UNIVERSITY OF MARIBOR
FACULTY OF MECHANICAL ENGINEERING

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DESIGN OF AUXILIARY FURNITURE FOR RECORD PLAYERS AND VINYLS

Diploma work
Industrial design and product development Engineering

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Design of auxiliary furniture for record players and vinyls

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STATEMENT BY CANDIDATE OF DIPLOMA THESIS

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I declare,

That the diploma thesis entiled:
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That my Diploma thesis will be result of my individual research work and that I am aware of potential criminal and disciplinary consequences, in case if I would use any unauthorized resources.

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ABSTRACT

This diploma work is based on the design of an auxiliary piece of sheet metal furniture intended solely for record players and vinyl records. First of all, the aim of the project is explained. Then a small market study of existing products and reference companies is shown. After taking into account the standard conditions and dimensions, we move on to the idea creation phase, which includes the conceptual design, variants and the detailed description of the final solution.

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1 OBJECTIVE

The aim is to design a piece of auxiliary furniture that adapts to different spaces and adds personality to an environment through simplicity, aesthetics, and special attention to detail. The sections of conceptual design, detailed design, cost calculation, materials, manufacturing process and planimetry will be developed.

2 BACKGROUND

2.1 Market research

Precedent 1

SOHO TURNTABLE STAND – Crosley

It is a record player cabinet with 4 shelves. The top shelf is to support the turntables and has two holes for the cables. The second shelf is ideal for accessories such as amplifiers or cleaning supplies for the turntable, it also has two other holes for the cables. The two lower shelves hold up to 100 discs each and are fitted with stops at the back to ensure that the discs are evenly spaced and easily accessible for picking.
Material: Wood
Dimensions: 55,24 x 45,085 x 99,06 cm

Figure 1 - Precedent 1

Precedent 2

WILTSHIRE TURNTABLE STAND - Crosley

This is a retro industrial style record stand with a small footprint. The black wire base can hold up to 10 records and display the full album artwork.
Material: Black wire and real mango wood
Dimensions: 48,26 x 35,56 x 50,8 cm

Figure 2 - Precedent 2

Precedent 3

JACOBSEN RECORD STORAGE CUBE – Crosley

Modular design allows multiple units to be paired together.
The top is sized to fit most standard turntables. Each shelf of the cube can hold approximately 60 albums in addition each storage cube has a cable management hole.
It is not a special piece of furniture for record players and vinyls, but also for storing other types of objects (books, toys, accessories, ...).
Material: Brown ash finish with matte black steel and sturdy steel.
Dimensions: 72,39 x 34,29 x 83,82 cm

Figure 3 - Precedent 3

Precedent 4

LELELINKY – Lelian
Record player station with two storage shelves for vinyl records with a metal frame.
The lower shelf is separated into 3 zones for the placement of the vinyls
Material: Wood and steel.
Dimensions: 48,26 x 30,48 x 72 cm

Figure 4 - Precedent 4

Precedent 5

SINGLE PLAYA EDITION TURNTABLE STAND – Atocha Design

Auxiliary turntable cabinet that has the essentials and a compact design. It has space for a sound system and 100 of your records. The design of the stand allows you to view the records from the front. The lower area has room for an amplifier and preamplifier plus space for ventilation. At the rear is the access for cable management.
Material: solid-birch–hardwood core plywood
Dimensions:
Overall: 95,88 x 60,96 x 97,79 cm
Turntable: 53,34 x 60,96 cm
Component shelf: 48,26 x 24,16 x 60,96 cm

Figure 5 - Precedent 5

Precedent 6

JEUSTENE – Gaëlle Pinel

Jeustene is a vinyl records and turntable storage unit made of steel, mat & slightly textured finish.
Dimensions: 50 x 40 x 80 cm

Figure 6 - Precedent 6

Precedent 7

HANNAH VINYL STORAGE RACK – Urban Outfitters

Vintage-inspired industrial furniture, consisting of a top shelf with edge, a side pocket sized to hold LPs and a shelf at the base, supported by slanted legs.
Material: Metal
Dimensions: 61 x 38 x 50,8 cm

Figure 7 - Precedent 7

Precedent 8

LARISA VINYL STORAGE – Urban Outfitters

Storage table for records, a record player and even speakers! Perfectly sized to fit in any space.
Material: Metal
Dimensions: 62,23 x 27,30 x 55,24 cm

Figure 8 - Precedent 8

Precedent 9

SYMBOL MAX RECORD STAND

This is an archive drawer for storing LPs. The cabinet can be customised to suit the user's taste, depending on storage needs. It consists of 3 shelves, two to place the records and one to support accessories. In addition, there are two cable slots on the back for the cables.
Material: Wood
Dimensions: 71,12 x 38 x 78,74 cm

Figure 9 - Precedent 9

Precedent 10

REGAL TURNTABLE STAND
Auxiliary stand with open shelves, the record player is placed on the top, the audio component on the bottom shelf and the records in the two divided bins at the bottom. Can also be used to store books, bottles or other objects. The recess at the back makes it easier to organise the cables of electronic devices.

Material: durable engineered wood, particle board and powder coated metal
Dimensions: 41 x 70 x 48,26 cm

Figure 10 - Precedent 10

Summary

After analyzing some of the record and vinyl players on the market, it can be said that they all have some features in common.

In terms of storage, most of them have at least two shelves, one for the record player and one for the records.

On the other hand, it is important that they have a hole in the back for the cables, as this makes it easier to place the cabinet in a space.

In respect of dimensions, these are compact and small-sized pieces of furniture as they are auxiliary and intended only as a turntable station.

Finally, there is hardly any furniture for this field that is made of sheet metal, the vast majority is made of wood.

2.2 Benchmark companies and inspirational moodboard

For the design of the furniture presented, I have been inspired by leading companies in the sheet metal auxiliary furniture sector. Among them, Made Design, Muuto, Fink, OUT, Very Simple Kitchen and Montana.

Made Design

Brand of decorative design accessories to cover different needs in work environments, public spaces, contract and home.

Figure 11 - Made Design

Muuto

Muuto has its roots in the Scandinavian design tradition characterized by enduring aesthetics, functionality and craftsmanship.

Figure 12 - Muuto

Fink

They design accessories for the home, residential and commercial spaces made of bent metal, simple and functional.

Figure 13 - Fink

OUT

OUT's aim is to create functional furniture and accessories that meet everyday needs. They value detail and are traditionally innovative.

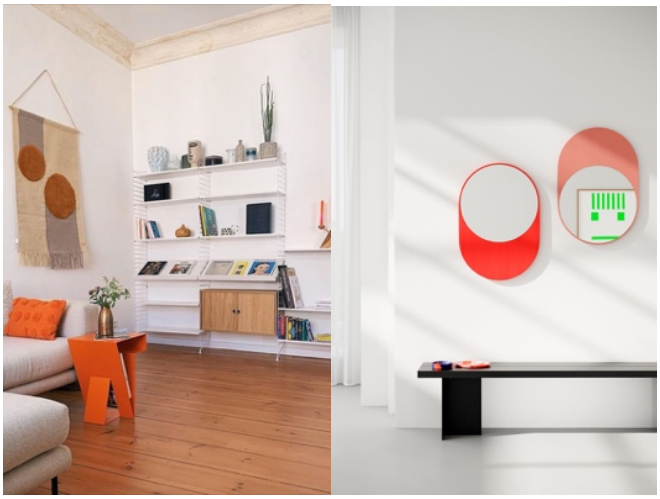


Figure 14 - OUT

Very Simple Kitchen

The company is inspired by the minimalism and straight lines of Italian industry.
Its products are a combination of industrial style and simple forms with careful attention to the use of colours, materials and finishes.

Figure 15 - Very Simple Kitchen

Montana

It is a Danish company dedicated to the sustainable design of customisable modular furniture; they have 42 eco-friendly colours.

Figure 16 - Montana

I want the product to have a variety of colours and a striking palette, adding personality to a space.

This aspect is related to music, as each user consumes a different type of music that describes their personality.

