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UNIVERSITAT POLITÈCNICA DE VALÈNCIA
CAMPUS D'ALCOI

REDESIGN OF A LINER SKI BOOT

CHANGING MATERIALS AND FORMS

REPORT SUBMITTED BY:

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ENGINEERING DEGREE IN INDUSTRIAL DESIGN AND PRODUCT DEVELOPMENT

Call for defence: *[June 2020]*

SUMMARY

This thesis project arises from the need to implement and improve the comfort of ski boots from the redesign of the liner, which is the one in contact with the user. This is intended to study new materials and fibers that, so far, this sector has not begun to use.

The new design is going to focus on getting antibacterial tissue, which is not damaged by external conditions such as moisture or sweat; Besides, the search for a lighter and breathable material than conventionally used. The study will be carried out according to the prescriptions indicated in the current regulations. The requirements and restrictions of the material will also be defined according to the processes, the user, and the development of the material. Finally, viable solutions will be obtained, specifying the characteristics of the material to be used and the basic forms that all the liners must have in common.

The project will reach all the phases proposed in the initial objectives since in the end all the necessary documents for its mass production and certification will be carried out.
It concludes with a technically and economically viable product for placing on the market.

Keywords: Ski boot, antibacterial yarn, EVA, spacer, liner.

RESUMEN

Este proyecto final de grado surge a partir de la necesidad de implementar y mejorar la comodidad de unas botas de esquí a partir del rediseño del botín interno, que es el que está en contacto con el usuario. Para ello se pretende estudiar nuevos materiales y fibras que, hasta el momento, este sector no ha comenzado a usar.

El rediseño se va a centrar en conseguir un tejido antibacteriano, que no se estropee por condiciones exteriores como la humedad o el sudor; además, de la búsqueda de un material más ligero y transpirable que el empleado convencionalmente.

El estudio se va a llevar a cabo según las prescripciones indicadas en la normativa vigente. También se definirán los requisitos y restricciones del material de acuerdo a los procesos, al usuario y al desarrollo del material. Finalmente se obtendrán soluciones viables, especificando las características del material a utilizar y las formas básicas que deben tener en común todos los botines.

El proyecto alcanzará todas las fases propuestas en los objetivos iniciales, ya que al final quedarán realizados todos los documentos necesarios para su fabricación en serie y su certificación.
Se concluye con un producto viable técnica y económicamente para su puesta en el mercado.

Palabras clave: Bota esquí, hilo antibacteriano, EVA, spacer, botín interno.

RESUM

Aquest projecte final de grau sorgeix a partir de la necessitat d'implementar i millorar la comoditat d'unes botes d'esquí a partir de el redisseny de l'botí intern, que és el que està en contacte amb l'usuari. Per això es pretén estudiar nous materials i fibres que, fins al moment, aquest sector no ha començat a utilitzar.

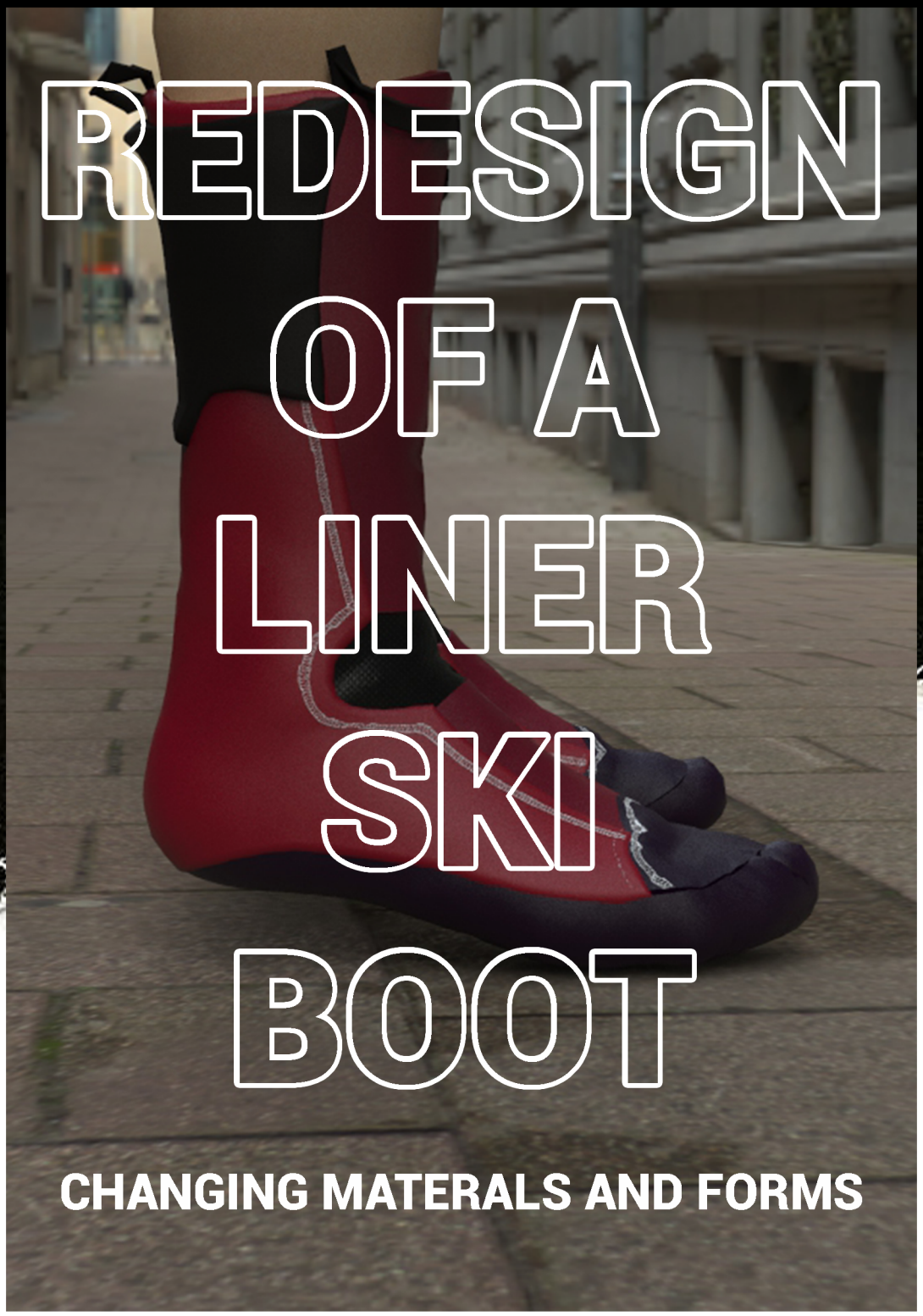
El redisseny es va a centrar en aconseguir un teixit antibacterià, que no es faci malbé per condicions exteriors com la humitat o la suor; a més, de la recerca d'un material més lleuger i transpirable que l'empleat convencionalment.

L'estudi es va a dur a terme segons les prescripcions indicades en la normativa vigent. També es definiran els requisits i restriccions de l'material d'acord amb els processos, a l'usuari i als el desenvolupament de l'material. Finalment s'obtindran solucions viables, especificant les característiques de l'material a utilitzar i les formes bàsiques que han de tenir en comú tots els botins.

El projecte arribarà totes les fases proposades en els objectius inicials, ja que a la fi quedaran realitzats tots els documents necessaris per a la seva fabricació en sèrie i la seva certificació.

Es conclou amb un producte viable tècnica i econòmicament per a la seva posada al mercat.

Paraules clau: Bota esquí, fil antibacterià, EVA, spacer, botí intern.



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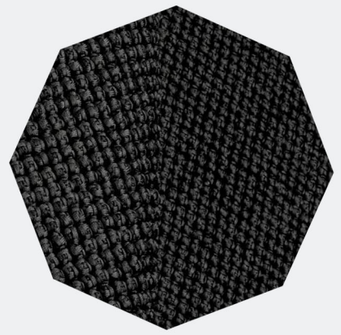


PULL TABS

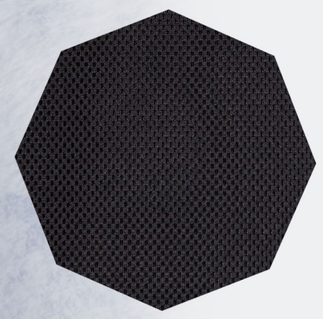
RETAINING TABS FOR BETTER FOOT PLACEMENT.

ELASTIC LAYER

SLIM NYLON LAYER ALLOWS MORE FLEXIBILITY AND BREATHABILITY

ANTIMICROBIAL YARN

SILVER COATED YARN FOR MICROBIAL AND ODOR PROTECTION



BREATHABLE MESH

3D SPACER LAYER WITH SMALL DIAMETER CELLS FOR BREATHABILITY AND THERMAL INSULATION

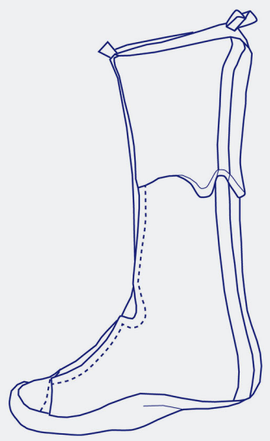
TARGET

Families
Coaches and staff
Advanced users
Competitors

DESIGN STATEMENT

Skiers often experience discomfort while skiing due to issues with ski boots. This results in users being unable to enjoy each session on the slope equally, and this problem is compounded over time.

The aim is to increase the comfort of the user, using new materials and technologies that are adapted to the current market.



NEW MATERIALS AND STRUCTURES

The new materials stand out for their breathability and humidity resistance as well as their anti-odor and anti-bacterial properties. Thus, the liner requires less maintenance.

The new structure allows greater cushioning and improved air flow to the surrondings. This allows for better moisture expulsion which enables the interior to dry faster.

Yasmín Inmaculada García Muñoz

ENGINEERING DEGREE IN INDUSTRIAL DESIGN AND PRODUCT DEVELOPMENT

Presentation: June 2020

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INDEX

1.

MEMORY

ANALYSIS OF THE WHOLE PRODUCT

1. PURPOSE AND JUSTIFICATION

1.1 Purpose

The idea of this end-of-degree work is to redesign the inner boot of a conventional ski boot, which is valid for alpine skiing. The aim is to increase the comfort of the user, using new materials and technologies that are adapted to the current market.

The scope of the project will be complete, it is expected that at the end of this work is documented both the graphic part through plans and technical drawings, as the part of development and research. The aim is to create a basis for manufacturing and marketing with a company in the sector in the future.

1.2 Justification

To determine the focus of the development of the booty, a study has been made, through analytical surveys, of the main discomforts that skiers have at the end of their day.

These surveys [will be shown on *5.3 surveys*] show that the majority of participants (71.4%) have discomfort at the end of the day, and notice that their boots are very heavy and wet. Besides, stains appear on the fabric caused by sweat and bacteria that are generated by the moisture generated by not drying the boots properly.

The user at whom this project is aimed is the one who is looking for the best characteristics in terms of design and functionality, usually families, people who work in the sector or even competitors, who spend a lot of time in continuous movement with their boots on.

2. BACKGROUND.

The beginning of the history of skiing is still somewhat diffuse, Chinese archaeologists date the first manifestations of skiing and some cave paintings found in the current Uyghur Autonomous Region, in Xinkiang, Northwest China. They say they number between 10,000 and 30,000 but there is some controversy.

The clearest example of the beginning of this activity is perhaps a ski found in Skellefteå (Norway), dated 3,200 BC; this model even shows the holes where the bindings were placed, which would probably be made of leather or sealskin.

Figure 1 Skis and rowing boat (kalvtraskskidan)

However, if we focus on the evolution of the ski boots, the situation is even more complex, since initially and until almost the end of the 19th century, the user's boots were used.

This was because until 1840 the ski binding was a simple leather strap that held the boot to the ski. The main design was conceived basically to keep the interior dry, this depended on the quality of the leather as well as the mixture of wax or animal fat used.

From 1840 onwards, with the development of new bindings that also held the heel of the boot, a protrusion was used in the rear area of the sole, and the toe was exaggerated to prevent the bindings from coming off.

Figure 2 Saami boots

Until 1928, the design of the boots hardly changed between artisans and women. It was thanks to skier Guido Reuge, who developed new bindings that linked the heel and toe to the ski using a steel cable, which these changes had a significant effect on the sole of the boots, which had to harden considerably.

After the Second World War, artisans developed the double boot, which had a flexible and comfortable boot inside, and another rigid one that had some hooks to be able to tie and adjust the boot to the user, externally. The outer boot had a protrusion in the toe that allowed for a better fit and reduced vibrations and friction on the way down.

Figure 3 Double ski boot

In 1954, the cyclist Hans Martin patented a new buckle system that replaced the typical laces, which had been used until then. This new fastening made the boot more rigid, so shoemakers also began to add plastic parts as reinforcement in the heel and toe.

Figure 4 Boots patented by Hans Martin

In 1966, it was the first time that boots with an all-plastic structure were used; this event was a big change since the power in the descent was improved simply by hardening the sides of the boot. Two years later, Lange introduced the first boot suitable for women.

Nordica was the first brand to introduce an all-plastic boot into its product line. In 1972, Lange developed what would be the first modern boot, with the removable inner boot and a tongue that allowed for a better fit to the wearer's leg. The outer shell was manufactured using injected urethane.

Figure 5 Lange boot

From this point on, there have been hardly any changes to the structure of the boot, but rather slight improvements in terms of weight, shell tension, pins, strength, and materials. Despite this, a market has been developed for different types of skiers, along with their different skill levels; although this last point only differs in the rigidity of the casing.

The classification according to the style of skiing would be as follows:

- Alpine ski boots: These are designed for use with alpine skis and bindings, securing both the toe and the heel of the boot; keeping the heel attached is the main difference that distinguishes pine skiing from other types of skiing.

This style of boot requires a pivot point near the ankle that allows the upper area of the outer shell to flex slightly for easier turning and braking.

- Freeride Ski Boots: While alpine skiing focuses on downhill riding on the piste, freeride skiing focuses on off-piste enjoyment, these boots require more lightweight than alpine ski boots; one of the main advantages of this type of boot is the versatility it has to work with any type of binding.

The current models have the Dynafit system, which allows the heel to be unlocked for walking as with the mountain ski boots.

- Ski mountaineering boots: These boots require a walking mode that can be activated or deactivated with a small lever. They must be light to be able to cross-mountain areas and rigid to guarantee the safety of the ankle in the descent.

Despite being boots designed for different purposes, they all share the same interior. The inner boot only changes depending on the brand and product range.

3. STANDARDS AND REFERENCES

- ISO 5355:2019 (Alpine ski boots-Requirements and test methods)

-ISO 9523:2019 (Touring ski-boots for adults - Interface with touring ski bindings - Requirements and test methods)

- ISO 5084 (Textiles – Determination of thickness of textile products. Geneva: International Organization for Standardization, 1996)

-ISO 11092. (Textiles – Physiological effects- Measurement of thermal and water-vapor resistance under steady-state conditions (sweating guarded hotplate test) 1993)

-Hes L and De Araujo M. Simulation of the effect of air gaps between the skin and a wet fabric on resulting cooling flow. Textile Res J 2010; 80(14): 1488-1497.

-UNE 53 200 83 (PLASTICS. DETERMINATION OF THE FLUIDITY INDEX OF THERMOPLASTIC MATERIALS IN MASS (IFM) AND IN VOLUME (IFV))

4. DEFINITIONS AND ABBREVIATIONS

In this point, reference is made to the terminology contemplated in the UNEEN1176 regulations, all the definitions here present are taken from those regulations.

-Core type yarn: The core type yarn is composed of a continuous filament yarn covered by a cut fiber yarn. This type of yarn is also known as Fibrofilament.

-Polyester yarn: Polyester yarn is made from any synthetic polymer. One of its main characteristics is that all its filaments are the same length as the same yarn and the total absence of hairs, therefore, the polyester yarn has greater tenacity and greater brightness in the fabric.

-Frostbite: Frostbite occurs when exposure to low temperatures causes freezing of the skin or other tissues. The initial symptom is typically numbness. This may be followed by clumsiness with white or bluish color to the skin. Swelling or blistering may occur following treatment. The hands, feet, and face are most commonly affected. Complications may include hypothermia or compartment syndrome.

-Grain: A product obtained from recycling used plastics and which is equivalent to first transformation plastic products or "virgin grain". It is usually presented in the form of fine cut "macaroni".

-Sizing: Final operation applied to the threads with chemical products.

-Nozzle: Tubular opening in a furnace or a forge, through which the air that feeds the combustion enters.

-Nylon: Synthetic polyamide from which elastic and very resistant filaments are made, used in the manufacture of various fabrics.

-Dreft spinning: A spinning system based on disintegrating fibers from a tape and condensing them by friction between two mechanical cylinders.

-Spacer fabric: Spacer fabrics are a kind of 3D manufactured textile structure in which two outer fabric layers are connected by a layer of pile threads.

-Electrospinning: Is a fiber production method that uses electric force to draw charged threads of polymer solutions or polymer melts up to fiber diameters in the order of some hundred nanometers.

5. DESIGN REQUIREMENTS

5.1 Description of requirements

As already explained in point 1 of this project, "Object and justification", the study of this project will be based on the replacement of the materials commonly used in the internal loot.

After conducting a survey in which different skiers of different levels of experience, ages, and countries were asked, different problems to be solved have been identified.

The first question was whether these users feel uncomfortable when using ski boots. 71.4% agreed that at the end of the day they felt pain in specific places.

Then it was asked if during the skiing session the user felt their feet wet, this time 48.1% confirmed that this was the case and that this also caused them some discomfort since with the cold of the mountain and the altitude this moisture was felt even more.

This means that if the boots do not dry properly, stains of dampness and sweat are generated. 38.6% of the participants stated that this is uncomfortable for them, especially when their equipment is rented or second-hand.

Finally, participants were asked about the weight of their boots, 54.3% of users agreed that their boots were heavy and that they would be willing to pay more for a lighter boot that would allow them to ski more easily.

The product is aimed at a small niche of people, as it is usually a high priced product and sometimes not accessible to all users, so they cannot have their own equipment. The fact that it is such a focused product means that increasing its price a little to improve the quality, transpiration, and lightness of the material does not mean a big problem.

The main users of this new improved product will be people with medium-high purchasing power who spend a great deal of time doing this sport and seek to improve their downhill experience, in addition to avoiding the extra care required by conventional boots.

At the same time, the improvements in terms of material also make the product more durable, so in the long run the product can be much cheaper.

5.1.1 Briefing

The needs required by the product in the form of initial specifications (P.C.I.) are as follows:

- To create a new standardized boot that can be used in conventional ski boots. - It is necessary to use current manufacturing methods to make this product easier to construct.

- The materials must be adjusted to the needs and main problems to be solved, without increasing their price excessively, but complying with the minimum quality objectives and requirements.

5.2 Product functions

5.2.1 Usage functions

5.2.1.1 Main functions of use

- Use in any style of ski boot.
- Be accessible to the maximum number of people.
- Promote skiing because of its comfort.

5.2.1.2 Complementary functions of use

- Functions derived from use:
  - Achieve the least deterioration of the elements over time.
  - Ease of assembly. Ease of handling.
- Functions of similar products:
  - Good transpiration.
  - Good absorption of sweat.
  - Good protection against foot rubbing against the boot shell.

5.2.1.3 Restrictive functions or use requirements

- Compliance with regulations concerning ski boots.
  - - ISO 5355 (Alpine ski boots-Requirements and test methods)
  - -ISO 9523:2019 (Touring ski-boots for adults - Interface with touring ski bindings - Requirements and test methods)

- Functions to reduce negative impacts:
  - Actions of the environment on the product:
    Must be able to withstand wet environments and sweat. It should be able to withstand low temperatures.
  - Actions of the product on the user:
    The shape, dimensions, and materials must comply with the ergonomic aspects of the user.
  - Actions of the user on the product
    The materials of the product must resist friction and prevent wear.

5.2.1.4 Industrial and commercial functions

- Aspects to be taken into account in manufacturing:
    - Use of the least number of different machines and tools. Use of the maximum number of standardized elements.
- Aspects to be taken into account in the assembly:
    - Minimize assembly sequences.
    - Minimize the number of different machines to be used.
    - Minimize the number of operators.
    - To facilitate the manipulation for the assembly.
- Aspects to be taken into account for assembly and transport Optimise space in the boxes as much as possible.
    - Use of the European pallet.
    - Take into account the dimensions of the packaged product to optimize space in transport.

5.2.2 Aesthetic functions

5.2.2.1 Emotional functions:

- The boot must convey comfort.
- It should be light.
- Be nice to the touch.
- It must give a feeling of quality according to its price.

