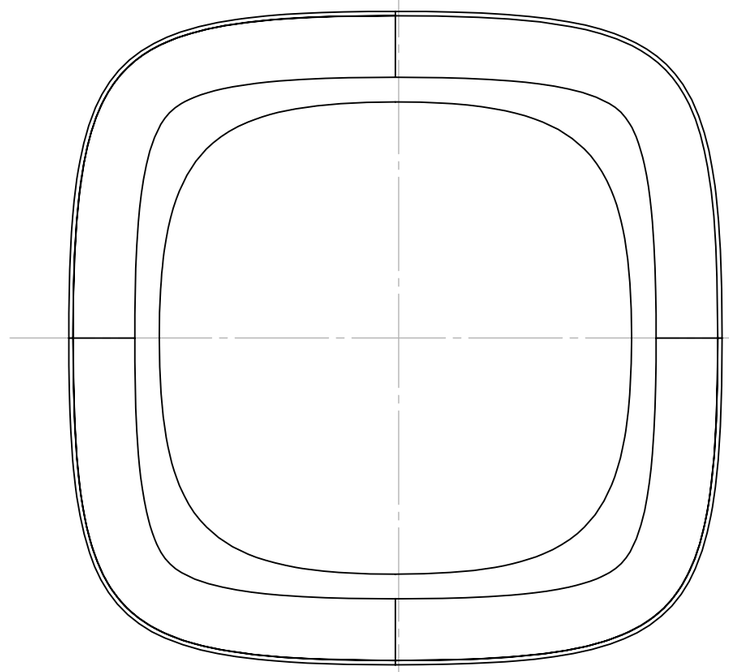


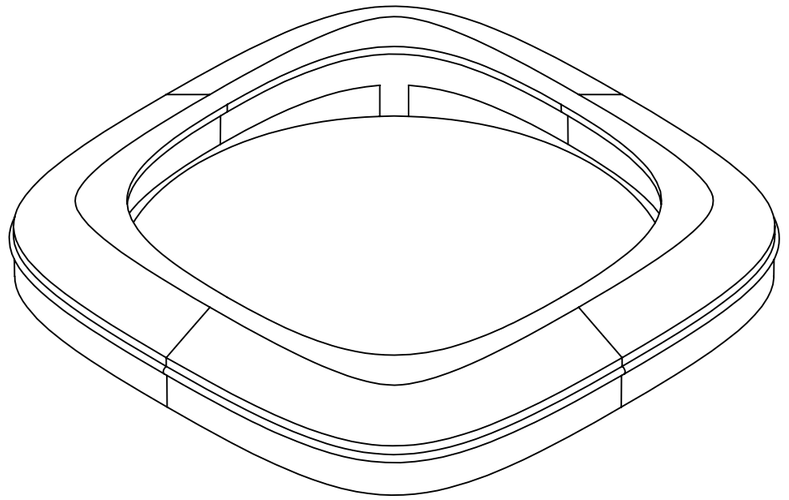


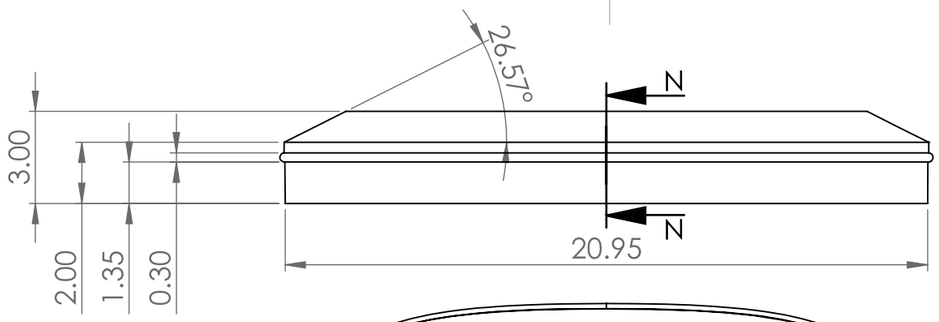


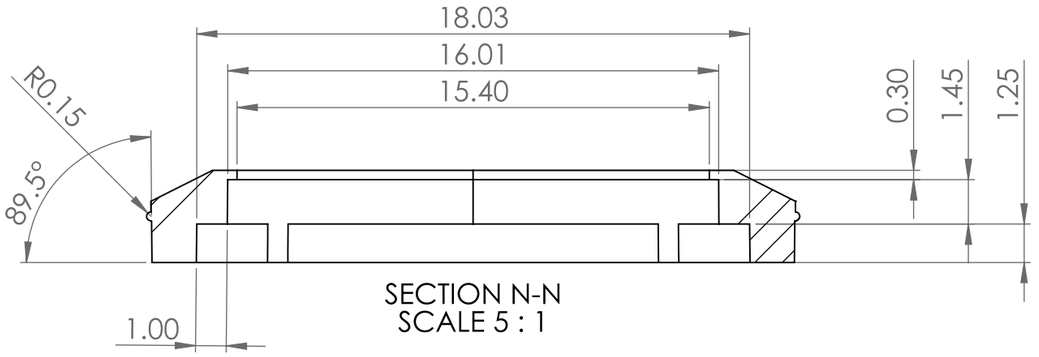


THESE TECHNICAL DRAWINGS ARE FOR SIZE REFERENCE AND NOT SPECIFIED FOR PRODUCTION UNLESS OTHERWISE SPECIFIED: DIMENSIONS ARE IN MILLIMETERS THESE DRAWING FOLLOW THE DS/ISO 2768-1 TOLERANCES (m) +-0,1 MM. UNLESS SPECIFIED ON THE DRAWING GEOMETRIC TOLERANCES WILL NOT BE SPECIFIED ON THESE DRAWINGS NO SURFACE FINISH IS SPECIFIED IN THESE DRAWINGS	PART NO. 34	DO NOT SCALE DRAWING
	MADE BY: MSc04-id4 Industrial Design S2022	
	MODEL NAME: VERSITY - BASE	
PRODUCTION METHOD: Injection molding		
MATERIAL: POM + PTEF (milky white)	PART NAME: Component housing_bottom	A3
WEIGHT: 0.37g	SCALE:5:1	DATE: 25.05.2022 / SHEET 25 OF 33

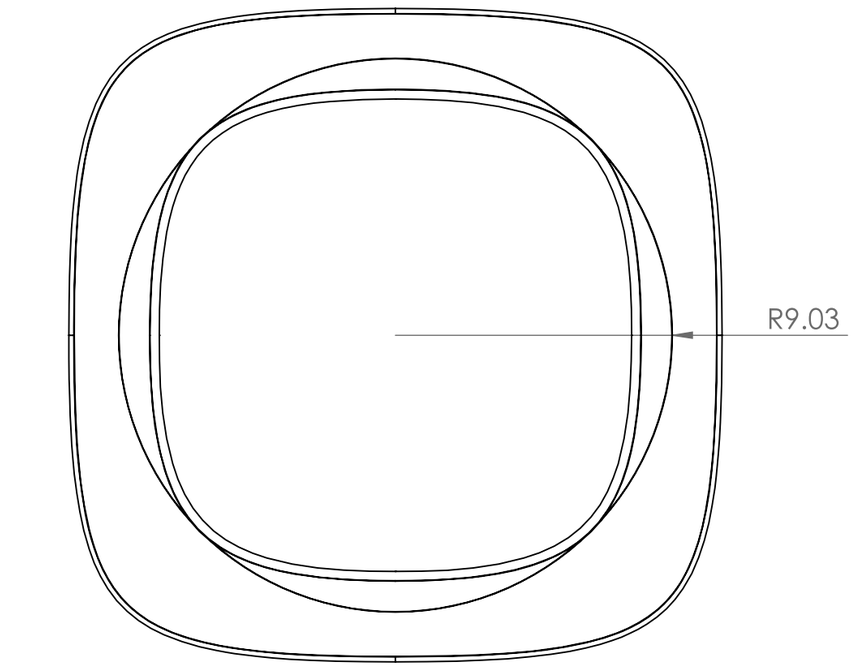








SECTION N-N
SCALE 5 : 1



THESE TECHNICAL DRAWINGS ARE FOR SIZE REFERENCE AND NOT SPECIFIED FOR PRODUCTION

UNLESS OTHERWISE SPECIFIED: DIMENSIONS ARE IN MILLIMETERS

THESE DRAWING FOLLOW THE DS/ISO 2768-1 TOLERANCES (m) +-0,1 MM. UNLESS SPECIFIED ON THE DRAWING

GEOMETRIC TOLERANCES WILL NOT BE SPECIFIED ON THESE DRAWINGS

NO SURFACE FINISH IS SPECIFIED IN THESE DRAWINGS

PRODUCTION METHOD:
Injection molding

MATERIAL:
PC / ABS blend (Black pigment)

WEIGHT: 0.52g

PART NO. 35

DO NOT SCALE DRAWING

MADE BY:
MSc04-id4 Industrial Design S2022

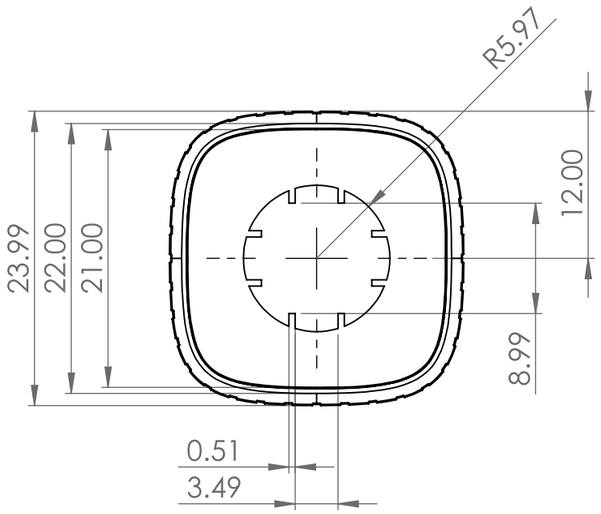
MODEL NAME
VERSITY - HANGER

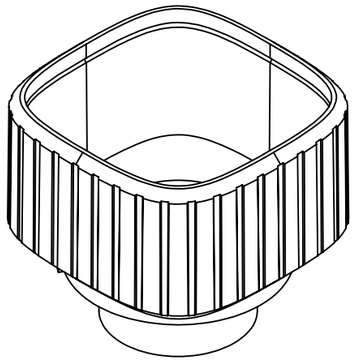
PART NAME
MSc04-id4 Industrial Design S2022