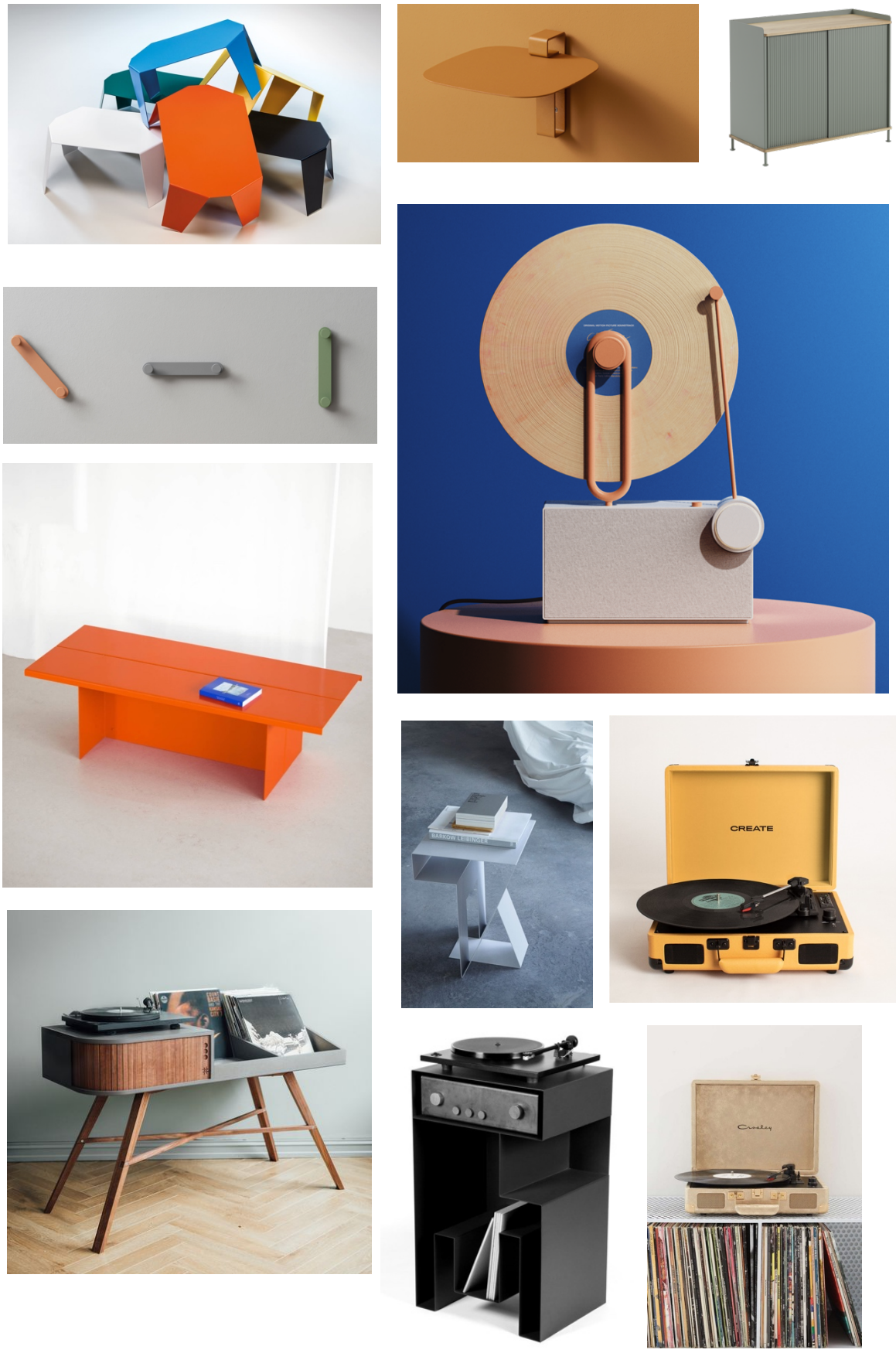


Figure 17 - Inspirational moodboard

2.3 Target market

A target market is a group of people with common characteristics that a company has recognised as potential customers for its products. Determining the target market helps in the decision-making process when a company designs, packages and markets its product.

A target market can be classified by age range, location, income and lifestyle, as well as their life stage, hobbies, interests and careers.

We will use a target to explain what type of person and what tastes the product to be designed is aimed at.

Gender: men
Age range: 27 – 37 years old
Location: Spain
Income: financially independent
Hobbies: People who like design and special pieces. They are also passionate about record players and vinyl records. They like to listen to music at any time of the day.

3 FACTORS TO BE CONSIDERED

3.1 Conditions

Before starting the conceptual phase, I want to make it clear what I want the product to look like and how I want it to comply with a series of commissioning conditions. These are based on three essential aspects that need to be taken into account: volume, production processes and materials.

As a business strategy, the final full-scale volume of the developed model must not exceed one cubic metre.
It is a business strategy because the volume is not too large and if a physical prototype is made, it can be shown and presented to companies. It is also better for transport and product logistics as it takes up less space.

As for the production processes for its manufacture, they must be economic processes without the need for initial investment in moulds, tooling, etc. These include cutting on a 2-axis CNC machine, laser cutting, folding, glued and mechanical joints including riveting.

And finally, using sheet steel as the main material and also laminates (polymers, thermo-polymers, acrylic resin, glass, natural stone, etc.), textiles, wood fibreboard and natural wood laminates.

3.2 Ergonomics

With regard to the ergonomics of the product, it has been decided to base it on the measurements of a kitchen. Thus, there is a relationship between the kitchen bench and the furniture to be designed, as the user uses the product in the same way, that is, standing up.

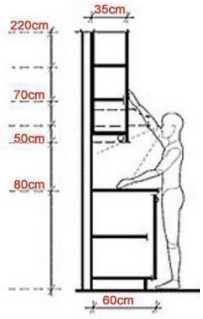


Figure 18 - Kitchen measures

As mentioned above, the most important measure to be taken into account in this case is the height of the bench, where the height of the user's hips must be taken into account. In the case of the image, it is 80 cm, and the width of the furniture will depend on the dimensions of the turntable, which will be seen in the next point, but it cannot exceed 60 cm.

3.3 Standard vinyl records and turntable dimensions

For the design of the cabinet, the dimensions of the turntables and records must be taken into account, as it is specially designed to support these objects.
As for vinyl records, there are three different sizes:

12 inches (30 cm)
The largest and most common size is the 12". Both sides of these discs can hold between 20 and 25 minutes of music. This size of record is often referred to as an LP (Long Play).

10 inches (25 cm)
The least common size is 10". They have the highest RPM, which increases their sound quality, this means that the longevity of the record decreases because it requires the record to spin faster. These records can hardly be found on the market, but they had a big impact on the industry.

7 inches (18 cm)
The smaller 7" size emerged as a cheaper way to produce singles. Being smaller, it does not store as much music as the other sizes. However, at their base speed of 45 RPM, these discs are a perfect method of distributing singles and extended singles. They are usually about 5 minutes long.

Figure 19 – Vinyl records sizes

Regarding record players, there are different types, so the size and weight will vary depending on the style and manufacturer.

In general, turntables are 50 cm long, 38 cm high and weigh between 4.5 and 6.8 kg.

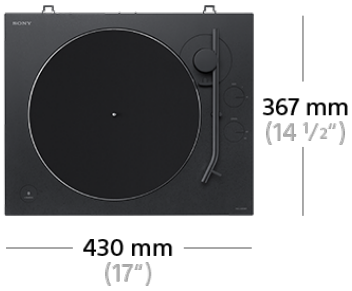


Figure 20 - Example turntable dimensions

4 CONCEPTUAL DESIGN

4.1 Sketches

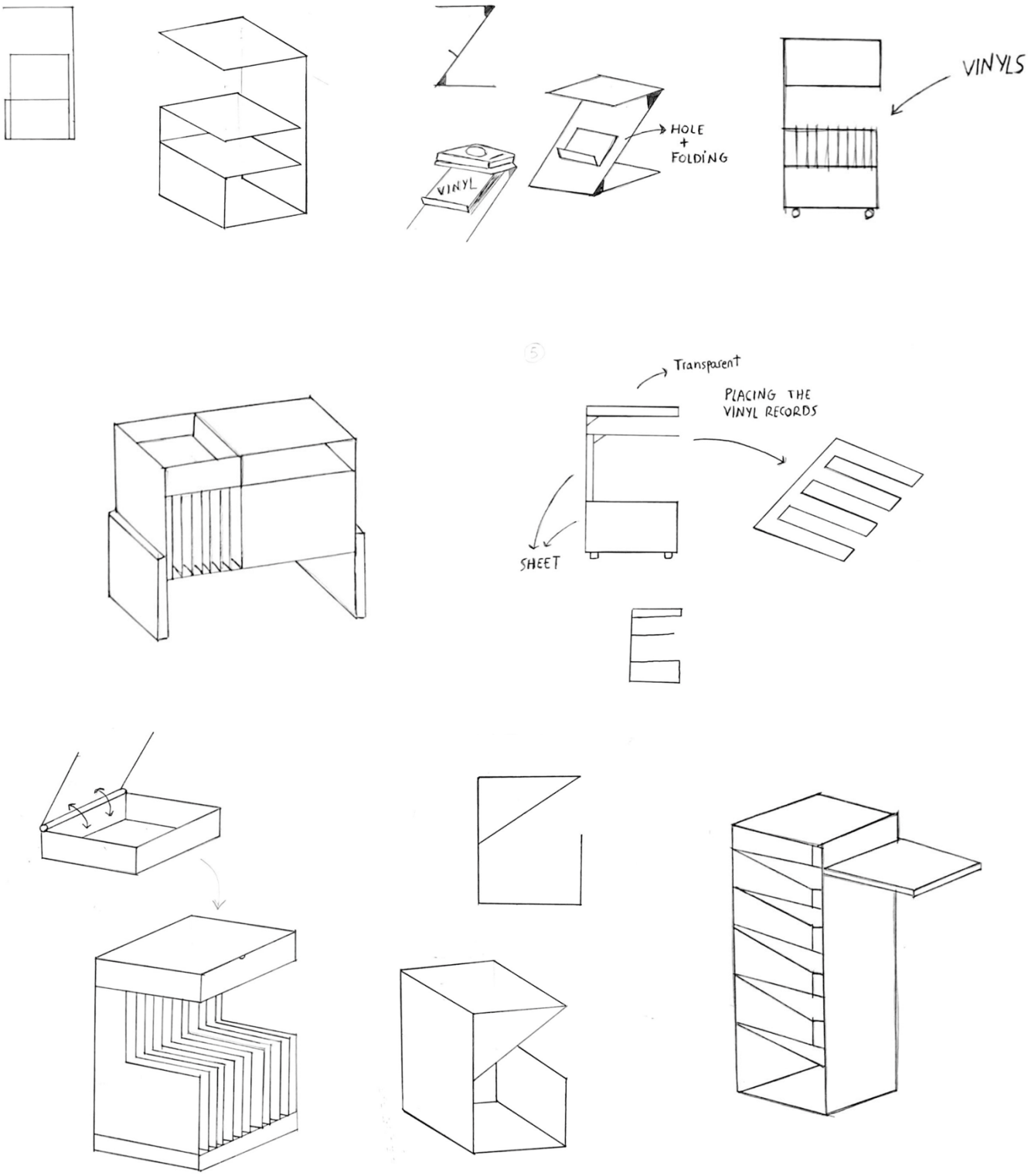


Figure 21 - Sketches

After carrying out the market study and getting to know the different products that exist, the sketches are made.