5.2.3 Functional specifications (F.C.P.)

Memory table 1 Functional specifications for use

FUNCTIONAL SPECIFICATIONS FOR USE						
FUNCTION		FEATURES OF THE FUNCTIONS				
Nº MANDATE	DESIGNATION	CRITERIA	LEVEL	FLEXIBILITY		Vi
				FLEXIBILITY	F	
5.2.1.1 Main functions of use						
5.2.1.1.1	Use in any style of ski boot	Versatility	-	-	1	3
5.2.1.1.2	Being accessible to the maximum number of people	Accessibility	-	-	1	3
5.2.1.1.3	Promote skiing because of its comfort	Advertising	-	-	3	1
5.2.1.2 Complementary functions of use						
5.2.1.2.1 Functions derived from use						
5.2.1.2.1.1	Achieve the least deterioration of the elements over time	Wear and tear	-	-	1	4
5.2.1.2.1.2	Easy assembly	Handly	-	-	1	4
5.2.1.2.1.3	Easy handling	Handly	-	-	2	3
5.2.1.2.2 Functions of similar products						
5.2.1.2.2.1	Good transpiration	Perspiration	-	-	0	5
5.2.1.2.2.2	Good absorption of sweat	Absorption	-	-	0	5
5.2.1.2.2.3	Good protection against the boot shell	Safety	-	-	0	5
5.2.1.3 Restrictive functions of requirements						
5.2.1.3.1 Compliance with regulations						
5.2.1.3.1.1	ISO 5355 (Alpine ski boots - Requirements and test methods)	Legislation	-	-	0	5
5.2.1.3.1.2	ISO 9523:2019 (Touring ski boots for adults – interface with touring ski boots and bindings- requirements and test methods)	Legislation	-	-	0	5
5.2.1.3.2 Functions to reduce negative impacts						
5.2.1.3.2.1 Actions of the environment on the product						
5.2.1.3.2.1.1	Must be able to withstand wet environment and sweat	Resistance	-	-	1	4
5.2.1.3.2.1.2	Should be able to withstand low temperatures	Resistance	-	-	1	4
5.2.1.3.2.2 Actions of the product on the user						
5.2.1.3.2.2.1	Shape, dimensions and materials must comply with the ergonomic aspects of the user	Ergonomics	m	-	0	5

5.2.1.3.2.3 Actions of the user on the product					
5.2.1.3.2.3.1	Materials must resist friction and prevent wear.	Material	-	- 1	4
5.2.1.4 Industrial and commercial functions					
5.2.1.4.1 Aspects to be taken into account in manufacturing					
5.2.1.4.1.1	Use of the least number of different machines ad tools	Optimization	-	- 2	2
5.2.1.4.1.2	Use of the maximum number of standardized elements	Optimization	-	- 2	2
5.2.1.4.2 Aspects to be taken into account in the assembly					
5.2.1.4.2.1	Minimize assembly sequences	Simplicity	-	- 2	2
5.2.1.4.2.2	Minimize the number of different machines to be used	Simplicity	-	- 2	3
5.2.1.4.2.3	Minimize the number of operators	Simplicity	-	- 3	3
5.2.1.4.2.4	Facilitate the manipulation for the assembly	Simplicity	-	- 2	2
5.2.1.4.3 Aspects to be taken into account for assembly and transport					
5.2.1.4.3.1	Optimise space in the boxes as much as possible	Optimization	-	- 1	3
5.2.1.4.3.2	Use of the European pallet	Dimension	-	- 1	3
5.2.1.4.3.3	Take into account dimensions of the packaged product	Dimension	-	- 1	3

Table 1 Flexibility

CLASS F	FLEXIBILITY	LEVEL OF NEGOTIATION
0	NULL	IMPERATIVE
1	BIT	NON-NEGOTIABLE
2	GOOD	NEGOTIABLE
3	HIGH	VERY NEGOTIABLE

Table 2 Importance of function.

VALUE (VI)	IMPORTANCE OF FUNCTION
NULL	USEFUL
BIT	NECESSARY
GOOD	IMPORTANT
HIGH	VERY IMPORTANT
GOOD	VITAL

Memory table 2 Aesthetic funtional specifications

AESTHETIC FUNCTIONS						
Function		Features of the functions				
Nº MANDATE	DESIGNATION	CRITERIA	LEVEL	FLEXIBILITY FLEXIBILITY	F	Vi
5.2.2.1 Emotional fuctions						
5.2.2.1.1	The liner must convey comfort	Comfort	-	-	0	5
5.2.2.1.2	It should be light	Weight	Kg	400-600 g	1	3
5.2.2.1.3	Be nice to the touch	Texture	-	-	2	3
5.2.2.1.4	It must give a feeling of quality according to its price	Quality	-	-	2	2

Table 1 Flexibility

CLASS F	FLEXIBILITY	LEVEL OF NEGOTIATION
0	NULL	IMPERATIVE
1	BIT	NON-NEGOTIABLE
2	GOOD	NEGOTIABLE
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Table 2 Importance of function.

VALUE (VI)	IMPORTANCE OF FUNCTION
NULL	USEFUL
BIT	NECESSARY
GOOD	IMPORTANT
HIGH	VERY IMPORTANT
GOOD	VITAL

5.3 Survey

As part of the project, a survey has been carried out to take into account the percentage of users affected by the aforementioned problem with the ski boots. In our case they are adults of different levels of experience, different ages, and nationalities, all of them direct users of the product.

The survey is intended to improve the focus of the project, focusing on those aspects where one of the responses is much more widespread than the others do.

For the V.T.P., some results of the survey will also be taken into account. The survey consists of 5 questions in which 70 people participated. The following are the answers:

1. **If you are a skier, do you spend a lot of time skiing? ***

Número de participantes: 70

27 (38.6%): sí

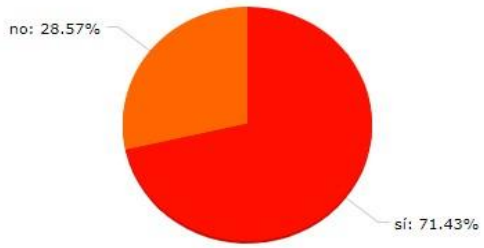
43 (61.4%): no

2. **Do you usually have discomfort caused by the boots at the end of the day? ***

Número de participantes: 70

50 (71.4%): sí

20 (28.6%): no

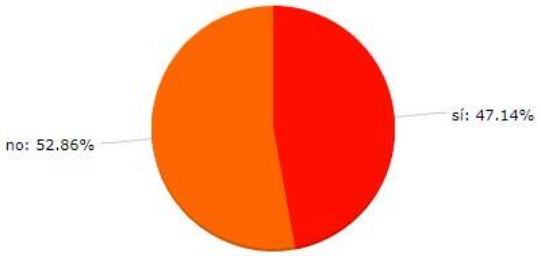


3. When you have been skiing for a while, do you feel you have wet feet?

Número de participantes: 70

33 (47.1%): sí

37 (52.9%): no



4. Do you feel your boots are too heavy?

Número de participantes: 70

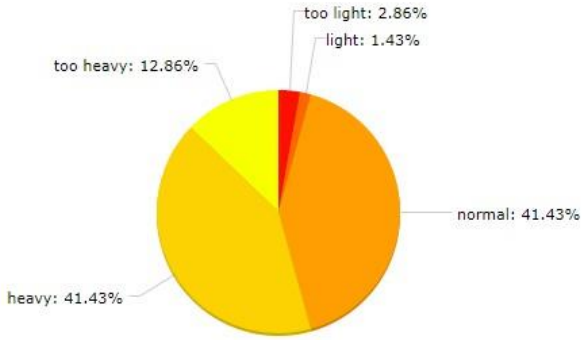
2 (2.9%): too light

1 (1.4%): light

29 (41.4%): normal

29 (41.4%): heavy

9 (12.9%): too heavy

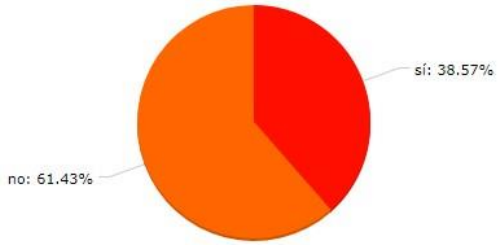


5. When you start the ski season again, do you notice that the inner boot has sweat spots?

Número de participantes: 70

27 (38.6%): sí

43 (61.4%): no



Because of these answers, the result will be adopted as far as possible as long as the opinions of the respondents do not conflict with certain variables with which the project may be compromised.

6. SOLUTION ANALYSIS

6.1 Influence of the market study

To understand the basis of the project, it is important to comment on the products already on the market, since this is where the need to look for new alternatives to the materials and designs already established arises.

This study has mainly served to discover which needs are not completely covered by the competition, in order to include them in the final product. With this, the user is satisfied by offering higher quality at slightly higher prices.

This study does not look for the final design or aesthetics of the product but is based on the study of the construction and new materials to be used. For this reason, in the following sketches the forms and colors will be simplified to the maximum, resorting to a simple and practical design for the client, even with modern and current stylistic touches.
[Market research is on first point of the Annexes]

6.2 First ideas.

Taking into account the briefing in point 5.1.1 and the market study, several sketches have been made of the form that the booty will take. All of this was done to simplify the process of making and understanding the object.

Since the inner boot cannot be modified much in terms of volume or structure, inasmuch as it will be found between the user and the casing of the ski boot, the boot must comply with very marked shapes. Furthermore, the style and colors are not of great importance in this case because it is a part of the object that goes inside and therefore will not be seen.

As mentioned in previous points, the idea is to modify the materials to improve the quality and design of the object. This would be one of the most complete models ever made, but following a simple aesthetic line that gives the user the feeling that it is easy to use and at the same time protects him from rubbing against the casing and the humidity of the environment.

The idea at the beginning of the project was to completely redesign the ski boot, both in terms of shape and materials. Including the closings, the bindings, the boot, and the casing of the boot, but this work would have been of an inconsiderate dimension because of the number of different typologies of projects that it housed.

6.2.3 Design ideas.

To begin developing the design and style of the boot, we must look at the basic and technical aspects that are currently shared by this market niche, in which we can generally see clearly how they are all made up of a tongue that helps them to fit more comfortably and a non-slip sole, which will prevent the boot from slipping or moving around inside the boot.

Figure 6

Figure 7

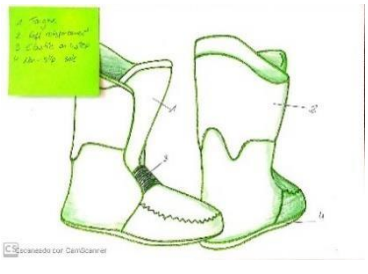


Figure 8

Figure 9

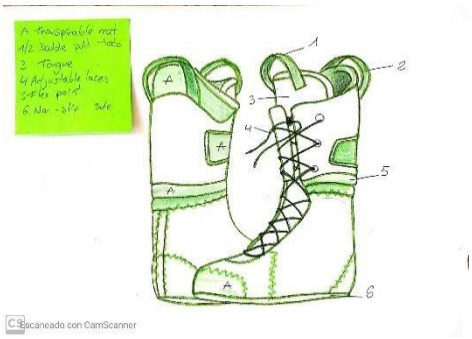


Figure 10

In the initial ideas you can see how they share many general aspects, which are explained one by one below.

-Figure 6: It is the style most similar to a common boot of low quality, it lacks elements since it is practically composed by the tongue and the sole, the part of the instep has a greater thickness to avoid the rubbing of the boot in that part of the foot.

-Figure 7: This is a higher quality design, it already has more padding and tape to be able to stretch and place the foot faster and better; it also closes completely thanks to the fact that one part of the tongue passes over the other and through a Velcro, it makes it stay together and compresses the user's leg.

-Figure 8: It is still a simple design to make and easy to use by the user. It has an elastic band on the tongue that exerts a slight pressure making it fit the foot of the skier, as the previous example also has the padding on the part of the calf that transmits greater comfort when it is being used.

-Figure 9: This is the most modern design and the one that would best fit the user, but the one with the highest price. It has two straps to be able to better introduce the foot in the boot, the reinforcement in the back part that avoids the rubbing with the shell, an elastic band so that the tongue does not move, and a non-slip sole. All this makes it a high-quality boot and at the same time complex construction processes, which is why this boot is discarded.

-Figure 10: It is a boot composed of a breathable material that allows greater evacuation of sweat, in turn, has greater reinforcement throughout its structure and an area that allows greater freedom when walking and moving with them. On the other hand, the laces may stick to the user's leg and generate discomfort when skiing; its structure is the most complex of all, and following one of the main bases of the design to be proposed (simplicity in the processes), this boot would be unviable.

6.2.1 Ideas for new materials

Memory table 3 Material comparison

MATERIAL	ADVANTAGES	INCONVENIENT
Silver-coated yarn [1]	- Antimicrobial performance. - Permanently bond. - Permanent Anti-odor. - High absorbency. - Good insulation.	- Need more development. - Need more processes
Ionized bamboo carbon [2]	- Antimicrobial. - Renewable. - High absorbency.	- Deforestation. - Need pesticides. - Intensive farming practices. - Monoculture bamboo forests. - The process is not completely green. - Decomposition in a short period of time.
Cotton fabric with plastic coating*	- Good insulation in a dry state. - Cooling effect. - Wind resistance.	- Dry heat loss. - Overnight drying inadequate. - Humidity between layers. - Low water vapor permeability. - Sweat reduces insulation.

*Currently in use.

6.2.2 Ideas for the new structure

Memory table 4 Structure comparison

STRUCTURE	ADVANTAGES	INCONVENIENT
Laminated material*	- Frequently used in ski liners. - It can be conformable. - Multiple layers allow multiple materials. - High insulation. - Closed-cell structure.	- No chance for moisture evaporation. - High foot sweating. - It can produce frostbite. - Condensation facilitates conductive heat loss.
3D Spacer fabric + EVA layer	- It can replace cushion materials. - Good comprehensive behavior. - Good energy absorption capability. - Good thermal characteristics. - Good air permeability. (WEFT KNITTED)	- Complex geometry. - Open cells. - Need EVA layer
EVA*	- Good insulation. - Closed cells. - Airflow.	- This airflow decreases thermal insulation. - Different layers. - Insufficient overnight drying.

*Currently in use

7. FINAL RESULTS

This section will describe and justify the product based on the changes in material, design, and structure of the fabric belonging to the object.

It should be clarified that, although there is a design proposal, the study of this project is based mainly on the study of materials and structures to improve the qualities and performance of the skier, increasing their comfort. Therefore, this is summarized in that it depends on the brand that wishes to implement its stock with boots that use these improvements, the aesthetic form of the same can be redesigned according to the requirements of the company.

7.1 Description and justification of the material.

Before continuing to explain the material finally chosen for the final design, it is necessary to carry out the weighted technical value (T.P.V) where we will consider which proposal is better in terms of materials.

The calculation of the T.P.V. will be carried out using the following formula:

$$T.P.V = \frac{\sum_{i=1}^{n} pi \; x \; gi}{p \max x \; \sum_{i=1}^{n} gi}$$

The upper part indicates the sum of multiplying each of the importance of the gi requirements by the qualifications given to each of the solutions for each pi section. This is divided by the sum of the importance values multiplied by the maximum value Pmax.

Memory table 5 T.P.V material

REQUIREMENTS	METHOD OF MEASUREMENT	IMPORTANCE	Silver-coated yarn	Ionized bamboo carbon	Cotton fabric with plastic coating
Resistance	Strength	9	9 / 81	8 / 72	7 / 63
Maintenance	User actions for product care	7	9 / 63	7 / 49	5 / 35
Thermal isolation	Standards	9	8 / 72	8 / 72	6 / 54
Renewable materials	Nº of renewable materials	5	7 / 35	9 / 45	5 / 25
Antimicrobial	Standards	8	8 / 64	8 / 64	5 / 40
Anti-humidity	Standards	9	7 / 63	6 / 54	6 / 54
Absorbency	Standards	8	7 / 56	7 / 56	5 / 40
Total		**55** / **T.P.V.**	**434** / **0,88**	412 / 0,83	311 / 0,63

At this point, three options are presented:

-Ionized bamboo thread: This is the second-best option proposed according to the V.T.P. but due to negative aspects such as deforestation, the need for pesticides, or the intensive bamboo production farms used to obtain it, this material is not the option chosen.

-Plastic-covered cotton yarn: As mentioned in the previous section, this is the most widely used material in this sector.

This material is the worst value according to the T.P.V. since, although it has good thermal insulation when it is dry, when it is wet there is a loss of dry heat in the user which, at extreme temperatures can cause discomfort and even pain. Together with this factor, the water absorption of the material must be taken into account, which will influence the weight of the boot and the comfort of the boot.

According to the study Microclimate in ski boots - Temperature, relative humidity, and water absorption, humidity absorption values in the following conditions (±10ºC, 0ºC, ±20ºC; 65% relative humidity; 1.5H in action that causes sweating) should be 78%, which causes an increase of 10g in the weight of the boot.

However, while you are skiing you must add the possibility of greater water penetration into the fabric due to the snow in the environment and possible falls of the user, this leads to the moisture of the boot to 93% and a weight of 45.5g. The amount of water stored in the boot is one of the main causes of heat loss and the feeling of tiredness in the user's feet.

This humidity and the improper drying of the same is the main cause of the formation of fungi and bacteria in the fabric of the boot that is in contact with the skier, besides, it causes bad smell and increases the possibility of rubbing between the boot and the sock, thus being able to damage the user's skin.

-Silver salt with PE yarn: To avoid the problem of cotton and following the T.P.V. it has been decided to use a fabric formed by core type yarns with a PE core and covered with 99.99% silver salt, this type of yarn has antimicrobial and antibacterial properties, thus permanently avoiding the bad smell caused by them. Besides, their temperature regulation values are very high due to the properties of silver, to which we must add the properties of the base yarn we decide to use, which in our case will be PE.

Its properties in terms of water absorption depend on the silver coating and not on the polyester, which allows the thread to remain absorbent and can collect the sweat and take it out, keeping the user's foot dry for as long as possible.

Exposure to air or moisture causes silver atoms on the surface to oxidize forming silver ions, which are the basis of the antimicrobial action. The silver protons are attracted to the electrons of the bacteria, these ions across the membrane to enter the interior of the bacteria where they attack its DNA, thus inhibiting the mutation and reproduction of new bacteria in the tissue.

Obtaining fabrics with this material is very simple, as it simply uses a silver-coated polyester thread, so the thread maintains all the properties of polyester such as elasticity, flexibility, and softness.

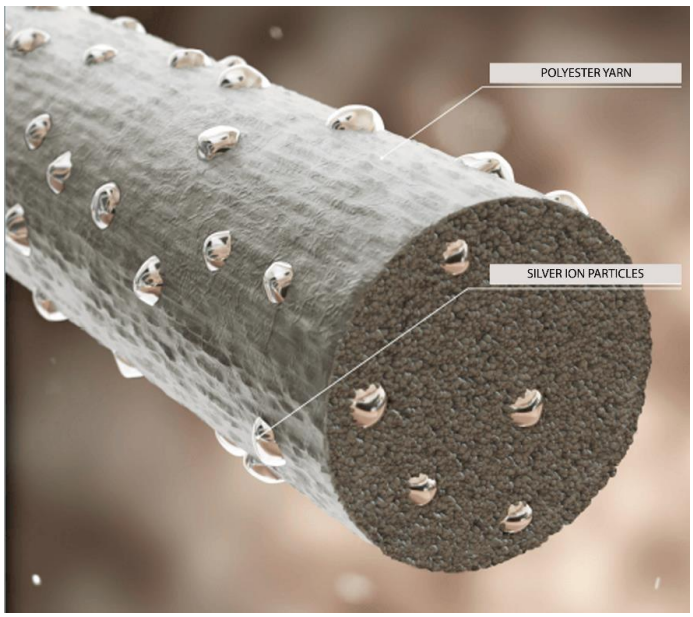


Figure 11 Silver coated PES yarn

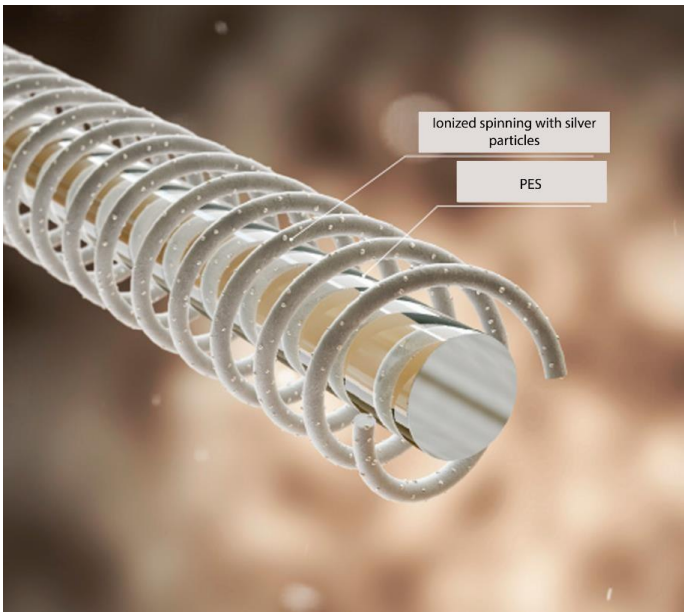


Figure 12 Silver thread-coated yarn

7.2 Description and justification of the tissue structure.

To evaluate the best option in the structure of the tissue, a comparison between three different types of structures will be carried out, for which a V.T.P. will also be used to give objective results.

These properties will be altered according to the yarn to be used.

-Laminated material: it offers us the possibility of using different textiles with different properties, these must be able to complement each other and never to cancel each other out, unless it is convenient for the product. The outer layer must have a higher pick up than the inner layers, and it must be covered with a plastic material that allows it to be hydrophobic. Interestingly, the intermediate layers are made of foam to ensure user comfort. [3]

-Plastic-coated cotton: Presents the same problem as the laminated material, moreover, the same padding, and comfort is not achieved. It needs further treatment which can sometimes be more expensive.

-3D Spacer + EVA layer: The EVA layer achieves the necessary thermal insulation, while the air chambers formed between the spacer threads cause water steam and sweat to flow out, avoiding constant humidity in the fabric that will be on the surface with the user. The gaps generated between the transversal threads of the spacer allowing for greater evaporation and therefore faster drying of the fabric.

The part of the spacer fabric in contact with the user will be hydrophobic, while the intermediate part will be the most absorbent to allow better transport of fluids to the outside.

Memory table 6 T.P.V structure

REQUIREMENTS	METHOD OF MEASUREMENT	IMPORTANCE	Laminated material	3D spacer + EVA layer	Cotton fabric with plastic coating
Resistance	Strength	7	7 / 49	8 / 56	8 / 56
Comfortability	survey	9	8 / 72	9 / 81	7 / 63
Thermal insulation	Standards	8	8 / 64	7 / 48	9 / 72
Overnight drying	% moisture	7	6 / 42	8 / 56	6 / 42
Air permeability	Standards	7	7 / 49	8 / 56	9 / 63
Energy absorption	Standards	9	6 / 54	7 / 63	6 / 54
Comprehensive behaviour	Standards	7	6 / 42	7 / 49	6 / 42
Total		**54** / **V.T.P.**	372 / 0,76	**410** / **0,84**	392 / 0,80

As you can see from the T.P.V. the best of the three options is the spacer fabric, which allows greater fluidity of air and liquids.