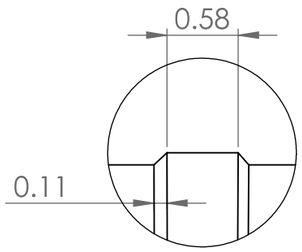
A3

SCALE: 5:1

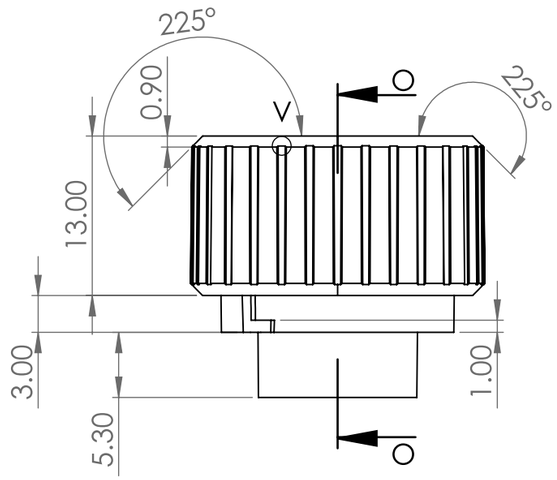
DATE: 25.05.2022

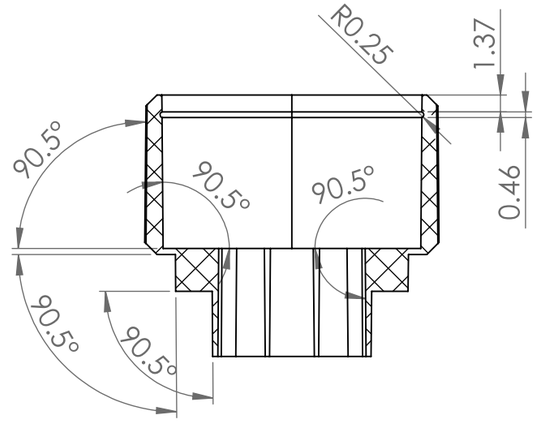




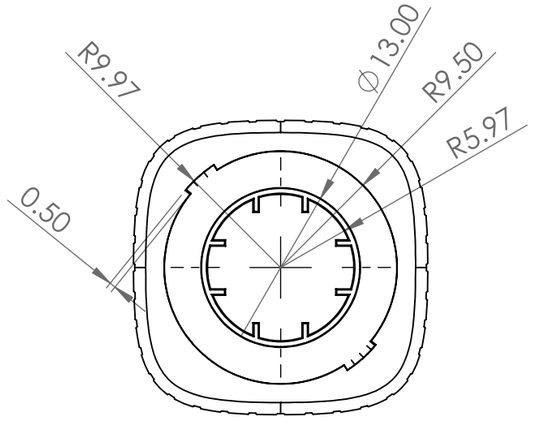


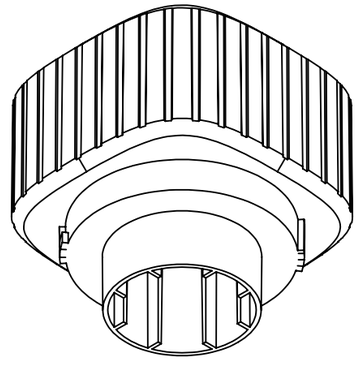
DETAIL V
SCALE 20 : 1



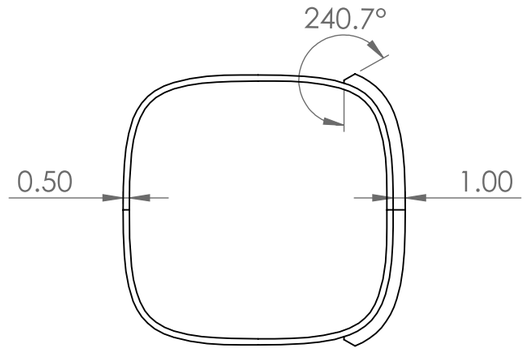


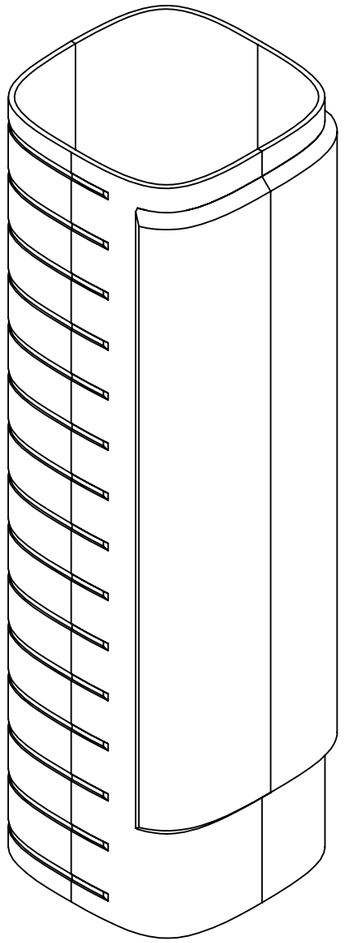
SECTION O-O

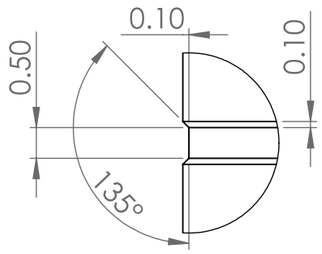




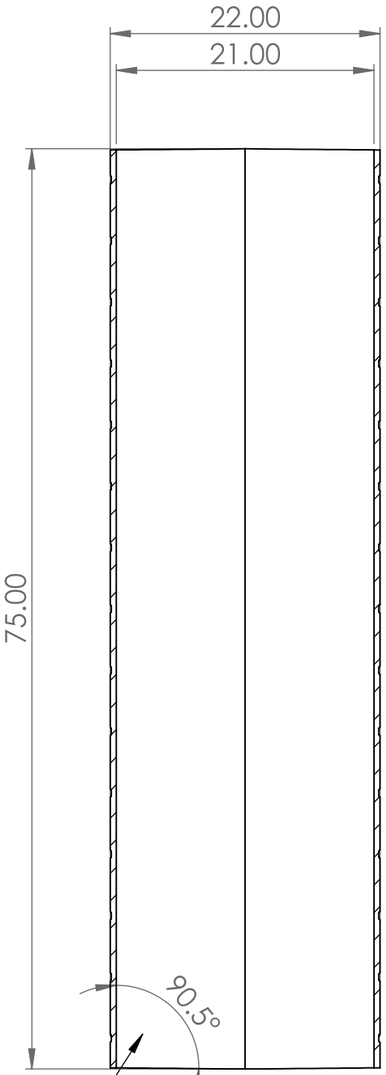
THESE TECHNICAL DRAWINGS ARE FOR SIZE REFERENCE AND NOT SPECIFIED FOR PRODUCTION UNLESS OTHERWISE SPECIFIED: DIMENSIONS ARE IN MILLIMETERS THESE DRAWING FOLLOW THE DS/ISO 2768-1 TOLERANCES (m) +-0,1 MM. UNLESS SPECIFIED ON THE DRAWING GEOMETRIC TOLERANCES WILL NOT BE SPECIFIED ON THESE DRAWINGS NO SURFACE FINISH IS SPECIFIED IN THESE DRAWINGS	PART NO. 36	DO NOT SCALE DRAWING
	MADE BY: MSc04-id4 Industrial Design S2022	
PRODUCTION METHOD: Injection molding	MODEL NAME: VERSITY - HANGER	
MATERIAL: PC / ABS blend (Black pigment)	PART NAME: MSc04-id4 Industrial Design S2022	A3
WEIGHT: 2.14g	SCALE:2:1	DATE: 25.05.2022	SHEET 27 OF 33



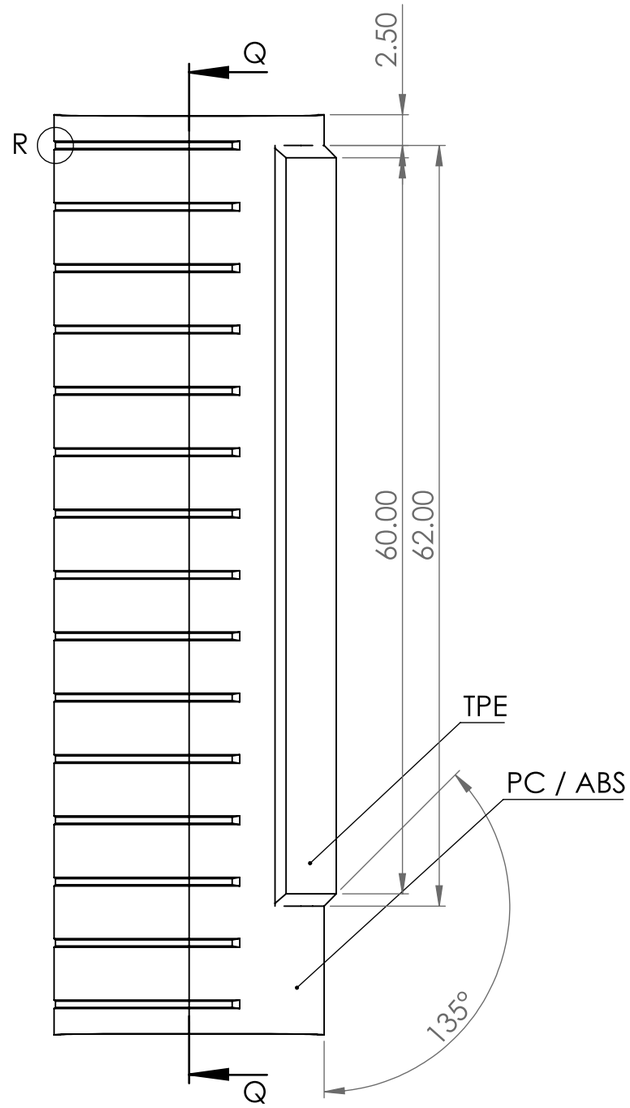




DETAIL R
SCALE 10 : 1

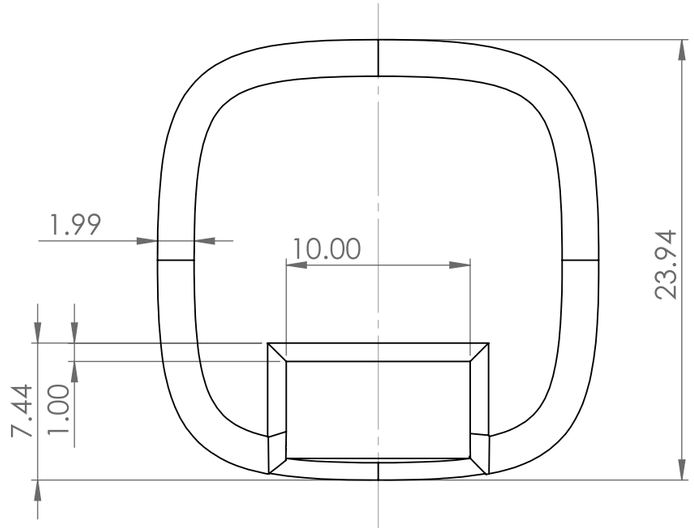


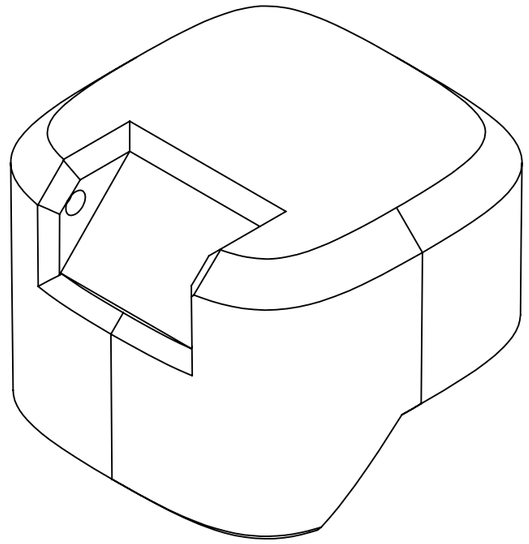
SECTION Q-Q
SCALE 2 : 1

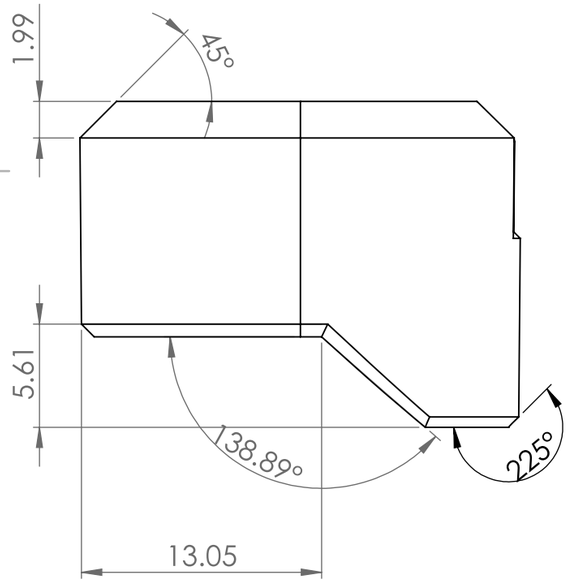


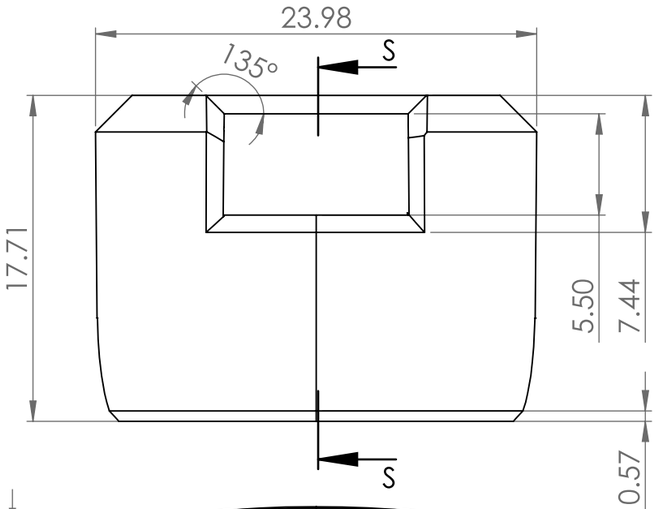
This angle is to small and need a draft of 3 degree

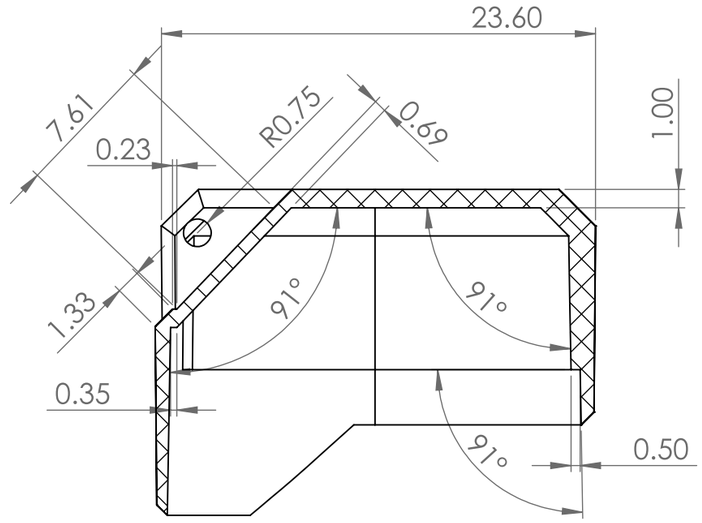
THESE TECHNICAL DRAWINGS ARE FOR SIZE REFERENCE AND NOT SPECIFIED FOR PRODUCTION UNLESS OTHERWISE SPECIFIED: DIMENSIONS ARE IN MILLIMETERS THESE DRAWING FOLLOW THE DS/ISO 2768-1 TOLERANCES (m) +-0,1 MM. UNLESS SPECIFIED ON THE DRAWING GEOMETRIC TOLERANCES WILL NOT BE SPECIFIED ON THESE DRAWINGS NO SURFACE FINISH IS SPECIFIED IN THESE DRAWINGS	PART NO. 37 + 44	DO NOT SCALE DRAWING
	MADE BY: MSc04-id4 Industrial Design S2022	
	MODEL NAME: VERSITY - HANGER	
PRODUCTION METHOD: Multi injection molding		
MATERIAL: PC / ABS blend (Green pigment) Thermoplastic elastomer (TPE) (polyester)	PART NAME: MSc04-id4 Industrial Design S2022	A3
WEIGHT: 3.27g + 1.76g	SCALE: 2:1 DATE: 25.05.2022	SHEET 28 OF 33



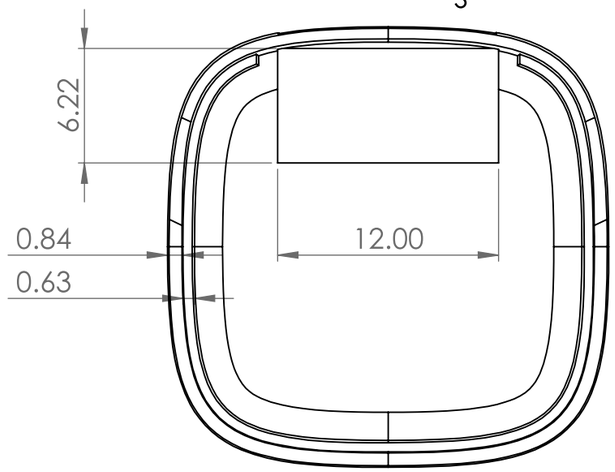








SECTION S-S
SCALE 3 : 1



THESE TECHNICAL DRAWINGS ARE FOR SIZE REFERENCE AND NOT SPECIFIED FOR PRODUCTION

UNLESS OTHERWISE SPECIFIED: DIMENSIONS ARE IN MILLIMETERS

THESE DRAWING FOLLOW THE DS/ISO 2768-1 TOLERANCES (m) +-0,1 MM. UNLESS SPECIFIED ON THE DRAWING

GEOMETRIC TOLERANCES WILL NOT BE SPECIFIED ON THESE DRAWINGS

NO SURFACE FINISH IS SPECIFIED IN THESE DRAWINGS

PART NO. 38

DO NOT SCALE DRAWING

MADE BY:
MSc04-id4 Industrial Design S2022

MODEL NAME
VERSITY - HANGER

PRODUCTION METHOD:
Injection molding

MATERIAL:
PC / ABS blend (Black pigment)