The ideas shown in figure 21 are some of the many that have been realised. Moreover, they have similarities between them, geometric shapes, rectangles, they all have different spaces to place the different elements, use of metal bending, …

4.2 Consideration of alternative solutions

Alternative 1

This first idea consists of a piece of furniture with three heights. The upper part holds the record player, the second height is a metal plate with slots for storing records and the lower part is a drawer for storing accessories or more records and is inspired by the glass shelves of a cabinet bar.
The first two shelves have a reinforcement bracket at the bottom.
Finally, the bottom part is fitted with a plug so that the cabinet is slightly raised.

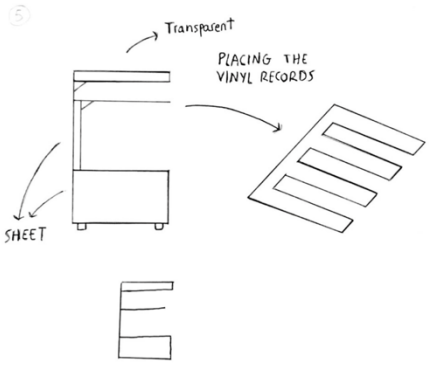


Figure 22 - Alternative 1

Alternative 2

This second idea is rectangular in shape and has different sloping shelves to hold the vinyl records. As in the first idea, the record player is placed at the top. In addition, it has an extension on the side to place speakers, decorative objects or even the envelope of the record being used.

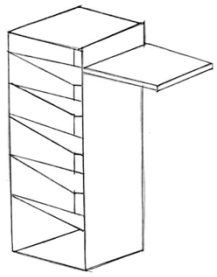


Figure 23 - Alternative 2

Alternative 3

This third idea is similar in form to the first solution. It has two parts. The first part is used to support the turntable and is also a drawer for storing accessories and the second part is made of metal sheets forming L-shaped grooves. It is characterised by orthogonal shapes.

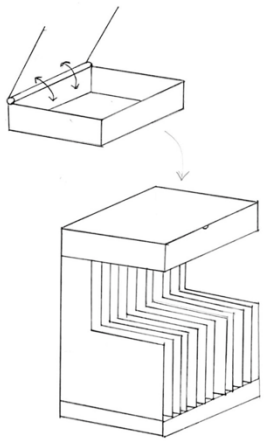


Figure 24 - Alternative 3

Alternative 4

Finally, this is a simpler piece that uses only sheet metal forming a single piece. Unlike the other ideas, this one has four heights.

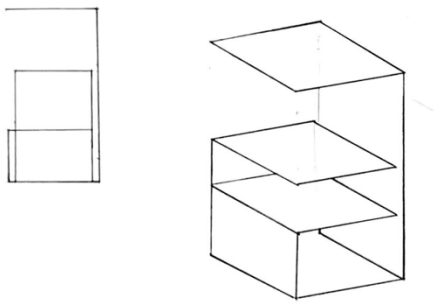


Figure 25 - Alternative 4

4.3 Selection criteria

Filtering or Pugh's selection matrix

In this selection criterion, concept filtering selection matrices are used to make a decision among the five alternatives. Are used to make a decision among the four alternatives.
The Pugh Matrix allows options to be compared with each other by means of a multidimensional array (a decision matrix).

The advantage of using such a matrix is to bring subjective decision making closer to objective, quantitative decision making.
As a first step, the evaluation criteria must be established and placed in the rows of the matrix.

Secondly, possible design concepts are placed in the columns of the matrix.
.
- A + will be awarded if the concept is fulfilled.
- A - will be awarded if the concept is not fulfilled.
- A 0 will be assigned if the result is neutral.

Finally, the different results will be added up, and the solution with the highest score will be the most suitable option to be implemented.

CONCEPTS	ALTERNATIVE 1	ALTERNATIVE 2	ALTERNATIVE 3	ALTERNATIVE 4
Ergonomics	**+**	**0**	**-**	**-**
Ease of use	**+**	**+**	**+**	**+**
Innovative	**0**	**0**	**+**	**0**
Viability	**+**	**+**	**-**	**-**
Lightness	**+**	**0**	**0**	**+**
Total +	4	2	2	2
Total -	0	0	2	2
Total 0	1	3	0	0
TOTAL	**4**	**2**	**0**	**0**

Table 1 -Filtering or Pugh's selection matrix

After carrying out the selection criteria, the idea to be developed is alternative 1, as it has obtained the highest score.

5 STRUCTURAL, FUNCTIONAL AND AESTHETIC VARIANTS

Once the concept has been selected, functional structural and aesthetic variants are developed to improve the product.

AESTHETICS

Formal exploration of the side. Aesthetically it looks less aggressive if it has a curved shape.

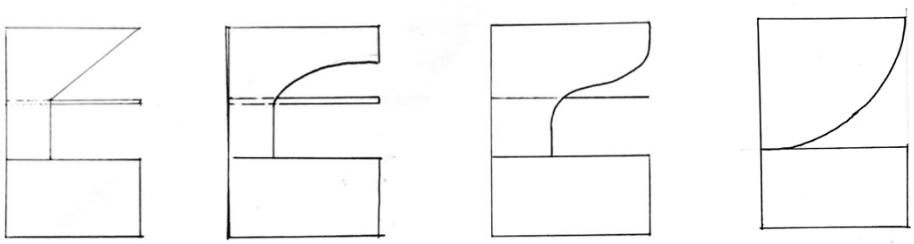


Figure 26 - Aesthetics variants

STRUCTURAL

Variants based on a structural and product feasibility study, so that the product can withstand different weights

BOX: Closed volumes are not possible as they do not allow the bending tool to pass through. Insertion of an intermediate beam to support the weight.

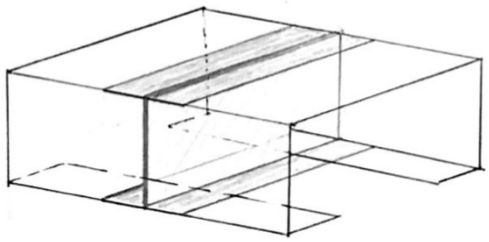


Figure 27 - Structural variant 1

Filling cabinet: “Filling cabinet” instead of dividers to provide more support to the surface and facilitate joining.

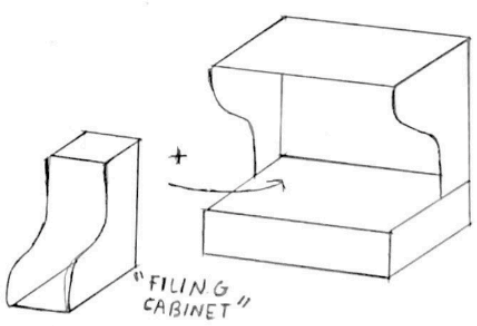


Figure 28 - Structural variant 2

FUNCTIONAL

At the rear, a space is added to accommodate and organise the wiring.

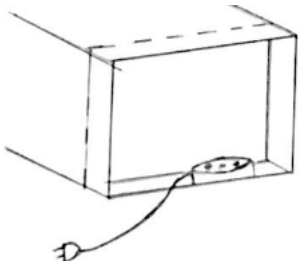


Figure 29 - Functional variant

6 FINAL SOLUTION

6.1 Description

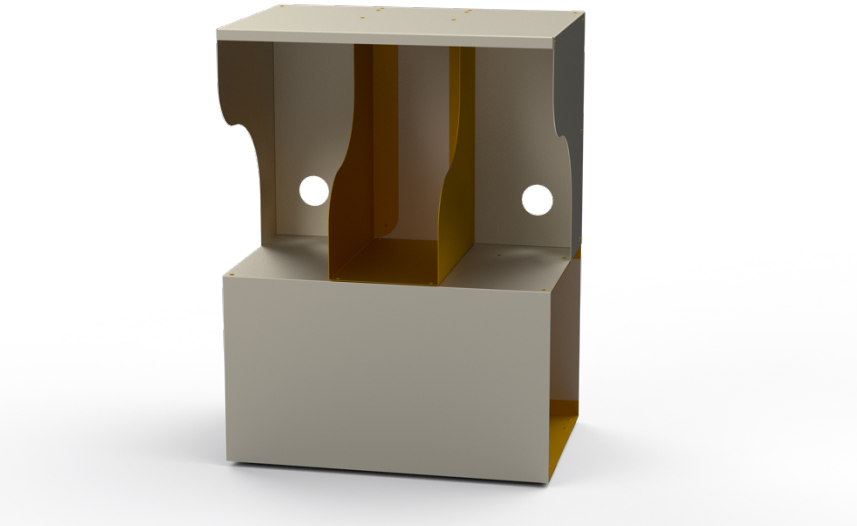


Figure 30 - Final design Binyl

This is the final design; I have decided to name it BINYL.

It is a piece of furniture with an industrial touch that gives a touch of personality to a space.

In addition, importance is given to the small details that make it an original piece of furniture, deciding that the rivets are visible and form part of the product as another piece.

As a whole, it consists of three parts. The upper part is where the turntable is located, the middle part is for the records and the lower part is where you can store more records and even accessories. In addition, holes are provided at the rear to allow cable management.

6.2 Renderings

CAD SolidWorks and SolidWorks Visualize were used for 3D modelling and rendering. This software has a sheet metal plug-in with which all kinds of operations can be carried out, including sheet metal bending.