Polyester is currently used as one of the main fabrics in sportswear due to its properties such as being very economical, lightweight, resisting humidity well, or drying very quickly, to which properties such as elasticity, resistance to abrasion, high temperatures and bacteria must be added.

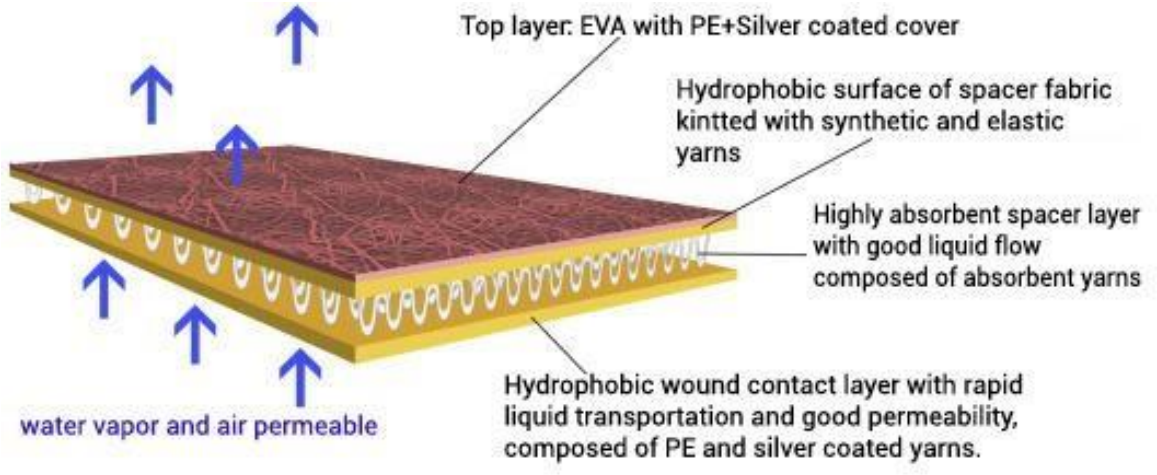


Figure 13 Sandwich structure with EVA and hydrophobic material

7.3 Design Justification.

Next, we will explain the final decisions taken regarding the design of the booty according to the company's criteria and according to the market study (Market study on annexes) carried out to better understand this project.

Figure 14: Front view elements
Software: Marvelous designer

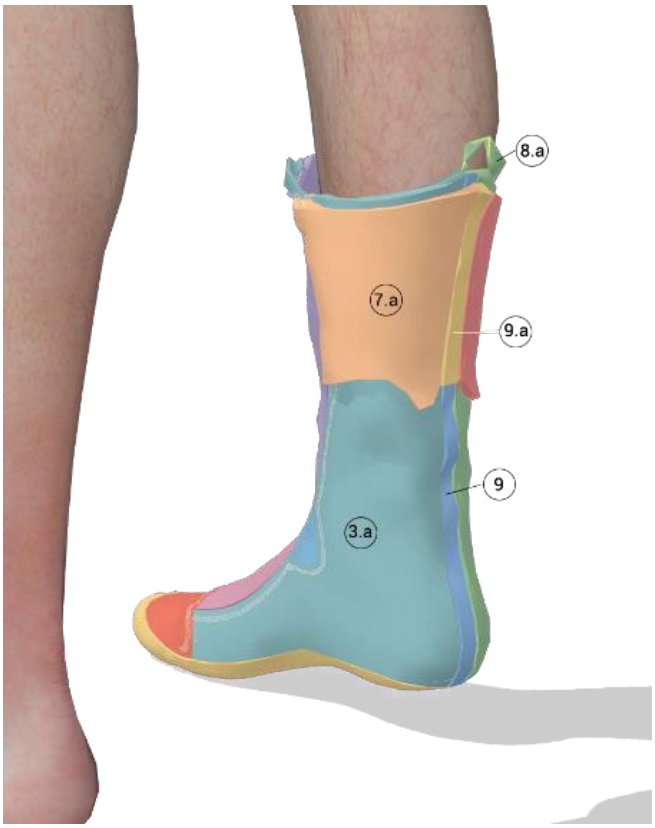


Figure 15: Back view elements
Software: Marvelous designer

1.- Sole: For better grip and contact with the casing. It allows for greater comfort underfoot and can be adjusted to fit.

2.-Moccasin toe construction: It must thermally insulate the user and not allow heat loss in the toes since, due to the absence of large muscles in the foot, it must be heated mainly by the blood flow, which is much less in the part of the toes. (In temperatures below 25ºC the flow is highly slowed down so there is a risk of suffering frostbite).

3/3a Walls: Allows the foot to be held in place while providing greater comfort and preventing the user from rubbing against the casing.

4.-Elastic instep: They offer greater support and facilitate the placement of the boot.

5.- Elastic flex point: This is an elastic Nylon fabric that allows the user to move more easily and not generate wrinkles in the fabric that can damage you while you are skiing.

6.-Tongue: Better positioning of the boot since it can be stretched to introduce the foot, it has thermoregulatory properties that avoid the cooling of the user and avoid the rubbing with the external boot.

7/7a .-Cuff reinforcement: It offers greater thermoregulation while cushioning the area of the calf and the user's calf in its pressure against the boot. These areas are usually the ones that suffer the most after a long day of skiing due to the pressure that the skier exerts leaving all the weight in front of the descent or controlling the turns.

8/8a .-Double pull tap: They allow the user to stretch and position the booty better. These can be made of any other material as they do not need any special properties as they are not in contact with the user's leg. They are usually made of much cheaper material and are resistant to traction.

9/9a .- Band of union of the walls and the reinforcement: It is in charge of keeping the walls and the reinforcement together. By dividing the walls of the boot into the left and right parts, it is much easier to make and it is more elastic as it is made of different parts.

In the design you can see how some of the stitches are visible. For a few years now and due to the few aesthetic modifications that these products undergo, many are the models that use this technique to add aesthetic functions to the boot without having to completely redesign it. This is usually done by using threads of different colors to the base shade on which it is being sewn.

We recommend the use of removable insoles that fit the user's foot for greater comfort.

7.3.1 Analysis of the design simulation.

In this section, we proceed to evaluate the pressure that the user exerts when putting on the boots and where the greatest friction with the casing is found. Thanks to this simulation, we can also interpret the points where greater reinforcement will be needed to prevent the boot from feeling uncomfortable.

To understand the graph we must understand the colors as the areas where the tissue is stretched more or less. Being 100% the tissue with its original shape, in green we can see that amounts to 111.43% where the increase in stretching is about 11%, and red 120% corresponds to the area that suffers more stretching with an increase of 20%.

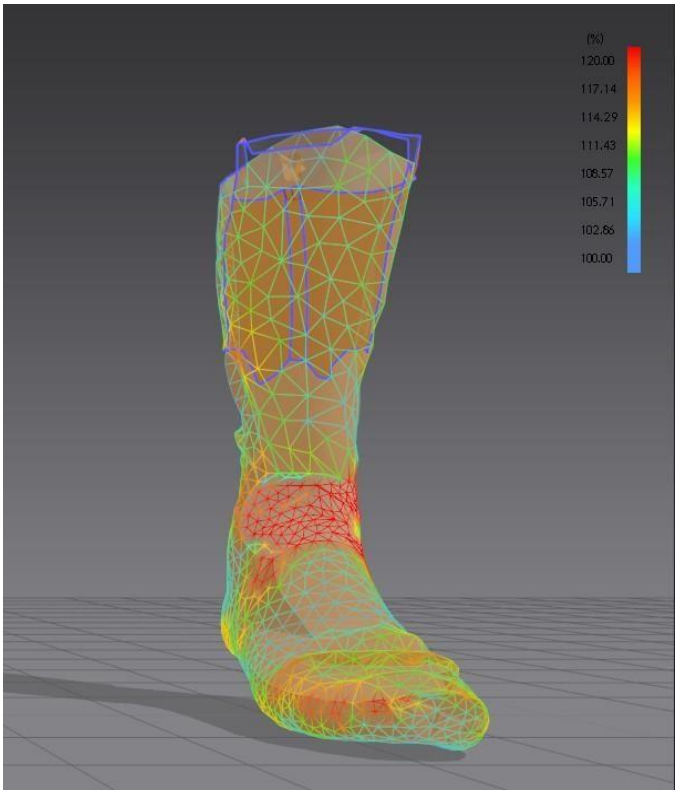
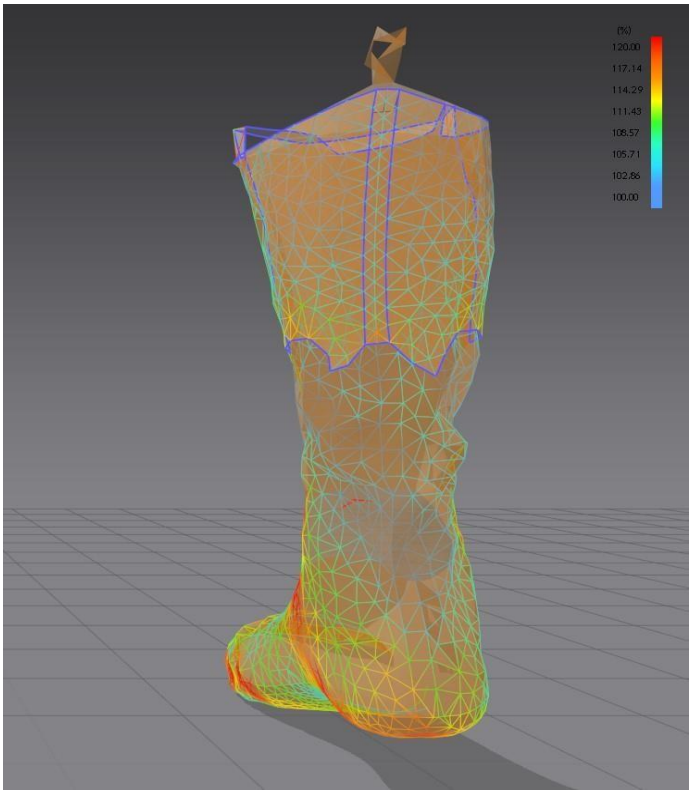


Figure 16 Power grid, front view
Software: Marvelous designer. Force map and pressure points



Software: Marvelous designer. Force map and pressure points
Figure 17 Power grid, back view.

In figures 16 and 17 you can clearly see how the parts that suffer the most are the areas surrounding the fabric that allows the foot to flex because it is the most elastic material and will, therefore, stick to the user.

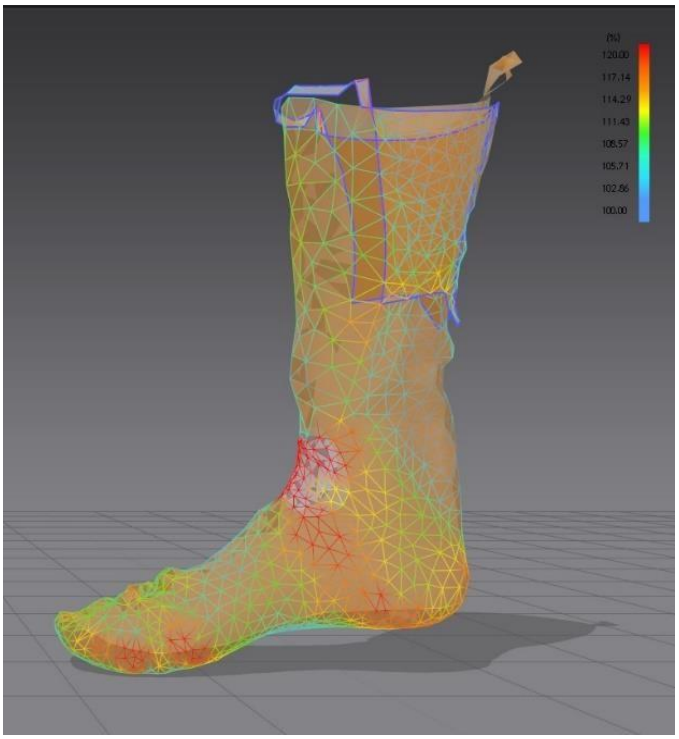
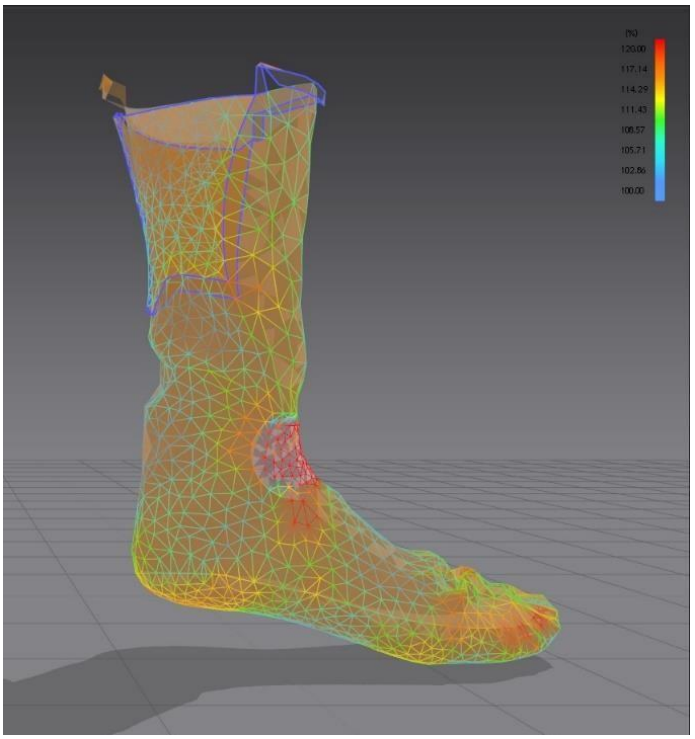


Figure 18 Power grid, right side view
Software: Marvelous designer. Force map and pressure points



Software: Marvelous designer. Force map and pressure points
Figure 19 Power grid, left side view

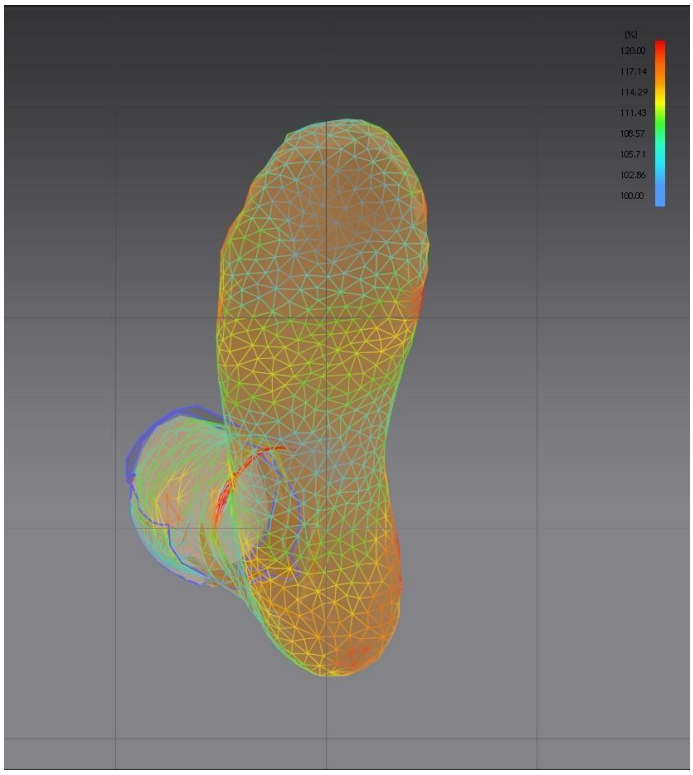


Figure 20 Power grid, bottom view
Software: Marvelous designer. Force map and pressure points

Figures 18, 19 and 20 also show some pressure in the outer area of the toes and heel, this is due to the shape of the user's foot, the pressure parameters and the critical areas can change depending on the type of user's step which can be supinator, neutral or pronator.

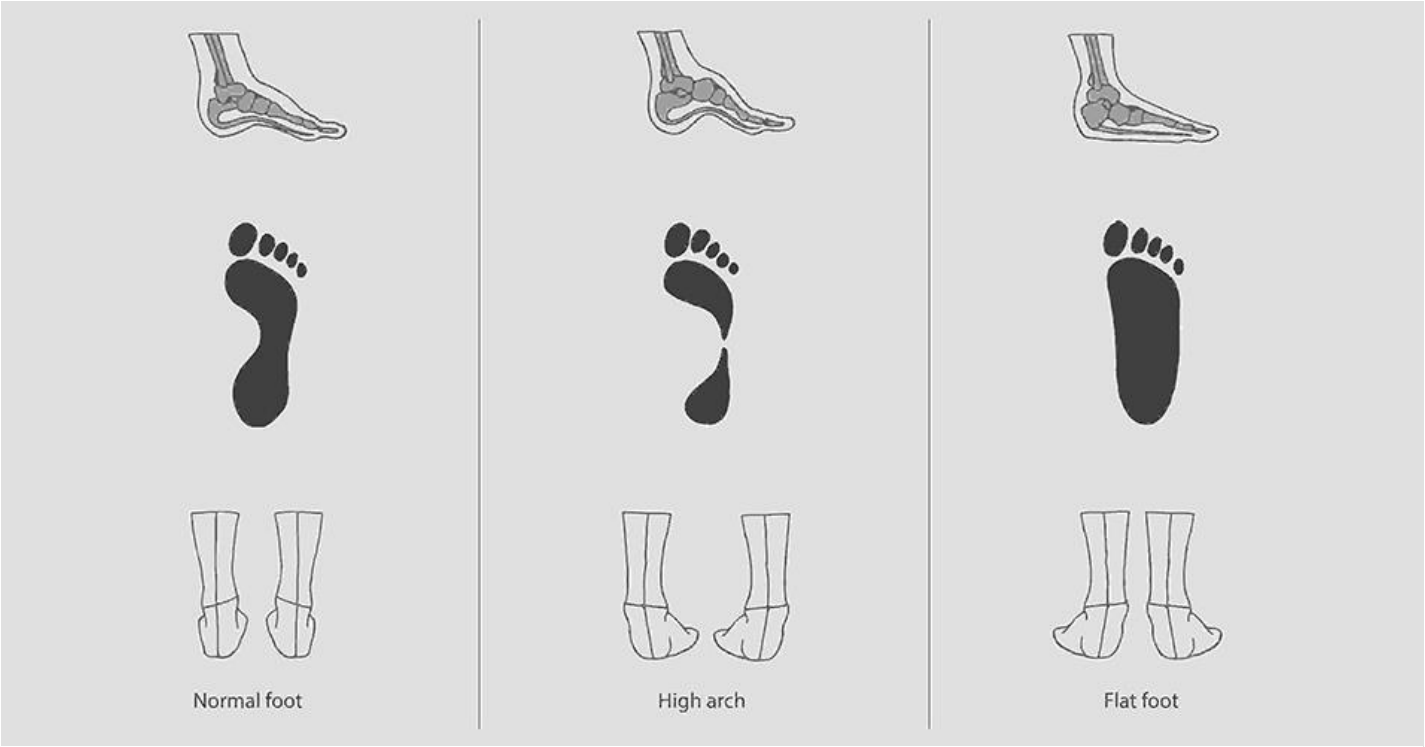


Figure 21 Footprints

Today there are thermoforming systems that allow for the adjustment of both the shell and the boot and the insole of the ski boot to the user; the aim is to achieve perfect adaptation of the user's foot to the boot. The new systems include a 3D scanner of the user's foot that enables the user to find the most suitable boot and discover the necessary modifications to be made to it. [4]

7.4 Technical and physical feasibility.

7.4.1 Pre-sizing.

For the following simulation, a male avatar with a size 43 foot was used. For a man of these characteristics the main measurements would be the following:

-Length of the foot: (Measured from the tip of the thumb to the point furthest from the Achilles heel) 279.5mm

-Ankle circumference: 283.4mm

-Circumference at the beginning of the twin: 501.8mm

-Total length of the boot (from heel to shooter): 326.6mm

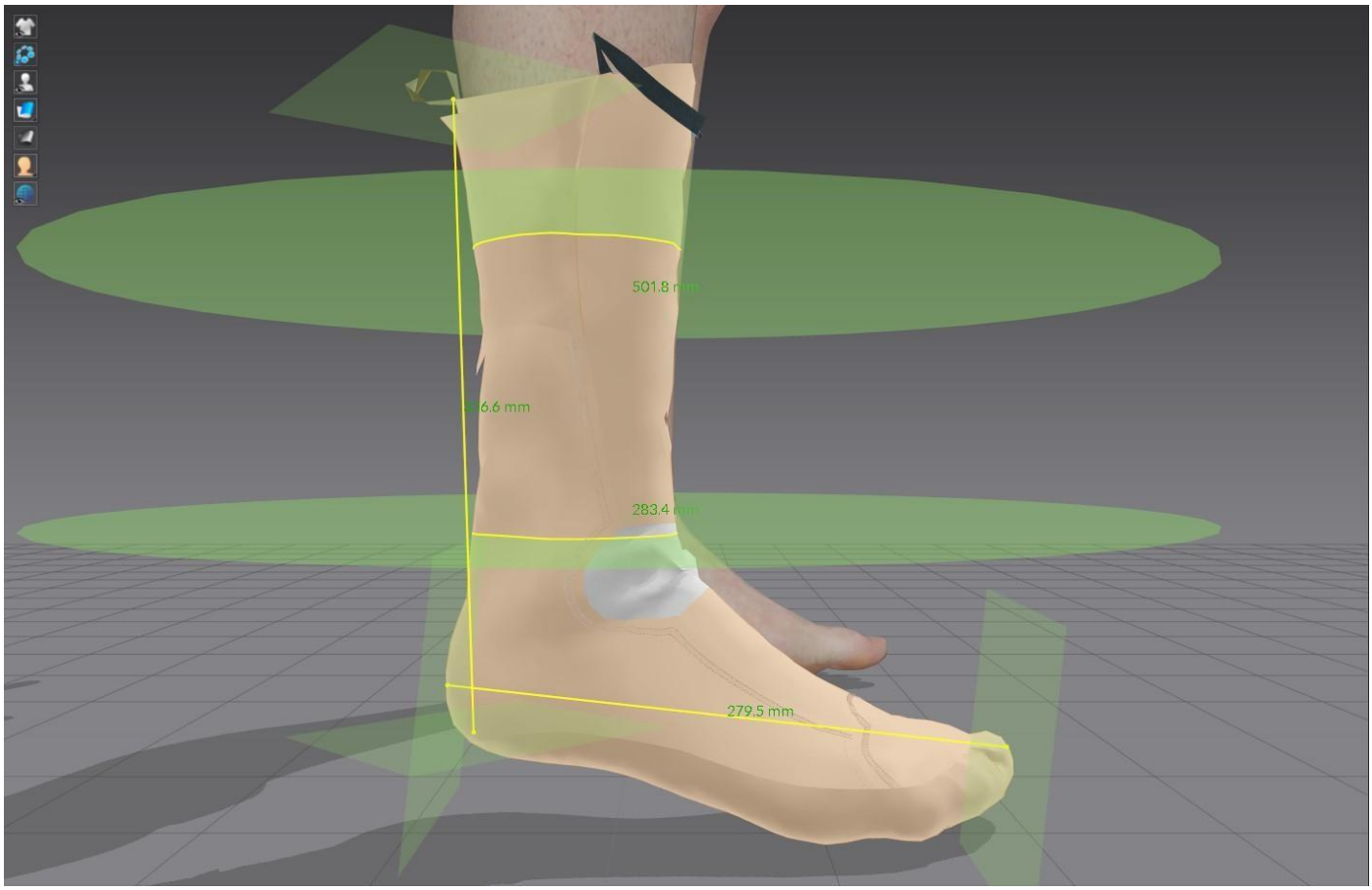


Figure 22 Basic measurements of the size of the liner
Software: Marvelous designer. Model measurement

Below, due to the great variety of systems and sizes in the market, is the sizing guide established by Nordica, one of the most important companies in the sector.