PART NAME
Lid_Top_Hanger

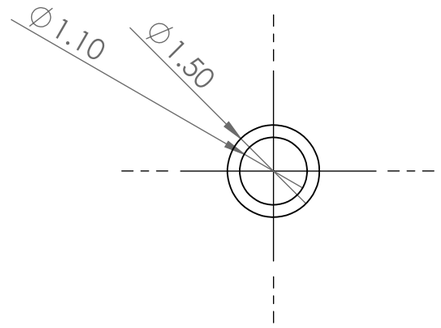
A3

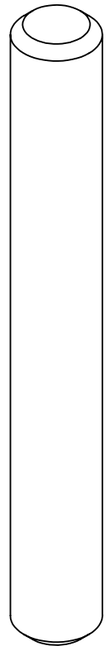
WEIGHT: 1.66g

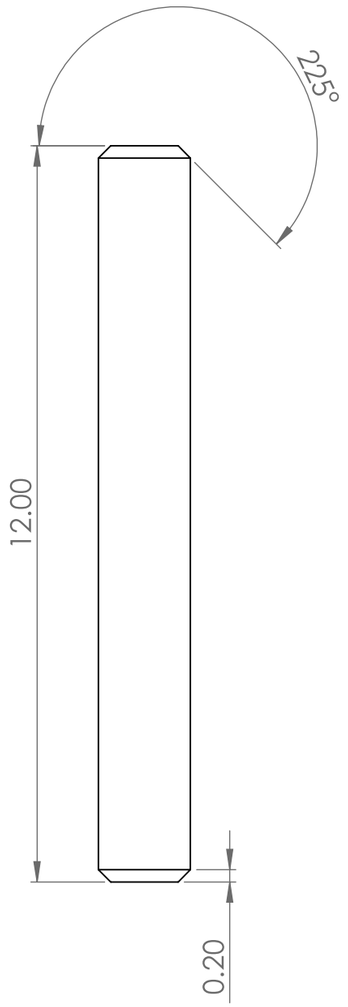
SCALE: 3:1

DATE: 25.05.2022

SHEET 29 OF 33







THESE TECHNICAL DRAWINGS ARE FOR SIZE REFERENCE AND NOT SPECIFIED FOR PRODUCTION

UNLESS OTHERWISE SPECIFIED: DIMENSIONS ARE IN MILLIMETERS

THESE DRAWING FOLLOW THE DS/ISO 2768-1 TOLERANCES (m) +-0,1 MM. UNLESS SPECIFIED ON THE DRAWING

GEOMETRIC TOLERANCES WILL NOT BE SPECIFIED ON THESE DRAWINGS

NO SURFACE FINISH IS SPECIFIED IN THESE DRAWINGS

PRODUCTION METHOD:

Bought externally and cut

MATERIAL:

Stainless steel alloy 304

WEIGHT: 0.06g

PART NO. 39

DO NOT SCALE DRAWING

MADE BY:

MSc04-id4 Industrial Design S2022

MODEL NAME

VERSITY - HANGER

PART NAME

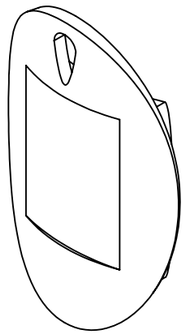
Lid_Pin_Hanger

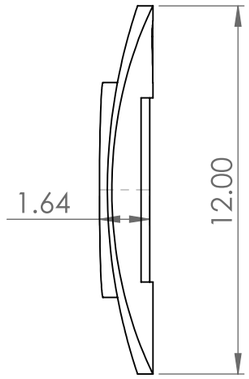
A3

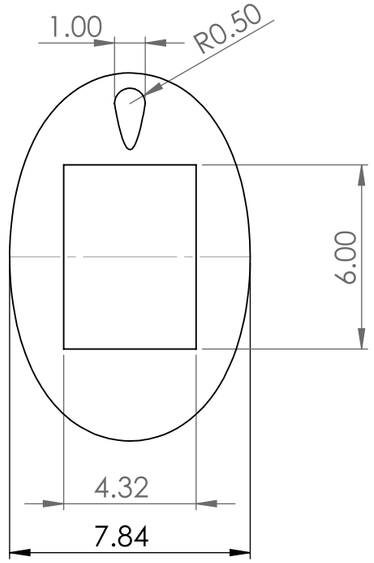
SCALE:10:1

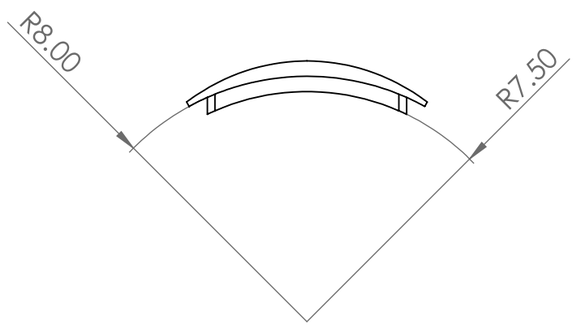
DATE: 25.05.2022

SHEET 30 OF 33









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UNLESS OTHERWISE SPECIFIED: DIMENSIONS ARE IN MILLIMETERS

THESE DRAWING FOLLOW THE DS/ISO 2768-1 TOLERANCES (m) +-0,1 MM. UNLESS SPECIFIED ON THE DRAWING

GEOMETRIC TOLERANCES WILL NOT BE SPECIFIED ON THESE DRAWINGS

NO SURFACE FINISH IS SPECIFIED IN THESE DRAWINGS

PRODUCTION METHOD:

Multishot injection molding

MATERIAL:

PMMA (trans) and
PMMA w. black pigment

WEIGHT: 0.06g

PART NO. 41

DO NOT SCALE DRAWING

MADE BY:

MSc04-id4 Industrial Design S2022

MODEL NAME

VERSITY - BASE

PART NAME

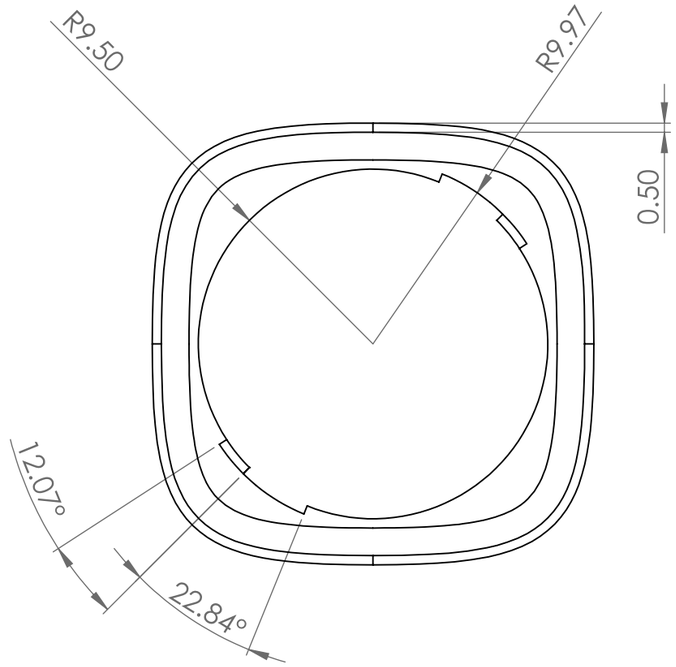
Unit counter window

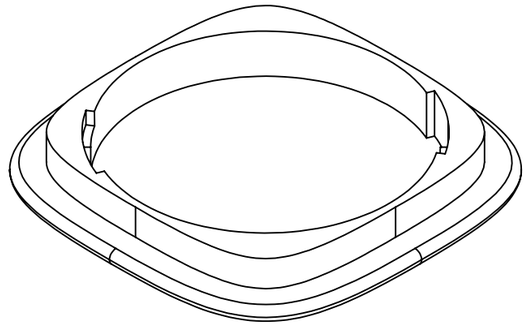
A3

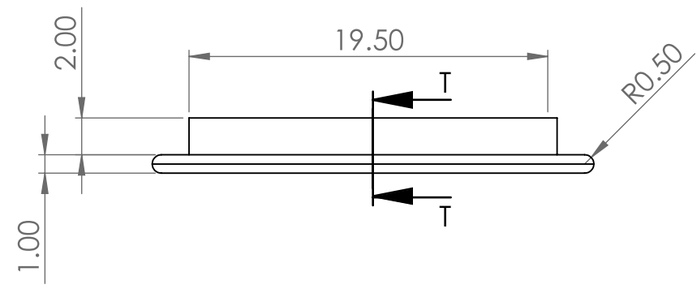
SCALE:5:1

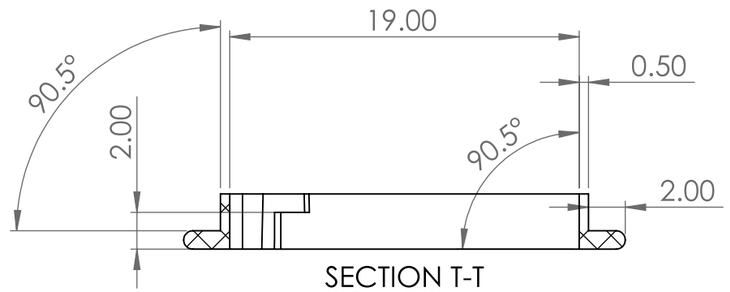
DATE: 25.05.2022

SHEET 31 OF 33

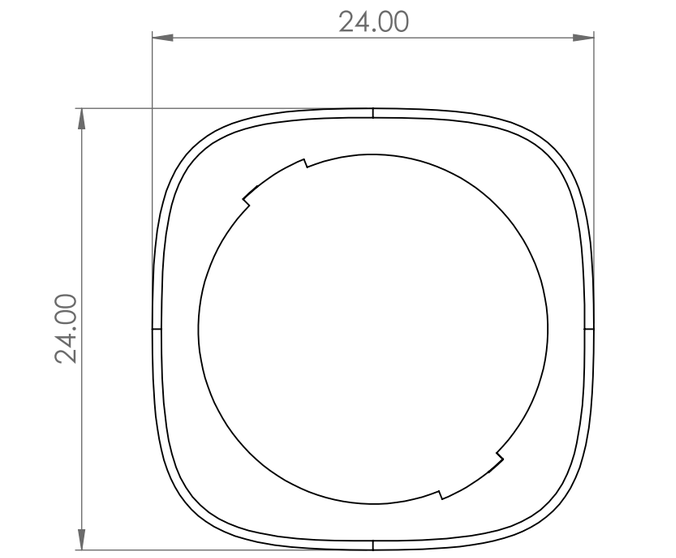








SECTION T-T
SCALE 3 : 1



THESE TECHNICAL DRAWINGS ARE FOR SIZE REFERENCE AND NOT SPECIFIED FOR PRODUCTION

UNLESS OTHERWISE SPECIFIED: DIMENSIONS ARE IN MILLIMETERS

THESE DRAWING FOLLOW THE DS/ISO 2768-1 TOLERANCES (m) +-0,1 MM. UNLESS SPECIFIED ON THE DRAWING

GEOMETRIC TOLERANCES WILL NOT BE SPECIFIED ON THESE DRAWINGS

NO SURFACE FINISH IS SPECIFIED IN THESE DRAWINGS

PRODUCTION METHOD: Injection molding

MATERIAL: PC / ABS blend (Orange pigment)

