EDEXCEL

GCE Design and Technology: Resistant Materials (AS)

EXEMPLAR MATERIAL 2

UNIT: 6RM01

T4

Photographic evidence for the Product Manufacture section

(A maximum of three photographs must be submitted)

Please refer to the instructions on page 2.

Contents Page

Section 1

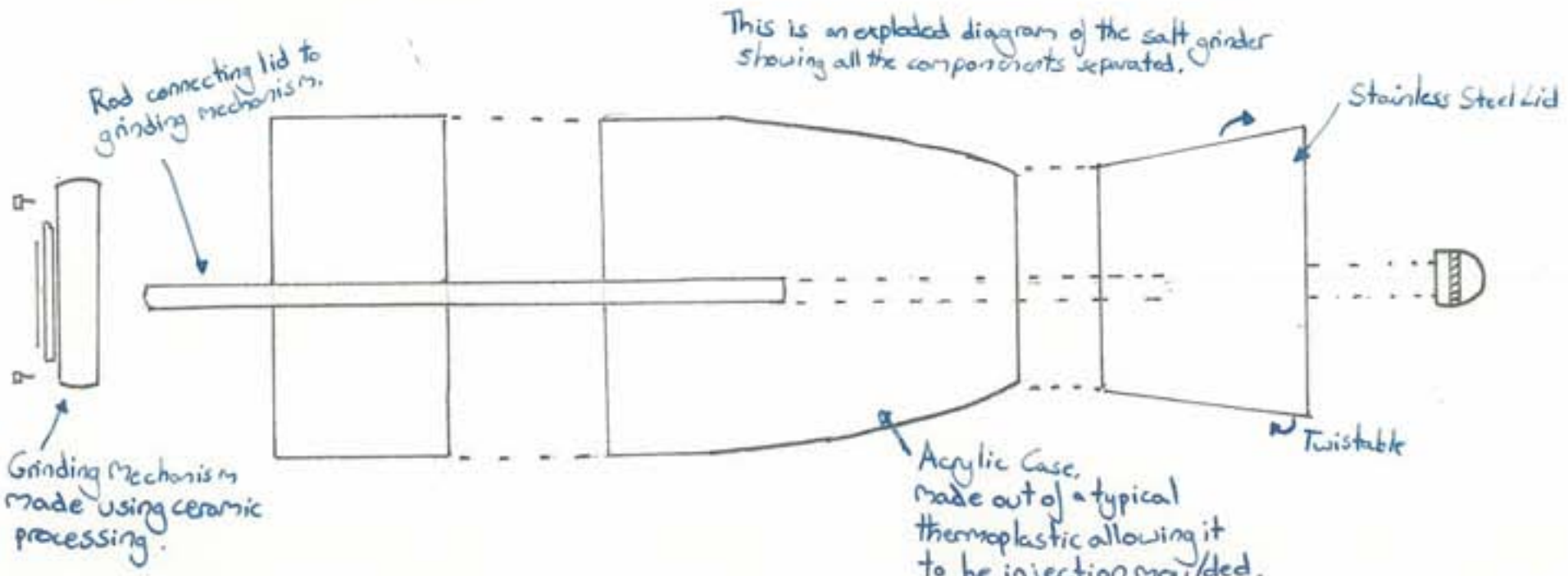
Product Study

This is my primary CAD work done on Sketch Up.