NORDICA BOOT SIZE CHART

SIZE CHART NORDICA

MONDO POINT	145	150	155	160	165	170	170	175	180	185	190	195	200	200	205	210	210	215	220	225
EU	24 1/3	24 2/3	25 1/2	26	26 2/3	27 1/2	28	28 1/2	29 1/3	29 2/3	30 1/2	31	31 2/3	32 1/3	33	33 2/3	34 1/3	35	35 1/2	36
UK	7	7,5	8	8 1/2	9	9 1/2	10	10 1/2	11	11 1/2	12	12 1/2	13	13 1/2	1	1 1/2	2	2 1/2	3	3 1/2
MONDO POINT	230	235	240	245	250	255	260	265	270	275	280	285	290	295	300	305	310	315	320	325
EU	36 2/3	37 1/2	38	38 2/3	39 1/2	40	40 2/3	41 1/2	42	42 1/2	43 1/3	44	44 1/2	45	45 2/3	46 1/2	47	47 2/3	48 1/2	49 1/3
UK	4	4 1/2	5	5 1/2	6	6 1/2	7	7 1/2	8	8 1/2	9	9 1/2	10	10 1/2	11	11 1/2	12	12 1/2	13	13 1/2

Figure 23 Nordica size chart

7.4.2 Gone off.

Once we have the final design, we proceed to divide the complete set and carry out its explosion, where all the parts that compose it will be seen and explained better.

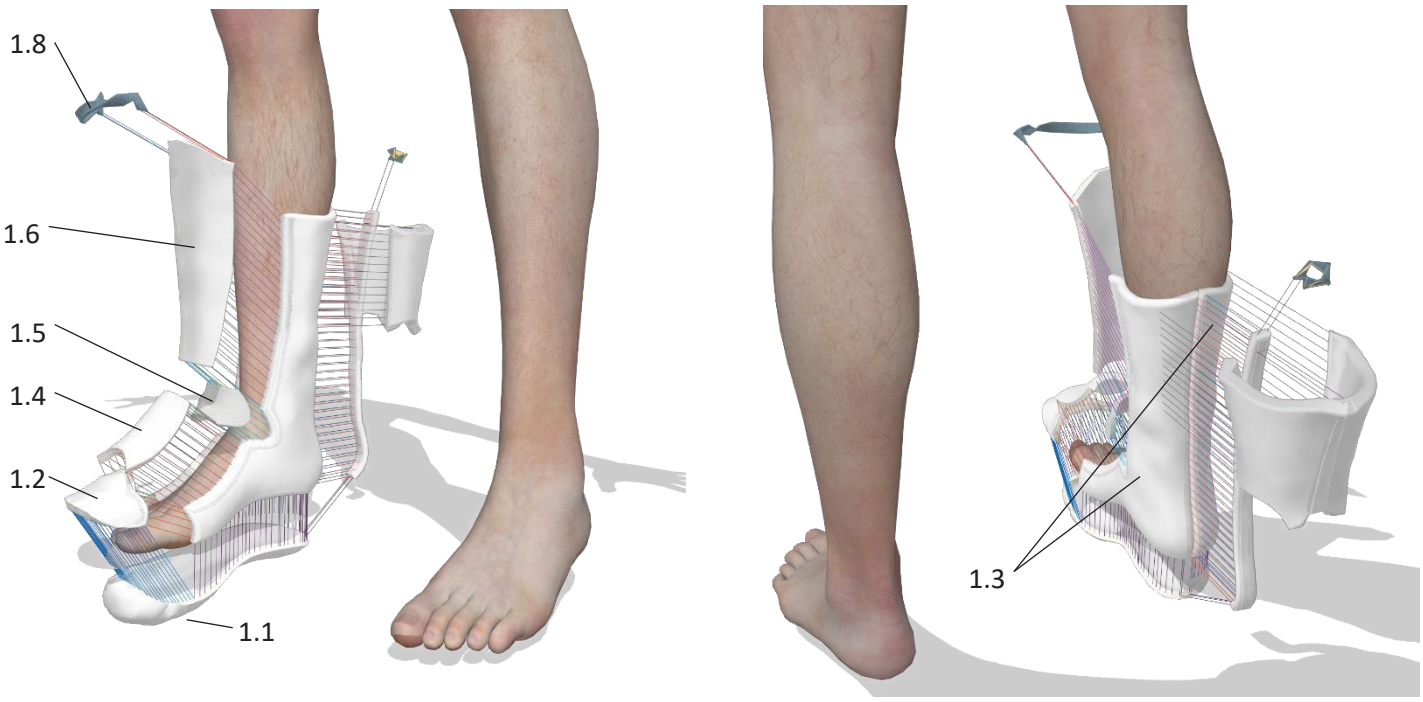


Figure 24 Explode 3/4 and back view
Software: Marvelous designer.

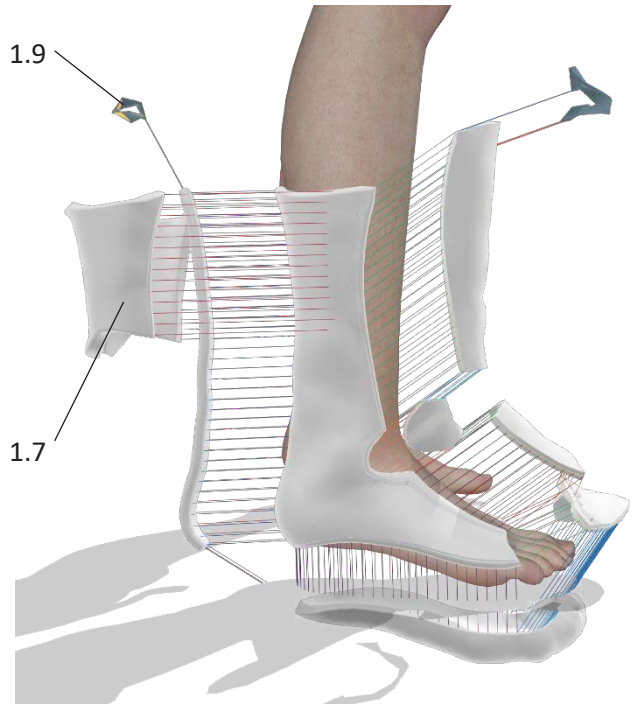


Figure 25 Explode right view
Software: Marvelous designer.

Software: Marvelous designer.
Figure 26 Explode general view

Memory table 7 Assembly elements list

	DENOMINATION	QUANTITY	REFERENCE	MATERIAL	THICKNESS
1.1	Sole	1		Silver coated yarn (3D spacer + EVA layer)	6 mm
1.2	Moccasin toe construction	1		Silver coated yarn (3D spacer + EVA layer)	6 mm
1.3	Wall	2		Silver coated yarn (3D spacer + EVA layer)	8 mm
1.4	Elastic instep	1		Silver coated yarn (3D spacer + EVA layer)	8 mm
1.5	Elastic flex point	1		Nylon	2 mm
1.6	Tongue	1		Silver coated yarn (3D spacer + EVA layer)	8 mm
1.7	Cuff reinforcement	2		Silver coated yarn (3D spacer + EVA layer)	3 mm
1.8	Front pull tap	1		Cordex (PE+CO)	1 mm
1.9	Back pull tap	1		Cordex (PE+CO)	1 mm

The set corresponds to a single boot, so for the construction of the product would be necessary the set 1 and another symmetrical that would correspond to the boot of the other foot.

7.5 Processes description.

The textile industry, in general, is structured in different specialized productive subsectors, they are in charge of obtaining the yarns, the fabrics, and the making of products.

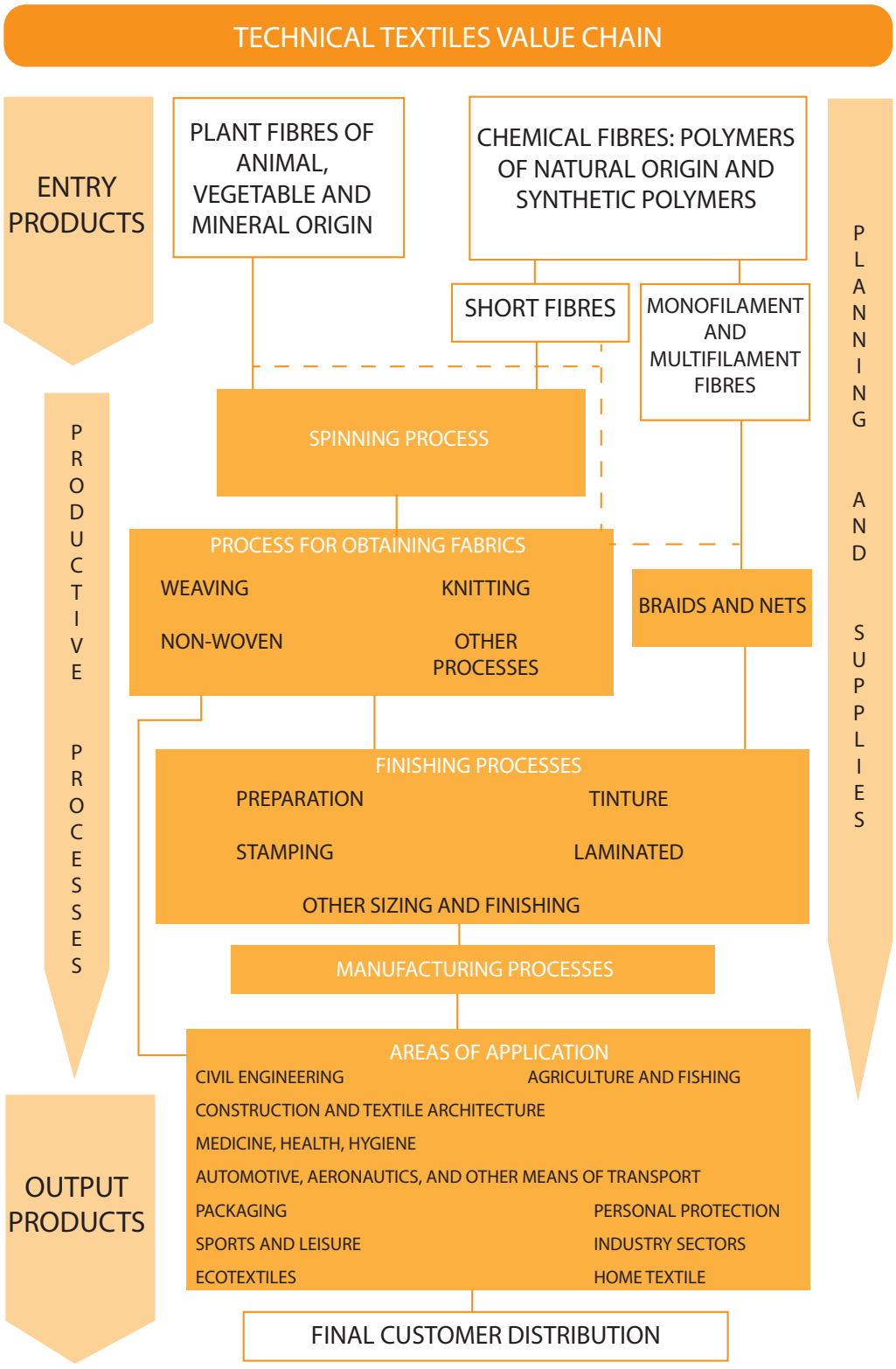


Figure 27 Technical textile value chain

7.5.1 Description of the process of obtaining the yarn.

As discussed in section *7.1 "Description and justification of the material"* the thread that makes up our fabric is a multi-component technical thread; the success of multi-component threads lies in the intimate or structured mixing of the participating materials.

Silver coated yarn: In our case, the main yarn, is a yarn composed of PE and added with silver salts. To obtain this type of yarn, PE granules are melted and extruded through a nozzle, so that the silver particles remain in the yarn matrix. Those must be extruded at the same time as the polyester, which will generate continuous yarns of a length established by the manufacturer. What is obtained in this process is a monofilament thread that will have the shape of the hole through which it has been extruded. (Figure 11)

This yarn will later be used as a coating for a 100% PES yarn composition, which will maintain all the material properties. (Figure 12)

PE + CO: It is also a core type yarn with a polyester core, but in this case the coating is made with cotton fibers creating a structured yarn with the elastic properties of polyester and the softness and comfort of cotton. To make this type of yarn, dreft (friction spinning) type systems are used.

Nylon: The Nylon or Polyamide salt is prepared in a viscous solution for its polymerization, using extrusion through a nozzle the yarn and state of fusion is obtained, for its later solidification, which is achieved utilizing coagulation, cooling or evaporation

7.5.2 Description of the process for obtaining Spacer tissue.

Spacer fabrics are created by connecting two independently knitted fabrics with spacer yarns so that the fabrics have a three-dimensional appearance. In general, spacer fabrics are categorized by their knitted structure, which is either warp or weft-knitted.

In the production of warp-knitted spacer fabric, a double-needle bar raschel machine is used. Weft knitted spacer fabrics are produced using a double-jersey circular machine that has a rotatable needle cylinder and needle dial. [5]

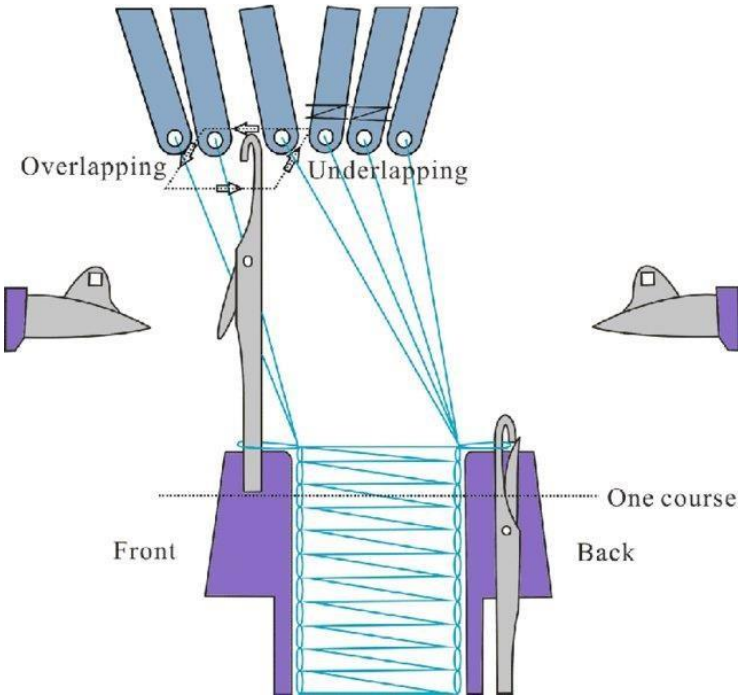


Figure 28 Double needle Raschel

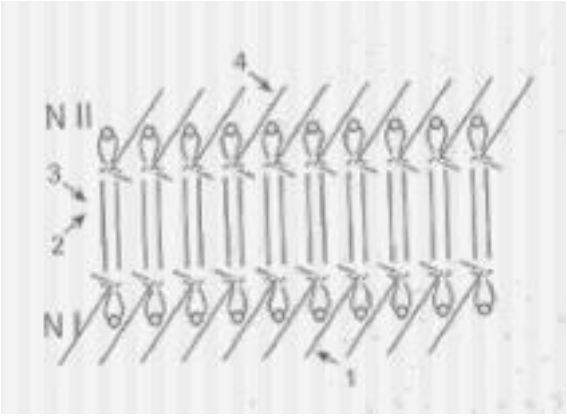


Figure 29 Needle function

As for obtaining the EVA film, these copolymers are obtained by a high-pressure reaction between ethylene and vinyl acetate monomers. The properties of the EVA copolymers depend strongly on their vinyl acetate (VA) content, presenting a random order of the VA monomers within the polymer chain so that the monomeric units are statistically arranged, without following any particular order in the chain. [6]

An electrospinning process has been used to join both fabrics. The electrospinning process was utilized for the deposition of the nanofibrous membrane. In this construction, the spacer layer was formed as the absorbent layer by knitting the yarns that possessed good absorbency and moisture conductivity. [7]

7.5.3 Description of the manufacturing process

The confection is based on the transformation of the fabric in a textile product directed to the final consumer, for it there are two central phases, the one of cut and the one of sewed; they must be realized after having realized the correct pattern and study of the marked one.

-Cutting process: After making the marker [See Drawings section] in the layer, the pieces are cut, in this case the best option would be water jet cutting machine since as they are polymeric materials they could melt with the heat produced in the cut.

-Sealing method: Due to the insulating characteristics of this product, the process of joining the parts must be as sealed as possible, which is why heat or ultrasound joining processes are used to join the parts.

To attach the handles to the boot it is necessary to use support seams that provide tensile strength, such as Class 400.
Decorative seams are often used on the walls of the shank and the tongue of the boot to provide aesthetics for this type of product. For this purpose, Class 600 type seams are used.

8. Conclusions

According to the initial briefing where the intentions to improve the thermal and humidity insulation characteristics, as well as the comfort of the liners were exposed, and taking into account the market study carried out. It can be considered that the project meets the exposed requirements and sets the basis for what could be a new product in the snow and high mountain sports market.

All parts of the project have been checked for compliance and are fully functional, so it is ready to be certified.

A viable project has been achieved that could perfectly start to be marketed among the ski brands that have a high range prepared for high-level skiers as elite sportsmen or coaches, who spend most of their time wearing this type of product.

2.

ANNEXES

BASIC PRODUCT DOCUMENTS

1. MARKET RESEARCH STUDY

In this section, we seek to meet the competition, see different designs and materials that may be useful for the development of the project, capture ideas, or improve those already thought of. At the same time, we want to check how many companies have products of these characteristics.