WEIGHT: 0.39g

PART NO. 42

DO NOT SCALE DRAWING

MADE BY: MSc04-id4 Industrial Design S2022

MODEL NAME

VERSITY - HANGER

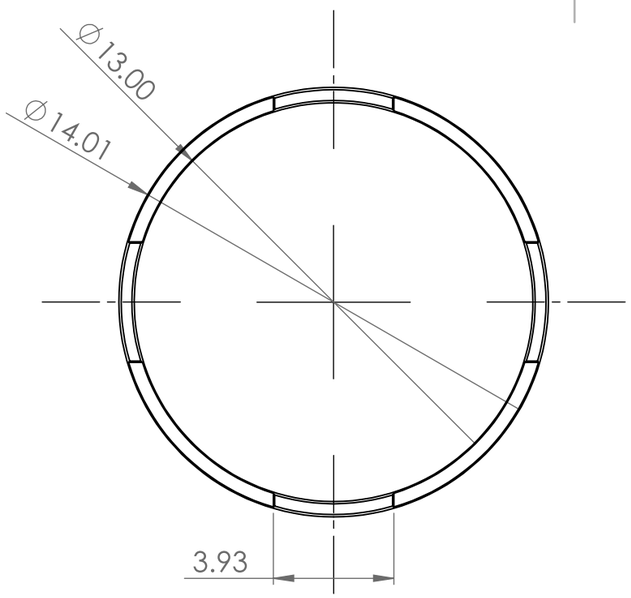
PART NAME: Lid_Lock_Hanger

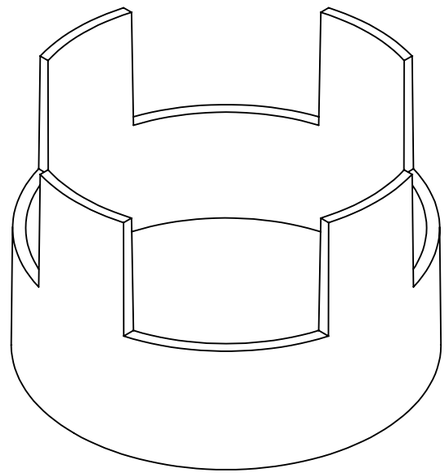
A3

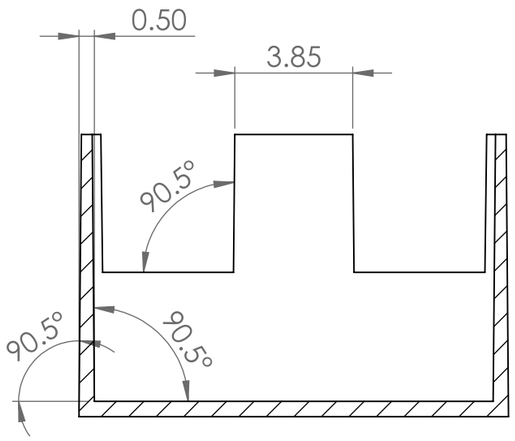
SCALE: 3:1

DATE: 25.05.2022

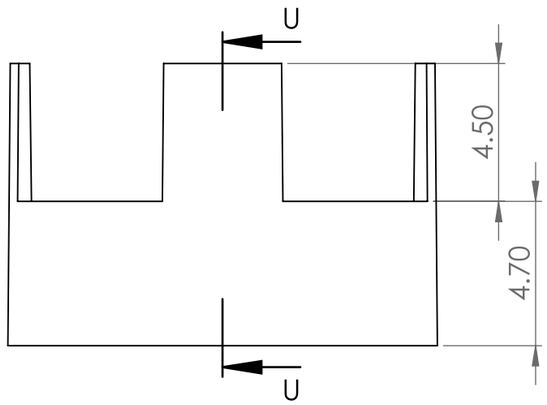
SHEET 32 OF 33

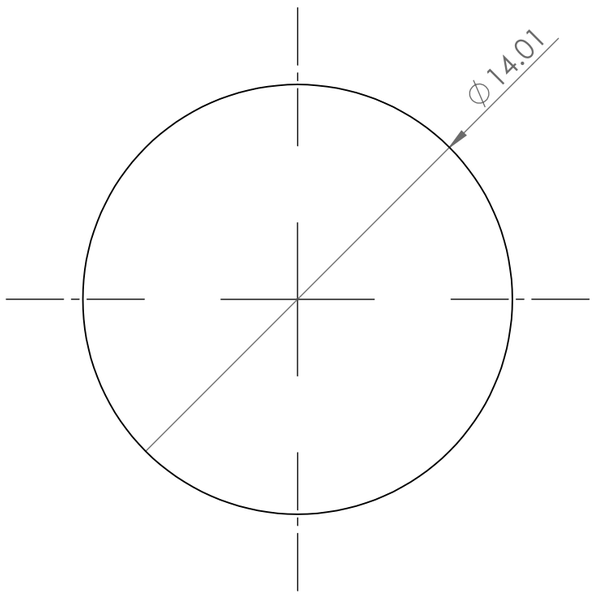






SECTION U-U





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UNLESS OTHERWISE SPECIFIED: DIMENSIONS ARE IN MILLIMETERS

THESE DRAWING FOLLOW THE DS/ISO 2768-1 TOLERANCES (m) +-0,1 MM. UNLESS SPECIFIED ON THE DRAWING

GEOMETRIC TOLERANCES WILL NOT BE SPECIFIED ON THESE DRAWINGS

NO SURFACE FINISH IS SPECIFIED IN THESE DRAWINGS

PRODUCTION METHOD:
Injection molding

MATERIAL:
POM + PTEF (black pigment)

PART NO. 43

DO NOT SCALE DRAWING

MADE BY:
MSc04-id4 Industrial Design S2022

MODEL NAME
VERSITY - BASE

PART NAME
Component housing_Top

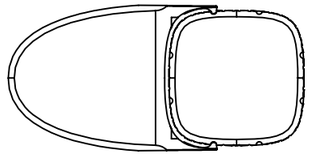
A3

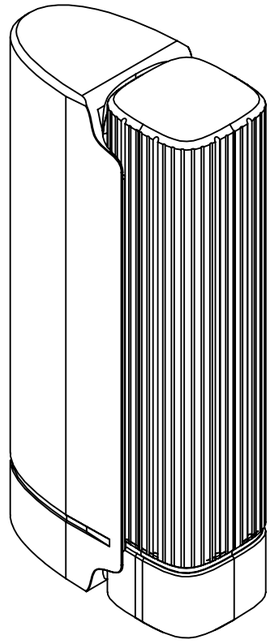
WEIGHT: 0.26g

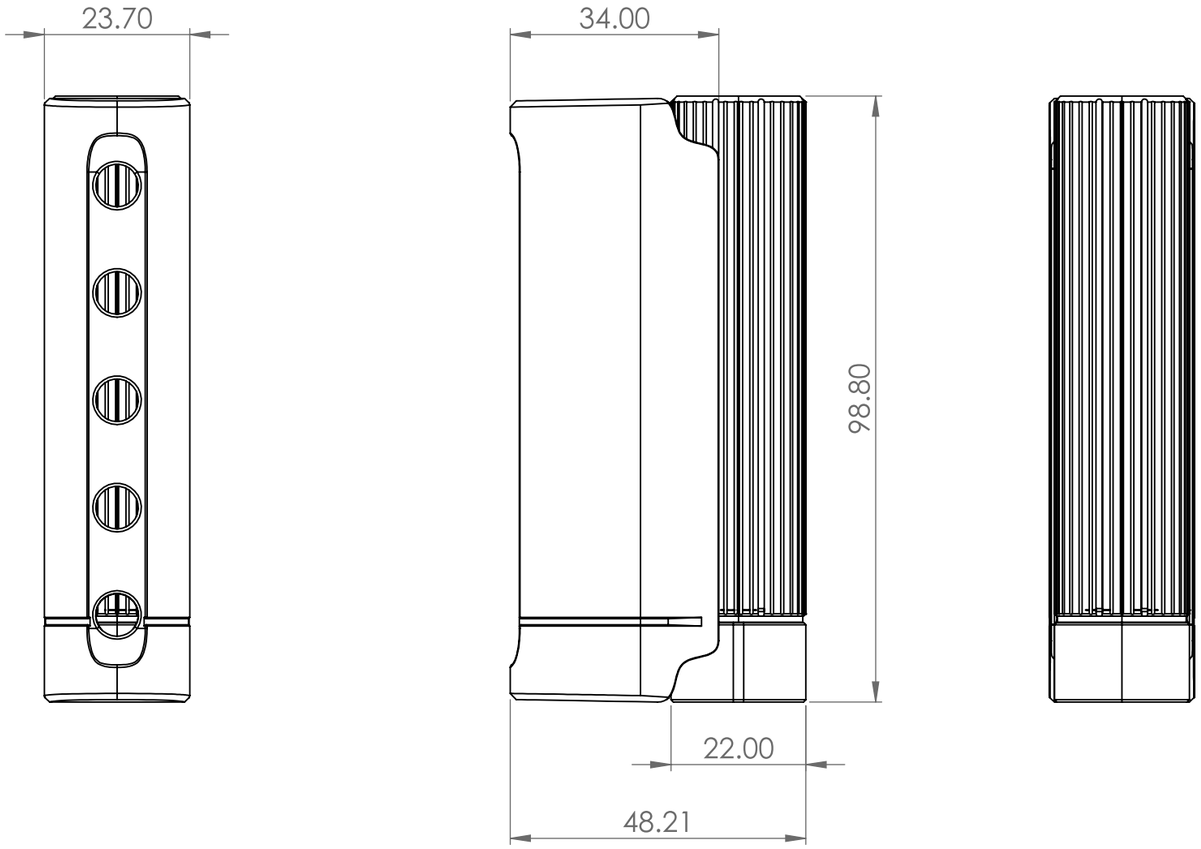
SCALE:5:1

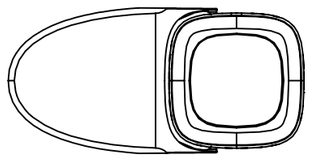
DATE: 25.05.2022

SHEET 33 OF 33

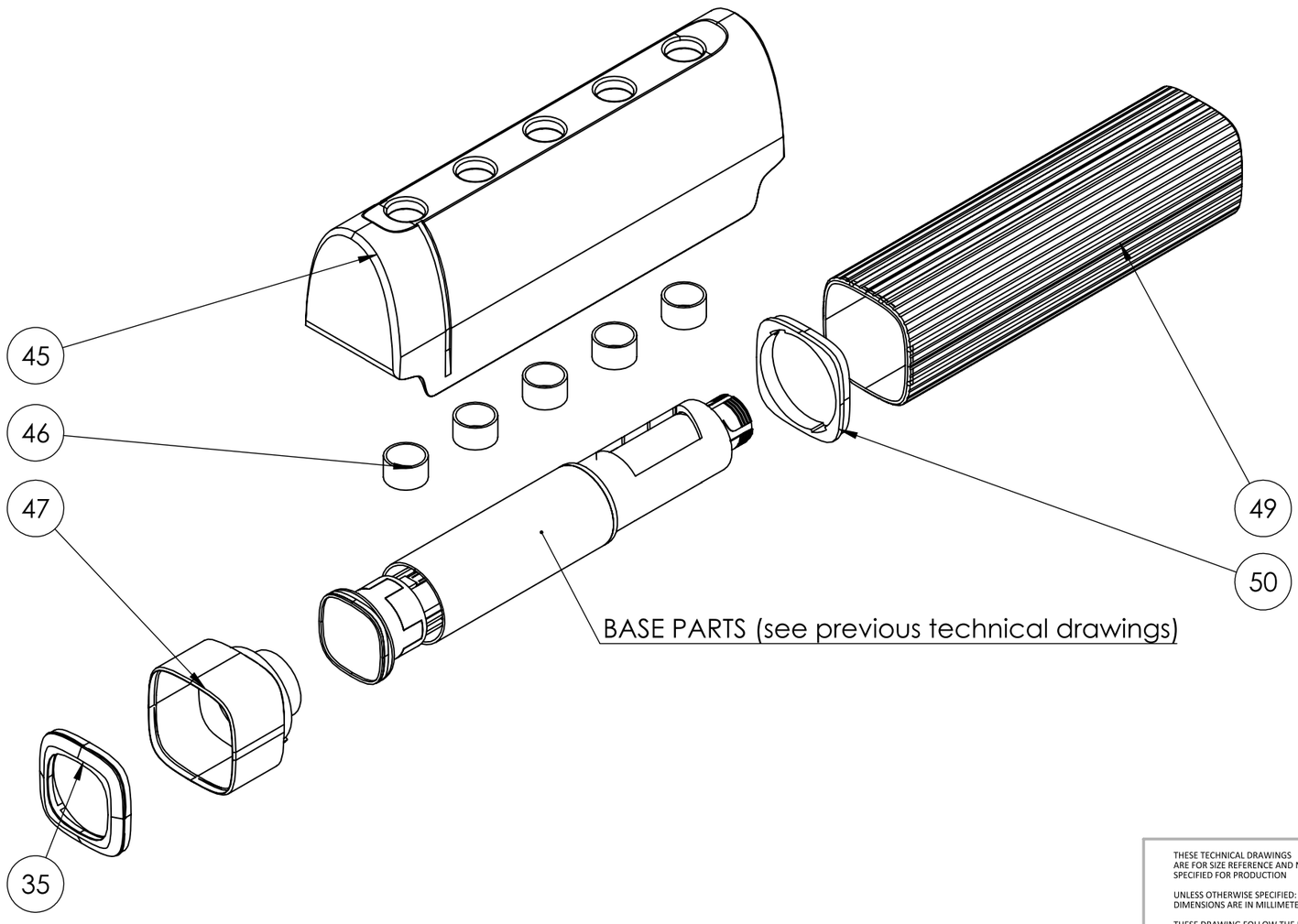








THESE TECHNICAL DRAWINGS ARE FOR SIZE REFERENCE AND NOT SPECIFIED FOR PRODUCTION UNLESS OTHERWISE SPECIFIED: DIMENSIONS ARE IN MILLIMETERS THESE DRAWING FOLLOW THE DS/ISO 2768-1 TOLERANCES (m) +-0,1 MM. UNLESS SPECIFIED ON THE DRAWING GEOMETRIC TOLERANCES WILL NOT BE SPECIFIED ON THESE DRAWINGS NO SURFACE FINISH IS SPECIFIED IN THESE DRAWINGS	PART NO.	DO NOT SCALE DRAWING
	MADE BY: MSc04-id4 Industrial Design S2022	
	MODEL NAME: VERSITY - CASE	
PRODUCTION METHOD:		
MATERIAL:	PART NAME	A3
WEIGHT: 63g	SCALE:1:1 / DATE: 25.05.2022	SHEET 1 OF 8



THESE TECHNICAL DRAWINGS ARE FOR SIZE REFERENCE AND NOT SPECIFIED FOR PRODUCTION

UNLESS OTHERWISE SPECIFIED: DIMENSIONS ARE IN MILLIMETERS

THESE DRAWING FOLLOW THE DS/ISO 2768-1 TOLERANCES (m) +-0,1 MM. UNLESS SPECIFIED ON THE DRAWING

GEOMETRIC TOLERANCES WILL NOT BE SPECIFIED ON THESE DRAWINGS

NO SURFACE FINISH IS SPECIFIED IN THESE DRAWINGS

PRODUCTION METHOD:

MATERIAL:

WEIGHT: 63g

PART NO.

DO NOT SCALE DRAWING

MADE BY:

MSc04-id4 Industrial Design S2022

MODEL NAME

VERSITY - CASE

PART NAME

A3

SCALE:1:5

DATE: 25.05.2022

ITEM NO.	PART NUMBER	Part nr.	QTY.
45	Slider_Case	45	1
46	Rubber lock_Case	46	5
47	Lid_Top_Case	47	1
48	Lid_Lock_Case	48	1
49	Lid_Shell_Case	49	1

THESE TECHNICAL DRAWINGS ARE FOR SIZE REFERENCE AND NOT SPECIFIED FOR PRODUCTION

UNLESS OTHERWISE SPECIFIED: DIMENSIONS ARE IN MILLIMETERS

THESE DRAWING FOLLOW THE DS/ISO 2768-1 TOLERANCES (m) +-0,1 MM. UNLESS SPECIFIED ON THE DRAWING

GEOMETRIC TOLERANCES WILL NOT BE SPECIFIED ON THESE DRAWINGS

NO SURFACE FINISH IS SPECIFIED IN THESE DRAWINGS

PRODUCTION METHOD:

MATERIAL:

WEIGHT:

PART NO.