Figure 31 - Render 1

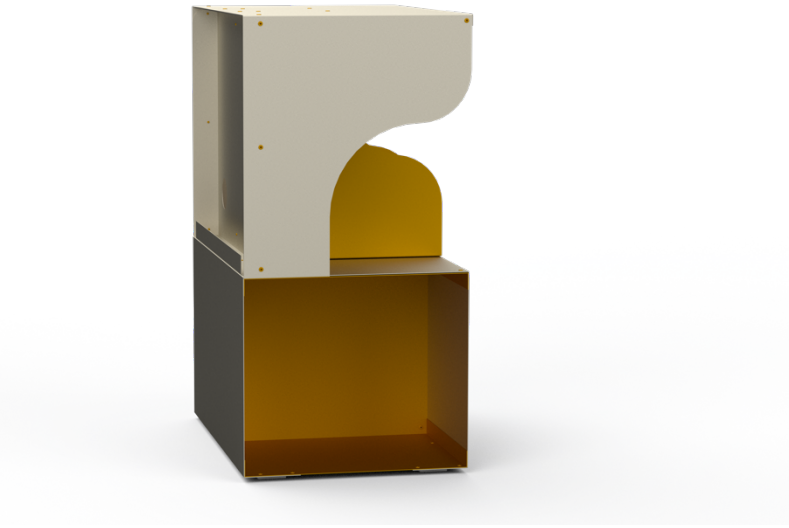


Figure 32 - Render 2

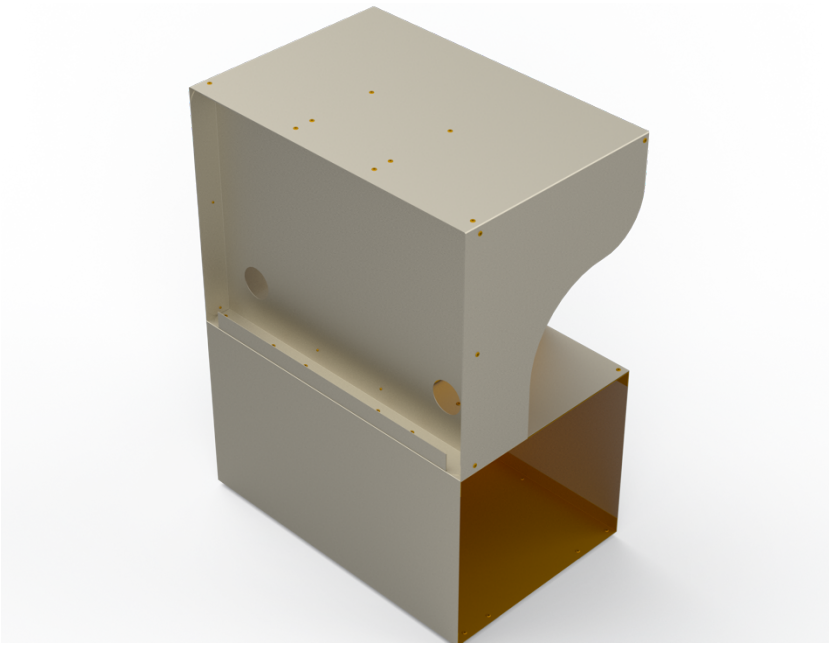


Figure 33 - Render 3

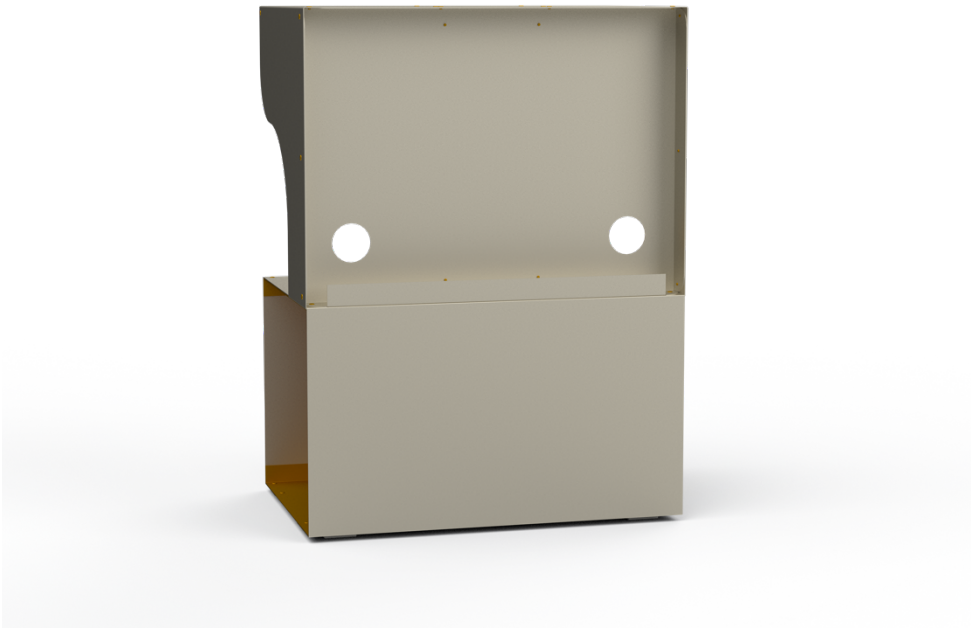


Figure 34 - Render 4

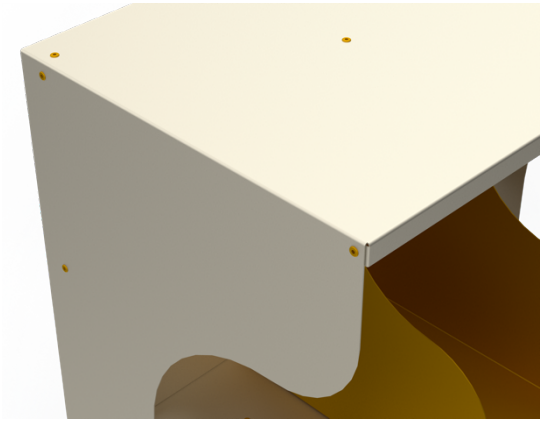


Figure 36 -Render 5, detail

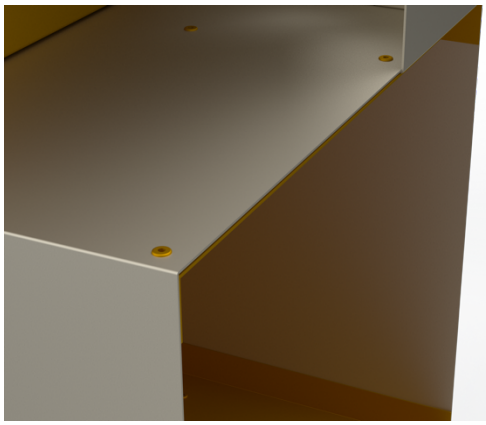


Figure 35 - Render 6, detail

6.3 Contextualization

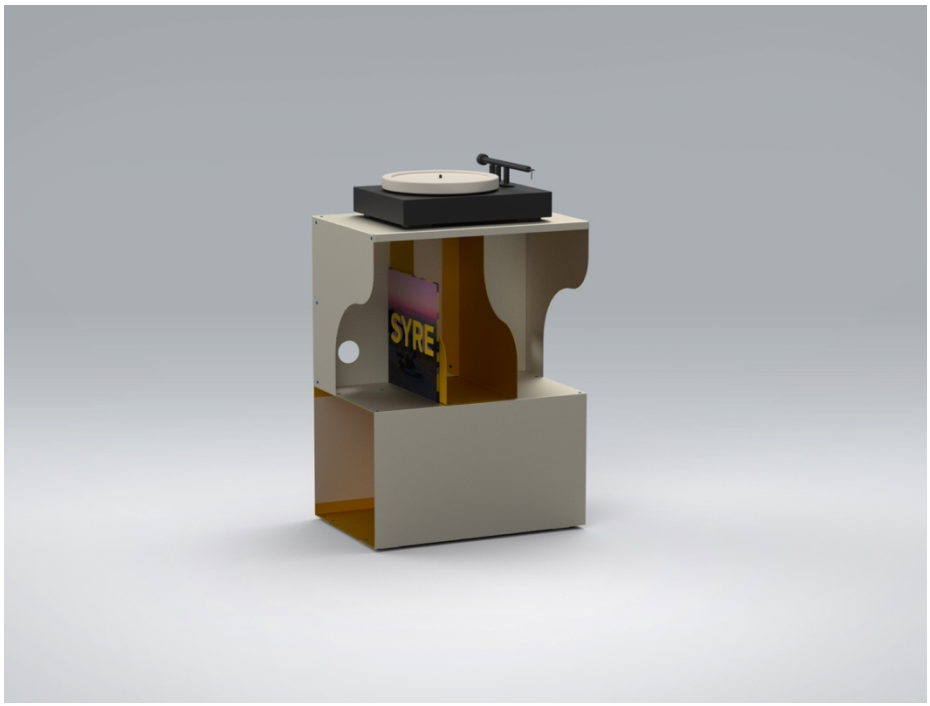


Figure 37 - Contextualization 1

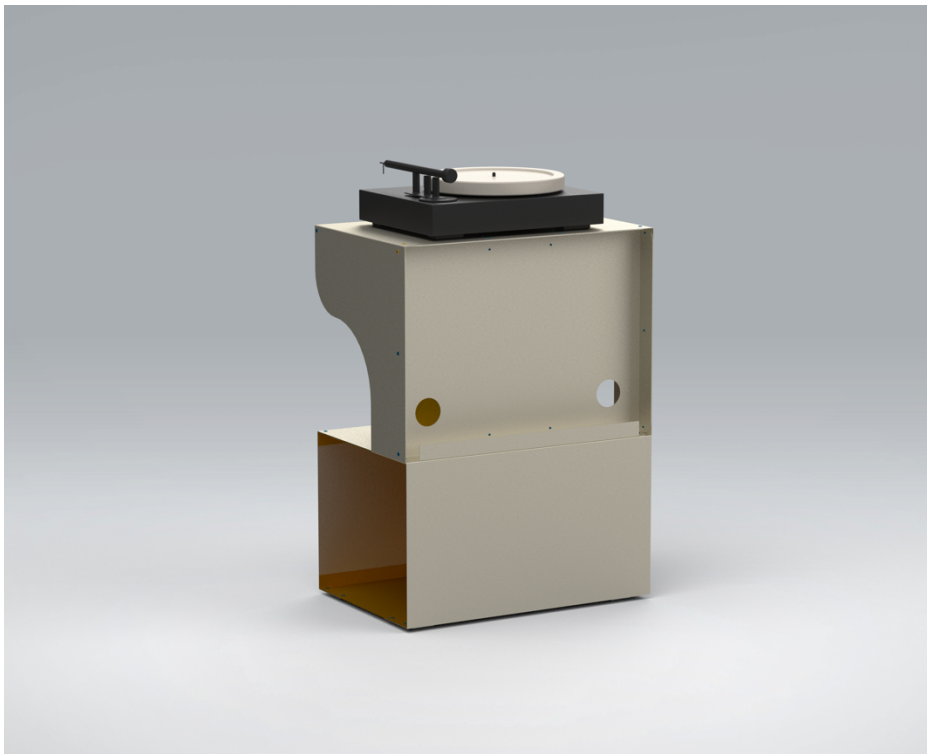


Figure 38 - Contextualization 2

Figure 39 - Contextualization 3

Figure 40 - Contextualization 4

7 DETAILED DESCRIPTION OF THE FINAL SOLUTION

7.1 Pieces

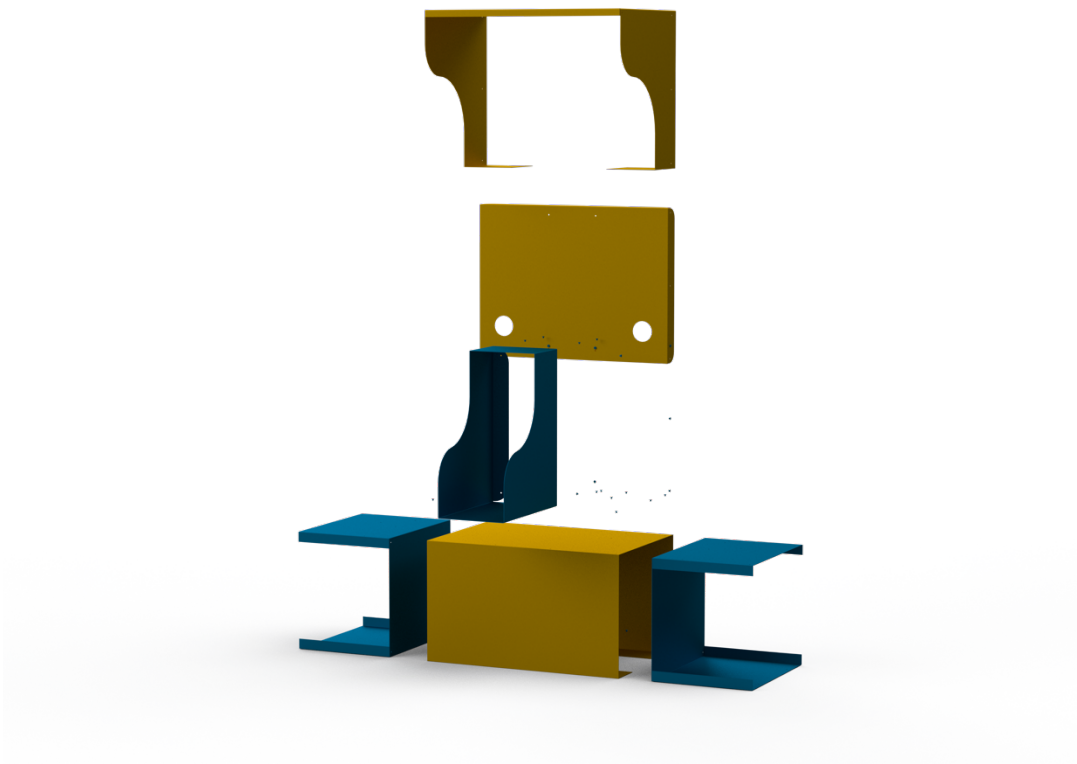


Figure 41 – Exploded view

7.1.1 Designed pieces

PIECE 1

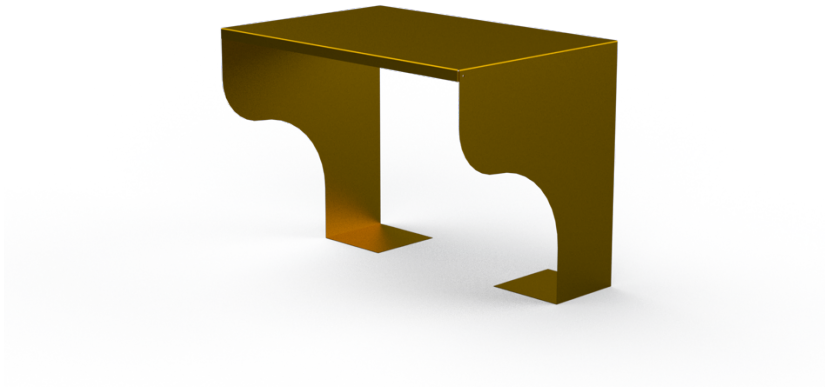


Figure 42 - Piece 1

Denomination: Top panel
Utility: Main structure of the upper part. Serves to support the turntable on the top and store the records on the inside. Superior flange to prevent damage and helps to close the structure.
Union: With piece 6
Dimensions: 600 x 400 x 450 mm
Material: coated matt steel

PIECE 2

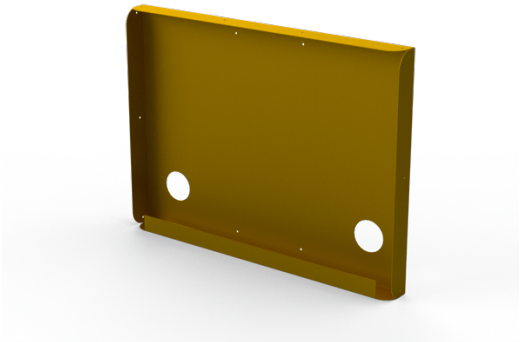


Figure 43 - Piece 2

Denomination: Back panel
Utility: This is the rear part of the upper part. It is used to keep the discs that are stored in the upper part from falling out and also to support and organise the cables.
It has 4 flanges to connect with the parts that are in contact with each other.
Union: With piece 1

Dimensions: 597,60 x 50 x 444,90 mm