ALPINE	
 *Ilustración 1 Alpìne liner*	
BRAND	INTUITION [1]
REFERENCE	1006 - ALP
REINFORCEMENT	NO
SYSTEM	WRAP
ANTI-MICROBIAL LINING	YES
SOLE	12 mm
WEIGHT	296 – 464g
SIZES	4 – 15 US
MODALITY	SKI, SNOWBOARD, TELEMARK

GODIVA	
 *Ilustración 2 Goldiva liner*	
BRAND	INTUITION [1]
REFERENCE	1007-GD
REINFORCEMENT	CUFF AND SHIN
SYSTEM	WRAP
ANTI-MICROBIAL LINING	YES
SOLE	9 mm
WEIGHT	312-470g
SIZES	4 – 11 US
MODALITY	SKI, SNOWBOARD, TELEMARK

PLUG	
 *Ilustración 3 Plug liner*	
BRAND	INTUITION [1]
REFERENCE	1005-PL
REINFORCEMENT	CUFF AND ANKLE
SYSTEM	WRAP
ANTI-MICROBIAL LINING	YES
SOLE	9 mm
WEIGHT	298 – 540g
SIZES	4 – 15 US
MODALITY	SKI, SNOWBOARD

PRO WRAP	
 *Ilustración 4 Pro wrap liner*	
BRAND	INTUITION [1]
REFERENCE	1015 - PROW
REINFORCEMENT	CUFF AND ANKLE
SYSTEM	WRAP
ANTI-MICROBIAL LINING	YES
SOLE	2 mm STROBEL SOLE WITH REMOVABLE 7 mm FOAM INSOLE
WEIGHT	416 - 614g
SIZES	4 – 13 US
MODALITY	SKI, SNOWBOARD

SBC WRAP	
 *Ilustración 5 SBC wrap liner*	
BRAND	INTUITION [1]
REFERENCE	1020-SBC
REINFORCEMENT	CUFF AND ANKLE
SYSTEM	WRAP
ANTI-MICROBIAL LINING	YES
SOLE	2 mm STROBEL SOLE WITH REMOVABLE 7 mm FOAM INSOLE
WEIGHT	508-756g
SIZES	4 – 13 US
MODALITY	SKI, SNOWBOARD

PRO TONGUE	
 *Ilustración 6 Pro tongue liner*	
BRAND	INTUITION [1]
REFERENCE	1014-PTN
REINFORCEMENT	CUFF AND TONGUE
SYSTEM	TONGUE
ANTI-MICROBIAL LINING	YES
SOLE	2 mm STROBEL SOLE WITH REMOVABLE 7 mm FOAM INSOLE
WEIGHT	540-764g
SIZES	4 – 15 US
MODALITY	SKI, SNOWBOARD, A/T, TELEMARK

LUXURY HV	
 *Ilustración 7 Luxury HV liner*	
BRAND	INTUITION [1]
REFERENCE	1001-LUXHV
REINFORCEMENT	CUFF AND TONGUE
SYSTEM	TONGUE WITH LACE LOCK
ANTI-MICROBIAL LINING	YES
SOLE	9mm
WEIGHT	428-708 g
SIZES	4 – 15 US
MODALITY	SKI, SNOWBOARD, A/T, TELEMARK

PRO TOUR HV	
 *Ilustración 8 Pro tour HV liner*	
BRAND	INTUITION [1]
REFERENCE	1003-PTHV
REINFORCEMENT	CUFF AND TONGUE
SYSTEM	TONGUE WITH LACE LOCK
ANTI-MICROBIAL LINING	YES
SOLE	9mm
WEIGHT	422-672 g
SIZES	4 – 13 US
MODALITY	SKI, A/T, TELEMARK

TOUR WRAP	
 *Ilustración 9 Tour wrap liner*	
BRAND	INTUITION [1]
REFERENCE	1028-TWRAP
REINFORCEMENT	NO
SYSTEM	WRAP WITH ADJUSTABLE LACE
ANTI-MICROBIAL LINING	YES
SOLE	4 mm SOLE WITH REMOVABLE 4 mm FOAM INSOLE
WEIGHT	380-520 g
SIZES	4 – 13 US
MODALITY	SKI, A/T, TELEMARK

TOUR MOD	
 *Ilustración 10 Tour mod liner*	
BRAND	INTUITION [1]
REFERENCE	1024-TMOD
REINFORCEMENT	MODULAR FOAM REINFORCEMENT
SYSTEM	VELCRO TONGUE
ANTI-MICROBIAL LINING	YES
SOLE	5 mm SOLE WITH REMOVABLE 4 mm FOAM INSOLE
WEIGHT	226-350 g
SIZES	4 – 13 US
MODALITY	SKI, SNOWBOARD, TELEMARK

PLUG RACE	
 *Ilustración 11 Plug race liner*	
BRAND	INTUITION [1]
REFERENCE	1023-PLR
REINFORCEMENT	TONGUE AND CUFF
SYSTEM	TONGUE WITH LACE LOCK
ANTI-MICROBIAL LINING	YES
SOLE	2 mm STROBEL WITH REMOVABLE 7mm FOAM INSOLES
WEIGHT	604-814 g
SIZES	4 – 13 US
MODALITY	SKI

FX RACE	
 *Ilustración 12 FX race liner*	
BRAND	INTUITION [1]
REFERENCE	1013-FXR
REINFORCEMENT	TONGUE AND CUFF
SYSTEM	TONGUE WITH LACE LOCK
ANTI-MICROBIAL LINING	YES
SOLE	7 mm
WEIGHT	420-636 g
SIZES	4 – 15 US
MODALITY	SKI

TOUR LITE PRO	
 *Ilustración 13 Tour lite pro liner*	
BRAND	PALAU [2]
REFERENCE	PAL-TLP07
REINFORCEMENT	TONGUE
SYSTEM	TONGUE WITH LACES
ANTI-MICROBIAL LINING	NO
SOLE	7 mm
WEIGHT	290 g
SIZES	4 – 15 US
MODALITY	SKI MOUNTAINEERING

ALPIN CLASSIC FIT RS	
 *Ilustración 14 Alpin classic fit rs liner*	
BRAND	PALAU [2]
REFERENCE	PAL-ALC08
REINFORCEMENT	CUFF
SYSTEM	CROSSLINK & EASY PLUG
ANTI-MICROBIAL LINING	NO
SOLE	8 mm
WEIGHT	- g
SIZES	4 – 15 US
MODALITY	SKI MOUNTAINEERING

ALL TRACK WOMAN	
 *Ilustración 15 All track woman liner*	
BRAND	PALAU [2]
REFERENCE	PAL-ATW10
REINFORCEMENT	CUFF AND ANKLE
SYSTEM	EASY PLUG
ANTI-MICROBIAL LINING	NO
SOLE	10 mm
WEIGHT	300 g
SIZES	4 – 15 US
MODALITY	SKI, TOURING AND TELEMARK

TOUR LITE ULTRA RS	
 *Ilustración 16 Tour lite ultra rs liner*	
BRAND	PALAU [2]
REFERENCE	PAL-TLUL05
REINFORCEMENT	NONE
SYSTEM	DOWNSIZED
ANTI-MICROBIAL LINING	NO
SOLE	5 mm
WEIGHT	170 g
SIZES	4 – 13 US
MODALITY	SKI MOUNTAINEERING AND SKI TOURING

ALPINE DUAL FIT HV	
 *Ilustración 17 Alpine dual fit hv liner*	
BRAND	PALAU [2]
REFERENCE	PAL-ALD10
REINFORCEMENT	CUFF AND TONGUE
SYSTEM	WRAP
ANTI-MICROBIAL LINING	NO
SOLE	10 mm
WEIGHT	- g
SIZES	4 – 15 US
MODALITY	SKI FREERIDE, ALPIN SKI AND TELEMARK

TOUR LITE PRO EVO	
 *Ilustración 18 Tour lite pro evo liner*	
BRAND	PALAU [2]
REFERENCE	PAL-TLP08
REINFORCEMENT	CUFF AND ANKLE
SYSTEM	WRAP
ANTI-MICROBIAL LINING	NO
SOLE	8 mm
WEIGHT	- g
SIZES	4 – 15 US
MODALITY	SKI FREERIDE, ALPIN SKI AND TELEMARK

CENTRAL WOMAN H	
 *Ilustración 19 Central women h liner*	
BRAND	SIDAS [3]
REFERENCE	CCHCFCENTWOH13
REINFORCEMENT	CUFF
SYSTEM	TONGUE WITH LACES
ANTI-MICROBIAL LINING	YES
SOLE	8 mm
WEIGHT	280 g
SIZES	4 – 15 US
MODALITY	SKI FREERIDE, ALPIN SKI AND TELEMARK

CENTRAL HIGH V3	
 *Ilustración 20 Central high ve liner*	
BRAND	SIDAS [3]
REFERENCE	CCHCFCENTHIV3
REINFORCEMENT	CUFF
SYSTEM	TONGUE WITH LACES
ANTI-MICROBIAL LINING	YES
SOLE	8 mm
WEIGHT	280 g
SIZES	3 - 13 US
MODALITY	ALPIN SKI AND SKI TOURING

LINER TLT8 CL	
 *Ilustración 21 Liner tlt8 cl*	
BRAND	DYNAFIT [4]
REFERENCE	08-0000065900
REINFORCEMENT	CUFF AND TONGUE
SYSTEM	TONGUE WITH LACES
ANTI-MICROBIAL LINING	YES
SOLE	4 mm
WEIGHT	140 g
SIZES	5 - 12 US
MODALITY	ALPIN SKI

RADICAL	
 *Ilustración 22 Radical liner*	
BRAND	DYNAFIT [4]
REFERENCE	08-0000065701
REINFORCEMENT	CUFF
SYSTEM	TONGUE WITH LACES
ANTI-MICROBIAL LINING	YES
SOLE	8 mm
WEIGHT	300 g
SIZES	5 - 12 US
MODALITY	TOURING SKI

BEAST CL	
 *Ilustración 23 Beast cl liner*	
BRAND	DYNAFIT [4]
REFERENCE	08-0000065669
REINFORCEMENT	CUFF
SYSTEM	TONGUE WITH LACES
ANTI-MICROBIAL LINING	YES
SOLE	8 mm
WEIGHT	185 g
SIZES	5 - 12 US
MODALITY	FREERIDE SKI

MEN PRO MACHINE	
 *Ilustración 24 Men promachine liner*	
BRAND	NORDICA [5]
REFERENCE	08L12500000
REINFORCEMENT	CUFF AND INSTEP
SYSTEM	TONGUE WITH LACES
ANTI-MICROBIAL LINING	YES
SOLE	8 mm
WEIGHT	300 g
SIZES	5 - 12 US
MODALITY	FREERIDE SKI, TOURING SKI AND TELEMARK

DOBERMANN WC	
 *Ilustración 25 Dobermann wc liner*	
BRAND	NORDICA [5]
REFERENCE	08L09500000
REINFORCEMENT	CUFF
SYSTEM	TONGUE WITH LACES
ANTI-MICROBIAL LINING	YES
SOLE	8 mm
WEIGHT	300 g
SIZES	5 - 12 US
MODALITY	FREERIDE SKI, TOURING SKI AND TELEMARK

2. FUNCTIONAL ANALYSIS TABLE

Among the characteristics to be taken into account when drawing up the functional specifications in section 5.2.3 of the report are flexibility and importance.

Flexibility is an estimated value that indicates how much tolerance is allowed when varying the value of the level. It is presented in the following table:

Table 1 Flexibility

CLASS F	FLEXIBILITY	LEVEL OF NEGOTIATION
0	NULL	IMPERATIVE
1	BIT	NON-NEGOTIABLE
2	GOOD	NEGOTIABLE
3	HIGH	VERY NEGOTIABLE

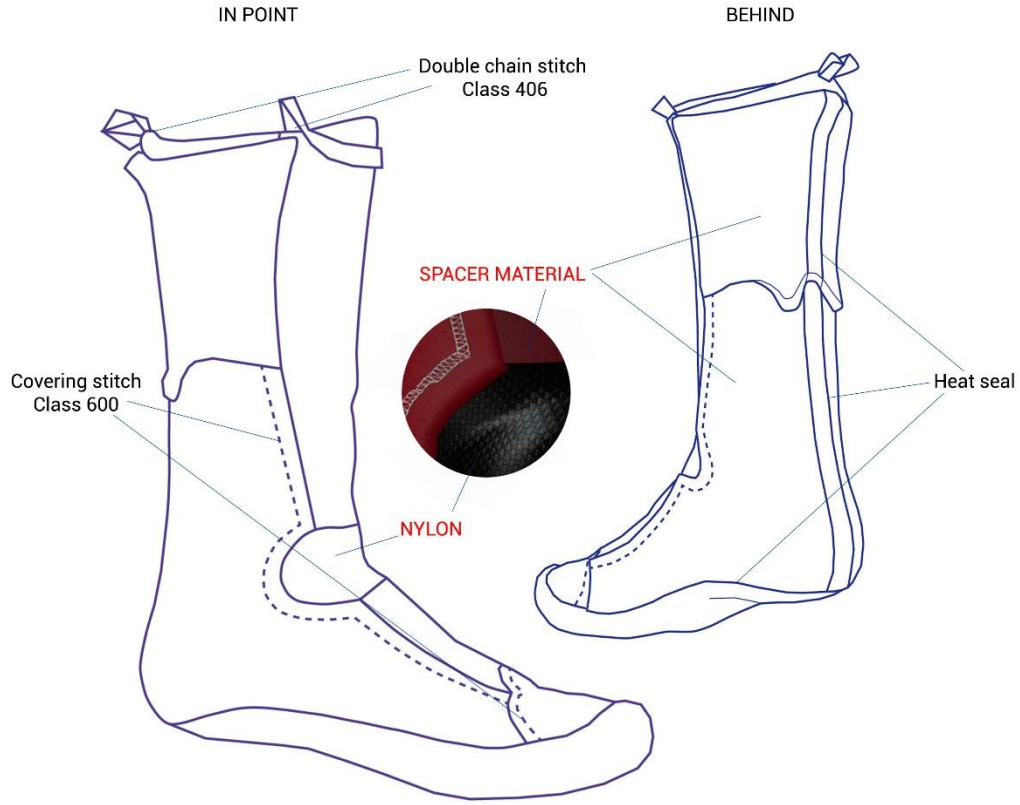
On the other hand, the importance value of the function (vi) is represented according to the following table:

Table 2 Importance of function.

VALUE (VI)	IMPORTANCE OF FUNCTION
NULL	USEFUL
BIT	NECESSARY
GOOD	IMPORTANT
HIGH	VERY IMPORTANT
GOOD	VITAL

3. TECHNICAL SPECIFICATIONS

TECHNICAL UNIVERSITY OF LIBEREC www.tul.cz	TECHNICAL SPECIFICATIONS: Liner ski-boot.		
	Product: Inner ski-boot resistant against humidity and antimicrobial **Reference:**	**Sizes:** 4 – 5 – 6 – 7 – 8 – 9 – 10 - 11 – 12 – 13	1/3



Software: Illustrator.

Table 3 Technical characteristics

TECHNICAL CARACHTERISTICS
- **Moisture protection**
- **Comfortable**
- **Antimicrobial performance**
- **Low-temperature insulation**
- **Overnight drying**
- **Air permeability**
- **Wear resistance**
- **Strong seams**

TECHNICAL UNIVERSITY OF LIBEREC www.tul.cz	TECHNICAL SPECIFICATIONS: Liner ski-boot.		
	Product: Inner ski-boot resistant against humidity and antimicrobial **Reference:**	**Sizes:** 4 – 5 – 6 – 7 – 8 – 9 – 10 - 11 – 12 – 13	2/3

Table 4 Size chart

SIZE CHART		
Boot size	**Foot length**	**EU Size**
4	230	36 2/3
5	240	37
6	250	39 1/2
7	260	40 2/3
8	270	42
9	280	43 1/3
10	290	44 1/2
11	300	45 2/3
12	310	47
13	320	48 1/2

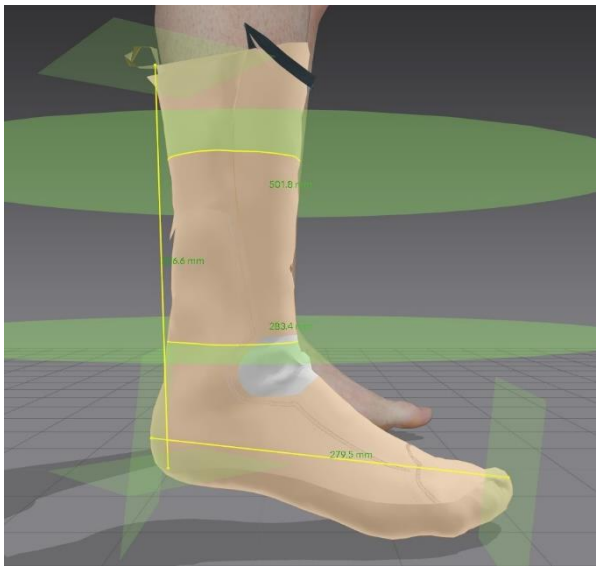
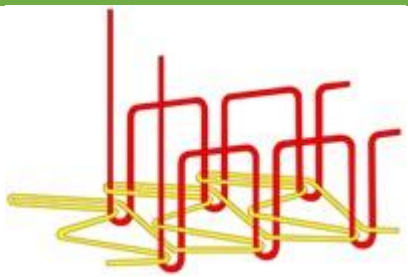
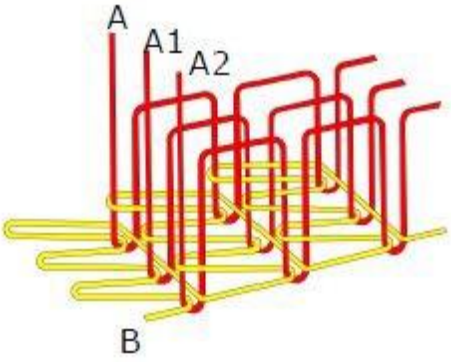


Table 5 Seams

SEAMS		
Class 406 – Double chain stitch Garments with a high degree of strength and extensibility		CO + PE
Class 600 – Covering stitch. Decorative stitch		CO + PE

TECHNICAL UNIVERSITY OF LIBEREC www.tul.cz	TECHNICAL SPECIFICATIONS: Liner ski-boot.		
	Product: Inner ski-boot resistant against humidity and antimicrobial **Reference:**	**Sizes:** 4 – 5 – 6 – 7 – 8 – 9 – 10 - 11 – 12 – 13	3/3

Table 6 Material properties

REFERENCE		STRUCTURE
YARN PROPERTIES	Silver coated PES yarn	3D Spacer with EVA layer
	Silver thread-coated yarn	
ELASTIC INSTEP	Nylon	Plain

Table 7 Standards

STANDARDS	
ISO 5355:2019	Alpine ski boots – Requirements and test methods
ISO 9523:2019	Touring ski – boots for adults. Interface with touring ski binding – Requirements and test methods.
ISO 5084	Textiles - Determination of thickness of textile products
ISO 11092	Textiles – Physiological effects- Measurement of thermal and water-vapour resistance under steady-state conditions (sweating guarded hotplate test)
UNE 53 200 83	(PLASTICS. DETERMINATION OF THE FLUIDITY INDEX OF THERMOPLASTIC MATERIALS IN MASS (IFM) AND IN VOLUME (IFV))

Table 8 Product description

PRODUCT DESCRIPTION

Inner ski boot. It consists of a tongue that permits a better footwear performance; two handlers and some decorative stitches around the liner boot. It also has a cuff reinforcement that makes the boot more comfortable.

4. MACHINES AND EQUIPMENT

4.1 Machinery.

Table 9 Machines. Yarn extruder.

YARN EXTRUDER [6]	PROPERTIES
	Multifilament yarn
	Only one screw
	Yarn diameter 0.13mm-0.3mm
	L/D relation: 33
	Velocity 20-90 rpm
	Max output 150kg/h
	Semi-automatic

Table 10 Dref system

DREF [7]	PROPERTIES
	Z/S Twist
	Fibre length 10-20mm
	Possible counts: Nm 0.5-25
	36 roving and 12 filament sensors
	Max speed 250m/min
	Extractor fan

Table 11 Flexible double-bar raschel

FLEXIBLE DOUBLE-BAR RASCHEL (RDJ 6/1) [8]	PROPERTIES
	5 Ground guide bars / one piezoJacquard guide bar
	Working width 3505mm
	Knock-over comb bar distance 2-8mm
	Warp beam suport 7 x 812 mm
	Four-roller System, driven by an electronic drive
	Batching Device No. 14-J1

Table 12 Ultrasound machine

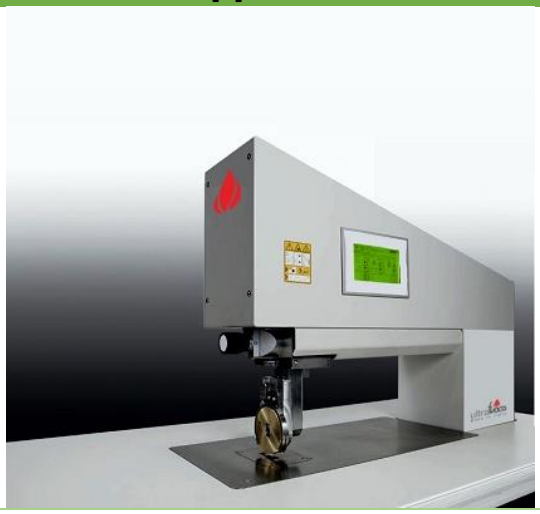
ULTRASOUND MACHINE [9]	PROPERTIES
	Continuous fabrics
	Max speed 350m/min
	Elastic welding
	Constant gliding through the fabric
	Replaces the glueing station
	Cut or weld
	Sewing operations for the filtration industry

Table 13 Water jet cutting machine

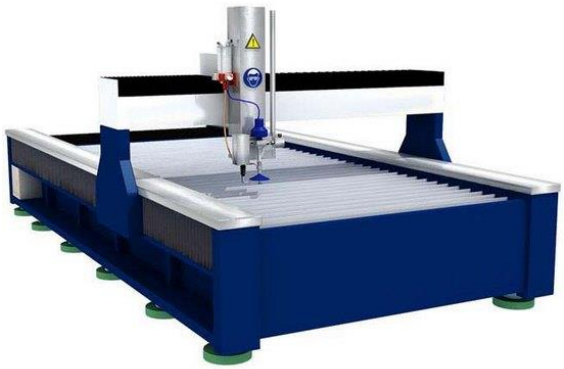
WATER JET CUTTING MACHINE [10]	PROPERTIES
	Water needs filtration and de-ionization treatment
	Not suitable for the depth of lay cutting
	No need os sharpening/grinding
	Velocity 60 000lb/square inch
	Special software is use
	Excess heat is not produced

Table 14 Stitch machine

STITCH MACHINE (MO-6800D) [11]	PROPERTIES
	Stitch length 0.6 – 3.8 mm
	Sewing speed 7000stich/min
	Needle gauge (mm) from 2.0 to 5.0 + 2.0
	Differential feed ratio: Gathering 1:2, Stretching 1:0.7
	Needle DCx27 (excluding some subclass model
	• 1 needle overlock • 2 needle overlock • Safety stitching • 3 needle safety stitching

5. MEASUREMENTS AND BUDGETS ANNEX

To correctly carry out the measurements and budgets section, information on material, machinery, and labor costs is required, which will be key in the operations processes.

-Operations:

- Extrusion of the thread
- Spinning
- Spacer tissue formation
- Spacer fabric and EVA sheet
- Cut
- Clothing
- Decoration

-Materials:

- Nylon mat 1500x3000x2 mm = 35,97€ [12] = **7,99 €/m^2**
- Spacer mat 1850x10000x3 mm = 340,90€ [13] = **18,43 €/m^2**
- Spacer mat 1550x10000x6 mm = 390,90€ [13] = **26,06 €/m^2**
- Spacer mat 1000x10000x8 mm = 270,90€ [13] = **27,09 €/m^2**
- PE + CO layer 1000x1524x1 mm = 130€ [14] = **13 €/m^2**

-Machinery:

- Yarn extruder = 76 128€ - redeemable in 15 years [15] = **2,53€/h**
- DREF spinning Machine = 55 000€ - redeemable in 10 years [16] = **2,75€/h**
- Flexible double bar raschel = 36 000€ - redeemable in 10 years [17] = **1,8€/h**
- Ultrasound Machine = 12 000€ - redeemable in 5 years [18] = **1,2€/h**
- Water jet cutting = 6 500€ - redeemable in 5 years [15] = **0,65€/h**
- Stitch Machine = 2 200€ - redeemable in 5 years [19] = **0,22€/h**

Estimate a usage of 2000h/year

-Labour force:

1st Officer = **30€/h**

2nd Officer = **25€/h**

3rd Officer = **20€/h**

There is a lack of information on tools and commercial elements.