DO NOT SCALE DRAWING

MADE BY:

MSc04-id4 Industrial Design S2022

MODEL NAME

VERSITY - CASE

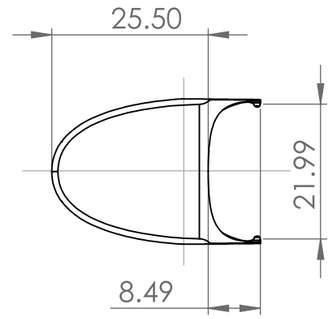
PART NAME

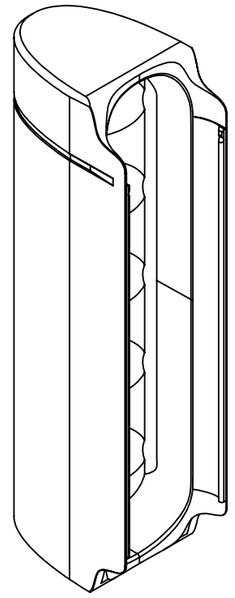
A3

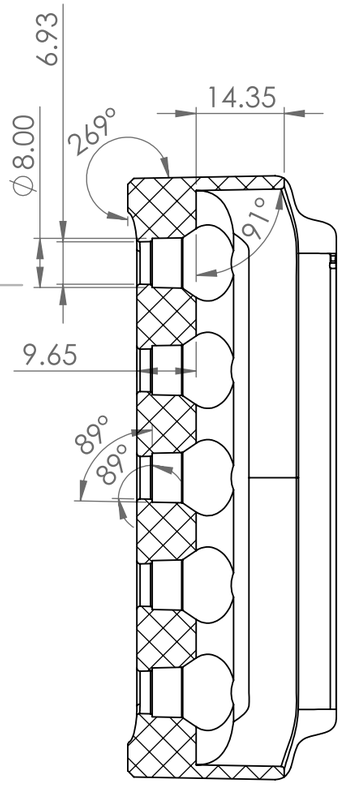
SCALE:

DATE: 25.05.2022

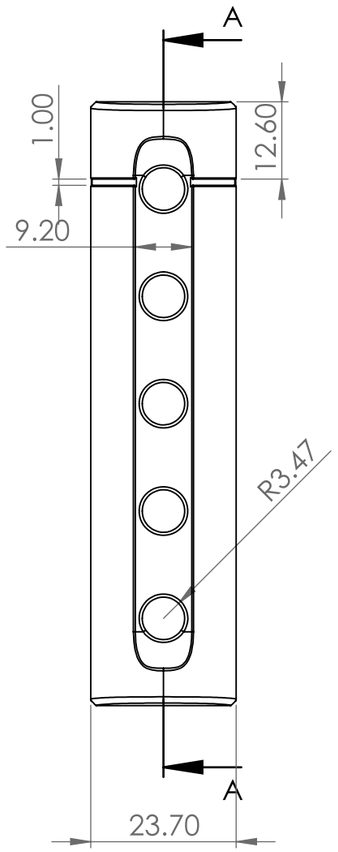
SHEET 3 OF 8

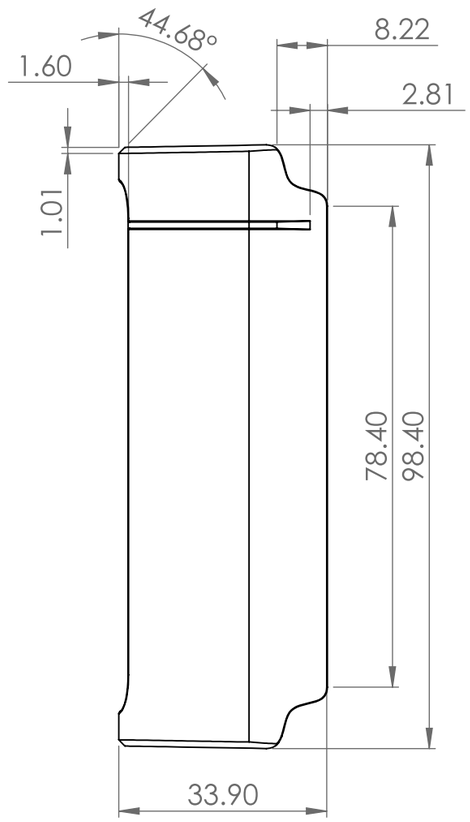


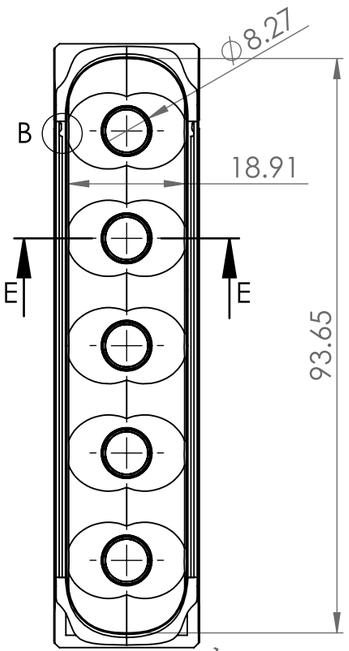


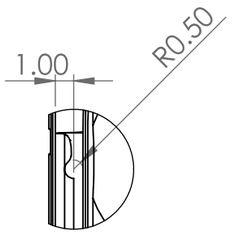


SECTION A-A

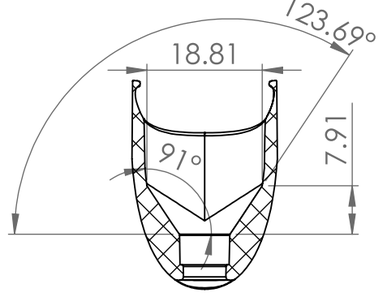








DETAIL B
SCALE 3 : 1



SECTION E-E

THESE TECHNICAL DRAWINGS ARE FOR SIZE REFERENCE AND NOT SPECIFIED FOR PRODUCTION

UNLESS OTHERWISE SPECIFIED: DIMENSIONS ARE IN MILLIMETERS

THESE DRAWING FOLLOW THE DS/ISO 2768-1 TOLERANCES (m) +-0,1 MM. UNLESS SPECIFIED ON THE DRAWING

GEOMETRIC TOLERANCES WILL NOT BE SPECIFIED ON THESE DRAWINGS

NO SURFACE FINISH IS SPECIFIED IN THESE DRAWINGS

PRODUCTION METHOD: Injection molding

MATERIAL: PC / ABS blend (Dark blue pigment)

WEIGHT: 30.62g

PART NO. 45

DO NOT SCALE DRAWING

MADE BY: MSc04-id4 Industrial Design S2022

MODEL NAME

VERSITY - CASE

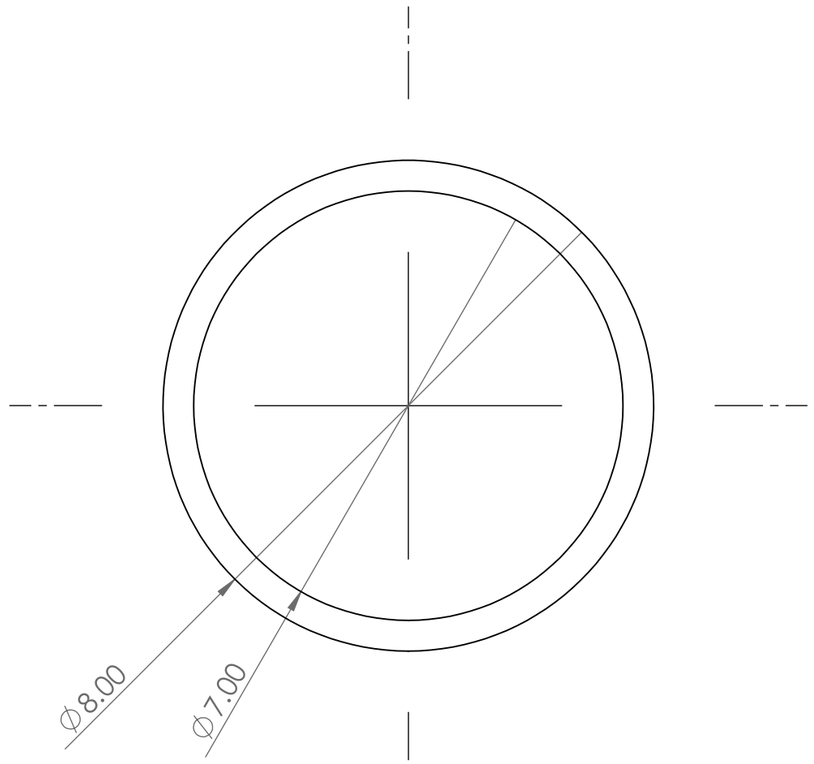
PART NAME: Slider_Case

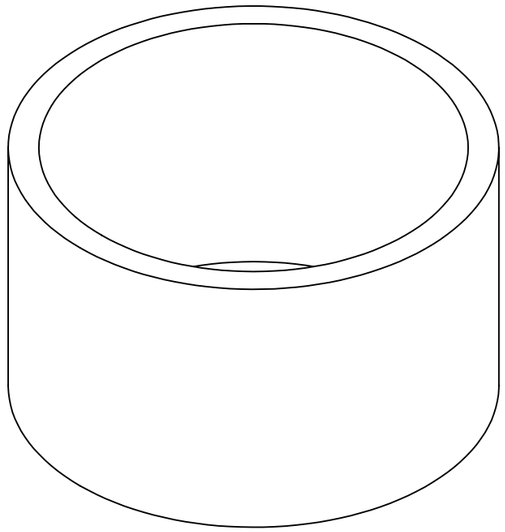
A3

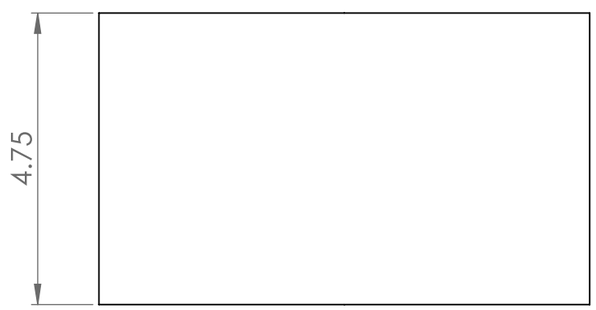
SCALE:1:1

DATE: 25.05.2022

SHEET 4 OF 8







THESE TECHNICAL DRAWINGS ARE FOR SIZE REFERENCE AND NOT SPECIFIED FOR PRODUCTION

UNLESS OTHERWISE SPECIFIED: DIMENSIONS ARE IN MILLIMETERS

THESE DRAWING FOLLOW THE DS/ISO 2768-1 TOLERANCES (m) +-0,1 MM. UNLESS SPECIFIED ON THE DRAWING

GEOMETRIC TOLERANCES WILL NOT BE SPECIFIED ON THESE DRAWINGS

NO SURFACE FINISH IS SPECIFIED IN THESE DRAWINGS

PRODUCTION METHOD:
Bought externally

MATERIAL:
Thermoplastic elastomer (TPE) (polyester)

WEIGHT: 0.06g

PART NO. 46

DO NOT SCALE DRAWING

MADE BY:
MSc04-id4 Industrial Design S2022

MODEL NAME
VERSITY - CASE

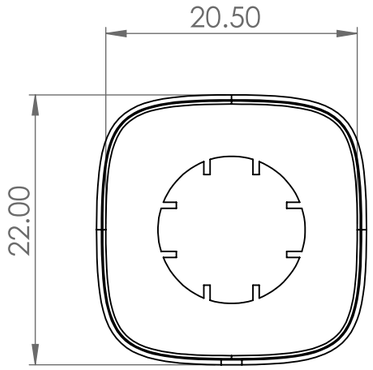
PART NAME
Rubber lock_Case

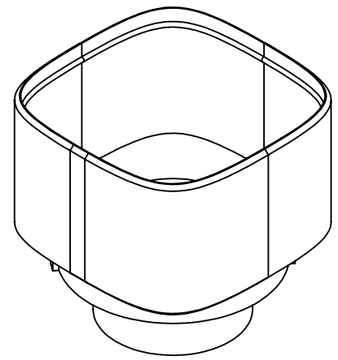
A3

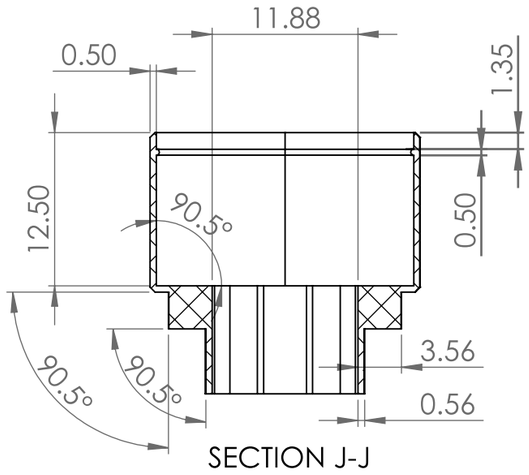
SCALE:10:1

DATE: 25.05.2022

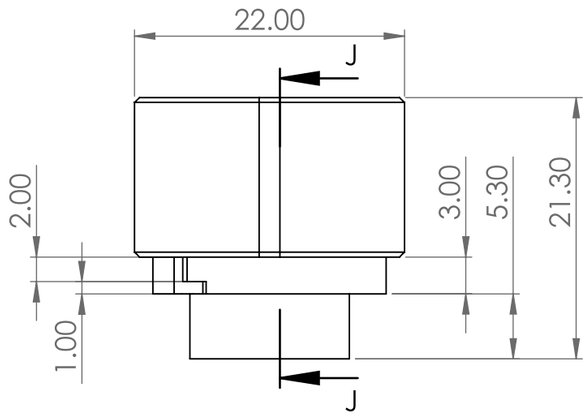
SHEET 5 OF 8

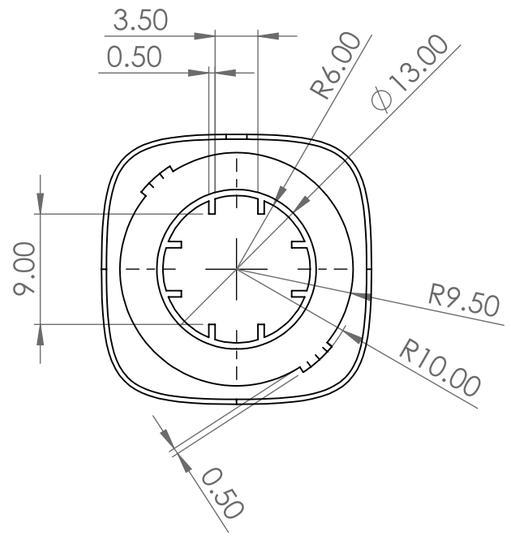






SECTION J-J





THESE TECHNICAL DRAWINGS ARE FOR SIZE REFERENCE AND NOT SPECIFIED FOR PRODUCTION

UNLESS OTHERWISE SPECIFIED: DIMENSIONS ARE IN MILLIMETERS

THESE DRAWING FOLLOW THE DS/ISO 2768-1 TOLERANCES (m) +-0,1 MM. UNLESS SPECIFIED ON THE DRAWING

GEOMETRIC TOLERANCES WILL NOT BE SPECIFIED ON THESE DRAWINGS

NO SURFACE FINISH IS SPECIFIED IN THESE DRAWINGS

PRODUCTION METHOD: Injection molding

MATERIAL: PC / ABS blend (Dark blue pigment)