Material: coated matt steel

PIECE 3

Figure 44 - Piece 3

Denomination: Folder

Utility: It is used to store vinyl records and also acts as a reinforcement for part 1, as it has to support the weight of the turntable. It is open at the back so that the folding process can be carried out.

Union: with piece 1, 2 and 6

Dimensions: 349,20 x 200 x 441 mm

Material: coated matt steel

PIECE 4 and 5

Figure 45 - Piece 4

Figure 46 - Piece 5

Denomination: Separator

Utility: Drawer divider. The two pieces together form a beam. In addition, the flanges act as a base for part 6.

Union: with piece 6

Dimensions: 298,80 x 397,60 x 346,4 mm

Material: coated matt steel

PIECE 6

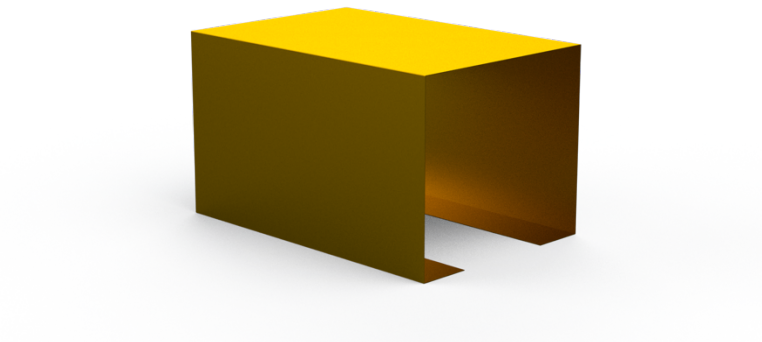


Figure 47 - Piece 6

Denomination: Box

Utility: drawer for storing cleaning items, records or other objects

Union: with piece 4 and 5

Dimensions: 597,60 x 400 x 350 mm

Material: coated matt steel

PIECE 7

Figure 48 - Piece 7

Denomination: Support block

Utility: so that the furniture is slightly elevated

Dimensions: 50 x 50 x 10 mm

Material: methacrylate

7.1.2 Commercial pieces

Figure 49 - Blind rivet

Denomination: Blind rivet

Utility: joining the pieces together

Dimensions and characteristics: d - 4,0; T - 8,0 mm; L - 8,0 mm; k - 1,0 mm

Shear strength - 1200 N

Tension force - 1700 N

Grip range 2,0 ÷ 4,0 mm

Hole diameter - 4,1 mm

Material: aluminium

7.2 Materials

All the parts that make up the furniture are made of the same material, steel. Exactly, it is made of powder-coated sheet steel.