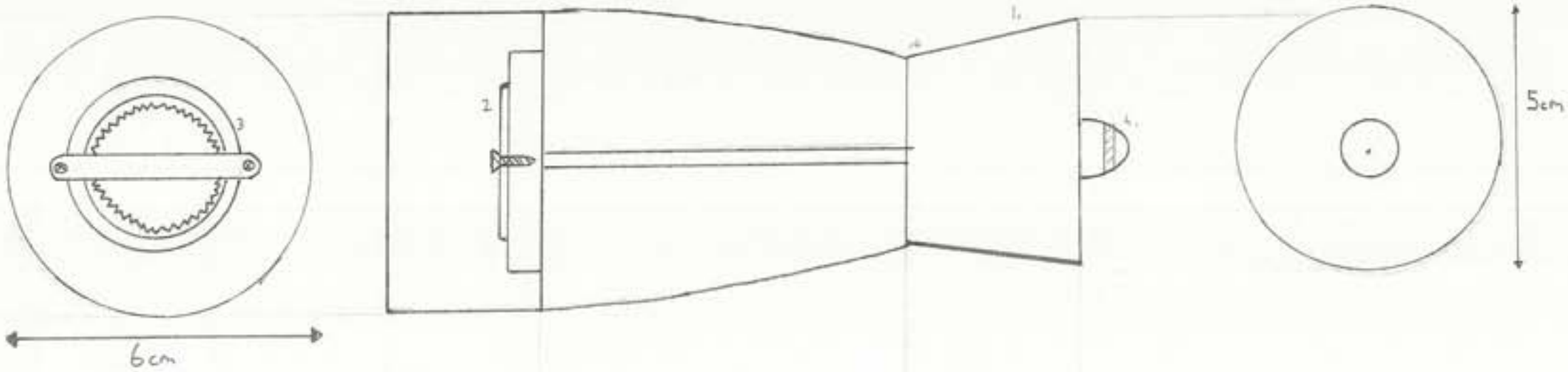
This is a picture of me using the salt grinder. As you can see two hands are needed when grinding however it is easily ground and therefore works correctly. The shape is ergonomically pleasing as it fits in my hand correctly.

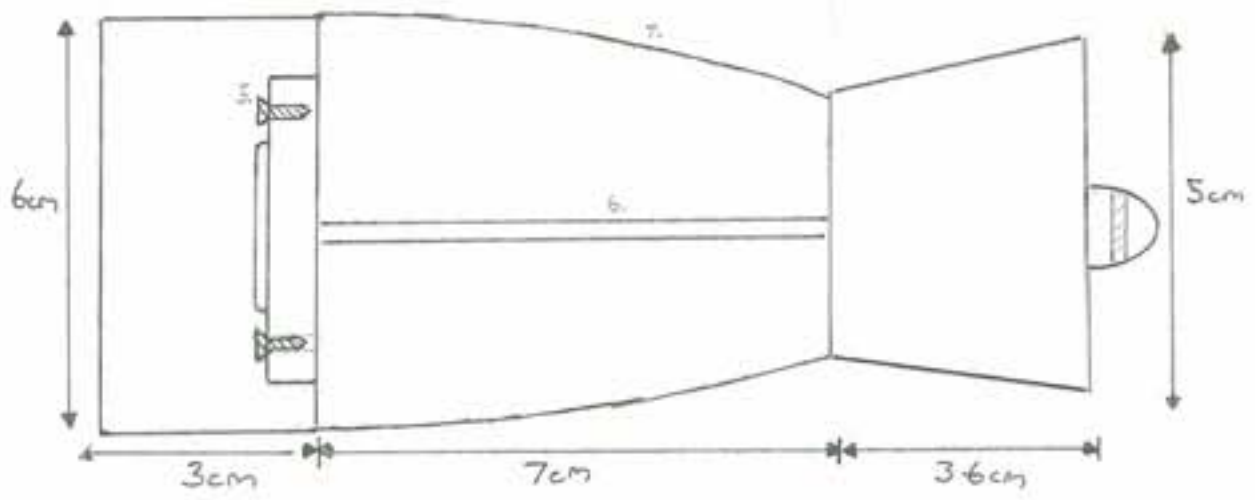
Below is an exploded diagram or the salt grinder.

This section focuses on the salt grinder pictured above. As you can see from the exploded diagram there are numerous, simple, components making up the salt grinder.



Orthographic Drawing





1. Stainless Steel Lid
2. Overview of ceramic grinder.
3. Underview of ceramic grinder
4. Stainless Steel ball holding components in.
5. Screws, made from mild steel
6. Bar down center activating grinder.
7. Acrylic Casing.

Product Name: Morrisons Salt Grinder	Your Name:	Scale: 1:1	

Performance Analysis

Designers Intent: This product was designed by Morrison's supermarket and was a salt grinder combined with a similar pepper grinder. I am going to focus on the stylish salt grinder which was designed in order to fit into the palm of the user easily and also to be used at any meal time or place and not stand out ridiculously. To be a modern, stylish salt pot to be used in all surroundings of meal times.