3.

TECHNICAL SPECIFICATION

TECHNICAL, ECONOMIC, ADMINISTRATIVE AND LEGAL CONDITIONS

1.TECHNICAL SPECIFICATIONS

Element 1.1 – Soles

Source material: 1550x10000x6 mm 3D Spacer layer + foam layer.

- 1st Operation: Cutting.

- Machinery: Water jet cutting.

- Labour: The work can be carried out by an operator with a minimum category of "2nd Officer".

- Way of execution:
1. Placing the sheet on the cutting surface.
2. Introduce the cutting model in the CNC.
3. Start up and execution of the cut.

- Safety: Gloves, glasses, work clothes and safety shoes.

- Controls:
1. Check the good condition of the machine.
2. Check that the dimensions of the sheet are correct for inserting it into the machine.
3. Check the positioning of the plate.
4. Check the final dimensions of the piece.

- Tests: Not precise.

Element 1.2 – Moccasin toe construction.

Source material: 1550x10000x6 mm 3D Spacer layer + foam layer.

- 1st Operation: Cutting.

- Machinery: Water jet cutting.

- Labour: The work can be carried out by an operator with a minimum category of "2nd Officer".

- Way of execution:
1. Placing the sheet on the cutting surface.
2. Introduce the cutting model in the CNC.
3. Start up and execution of the cut.

- Safety: Gloves, glasses, work clothes and safety shoes.

- Controls:
1. Check the good condition of the machine.
2. Check that the dimensions of the sheet are correct for inserting it into the machine.
3. Check the positioning of the plate.
4. Check the final dimensions of the piece.

- Tests: Not precise.

- 2nd Operation: Details.
- Machinery: Stitch Machine (MO-6800D)

- Labour: The work can be carried out by an operator with a minimum category of "3rd Officer".

- Way of execution:
1. Place the elements on the surface of the sewing machine
2. Start up and execution of the detail stitching.

- Safety: Gloves, glasses, work clothes and safety shoes.

- Controls:
1. Check the good condition of the machine.
2. Check that there are not aesthetic flaws

- Tests: Not precise.

Element 1.3 – Walls.

Source material: 1550x10000x8 mm 3D Spacer layer + foam layer.

- 1st Operation: Cutting.

- Machinery: Water jet cutting.

- Labour: The work can be carried out by an operator with a minimum category of "2nd Officer".

- Way of execution:
1. Placing the sheet on the cutting surface.
2. Introduce the cutting model in the CNC.
3. Start up and execution of the cut.

- Safety: Gloves, glasses, work clothes and safety shoes.

- Controls:
1. Check the good condition of the machine.
2. Check that the dimensions of the sheet are correct for inserting it into the machine.
3. Check the positioning of the plate.
4. Check the final dimensions of the piece.

- Tests: Not precise.

- 2nd Operation: Weld.

- Machinery: Ultrasound Machine.

- Labour: The work can be carried out by an operator with a minimum category of "2nd Officer".

- Way of execution:
1. Placing the pieces together.
2. Start up and execution of the weld.

- Safety: Gloves, glasses, work clothes and safety shoes.

- Controls:
1. Check the good condition of the machine.
2. Check that all the pieces are attached.

- Tests: Check that the weld does not break. (Tensile test)

- **3rd Operation:** Details.
- **Machinery:** Stitch Machine (MO-6800D)

- **Labour:** The work can be carried out by an operator with a minimum category of "3rd Officer".

- **Way of execution:**
1. Place the elements on the surface of the sewing machine
2. Start up and execution of the detail stitching.

- **Safety:** Gloves, glasses, work clothes and safety shoes.

- **Controls:**
1. Check the good condition of the machine.
2. Check that there are not aesthetic flaws

- **Tests:** Not precise.

Element 1.4 – Elastic instep.

Source material: 1550x10000x8 mm 3D Spacer layer + foam layer.

- 1st Operation: Cutting.

- Machinery: Water jet cutting.

- Labour: The work can be carried out by an operator with a minimum category of "2nd Officer".

- Way of execution:
1. Placing the sheet on the cutting surface.
2. Introduce the cutting model in the CNC.
3. Start up and execution of the cut.

- Safety: Gloves, glasses, work clothes and safety shoes.

- Controls:
1. Check the good condition of the machine.
2. Check that the dimensions of the sheet are correct for inserting it into the machine.
3. Check the positioning of the plate.
4. Check the final dimensions of the piece.

- Tests: Not precise.

Element 1.5 – Elastic flex point.

Source material: 1500x3000x2 mm Nylon layer.

- 1st Operation: Cutting.

- Machinery: Water jet cutting.

- Labour: The work can be carried out by an operator with a minimum category of "2nd Officer".

- Way of execution:
1. Placing the sheet on the cutting surface.
2. Introduce the cutting model in the CNC.
3. Start up and execution of the cut.

- Safety: Gloves, glasses, work clothes and safety shoes.

- Controls:
1. Check the good condition of the machine.
2. Check that the dimensions of the sheet are correct for inserting it into the machine.
3. Check the positioning of the plate.
4. Check the final dimensions of the piece.

- Tests: Not precise.

Element 1.6 – Tongue

Source material: 1550x10000x8 mm 3D Spacer layer + foam layer.

- 1st Operation: Cutting.

- Machinery: Water jet cutting.

- Labour: The work can be carried out by an operator with a minimum category of "2nd Officer".

- Way of execution:
1. Placing the sheet on the cutting surface.
2. Introduce the cutting model in the CNC.
3. Start up and execution of the cut.

- Safety: Gloves, glasses, work clothes and safety shoes.

- Controls:
1. Check the good condition of the machine.
2. Check that the dimensions of the sheet are correct for inserting it into the machine.
3. Check the positioning of the plate.
4. Check the final dimensions of the piece.

- Tests: Not precise.

Element 1.7 – Cuff reinforcement.

Source material: 1850x10000x3 mm 3D Spacer layer + foam layer.

- 1st Operation: Cutting.

- Machinery: Water jet cutting.

- Labour: The work can be carried out by an operator with a minimum category of "2nd Officer".

- Way of execution:
1. Placing the sheet on the cutting surface.
2. Introduce the cutting model in the CNC.
3. Start up and execution of the cut.

- Safety: Gloves, glasses, work clothes and safety shoes.

- Controls:
1. Check the good condition of the machine.
2. Check that the dimensions of the sheet are correct for inserting it into the machine.
3. Check the positioning of the plate.
4. Check the final dimensions of the piece.

- Tests: Not precise.

- 2nd Operation: Weld.

- Machinery: Ultrasound Machine.

- Labour: The work can be carried out by an operator with a minimum category of "2nd Officer".

- Way of execution:
1. Placing the pieces together.
2. Start up and execution of the weld.

- Safety: Gloves, glasses, work clothes and safety shoes.

- Controls:
1. Check the good condition of the machine.
2. Check that all the pieces are attached.

- Tests: Check that the weld does not break. (Tensile test)

Element 1.8 Front pull tap.

Source material: PE + PU 1000x1534x1 mm layer

- 1st Operation: Cutting.

- Machinery: Water jet cutting.

- Labour: The work can be carried out by an operator with a minimum category of "3rd Officer".

- Way of execution:
1. Placing the sheet on the cutting surface.
2. Introduce the cutting model in the CNC.
3. Start up and execution of the cut.

- Safety: Gloves, glasses, work clothes and safety shoes.

- Controls:
1. Check the good condition of the machine.
2. Check that the dimensions of the sheet are correct for inserting it into the machine.
3. Check the positioning of the plate.
4. Check the final dimensions of the piece.

- Tests: Not precise.

Element 1.9 - Back pull tap

Source material: PE + CO 1000x1534x1 mm layer

- 1st Operation: Cutting.

- Machinery: Water jet cutting.

- Labour: The work can be carried out by an operator with a minimum category of "3rd Officer".

- Way of execution:
1. Placing the sheet on the cutting surface.
2. Introduce the cutting model in the CNC.
3. Start up and execution of the cut.

- Safety: Gloves, glasses, work clothes and safety shoes.

- Controls:
1. Check the good condition of the machine.
2. Check that the dimensions of the sheet are correct for inserting it into the machine.
3. Check the positioning of the plate.
4. Check the final dimensions of the piece.

- Tests: Not precise.

Set 1- Liner.

Elements 1.1, 1.2, 1.3,1.4, 1.5, 1.6, 1.7, 1.8 and 1.9.

- 1st Operation: Weld.

- Machinery: Ultrasound Machine.

- Labour: The work can be carried out by an operator with a minimum category of "1st Officer".

- Way of execution:
1. Place elements 1.1, 1.2, 1.3, 1.4, 1.5 and 1.6.
2. Start up and execution of the weld.
3. Place the welded elements next to element 1.7.
4. Start up and execution of the weld.
5. Place all the elements welded adding 1.8 and 1.9.
6. Star up and execution of the final weld.

- Safety: Gloves, glasses, work clothes and safety shoes.

- Controls:
1. Check the good condition of the machine.
2. Check that all the pieces are attached.

- Tests: Check that the weld does not break. (Tensile test)

4.

MEASUREMENTS AND BUDGET

PRODUCT FEATURES, DIMENSIONS AND BUDGET

WORK UNIT	MEASURING		DESCRIPTION	UNITARY PRICE (€/Ud)	AMOUNT (€)	TOTAL (€)
	QUANTITY	Ud				
1.1	2	Ud.	**Soles**			
	0,01145	m^2	**Material:** 1550x10000x6 mm 3D Spacer + foam layer	26,06	0,298	
	0.15 0.15	h h	Work of: water jet cutting **Machinery:** Water jet cutting **Labour:** 2nd officer	0,65 25	0,0975 3,75	
					TOTAL=	**4,146**
1.2	2	Ud.	**Moccasin toe construction**			
	0,002602	m^2	**Material:** 1550x10000x6 mm 3D Spacer + foam layer	26,06	0,0678	
	0,1 0,1	h h	Work of: water jet cutting **Machinery:** Water jet cutting **Labour:** 2nd officer	0,65 25	0,065 2,5	
	0,05 0,05	h h	Work of: Details **Machinery:** Stitch Machine **Labour:** 3rd officer	0,22 20	0,011 1	
					TOTAL=	**3,644**
1.3	4	Ud.	**Walls**			
	0,027965	m^2	**Material:** 1000x10000x8 mm 3D Spacer + foam layer	27,09	0,757	
	0,25 0,25	h h	Work of: water jet cutting **Machinery:** Water jet cutting **Labour:** 2nd officer	0,65 25	0,163 6,25	

			Work of: weld			
			Machinery:			
	0,083	h	Ultrasound machine	1,2	0,099	
			Labour:			
	0,083	h	1st officer	30	0,099	
			Work of: Details			
			Machinery:			
	0,15	h	Stitch Machine	0,22	0,033	
	0,15	h	**Labour:** 3rd officer	20	3	
					TOTAL=	**10,401**
1.4	2	Ud.	**Elastic instep**			
	0,002488	m^2	**Material:** 1000x10000x8 mm 3D Spacer + foam layer	27,09	0,067	
			Work of: water jet cutting			
			Machinery:			
	0,083	h	Water jet cutting	0,65	0,054	
			Labour:			
	0,083	h	2nd officer	25	2,075	
					TOTAL=	**2,196**
1.5	2	Ud.	**Elastic flex point**			
	0,00211	m^2	**Material:** 1500x3000x2 mm Nylon layer	7,99	0,017	
			Work of: water jet cutting			
			Machinery:			
	0,08	h	Water jet cutting	0,65	0,052	
			Labour:			
	0,08	h	2nd officer	25	2	
					TOTAL=	**2,069**
1.6	2	Ud.	**Tongue**			
	0,008965	m^2	**Material:** 1000x10000x8 mm 3D Spacer + foam layer	27,09	0,243	
			Work of: water jet cutting			
			Machinery:			
	0,18	h	Water jet cutting	0,65	0,117	
			Labour:			

	0,18	h	2nd officer	25	4,5	
					TOTAL=	**4,86**
1.7	2	Ud.	**Cuff reinforcement**			
	0,008492	m^2	**Material:** 1850x10000x3 mm 3D Spacer + foam layer	18,43	0,157	
			Work of: water jet cutting **Machinery:**			
	0,16	h	Water jet cutting	0,65	0,104	
			Labour:			
	0,16	h	2nd officer	25	4	
			Work of: weld **Machinery:**			
	0,083	h	Ultrasound machine	1,2	0,099	
			Labour:			
	0,083	h	1st officer	30	0,099	
					TOTAL=	**4,46**
1.8	2	Ud.	**Front pull tap**			
	0,000836	m^2	**Material:** 1000x1534x1 mm PE+CO layer	13	0,0108	
			Work of: water jet cutting **Machinery:**			
	0,05	h	Water jet cutting	0,65	0,0325	
			Labour:			
	0,05	h	2nd officer	25	1,25	
					TOTAL=	**1,293**
1.9	2	Ud.	**Back pull tap**			
	0,000286	m^2	**Material:** 1000x1534x1 mm PE+PU layer	13	0,0037	
			Work of: water jet cutting **Machinery:**			
	0,05	h	Water jet cutting	0,65	0,0325	
			Labour:			
	0,05	h	2nd officer	25	1,25	
					TOTAL=	**1,286**
1	2	Ud.	**Liner Assembly**			

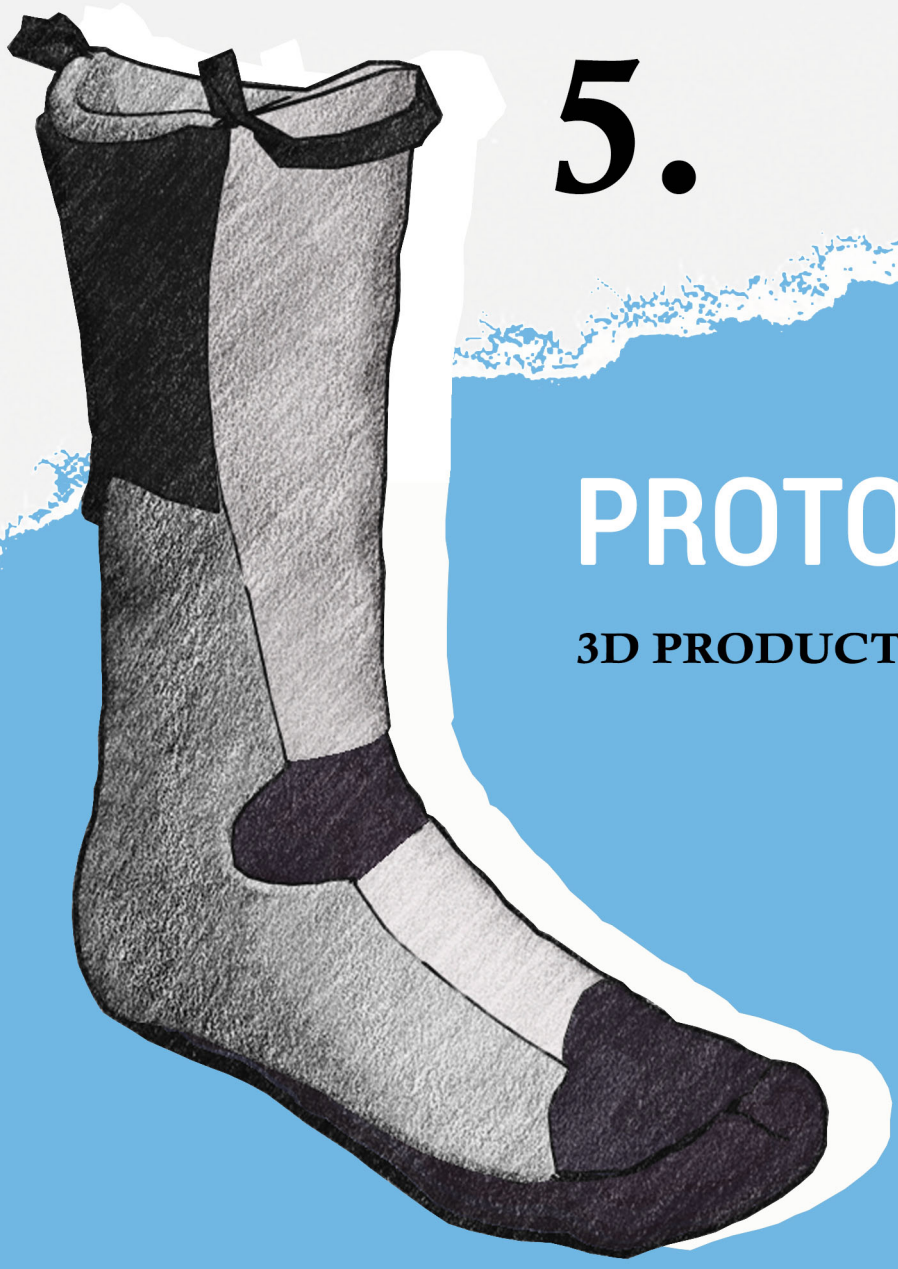
			Material: Elements: 1.1, 1.2, 1.3, 1.4, 1.5, 1.6, 1.7, 1.8 and 1.9			
	0,33 0,33	h h	Work of: weld **Machinery:** Ultrasound machine **Labour:** 1st officer	1,2 30	0,396 9,9	
					TOTAL=	**10,296**
					TOTAL=	**44,651€**

This table shows the budget for the production of assembly 1 (one pair of liner ski boots, size 43).

In calculating this price, neither production waste nor the cost of the yarn has been taken into account as no price has been offered by the supplier for the yarn.

Bearing this in mind, the production cost of the inner boot is 44.65 € which, if we compare it with the market, the selling price of quality boots is usually between 150 and 300 € depending on the manufacturer and the model.

This leaves us enough of a price margin to be able to present ourselves as a competitive product in terms of price and quality.



5.

PROTOTYPES

3D PRODUCT SIMULATION

Illustration 26
Software: Marvelous designer.
Rendering: Keyshot8.

Illustration 27
Software: Marvelous designer.
Rendering: Keyshot8.

Illustration 28
Software: Marvelous designer.
Rendering: Keyshot8.

Illustration 29
Software: Marvelous designer.
Rendering: Keyshot8.

Illustration 30
Software: Marvelous designer.
Rendering: Keyshot8.

Illustration 31
Software: Marvelous designer.
Rendering: Keyshot8.

Illustration 32
Software: Marvelous designer.
Rendering: Keyshot8.

Illustration 33
Software: Marvelous designer.
Rendering: Keyshot8.

Illustration 34
Software: Marvelous designer.
Rendering: Keyshot8.

Illustration 35
Software: Marvelous designer.
Rendering: Keyshot8.

Illustration 36
Software: Marvelous designer.
Rendering: Keyshot8.

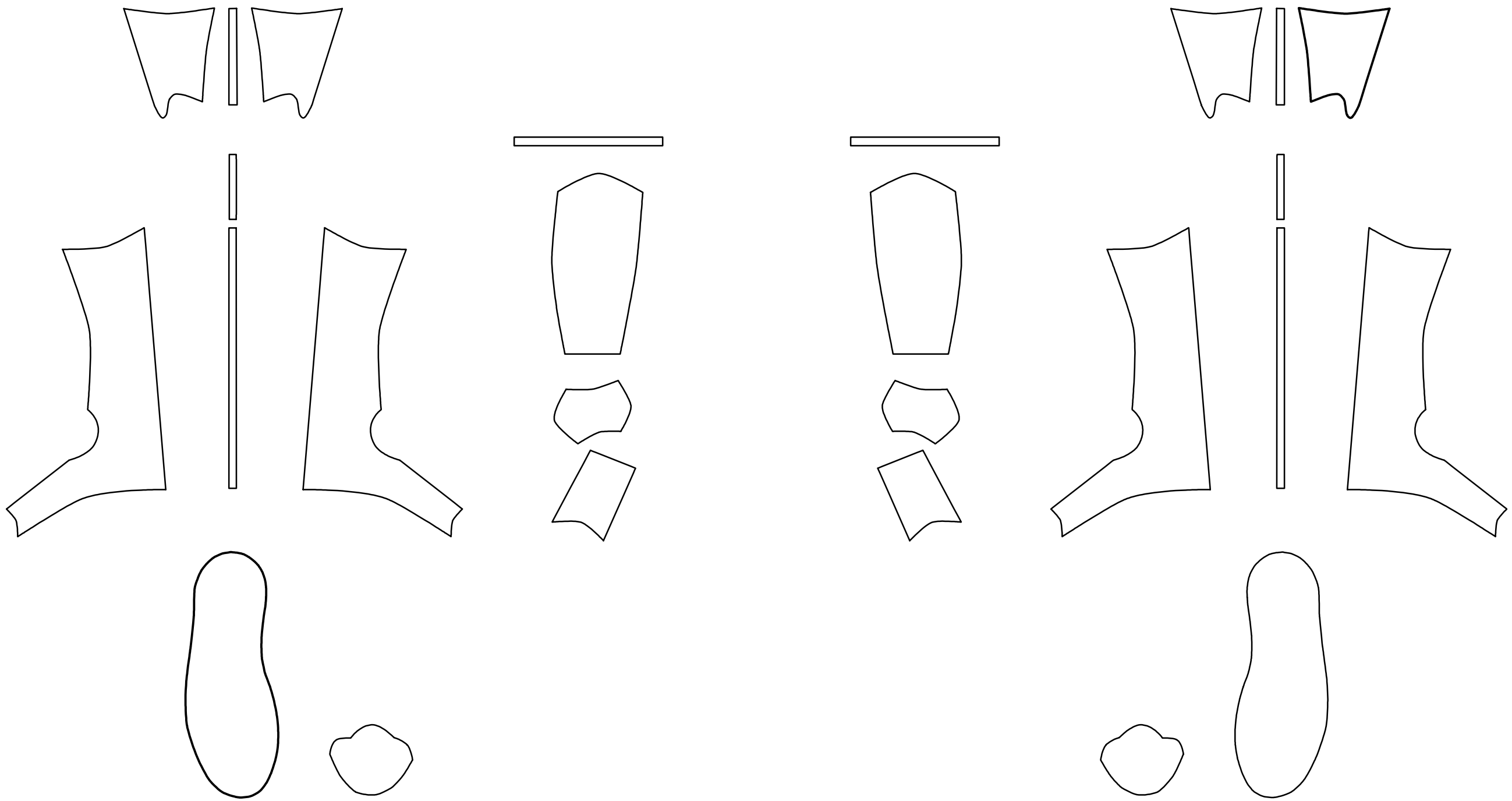
Illustration 37
Software: Marvelous designer.
Rendering: Keyshot8.