7.2.1 Steel

Steel is an alloy of iron and carbon with a carbon content varying between 0.03% and 1.075% by mass of its composition.

Steel should not be confused with iron.

The main difference between iron and steel lies in the percentage of carbon: steel is iron with a carbon content of between 0.03 % and 1.075 %; when it exceeds this percentage, other alloys with iron are considered.

Steel and iron in their pure state retain the same metallic characteristics, but the addition of carbon and other metallic and non-metallic elements improves their physico-chemical properties.

However, castings are produced if the alloy has a carbon concentration higher than 1.8%. These castings are weaker than steel and cannot be forged but must be cast.

Different types of steel can be found depending on the alloying element or elements that are present. The definition in percentage of carbon applies to carbon steels, in which this non-metal is the only alloying element, or others are present in lower concentrations.
These include, the elements that predominate in their composition (silicon steels), their susceptibility to certain treatments (case hardening steels), some enhanced characteristics (stainless steels) and even according to their use (structural steels).

Procurement

Today, various metals, non-metals and metalloids that create ferroalloys, which provide hardness and strength, are included in the steelmaking technique. The process involves secondary metallurgy, which provides the desired chemical properties and level of inclusions and impurities.

The procurement process consists of several stages:

First, a mixture of iron ore (and coke) is added to the high-temperature furnace, a coal-like fuel that serves to separate impurities from the material. This leaves pure iron with small amounts of carbon. Then, with the steel in a liquid state, carbon is added in the necessary quantity. Finally, it is cast and left to cool.

Mechanical and physical properties

The mechanical and physical properties of steel can change depending on its composition and percentage of impurities.

Density	7850 kg/m³.
Melting point	1375 ºC
Boiling point	3000 °C.
Characteristics	tenacious
	ductile
	welding
	malleable
	high thermal conductivity
	contract, dilate or melt
Disadvantage	corrosion

Table 2 - Mechanical and physical properties

Classification

Steel can be classified according to:

Manufacturing method	Electrical steel
	Cast steel
	Calendered steel
	Effervescent steel
	Fritted steel
	Drawn steel

How to work it	Cast steel
	Forged steel
	Rolled steel
Its application	Construction steels
	General purpose steels
	Case-hardened steels
	Stainless and special purpose steels
	Steels for cutting and machining tools

The composition and the structure	Ordinary steels
	Alloy or special steels
The uses	Magnet or magnetic steel
	Self-hardening steel
	Construction steel
	High-speed cutting steel
	Decolletting steel
	Magnet or magnetic steel
	Cutting steel Stainless steel
	Non-deformable steel
	Stainless steel
	Tool steel
	Spring steel

Table 3 - Steel classification

Normalisation

There are systems of standards that regulate the composition of steels and the performance of steels in each country, in each steel producer and in the consumers of steels in order to standardise the different types of steel that can be produced

In Europe they are regulated by the European standard EN-10027.

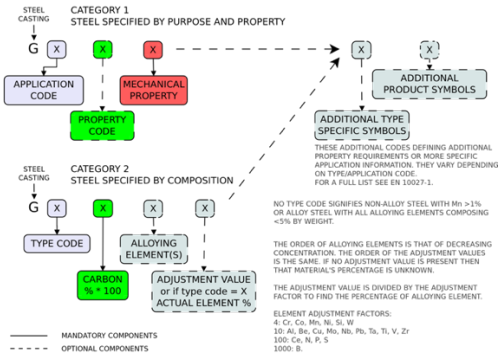


Figure 50 - Normalisation

Steel machining

Steel machining *"is the set of industrial processes carried out on a piece of raw material or semi-finished steel product, removing excess or unwanted material*

so that it acquires the final shape and size desired for manufacturing." (Planes, 2021)

Rolled steel

The rolling process is carried out in a rolling mill, also called a roller mill, in which the molten steel ingots pass through the drawing and grinding process. The molten steel ingots are preheated to a temperature that allows them to be deformed.

Figure 51 - Rolled steel

Forged steel

Forging consists of subjecting the piece of steel to pressure or impacts that modify the shape of the metal. This process is carried out at high temperatures to increase the metallurgical quality and mechanical properties of the steel.

The aim of forging is to minimise the amount of material to be removed from parts.
The process is carried out with machine tools called presses. Matrices, dies and moulds are used for this purpose.

Figure 52 - Forged steel

Steel stamping

It is a non-chipping machining process, in which the steel sheet is drawn and stamped between two dies or a press.

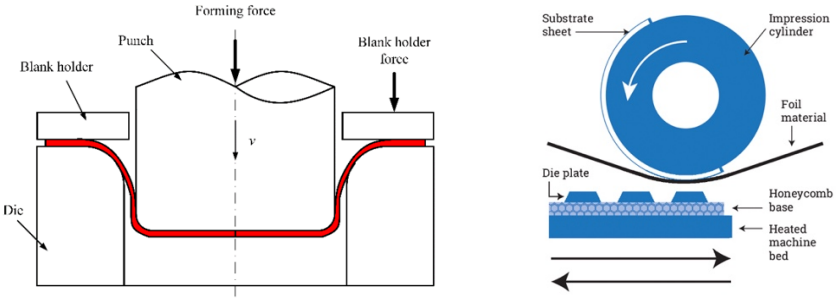


Figure 53 - Steel stamping

Steel punching

Punching consists of the perforation of a sheet of metal by a tool called a die, consisting of a punch and a die.

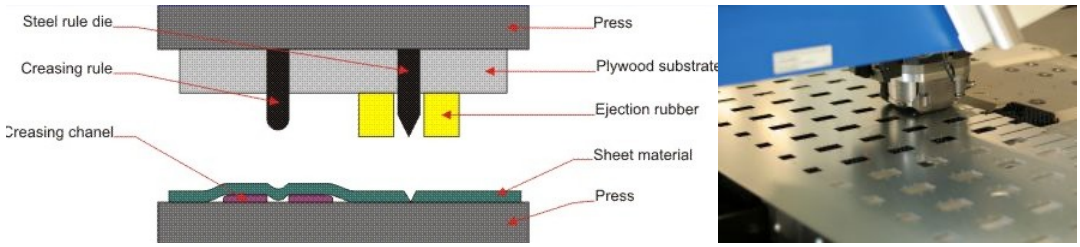


Figure 54 - Steel punching

Different operations can be carried out including: bending, punching, deep drawing, stamping, shearing, etc.

Grinding

The grinding process is carried out on a grinding machine using an abrasive tool (grinding wheel). This machining process is used in the final stage of manufacture, after turning or milling, to improve the dimensional tolerance and surface finish of the product.

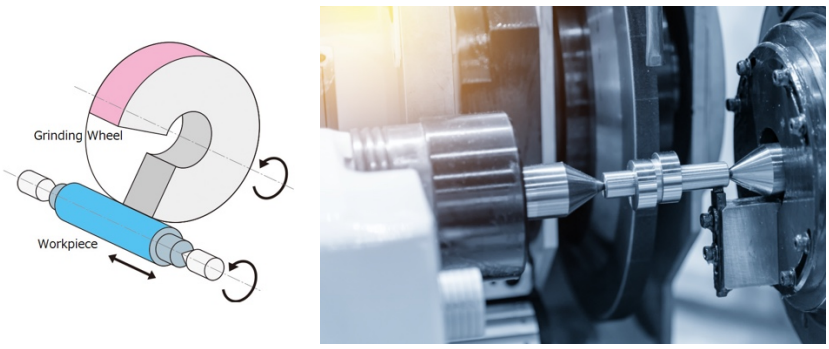


Figure 55 - Grinding

7.2.2 Polymethyl methacrylate (PMMA)

PMMA, also known as acrylic or acrylic glass, is a polymer that behaves as a thermoplastic material and belongs to the group of acrylates. It is transparent and rigid and is often used as a substitute for glass.

This polymer can be found in granules or in sheets.

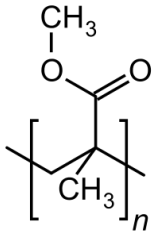


Figure 56 - Polymethyl methacrylate structure

Properties

Physical properties	
Density	1180 kg/m³
Molar mass	Various g/mol
Melting point	160ºC (320 ºF;433K)
Refractive index	1.4905 at 589.3 nm
Combustion	460ºC (860ºF; 733,15K)

Table 4 - Physical properties

- 93% transparency
- High impact resistance
- Light
- Thermal and acoustic insulation
- Ease of machining and moulding

- Wide range of thicknesses (2 mm -12 mm) and colours
- 100% recyclable

Applications

It is an easily transformable material and is used in a wide range of fields and applications, including in the automotive field for lights and instrument panels, household appliances and spectacle lenses.

PMMA in sheet form is used to develop window panels, security barriers, displays, signage, sanitary products, LCD screens, furniture and more.

7.3 Manufacturing process

For the manufacture of the auxiliary furniture, the same industrial processes will be used for all the pieces. Except for the floor support blocks.
The processes used are the following:

7.3.1 Laser cutting

Laser cutting is a thermal separation process. The laser beam strikes a localised area of the material to melt it. Once the beam has penetrated the material, the cutting process begins, in which a coaxial gas jet is used to remove the molten material. The cutting that takes place is continuous and is carried out under CNC control linked to a CAD file.

Advantages	Disadvantages
Precise and fast for singles parts	Slow process for large print runs
Hardly and clamping fixtures required	Thickness limit, (1 - 12 mm)
Applicable to many materials	Two-dimensional models only
Little post-tratment	
No cutting dies required	
Low cost per piece	

Table 5 - Advantages and disadvantages

Figure 57 - Laser cutting machine

Laser cutting is necessary for cutting metal parts and make the holes for the rivets before bending.