Cost & Scale of Production

£4.99 / salt grinder

The cost of this product is relatively cheap as it is made out of materials which are easily accessible to the manufacturer and it is also made on a mass production scale and therefore the more produced the cheaper it gets. All process in the manufacturer can be done quickly and assembled easily. The price is the average price for similar products on the internet.

Form + Aesthetics- This grinder is 140mm tall and is aesthetically pleasing to the user with its looks as it is sleek, simple & stylish and can suit most surrounding areas. It also has been designed so the user can hold the product in the palm of his hand and grinding the top forcing the salt to come out. Therefore there are a few user requirements necessary for this product such as it must fit into the palm of the user, not be too wide for the users palm and it must also have nice smooth feel for the user. The user may also want the product to look nice and this means the form must be good so that it meets the requirements.

Function- Another bonus of having such a hardwearing material is that in a domestic situation glass objects sometime get dropped and break whereas this will not break as Acrylic plastic is durable. Stainless Steel on the other hand makes it more attractive to the user and it also a very good product as it is very durable, tough and will not corrode in its environment

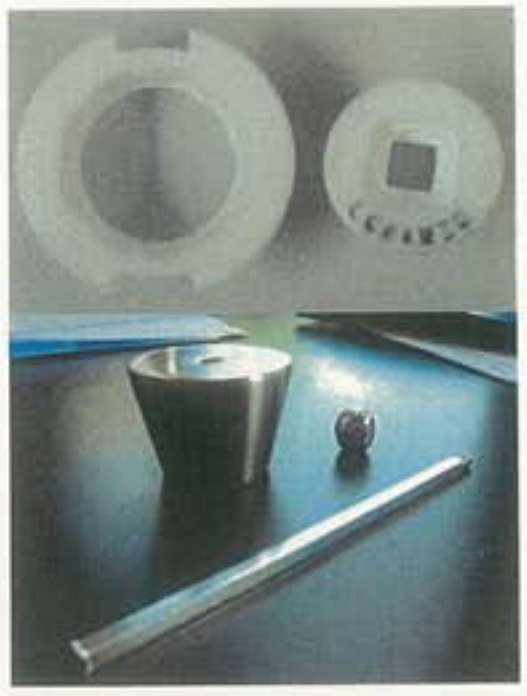
There are gears inside the mould which when the top section is turned by the user the grinders spin taking in the rock salts and turning them into finer salt particles.

Materials-

Acrylic- Acrylic is a useful, clear plastic that resembles glass, but has properties that make it superior to glass in many ways. There are two basic types of acrylic: extruded and cell cast. Extruded or "continuous cast" acrylic is made by a less expensive process, is softer, can scratch easier and may contain impurities. Cell cast acrylic is a higher quality acrylic and is less easily scratched and has been moulded. It is chosen over glass for many reasons. This is many times stronger than glass, making it much more impact resistant and therefore safer.

Stainless Steel- Stainless steel is defined as a steel alloy with a minimum of 11.5% chromium content by mass. Stainless steel does not stain, corrode or rust as easily as ordinary steel. Stainless steel's resistance to corrosion and staining, low maintenance and its relative inexpensive makes it an ideal base material for a host of commercial applications especially for kitchen based products such as this. It is hard to work as a material (not cheap)

Performance- The product has to be tough in order to support the force of the user grinding the salt rocks and therefore it needs to have a rigid structure so it doesn't collapse under the pressure. The product was quite stiff to turn which made it hard for me (the user) to turn the salt grinder and therefore it took a while for the salt to come out. However, the product is aesthetically pleasing as it fits well in a kitchen/dinner environment and ergonomically it fits in the palm of the hand well. The product does do its job and provides a satisfactory mechanism for adding salt to your food and therefore performs well. Overall I felt this product does a good job and I , the user, and happy with how it has worked out.