6.

DRAWINGS

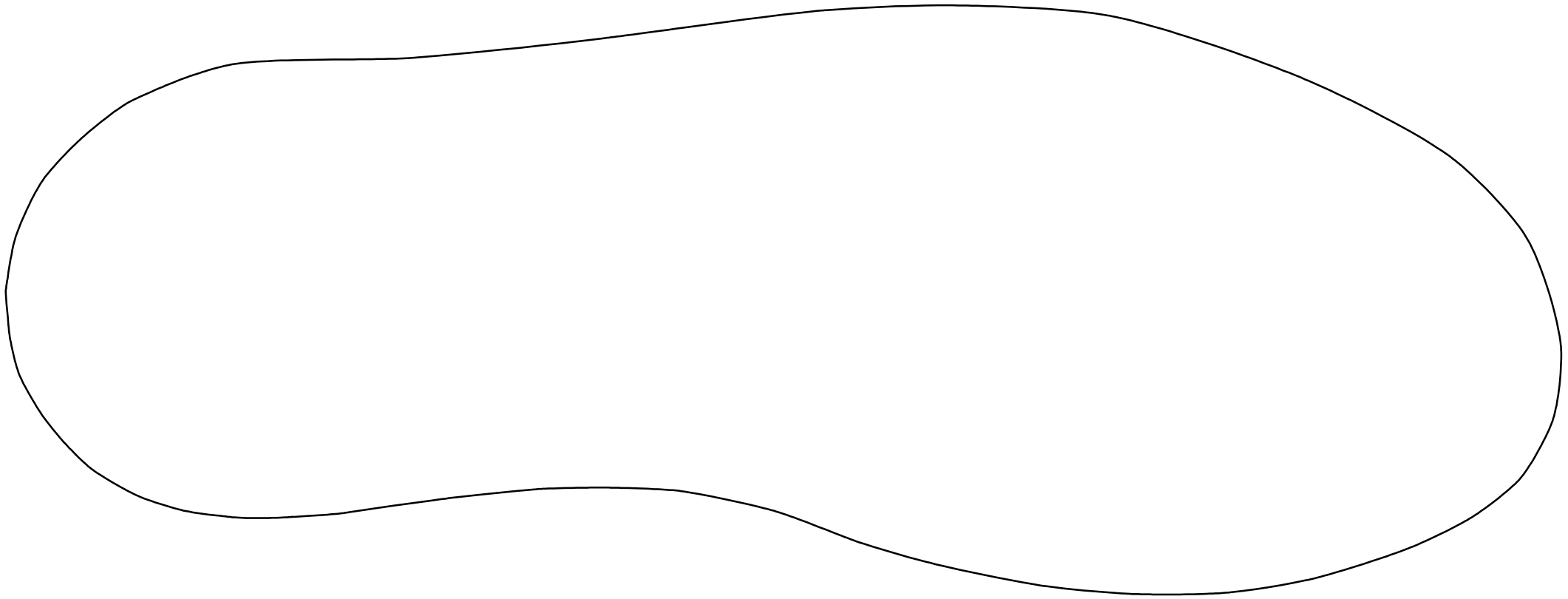
GRAPHICAL INFORMATION

1. Overall drawing.

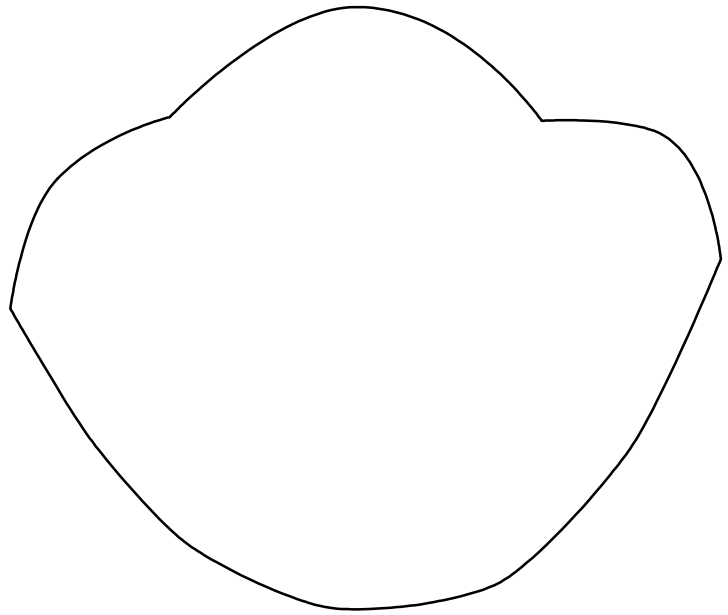


Tipo de documento:	TITULO DEL TRABAJO: LINER SKI BOOT - SIZE 43		
DEPARTAMENTO: Clothing, Faculty of Textile Engineering			
Ref. técnica: 1	TITULO DEL DIBUJO: GENERAL SET		ESCALA 1 : 5
Creado por: GARCÍA MUÑOZ, Y.			
Aprobado por:		Nº de identificación:	
		Revisión:	HOJA
		Fecha:	

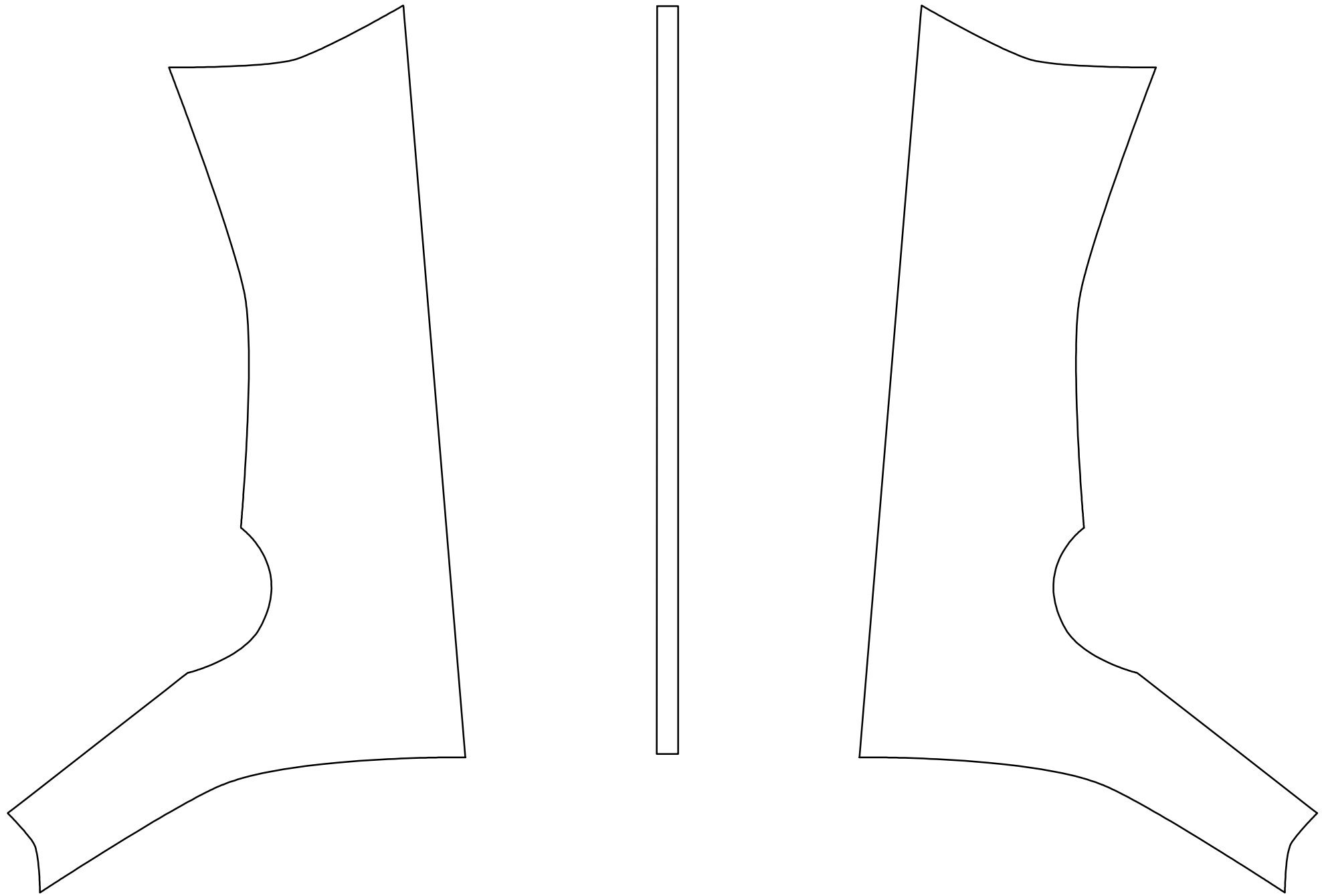
2. Sub-assembly drawing.



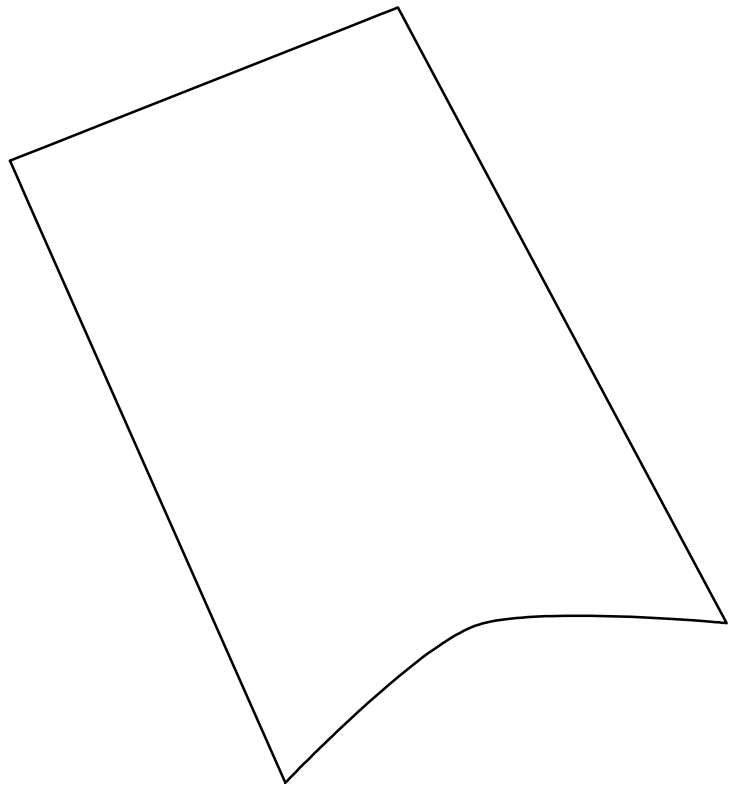
Tipo de documento:	TITULO DEL TRABAJO: LINER SKI BOOT - SIZE 43
DEPARTAMENTO: **Clothing, Faculty of Textile Engineering**	
Ref. técnica: **1.1**	TITULO DEL DIBUJO: **SOLE (LEFT LINER)** — ESCALA **1 : 1**
Creado por: **GARCÍA MUÑOZ, Y.**	
Aprobado por:	Nº de identificación:
	Revisión: — HOJA
	Fecha:



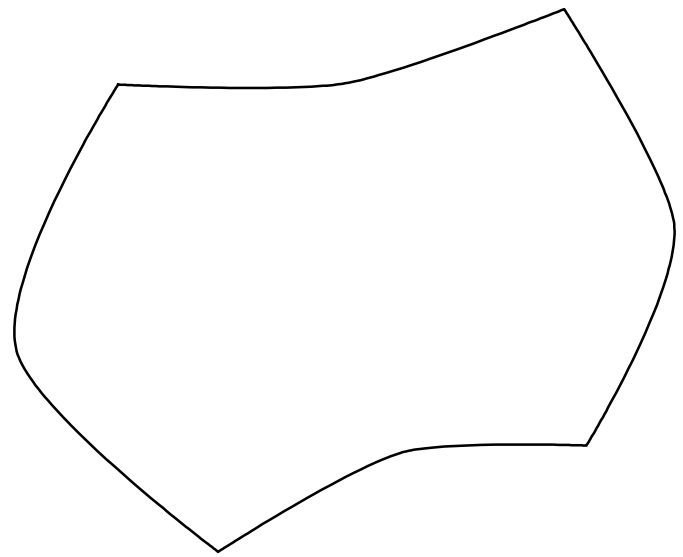
Tipo de documento:	TITULO DEL TRABAJO: LINER SKI BOOT - SIZE 43		
DEPARTAMENTO: **Clothing, Faculty of Textile Engineering**			
Ref. técnica: **1.2**	TITULO DEL DIBUJO: **MOCCASIN TOE CONSTRUCTION (LEFT LINER)**		ESCALA **1 : 1**
Creado por: **GARCÍA MUÑOZ, Y.**			
Aprobado por:		Nº de identificación:	
		Revisión:	HOJA
		Fecha:	



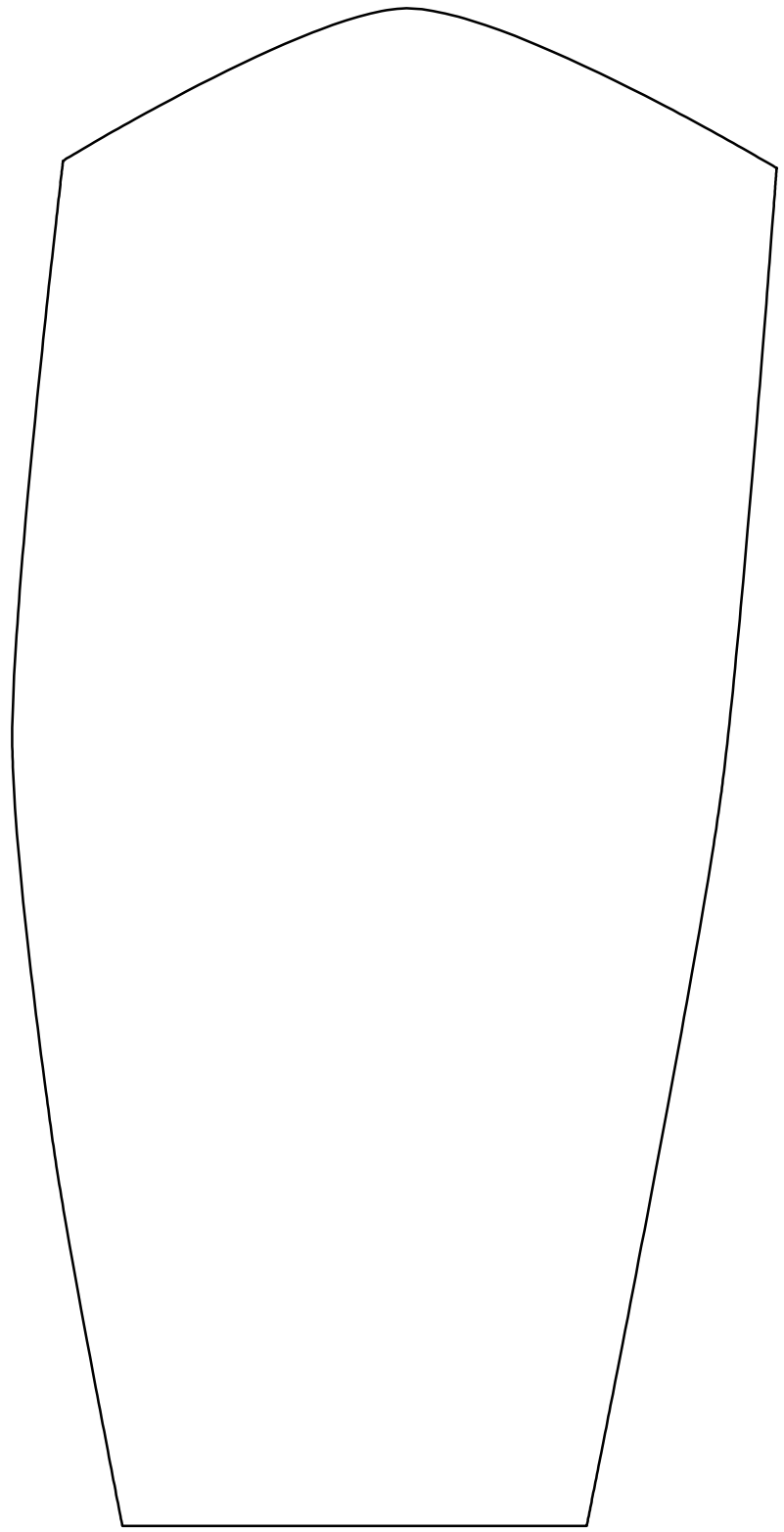
Tipo de documento:	TITULO DEL TRABAJO: LINER SKI BOOT - SIZE 43		
DEPARTAMENTO: **Clothing, Faculty of Textile Engineering**			
Ref. técnica: **1.3**	TITULO DEL DIBUJO: **WALL (LEFT LINER)**		ESCALA **1 : 2**
Creado por: **GARCÍA MUÑOZ, Y.**			
Aprobado por:		Nº de identificación:	
		Revisión:	HOJA
		Fecha:	



Tipo de documento:	TITULO DEL TRABAJO: LINER SKI BOOT - SIZE 43		
DEPARTAMENTO: **Clothing, Faculty of Textile Engineering**			
Ref. técnica: **1.4**	TITULO DEL DIBUJO: **ELASTIC INSTEP (LEFT LINER)**	ESCALA **1 : 1**	
Creado por: **GARCÍA MUÑOZ, Y.**			
Aprobado por:		Nº de identificación:	
		Revisión:	HOJA
		Fecha:	

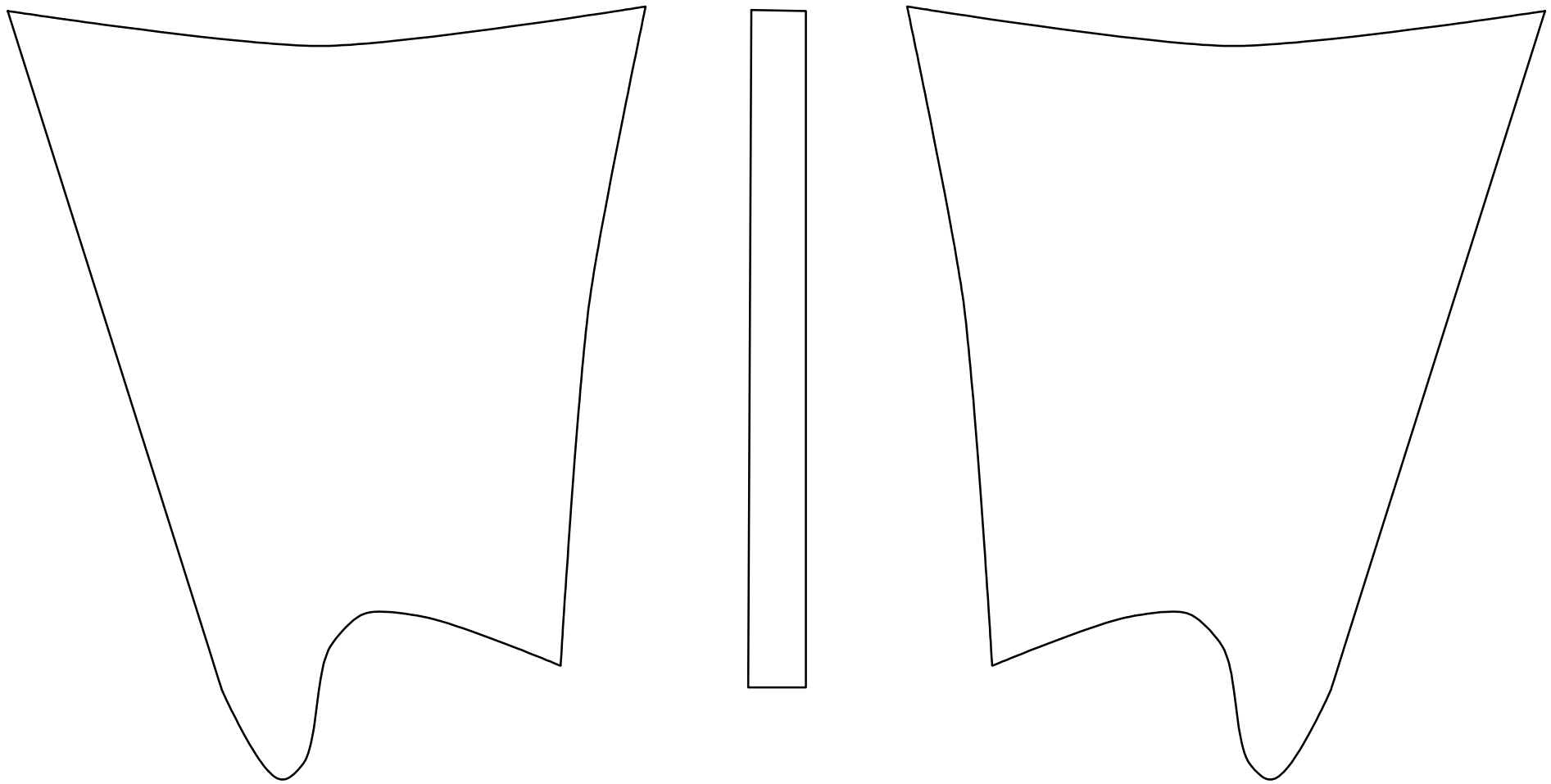


Tipo de documento:	TITULO DEL TRABAJO: LINER SKI BOOT - SIZE 43		
DEPARTAMENTO: Clothing, Faculty of Textile Engineering			
Ref. técnica: 1.5	TITULO DEL DIBUJO: ELASTIC FLEX POINT (LEFT LINER)		ESCALA 1 : 1
Creado por: GARCÍA MUÑOZ, Y.			
Aprobado por:		Nº de identificación:	
		Revisión:	HOJA
		Fecha:	