WEIGHT: 1.53g

PART NO. 47

DO NOT SCALE DRAWING

MADE BY: MSc04-id4 Industrial Design S2022

MODEL NAME

VERSITY - CASE

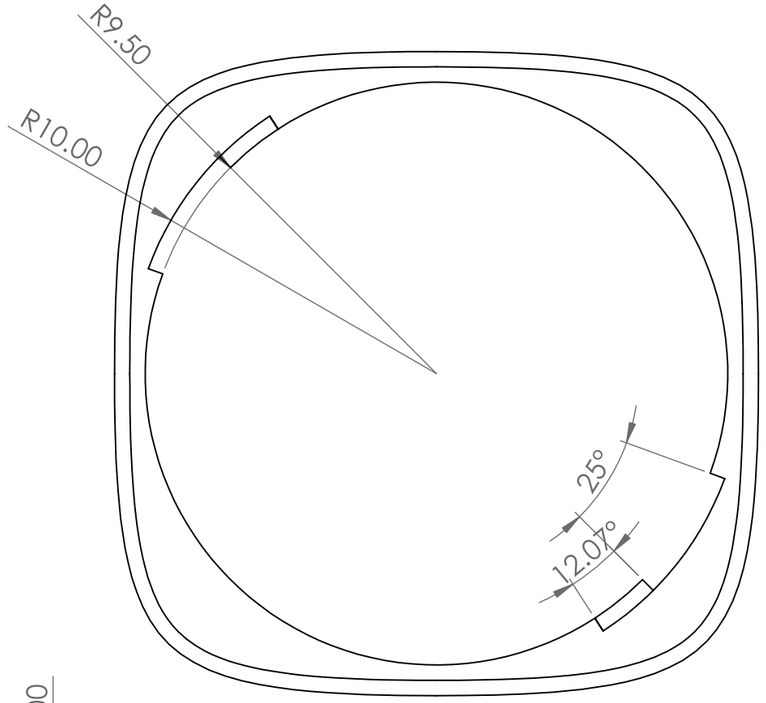
PART NAME: MSc04-id4 Industrial Design S2022

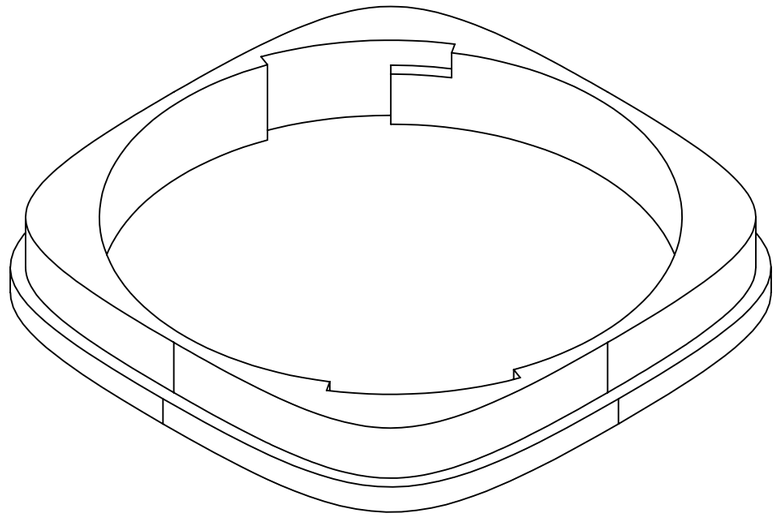
A3

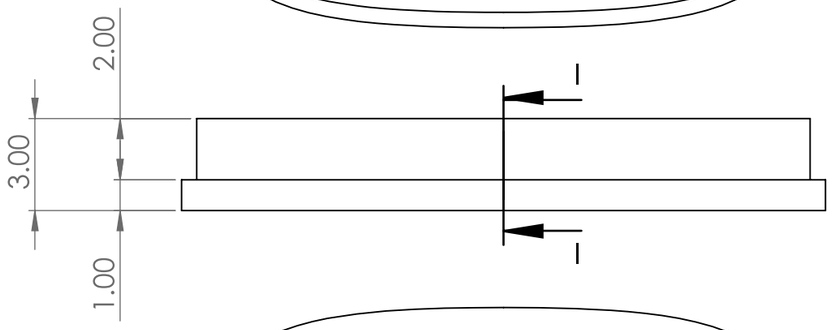
SCALE:2:1

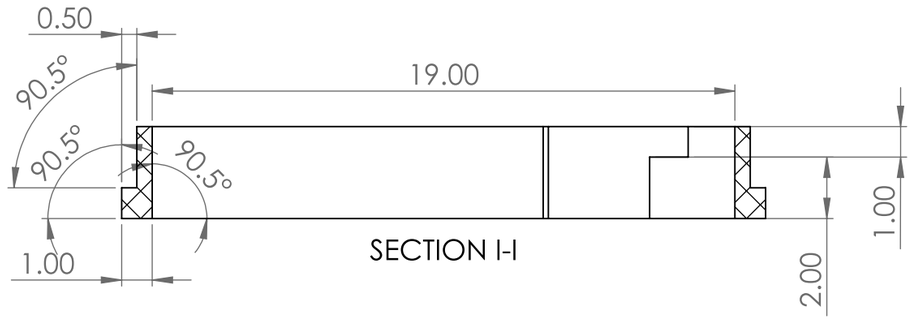
DATE: 25.05.2022

SHEET 6 OF 8

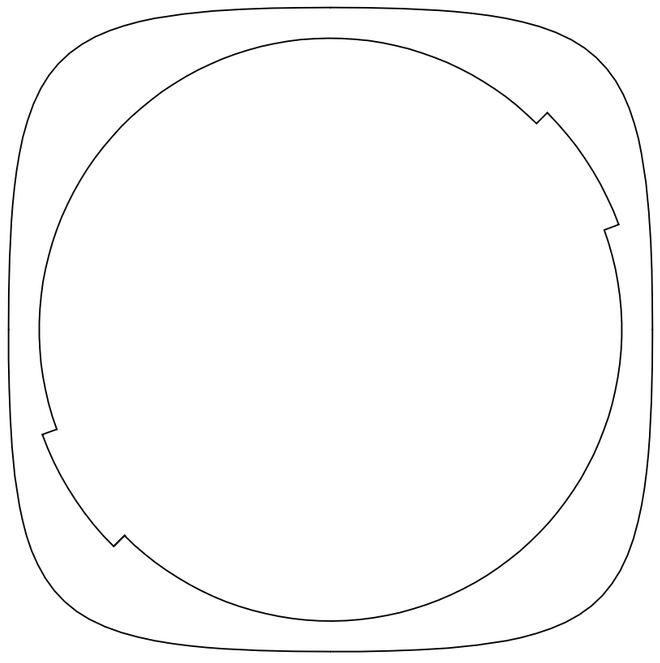




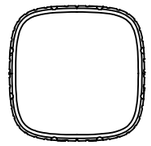


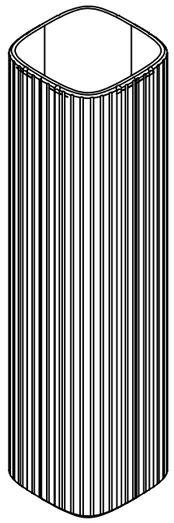


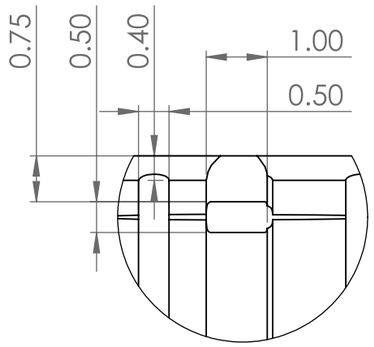
SECTION I-I



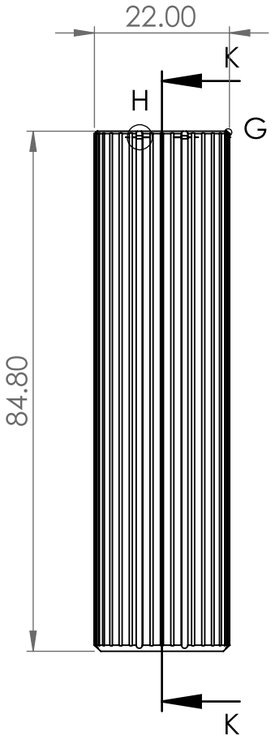
THESE TECHNICAL DRAWINGS ARE FOR SIZE REFERENCE AND NOT SPECIFIED FOR PRODUCTION UNLESS OTHERWISE SPECIFIED: DIMENSIONS ARE IN MILLIMETERS THESE DRAWING FOLLOW THE DS/ISO 2768-1 TOLERANCES (m) +-0,1 MM. UNLESS SPECIFIED ON THE DRAWING GEOMETRIC TOLERANCES WILL NOT BE SPECIFIED ON THESE DRAWINGS NO SURFACE FINISH IS SPECIFIED IN THESE DRAWINGS	PART NO. 48	DO NOT SCALE DRAWING
	MADE BY: MSc04-id4 Industrial Design S2022	
	MODEL NAME: VERSITY - CASE	
PRODUCTION METHOD: Injection molding		
MATERIAL: PC / ABS blend (Silver pigment)	PART NAME: Lid lock_Case	A3
WEIGHT: 0.33g	SCALE:5:1	DATE: 25.05.2022 / SHEET 7 OF 8

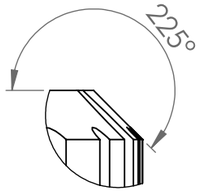




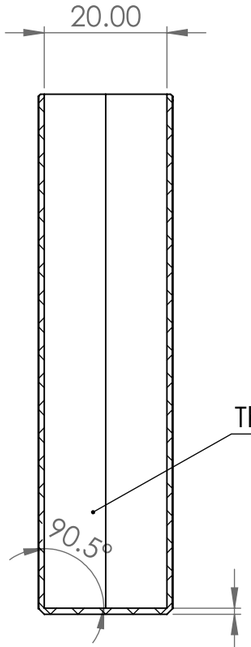


DETAIL H
SCALE 10 : 1



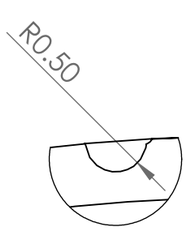


DETAIL G
SCALE 20 : 1

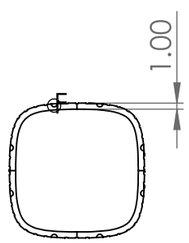


SECTION K-K

This angle is to small and need a draft of 3 degree



DETAIL F
SCALE 10 : 1



THESE TECHNICAL DRAWINGS ARE FOR SIZE REFERENCE AND NOT SPECIFIED FOR PRODUCTION

UNLESS OTHERWISE SPECIFIED: DIMENSIONS ARE IN MILLIMETERS

THESE DRAWING FOLLOW THE DS/ISO 2768-1 TOLERANCES (m) +-0,1 MM. UNLESS SPECIFIED ON THE DRAWING

GEOMETRIC TOLERANCES WILL NOT BE SPECIFIED ON THESE DRAWINGS

NO SURFACE FINISH IS SPECIFIED IN THESE DRAWINGS

PRODUCTION METHOD: Injection molding

MATERIAL: PC / ABS blend (Dark blue pigment)

WEIGHT: 7.29g

PART NO. 49

DO NOT SCALE DRAWING

MADE BY: MSc04-id4 Industrial Design S2022

MODEL NAME

VERSITY - CASE

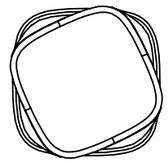
PART NAME: Lid shell_Case

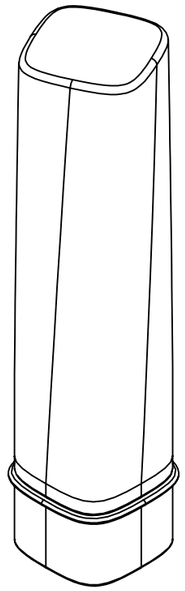
A3

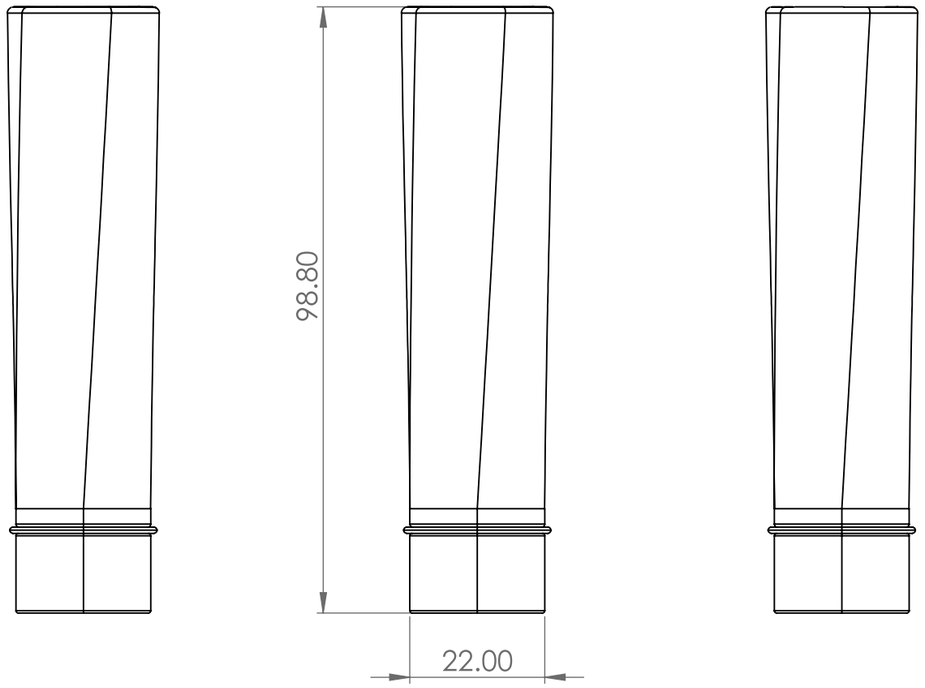
SCALE:1:1

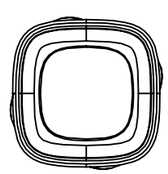
DATE: 25.05.2022

SHEET 8 OF 8









THESE TECHNICAL DRAWINGS ARE FOR SIZE REFERENCE AND NOT SPECIFIED FOR PRODUCTION

UNLESS OTHERWISE SPECIFIED: DIMENSIONS ARE IN MILLIMETERS

THESE DRAWING FOLLOW THE DS/ISO 2768-1 TOLERANCES (m) +-0,1 MM. UNLESS SPECIFIED ON THE DRAWING

GEOMETRIC TOLERANCES WILL NOT BE SPECIFIED ON THESE DRAWINGS

NO SURFACE FINISH IS SPECIFIED IN THESE DRAWINGS

PRODUCTION METHOD:

MATERIAL:

WEIGHT:

PART NO.