This is the grinding mechanism and is made out of two ceramic pieces along with a few stainless steel pieces. This is the main weight of the product and has to be very hard/tough in order to put enough force on the small salt rocks to make them small enough for food etc. As I took the salt grinder apart I dissembled the grinding mechanism and found these pieces were the main structural pieces. The long metal rod is connected between the ceramic grinders and the stainless steel lid which in turn grinds down the salt. The long stainless steel component is the main piece in the grinder and is screwed into place with the tiny ball.

Comparison on similiar product

	Morrison's Salt Grinder	Chef'n salt ball/pepper ball sold by Tesco Direct	Advantages/ Disadvantages
COST	£4.99	£12.99, however you get a salt and pepper rather that just salt.	You get slightly more for your money with the Morrison's design.
MATERIALS	Acrylic, Stainless Steel and a tiny bit of Ceramic for the grinder.	Acrylic with a zinc alloy grind plate	Both production manufactures are similar and therefore cost around the same to produce.
PERFORMANCE	Grinds the salt rocks into fine salt particles easily and is made to withstand force such as being dropped onto the floor as it is made of Acrylic.	These attractive salt and pepper mills are fully adjustable with a fine and coarse grind setting, have a one hand operation making it easier for the user as the crushing mechanism is less forceful.	
BENEFITS	Cheap, Thin, Refillable, Stylish modern look	Tad more expensive, rounded look, fun to use and refillable.	The comparison has the added advantage of having a unique method of crushing and can be sue din one hand making it more fun.
PRODUCTION	Injection moulding casing and electric arc furnace for production of stainless steel	Injection Moulded casing	As the Chef''n Salt grinder is produced purely using injection moulding it is cheaper to make and therefore provides greater profit per pot sold.

Benefits of the Salt'n Pepper Balls: The grinders are designed for each spice. For example the grinding mechanisms for the salt and pepper complement each spice. Salt requires a relatively soft tool for grinding, so ceramic blades are used. Peppercorns are harder than salt and need sharp blades to grind them, so zinc rasps are used in the grinding of pepper. A single bonus of having a one handed grinder is that if your other hand is wet or if you're using it to stir a pot of sauce then you can still add flavouring. The designer even thought about the handles by providing soft ergonomic spongy handles. When it's time to grind, you have to squeeze the spring-loaded handles in order to produce small pepper/salt granules. However, If you need to adjust the coarseness of your grounded substance you can flip the Ball Grinder over and set the grind-tune lever to one of five different settings which helps the user as people like different levels. The ball has a sliding door on the side in case the pepper balls run out and the ball needs refilling.

Manufacture: Injection moulding is a very cheap process and therefore keeps cost down however the production of the grinding mechanisms is more expensive which is why costs are more for the Tesco's product as it has to produce two mechanisms and two cases and so on, pushing costs up ever so slightly. Both products are mass produced as it is cheaper this way which benefits the customer.

Form of Tesco's Direct salt/pepper balls: These balls are aesthetically pleasing for the user as they have a modern look which could suit any house, especially if you are going for the funky look as they are different to your usual salt/pepper grinders e.g. the Morrison's one.

Function of Tesco's Direct salt/pepper balls – These are ergonomically pleasing as they can be used with one hand making it a lot easier for the user and therefore saving time/effort and allows for a better grip when giving added flavour to your food.

The gears in the balls use the pressure your hand applies and grinds the pepper/salt granules into finer particles and filters them out the bottom. As the case with the Morrison's salt grinder, both are refillable and therefore only need to be used once therefore saving costs for the user and producing less waste as the user does not need to throw it away after use, making it more environmentally friendly then a possible disposable one.

Overall Comparison: The Morrison's Grinder is slightly bigger in size and therefore has the potential to be less comfortable as well as the fact that the Chef'n salt grinder can be used one handed and is therefore easier to use when preparing food and multi-tasking. I feel that although being more expensive the Chef'nSalt grinders are made up of a more interesting design and are more unique with there size and way of use therefore being my preference.

V.S

£4.99 salt pot from Morrison's.