Tipo de documento:	TITULO DEL TRABAJO: LINER SKI BOOT - SIZE 43
DEPARTAMENTO: **Clothing, Faculty of Textile Engineering**	
Ref. técnica: **1.6**	TITULO DEL DIBUJO: **TONGUE (LEFT LINER)** — ESCALA: **1 : 1**
Creado por: **GARCÍA MUÑOZ, Y.**	
Aprobado por:	Nº de identificación:
	Revisión: — HOJA
	Fecha:

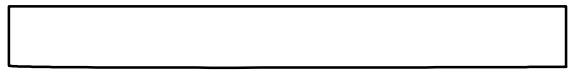
A3



Tipo de documento:	TITULO DEL TRABAJO: LINER SKI BOOT - SIZE 43	
DEPARTAMENTO: Clothing, Faculty of Textile Engineering		
Ref. técnica: 1.7	TITULO DEL DIBUJO: CUFF REINFORCEMENT (LEFT LINER)	ESCALA 1 : 1
Creado por: GARCÍA MUÑOZ, Y.		
Aprobado por:	Nº de identificación:	
	Revisión:	HOJA
	Fecha:	

Tipo de documento:	TITULO DEL TRABAJO: LINER SKI BOOT - SIZE 43		
DEPARTAMENTO: Clothing, Faculty of Textile Engineering			
Ref. técnica: 1.8	TITULO DEL DIBUJO: FRONTAL PULL TAP (LEFT LINER)		ESCALA 1 : 1
Creado por: GARCÍA MUÑOZ, Y.			
Aprobado por:		Nº de identificación:	
		Revisión:	HOJA
		Fecha:	

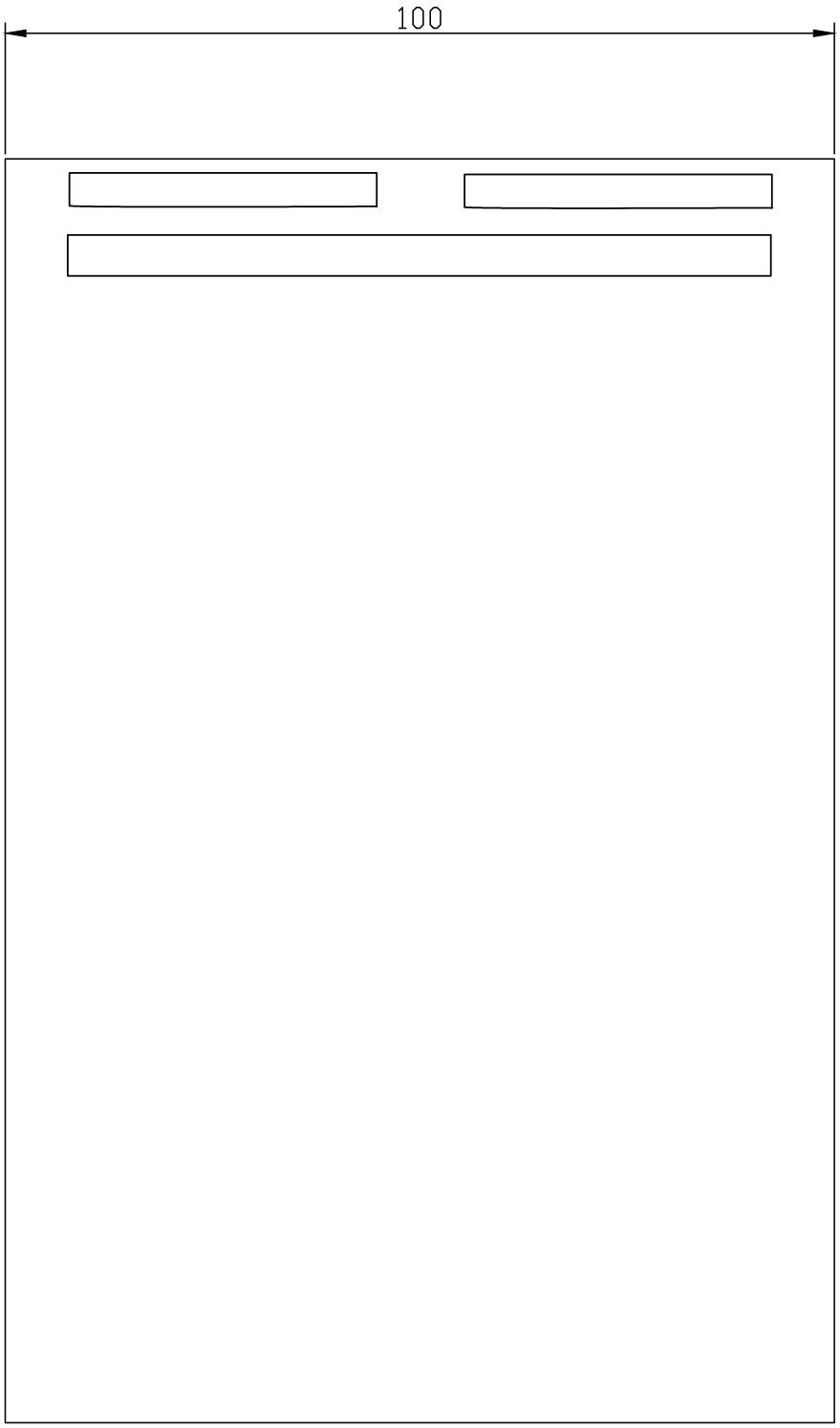
A3



Tipo de documento:	TITULO DEL TRABAJO: LINER SKI BOOT - SIZE 43
DEPARTAMENTO: Clothing, Faculty of Textile Engineering	
Ref. técnica: 1.9	TITULO DEL DIBUJO: BACK PULL TAP (LEFT LINER) — ESCALA 1 : 1
Creado por: GARCÍA MUÑOZ, Y.	
Aprobado por:	Nº de identificación:
	Revisión: — HOJA
	Fecha:

A3

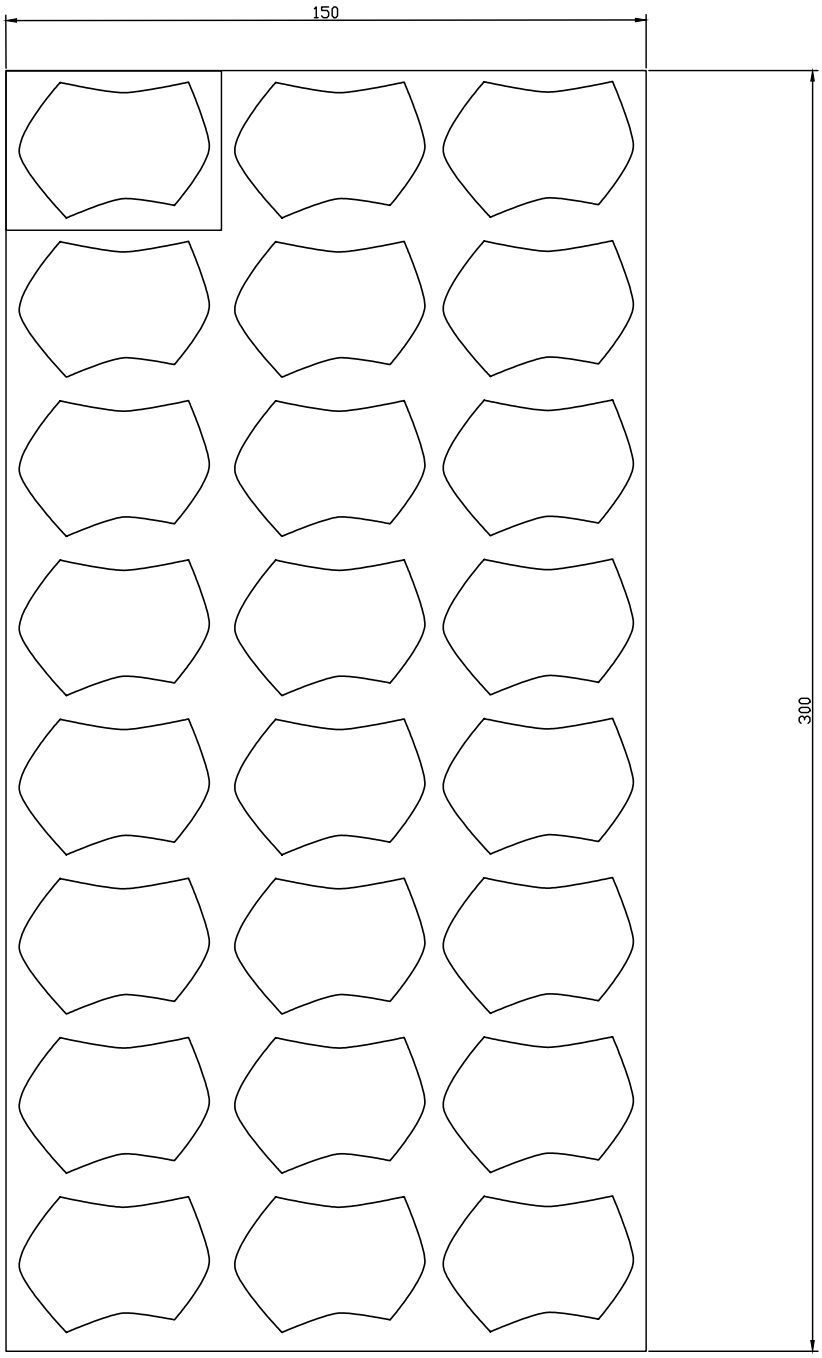
3. Study of the marker.



PE + CO LAYER

The original sheet measures 1000x1524x1mm.

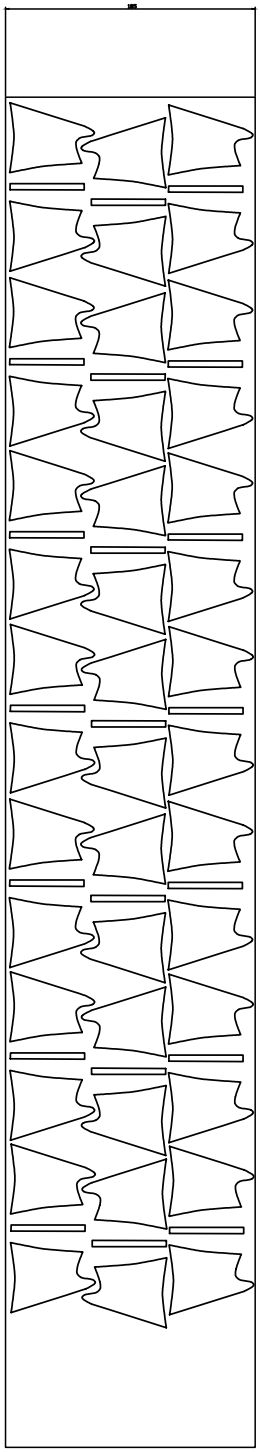
A sample of 100x152.4x1mm has been taken to make a proposal of the space to be occupied.



NYLON LAYER

The original sheet measures 1500X3000X2mm.

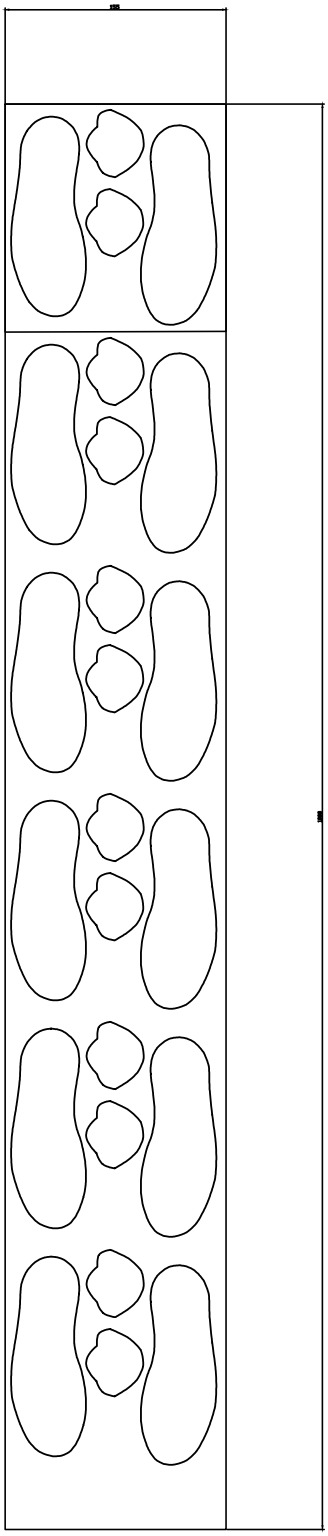
A sample of 150X300X2mm has been taken to make a proposal of the space to be occupied.



SPACER MAT 3MM

The original sheet measures 1850X10000X3mm.

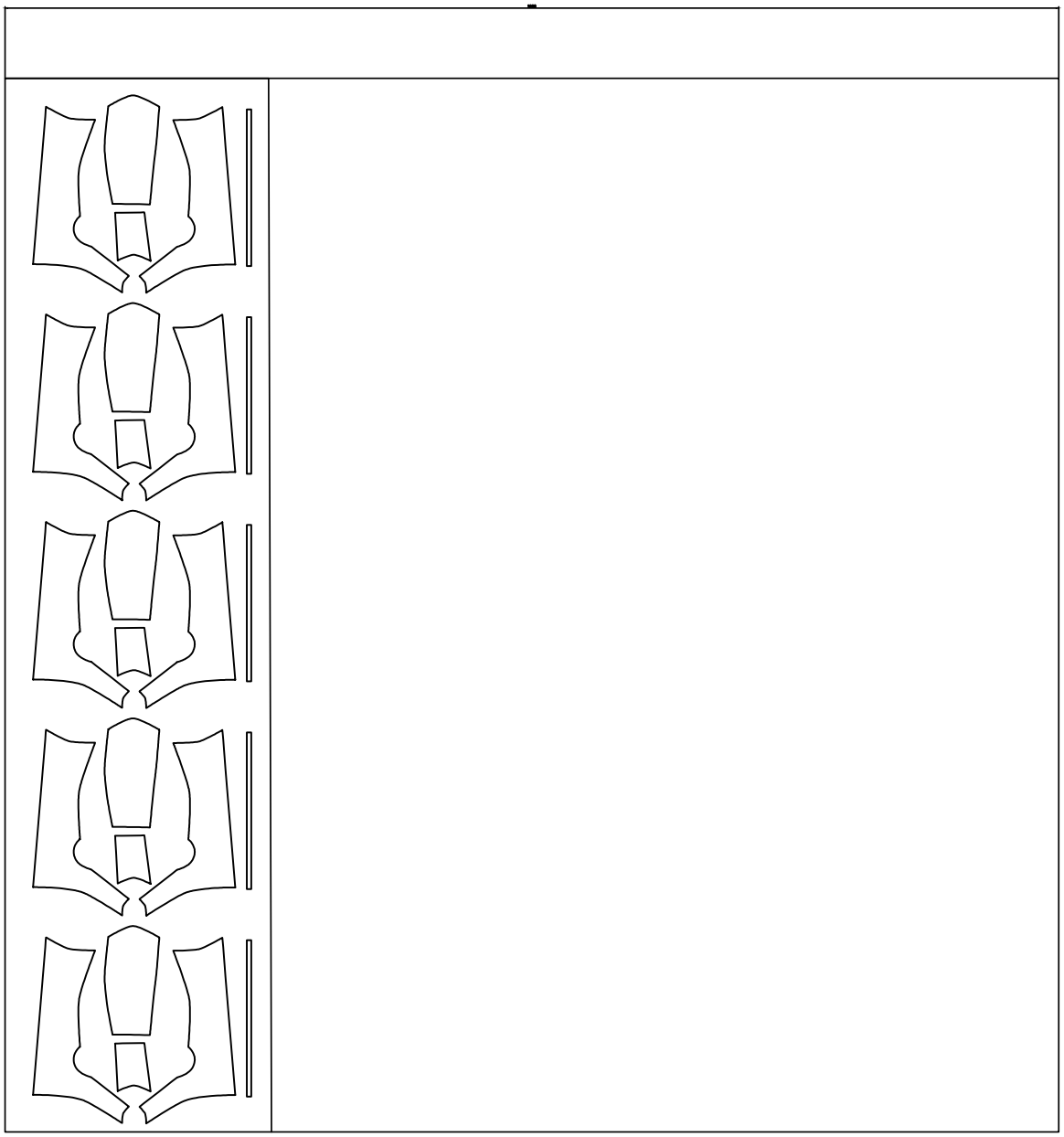
A sample of 185X1000X3mm has been taken to make a proposal of the space to be occupied.



SPACER MAT 6MM

The original sheet measures 1550X10000X6mm.

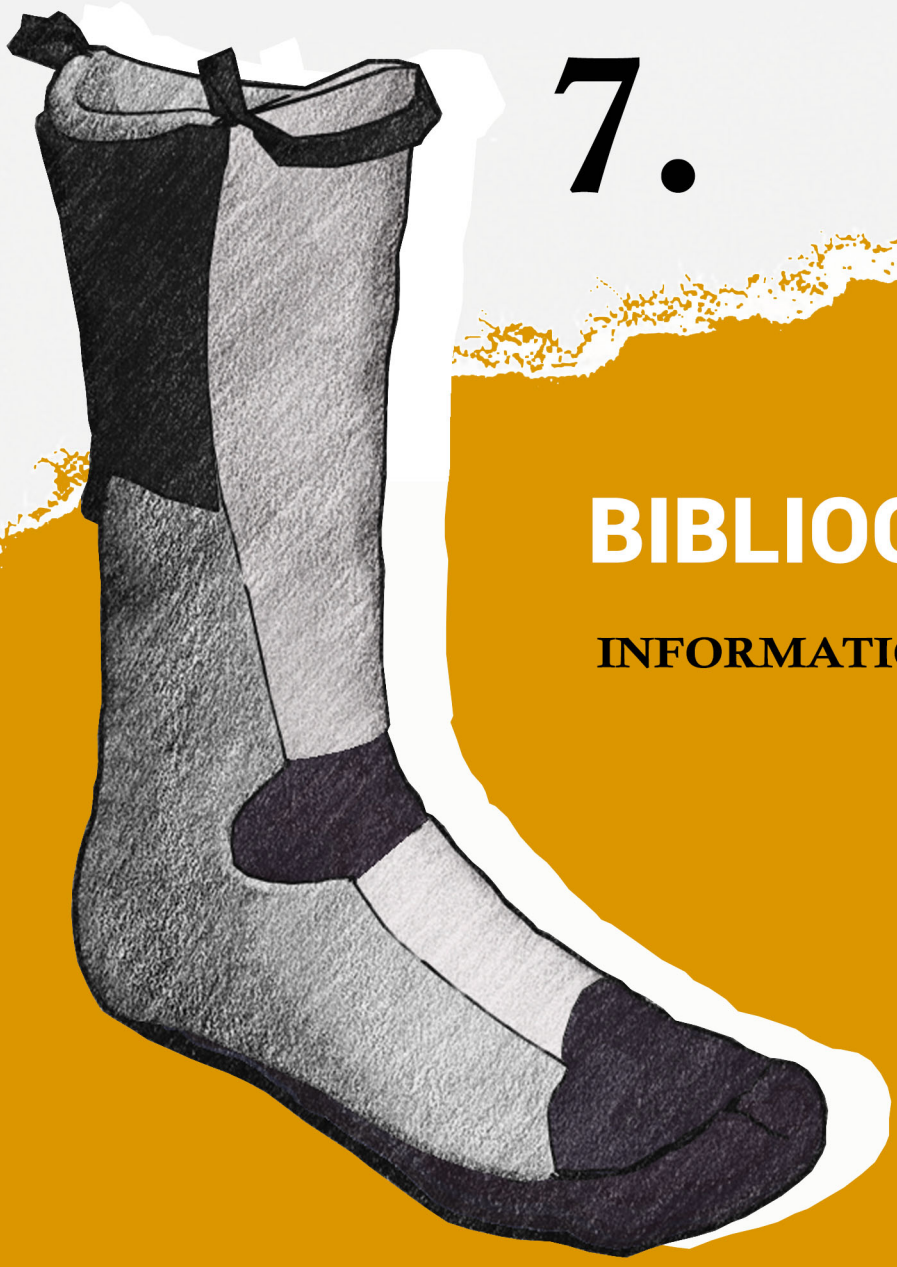
A sample of 155X1000X6mm has been taken to make a proposal of the space to be occupied.



SPACER MAT 8MM

The original sheet measures 10000X10000X8mm.

A sample of 1000X1000X8mm has been taken to make a proposal of the space to be occupied.



7.

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INFORMATION SOURCES

1. Figure index.

1.1 Memory figures

1.2 Annexes figures

2. Tables of content.

2.1 Memory tables

2.2 Annexes tables

3. Information Sources.

3.1 Memory information sources

Víctor Martín.(2015). "Evolución de las botas de esquí" <http://vts-esqui.com/blog/2014/evolucion-botas-esqui.php >[Consulta: 9 de Febrero de 2020]

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Figure 6 to 10: selfmade

Figure 11: https://www.lurbel.es/tecnologia/6/sylver-base/

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Figure 14 to 20: made with Marvelous designer

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Figure 24 to 26: Made with Marvelous designer

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Ilustration 1 to 12: https://intuitionliners.com/product-category/the-liners/

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Ilustration 26 to 37: Prototype with Marvelous designer; Rendering with Keyshot 8