DO NOT SCALE DRAWING

MADE BY:

MSc04-id4 Industrial Design S2022

MODEL NAME

VERSITY - BASIC

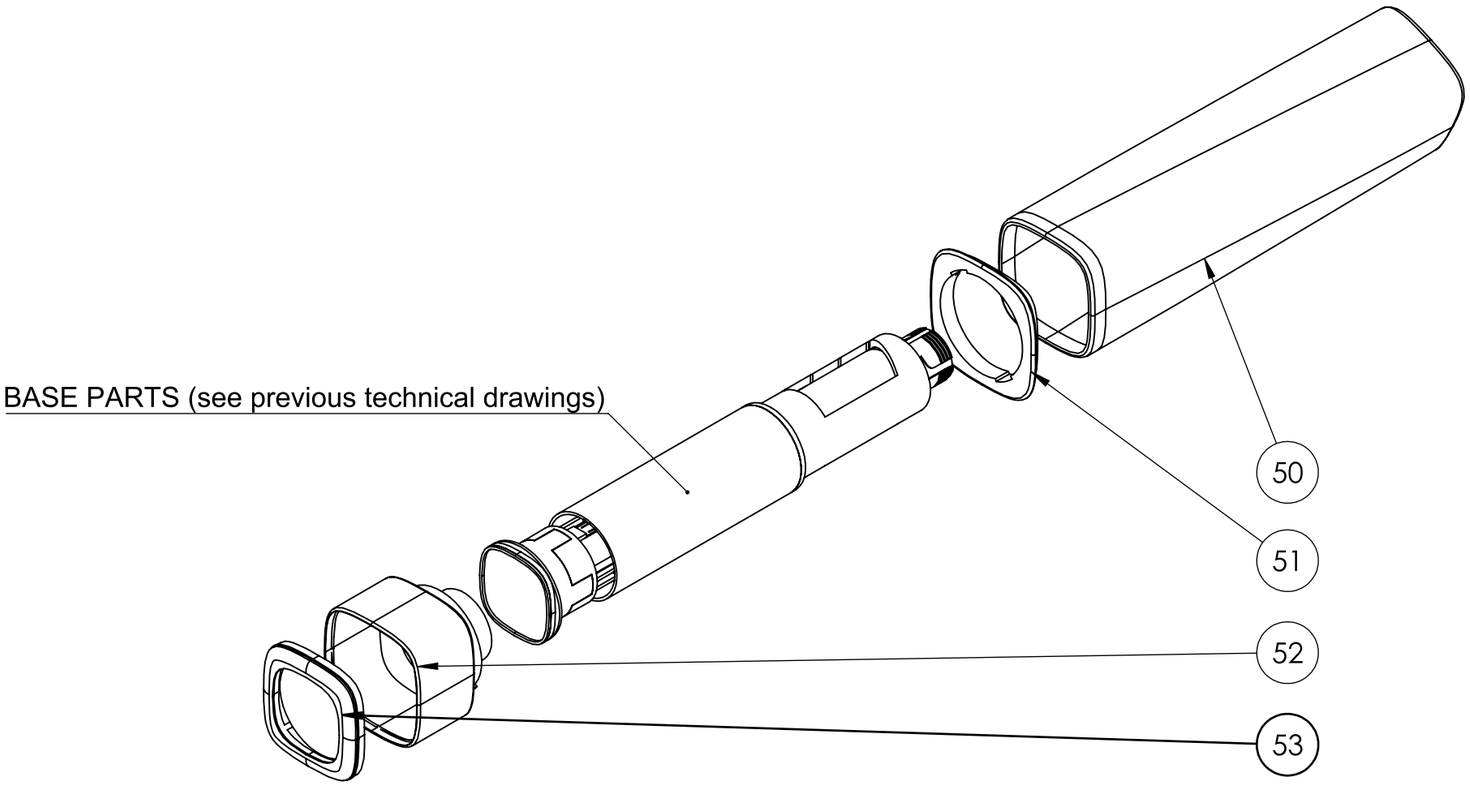
PART NAME

A3

SCALE:1:1

DATE: 25.05.2022

SHEET 1 OF 7



THESE TECHNICAL DRAWINGS ARE FOR SIZE REFERENCE AND NOT SPECIFIED FOR PRODUCTION

UNLESS OTHERWISE SPECIFIED: DIMENSIONS ARE IN MILLIMETERS

THESE DRAWING FOLLOW THE DS/ISO 2768-1 TOLERANCES (m) +-0,1 MM. UNLESS SPECIFIED ON THE DRAWING

GEOMETRIC TOLERANCES WILL NOT BE SPECIFIED ON THESE DRAWINGS

NO SURFACE FINISH IS SPECIFIED IN THESE DRAWINGS

PRODUCTION METHOD:

MATERIAL:

WEIGHT: 33g

PART NO.

DO NOT SCALE DRAWING

MADE BY:

MSc04-id4 Industrial Design S2022

MODEL NAME

VERSITY - BASIC

PART NAME

A3

SCALE: 1:1

DATE: 25.05.2022

ITEM NO.	PART NUMBER	Part nr.	QTY.
50	Lid_Basic	50	1
51	Lid lock_Basic	51	1
52	Lid top_Basic	52	1
53	Screen lock_Basic	53	1

THESE TECHNICAL DRAWINGS ARE FOR SIZE REFERENCE AND NOT SPECIFIED FOR PRODUCTION

UNLESS OTHERWISE SPECIFIED: DIMENSIONS ARE IN MILLIMETERS

THESE DRAWING FOLLOW THE DS/ISO 2768-1 TOLERANCES (m) +-0,1 MM. UNLESS SPECIFIED ON THE DRAWING

GEOMETRIC TOLERANCES WILL NOT BE SPECIFIED ON THESE DRAWINGS

NO SURFACE FINISH IS SPECIFIED IN THESE DRAWINGS

PRODUCTION METHOD:

MATERIAL:

WEIGHT:

PART NO.

DO NOT SCALE DRAWING

MADE BY:

MSc04-id4 Industrial Design S2022

MODEL NAME

VERSITY - BASIC

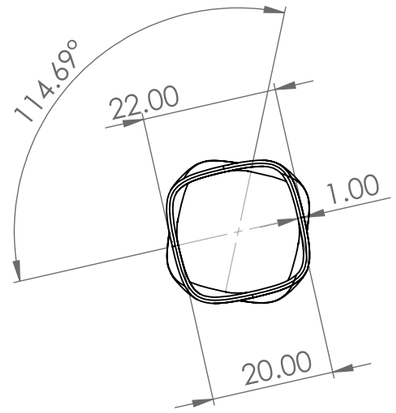
PART NAME

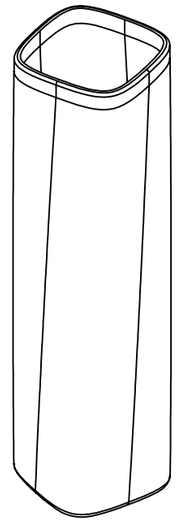
A3

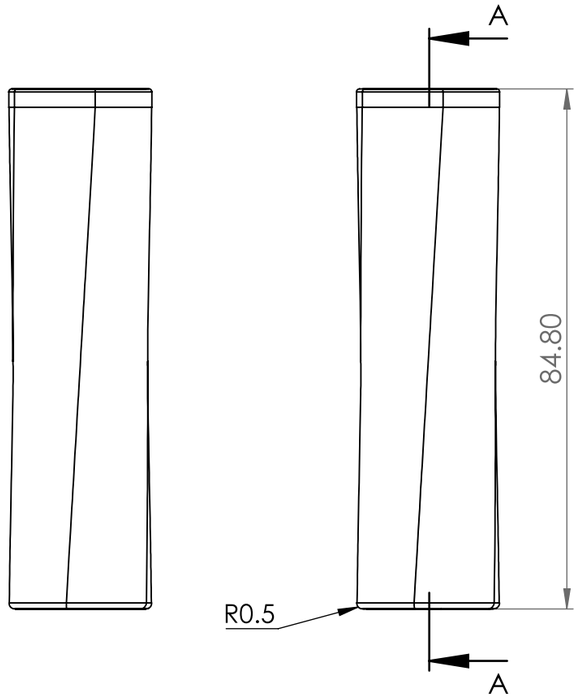
SCALE:1:2

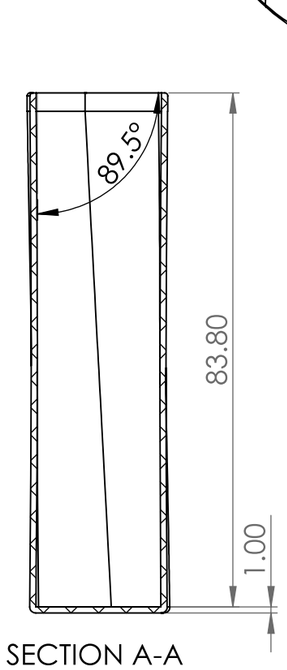
DATE: 25.05.2022

SHEET 3 OF 7

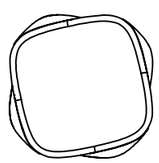








SECTION A-A



THESE TECHNICAL DRAWINGS ARE FOR SIZE REFERENCE AND NOT SPECIFIED FOR PRODUCTION

UNLESS OTHERWISE SPECIFIED: DIMENSIONS ARE IN MILLIMETERS

THESE DRAWING FOLLOW THE DS/ISO 2768-1 TOLERANCES (m) +-0,1 MM. UNLESS SPECIFIED ON THE DRAWING

GEOMETRIC TOLERANCES WILL NOT BE SPECIFIED ON THESE DRAWINGS

NO SURFACE FINISH IS SPECIFIED IN THESE DRAWINGS

PRODUCTION METHOD:
Multi Injection molding

MATERIAL:
PC / ABS blend
(Baige + gold pigment)