7.3.2 Sheet metal bending

Metal bending, also called die bending, press bending or press brake bending, is a forming process in which there is no metal removal. A plastic deformation is carried out to shape a sheet around an angle.
For this process, a press is used in which the sheet metal is first cut to the desired shape. The press has a die and a punch that presses the sheet metal. The radius and angle formed depends on the dies used, the material properties and the thickness of the material.

The pressure must exceed the elastic limit of the material to obtain a plastic deformation.

Figure 58 - Press brake

Parts of a press brake

A: Frame

B: Support system

C: Punch: moving part of the tool, which pushes the sheet against the die.

D: Die: fixed part of the bending tool. The part, on the outside, will take the shape of the die.

There are 3 types of bending:

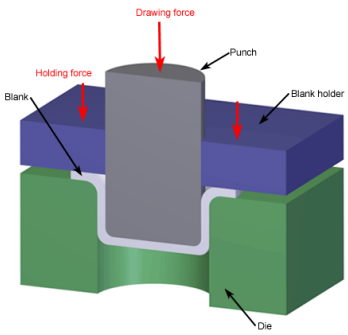


Figure 60 - U-bending

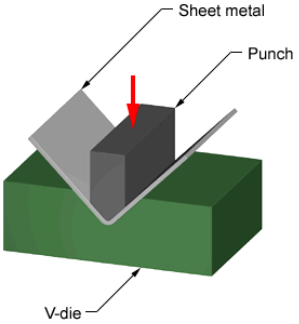


Figure 59 - V-bending

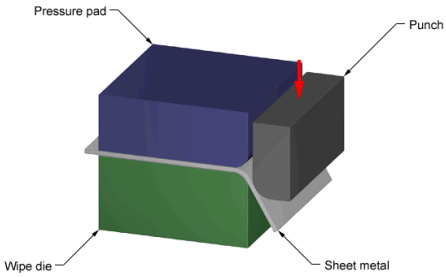


Figure 61 - L-bending

Type of folding used for each part

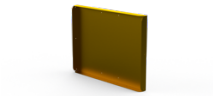
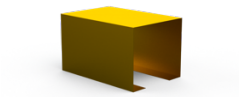
Piece	U-bending	V-bending	L-bending
			
			
			
			
			
			

Table 6 - Type of folding used for each part

All bending angles are 90°, therefore the most appropriate methods for these parts are the V-fold and L-fold.

7.3.3 Powder coating

Is a dry finishing process formed by an electrical charge that creates a dry powder to bond with the metal area.

To produce the powder, polymer granules, hardener, pigments and other powdered ingredients are first mixed in a turbomixer. The mixture is then heated in an extruder. The mixture is then smoothed, cooled and cut into shavings and finally the shavings are ground and sieved into a fine powder.

By using this process for the finishing of the parts, the following is achieved:

- a wide variety of colours,
- a corrosion protection layer

- quality finish
- more economical finishing
- thicker coatings

It is also non-toxic and less flammable than wet spray paint

7.4 Cost

RAW MATERIALS	
SHEET STEEL 1,2 MM (41,41€/m2)	156,10 €
BLIND RIVET (100 UNITS 12€) = 52 UNITS X 0,12€	6,24 €
METHACRYLATE BOARD (4 UNITS)	16,62 €
POWDER COATING	130 €
SUBTOTAL 1	**308,96 €**

MANPOWER			
ACTION	**€/HOUR**	**TIME (h)**	**€/operator**
Laser Cutting	12€/h	0,2	2,4 €
Bending	12€/h	0,283	3,4 €
Powder coating	12€/h	0,3	3,6 €
SUBTOTAL 2			**9,4 €**

SUBTOTAL 1	308,96 €
SUBTOTAL 2	9,4 €
TOTAL	**318,36 €**

Table 7 - Cost

Detailed cost can be found in point 9

7.5 Planimetry

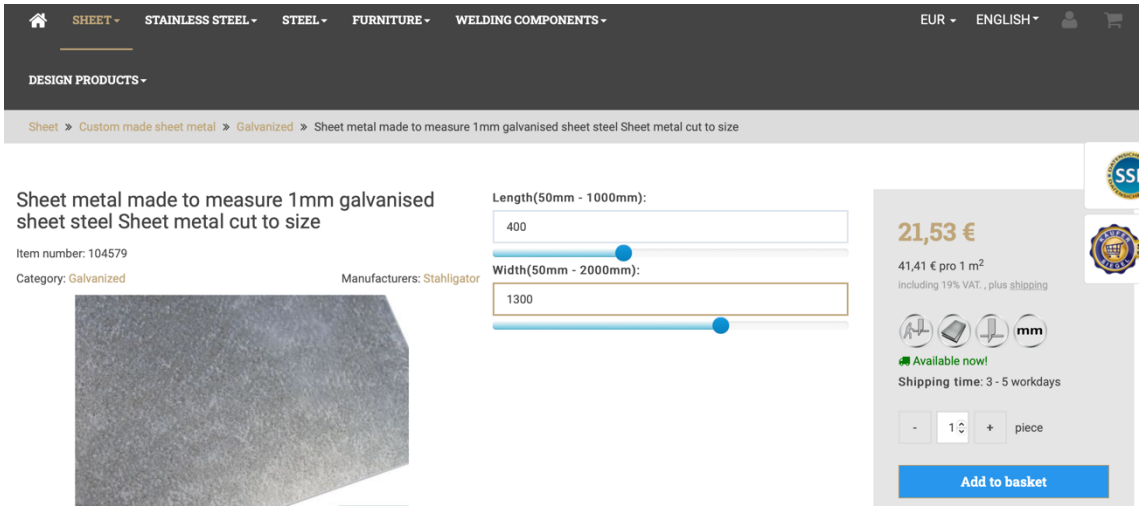
8 CONCLUSIONS

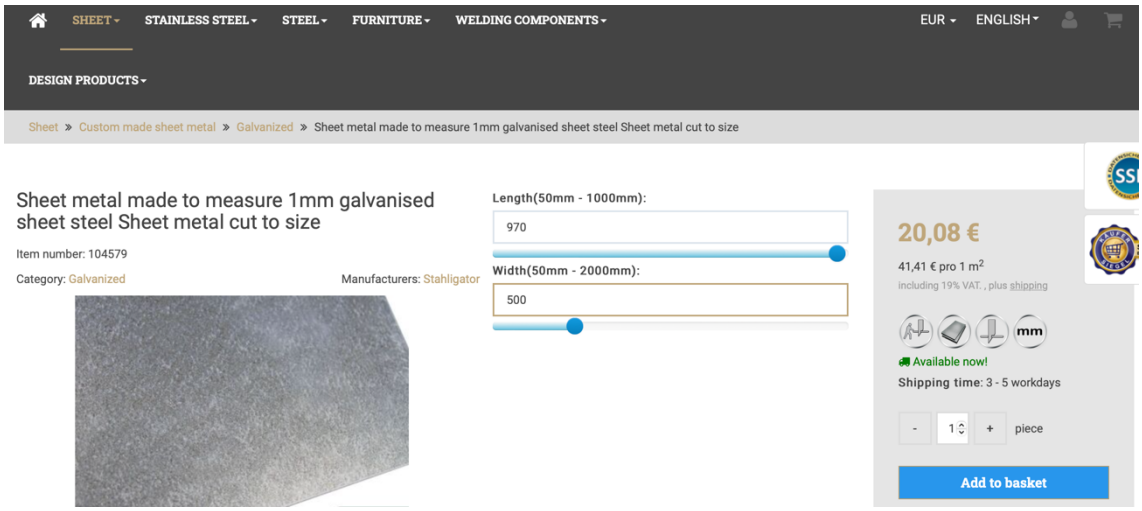
The objectives set out have been met, thus obtaining a piece of furniture that creates a space with personality, destined for record players and vinyl records. All this is thanks to the materials and manufacturing processes used, which are simple and uncomplicated processes with which different high quality finishes can be achieved.