WEIGHT: 7.78g

PART NO. 50

DO NOT SCALE DRAWING

MADE BY:
MSc04-id4 Industrial Design S2022

MODEL NAME
VERSITY - BASIC

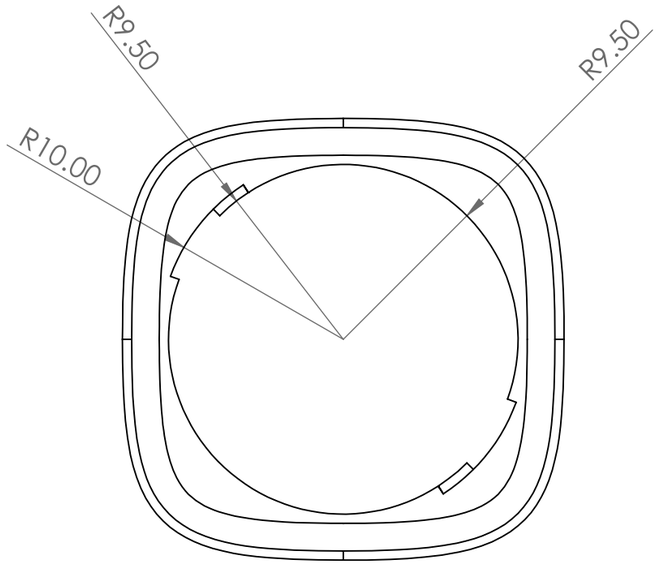
PART NAME
Lid_Basic

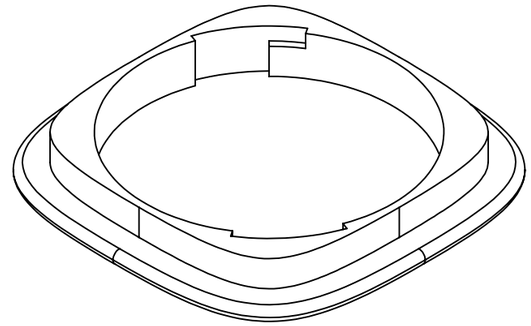
A3

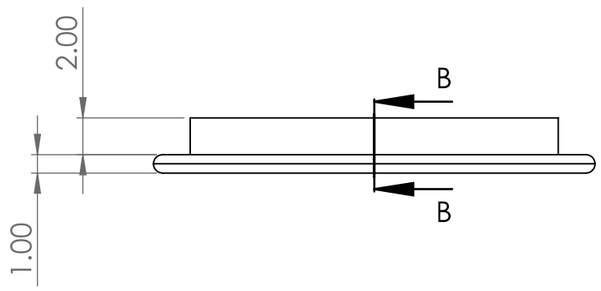
SCALE:1:1

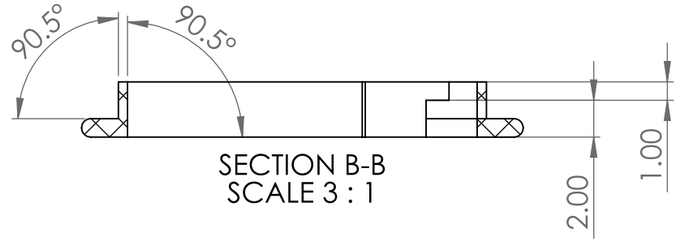
DATE: 25.05.2022

SHEET 4 OF 7

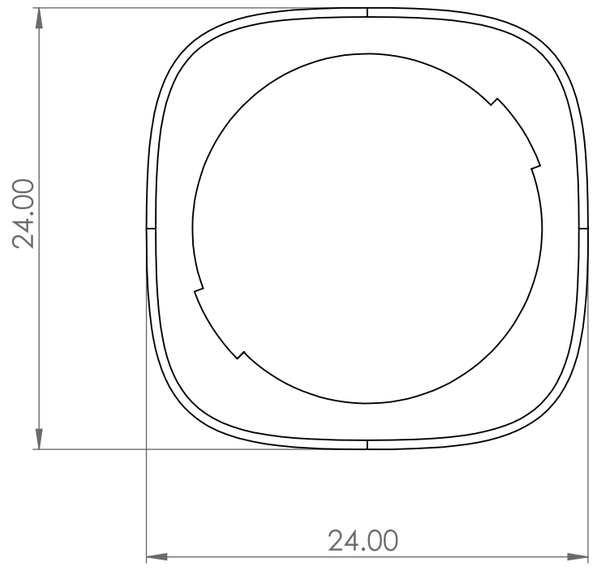








SECTION B-B
SCALE 3 : 1



THESE TECHNICAL DRAWINGS ARE FOR SIZE REFERENCE AND NOT SPECIFIED FOR PRODUCTION

UNLESS OTHERWISE SPECIFIED: DIMENSIONS ARE IN MILLIMETERS

THESE DRAWING FOLLOW THE DS/ISO 2768-1 TOLERANCES (m) +-0,1 MM. UNLESS SPECIFIED ON THE DRAWING

GEOMETRIC TOLERANCES WILL NOT BE SPECIFIED ON THESE DRAWINGS

NO SURFACE FINISH IS SPECIFIED IN THESE DRAWINGS

PRODUCTION METHOD:
Injection molding

MATERIAL:
PC / ABS blend (Gold pigment)

WEIGHT: 0.45g

PART NO. 51

DO NOT SCALE DRAWING

MADE BY:
MSc04-id4 Industrial Design S2022

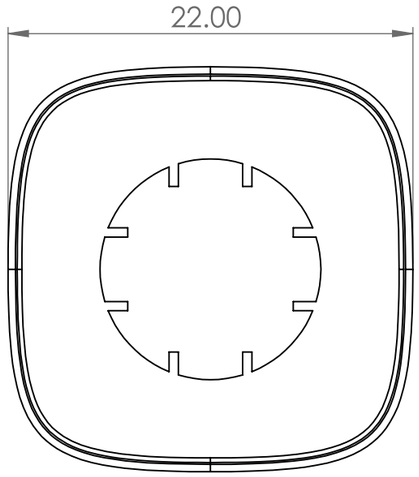
MODEL NAME
VERSITY - BASIC

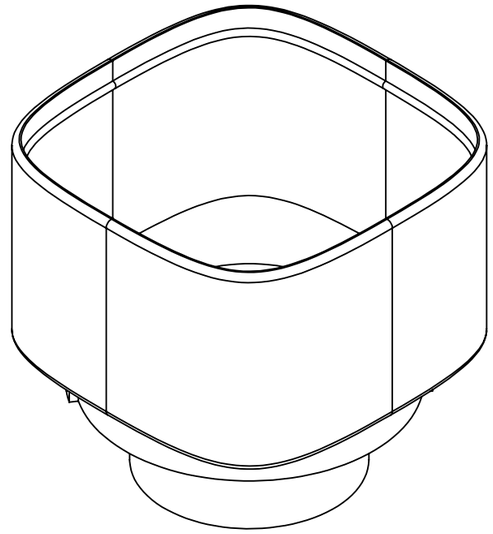
PART NAME
Lid lock_Basic

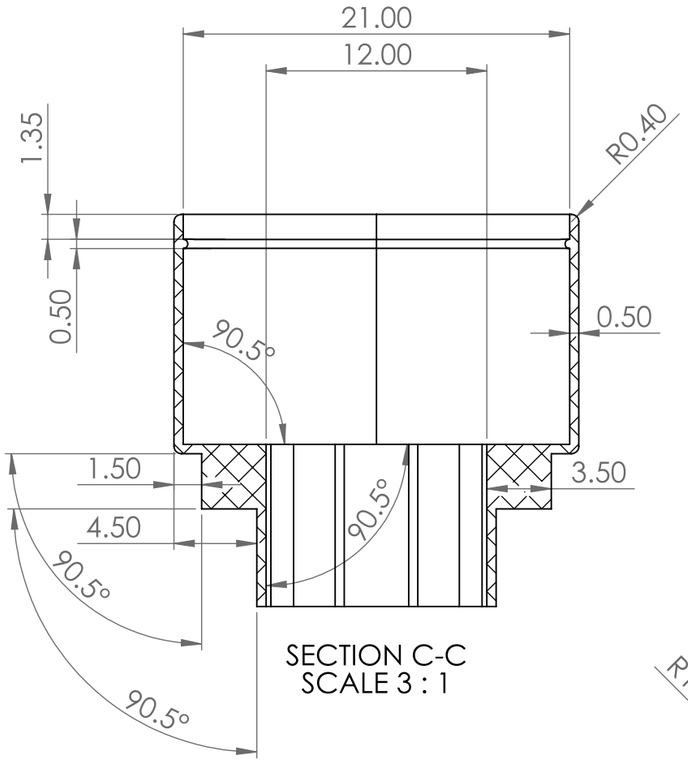
A3

SCALE: 3:1

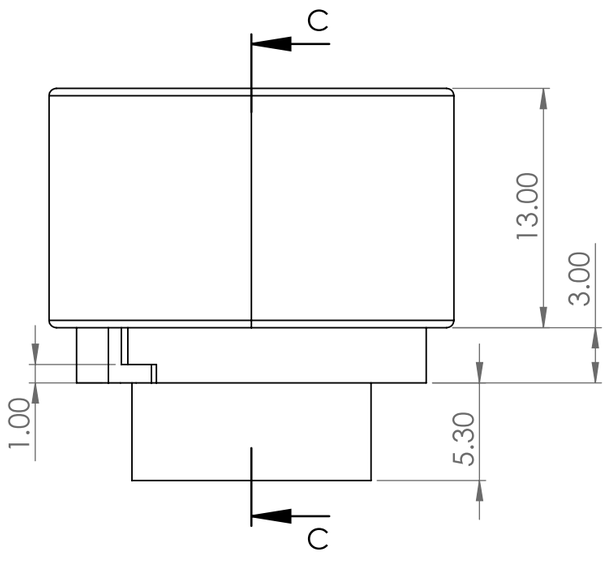
DATE: 25.05.2022

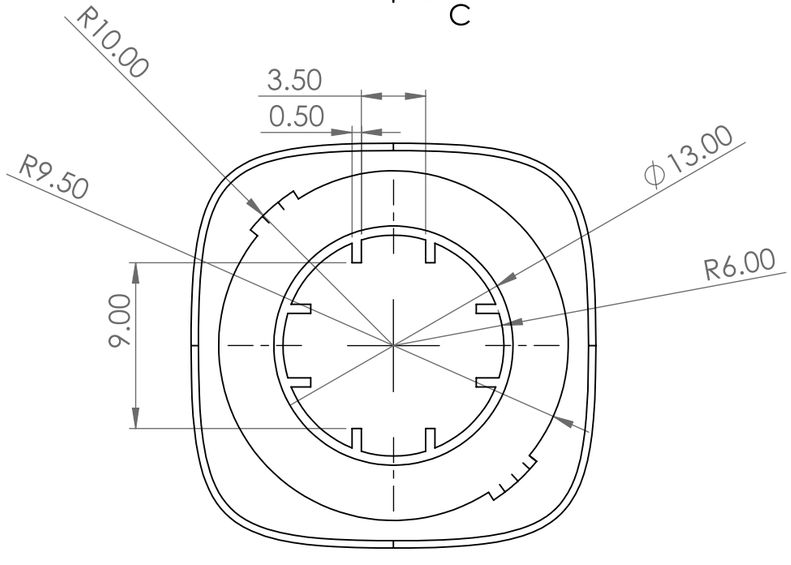






SECTION C-C
SCALE 3 : 1





THESE TECHNICAL DRAWINGS ARE FOR SIZE REFERENCE AND NOT SPECIFIED FOR PRODUCTION

UNLESS OTHERWISE SPECIFIED: DIMENSIONS ARE IN MILLIMETERS

THESE DRAWING FOLLOW THE DS/ISO 2768-1 TOLERANCES (m) +-0,1 MM. UNLESS SPECIFIED ON THE DRAWING

GEOMETRIC TOLERANCES WILL NOT BE SPECIFIED ON THESE DRAWINGS

NO SURFACE FINISH IS SPECIFIED IN THESE DRAWINGS

PRODUCTION METHOD:
Injection molding

MATERIAL:
PC / ABS blend (Dark baige pigment)

WEIGHT: 1.54g

PART NO. 52

DO NOT SCALE DRAWING

MADE BY:
MSc04-id4 Industrial Design S2022

MODEL NAME
VERSITY - BASIC

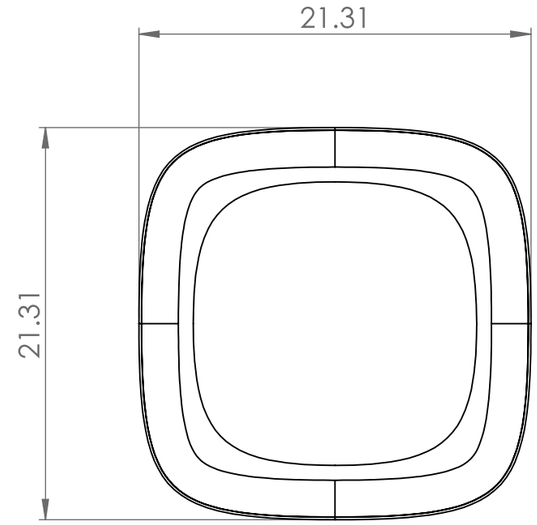
PART NAME
Lid top_Basic

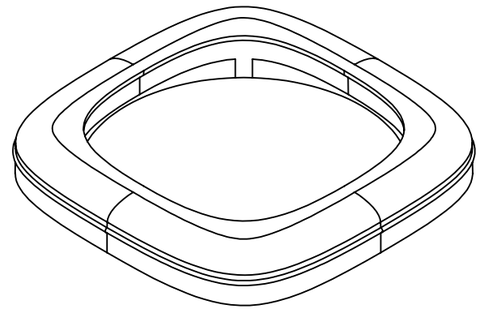
A3

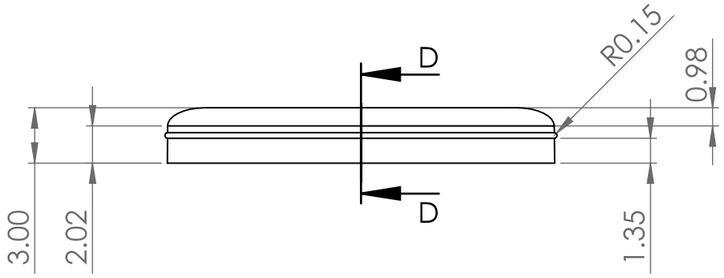
SCALE: 3:1

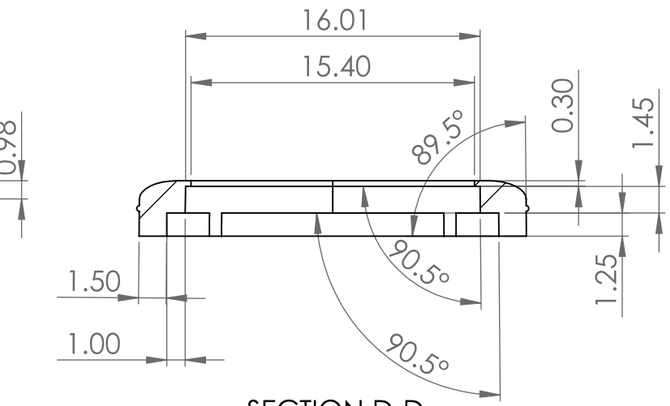
DATE: 25.05.2022

SHEET 6 OF 7

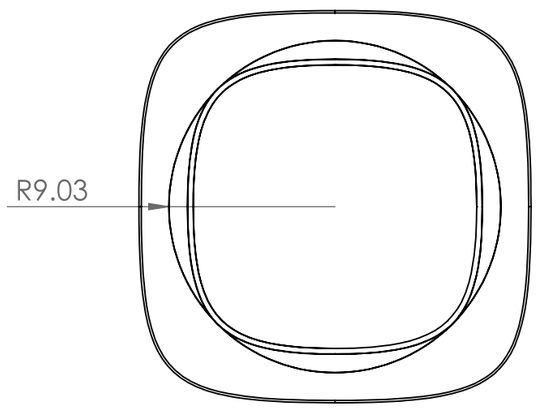








SECTION D-D
SCALE 3 : 1



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UNLESS OTHERWISE SPECIFIED: DIMENSIONS ARE IN MILLIMETERS

THESE DRAWING FOLLOW THE DS/ISO 2768-1 TOLERANCES (m) +-0,1 MM. UNLESS SPECIFIED ON THE DRAWING

GEOMETRIC TOLERANCES WILL NOT BE SPECIFIED ON THESE DRAWINGS

NO SURFACE FINISH IS SPECIFIED IN THESE DRAWINGS

PRODUCTION METHOD: Injection molding

MATERIAL: PC / ABS blend (Silver pigment)

WEIGHT: 0.52g

PART NO. 53

DO NOT SCALE DRAWING

MADE BY: MSc04-id4 Industrial Design S2022

MODEL NAME

VERSITY - BASIC

PART NAME: MSc04-id4 Industrial Design S2022

A3

SCALE: 3:1

DATE: 25.05.2022

SHEET 7 OF 7