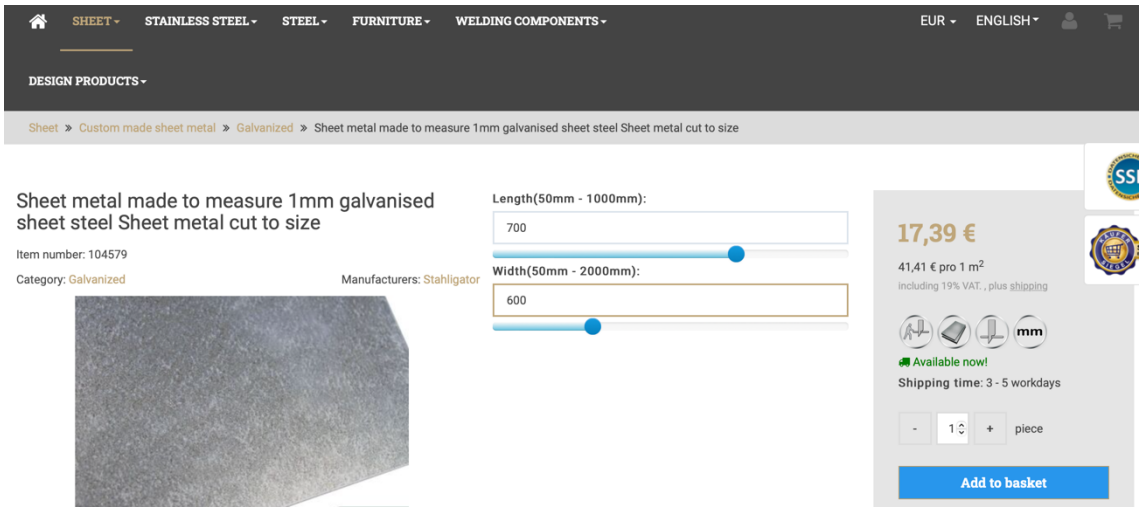
9 ANNEXES

9.1 Costs

STEEL SHEET



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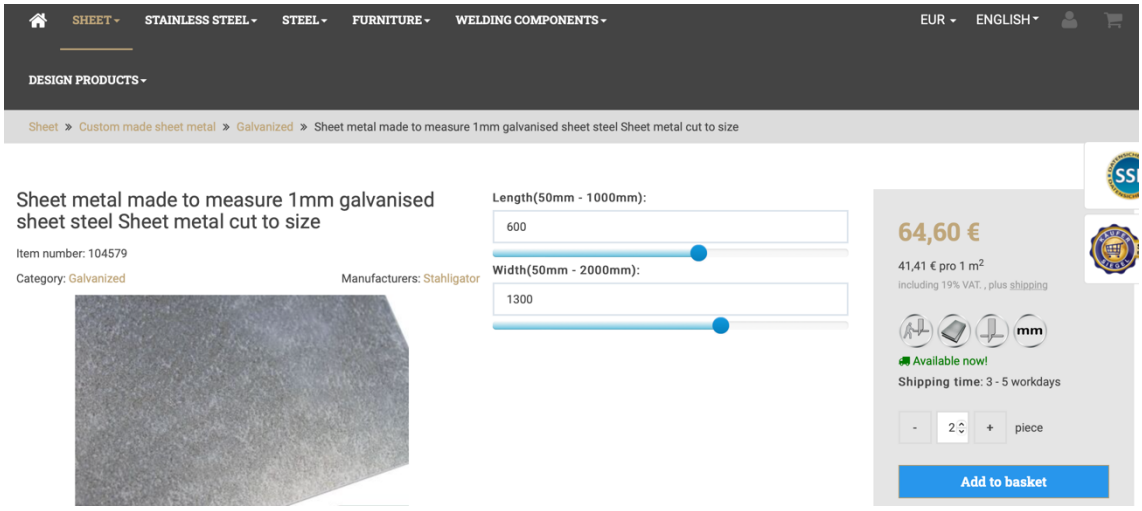
STAINLESS STEEL
STEEL
FURNITURE
WELDING COMPONENTS
EUR
ENGLISH
DESIGN PRODUCTS
Sheet » Custom made sheet metal » Galvanized » Sheet metal made to measure 1mm galvanised sheet steel Sheet metal cut to size
Sheet metal made to measure 1mm galvanised sheet steel Sheet metal cut to size
Item number: 104579
Category: Galvanized
Manufacturers: Stahligator
Length(50mm - 1000mm):
700
Width(50mm - 2000mm):
600
17,39 €
41,41 € pro 1 m2
including 19% VAT. , plus shipping
mm
Available now!
Shipping time: 3 - 5 workdays
1
piece
Add to basket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Sheet metal made to measure 1mm galvanised sheet steel Sheet metal cut to size
Item number: 104579
Category: Galvanized
Manufacturers: Stahligator
Length(50mm - 1000mm):
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Width(50mm - 2000mm):
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64,60 €
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including 19% VAT. , plus shipping
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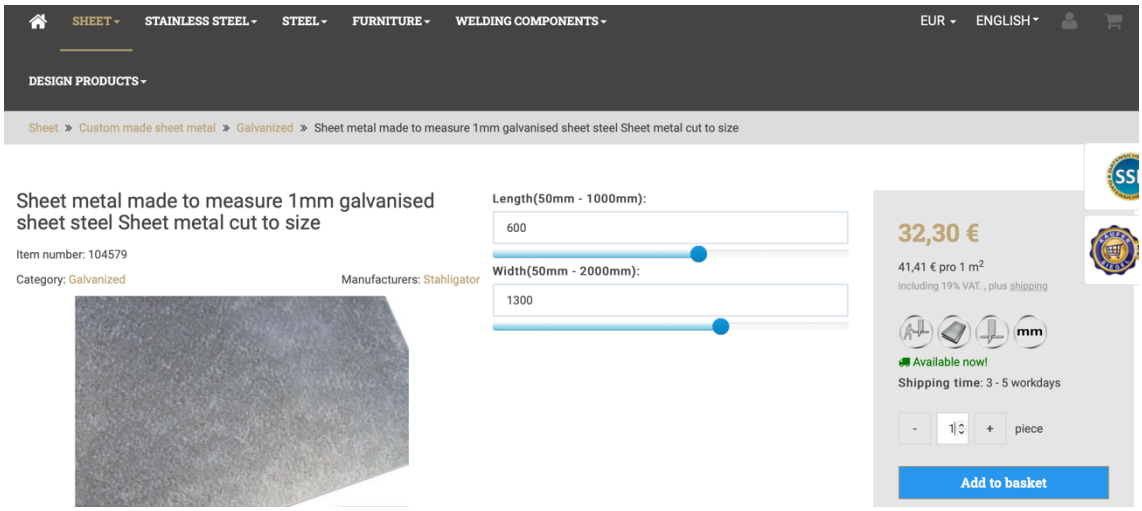
Available now!
Shipping time: 3 - 5 workdays
2
piece
Add to basket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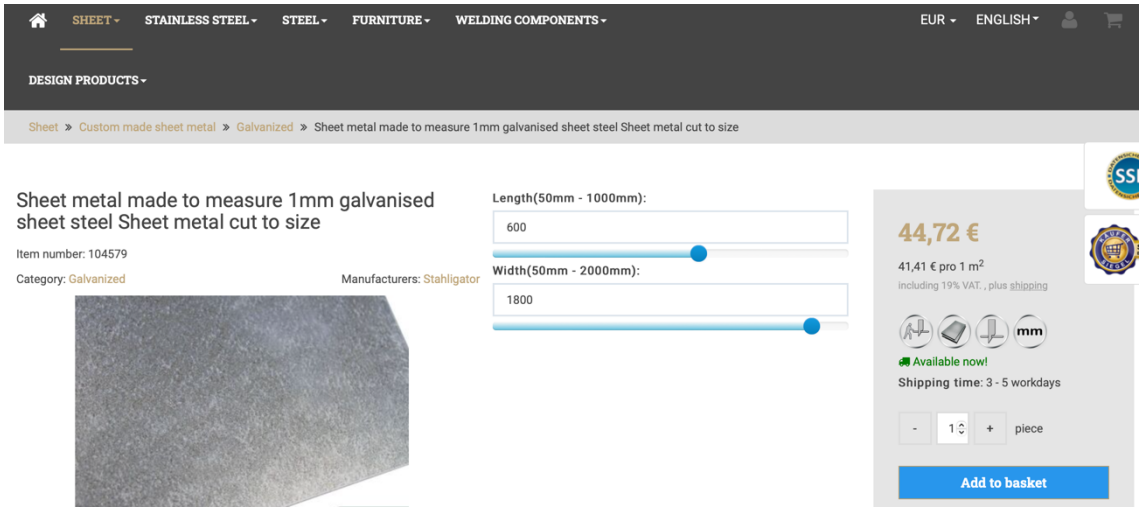
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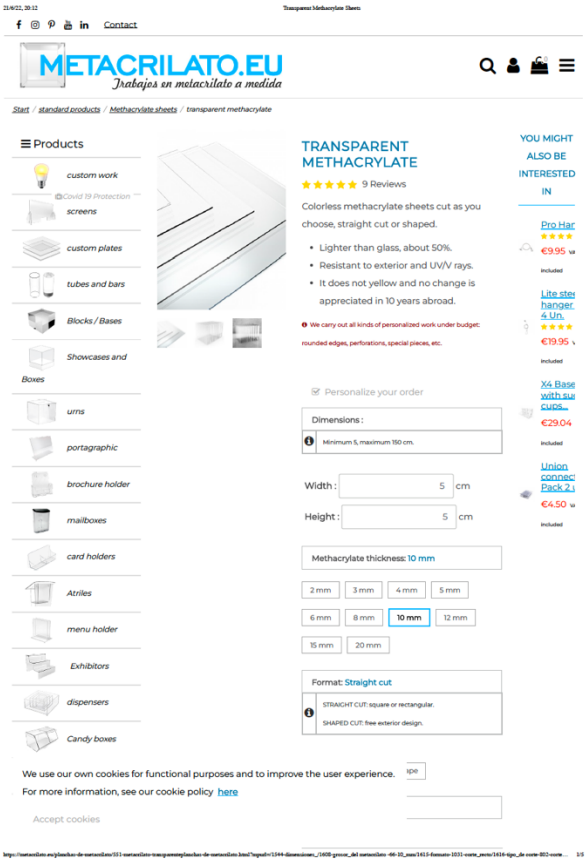
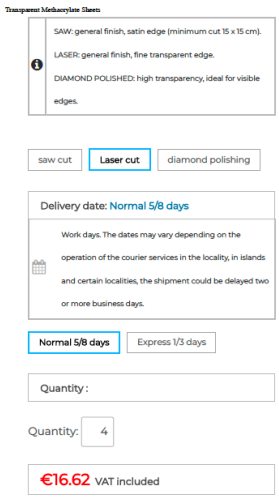
Sheet metal made to measure 1mm galvanised sheet steel Sheet metal cut to size
Item number: 104579
Category: Galvanized
Manufacturers: Stahligator
Length(50mm - 1000mm):
600
Width(50mm - 2000mm):
1800
44,72 €
41,41 € pro 1 m²
including 19% VAT. , plus shipping
mm
Available now!
Shipping time: 3 - 5 workdays
piece
Add to basket

METHACRYLATE BOARD





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