£12.99 from Tesco Direct

Materials and Components Analysis- Morrisons Salt Grinder

	Where can it be found on the product?	What process has been used to produce it?
Stainless Steel	The twisting top connected via a steel pole down to the grinding mechanism. It can also be found as a tiny ball that screws the steel rod into place so it doesn't slide out.	Blast Furnace and then sorted out and made into correct shapes.
Ceramic	In the grinding mechanism.	Granulate pressing
Acrylic	The overall plastic casing.	Injection Moulding.

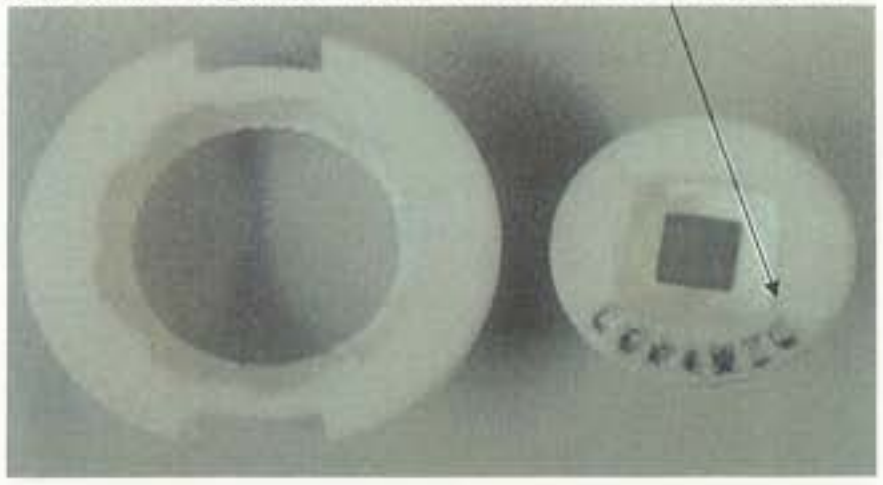
Ceramic

Properties: Ceramic materials are hard, porous, and brittle.

Produced how? The ceramic grinder is produced using Granulate pressing. As the name suggests, this is the operation of shaping pottery by pressing clay in a semi-dry and granulated condition in a mould. The clay is pressed into the mould by a porous die through which water is pumped at high pressure. The granulated clay is prepared by spray-drying to produce a fine and free flowing material. Granulate pressing, also known as dust pressing, is widely used in the manufacture of ceramic tiles and ceramic objects such as the grinder in my salt pot.

Environmental Impacts: Ceramic's are long lasting and therefore don't need to be replaced and they can be re-formed and recycled to be used again.

The name on the grinder shows me how it is a ceramic piece.



Acrylic

Materials used: The most common Acrylic plastic is PMMA (**polymethyl methacrylate**). PMMA is a tough, highly transparent material with excellent resistance to UV radiation and weathering. PMMA is highly recyclable and therefore environmentally friendly which is an added bonus. PMMA has easy handling and processing, and low cost therefore a good casing plastic as it can also be injection moulded.

General Info: The acrylic in this instance is used for the casing of the overall salt grinder. As you can see in the picture below it is a one process case and won't take very long to make. Acrylic is often used as a glass substitute as it is safer for the user as it does not damage as easily which is a good bonus especially as it is used in food environments. It can be coloured, moulded, cut, drilled, and formed. In this case it is moulded into shape specifically for this purpose. In this product I can see why this material was chosen because it is clear material allowing the user to see the salt and check levels of salt. The acrylic is also used because it is a replacement for glass as it is safer to use in a kitchen environment and finally the plastic is not poisonous and therefore cannot effect the user.

Properties: The words hardness, toughness, and strength have very specific meanings. Toughness is defined as the ability of this material to absorb energy and stand strong. The toughness of a product, in this case the casing, is characterized by impact strength and is only partly dependent on the material. However, other contributing factors include: wall thickness and how the component is moulded. In this case the wall is thick and the case is injection moulded making the casing of the salt grinder very tough, an ideal quality in this case.

Acrylic casing when disassembled showing it is a one piece structure.

Acrylic is a good thing to use in this case as it is much more hardwearing than glass and is also lighter to use and easier to mould into shape and therefore a better material to use for the overall casing.

Materials and Components Analysis-Cont...

Stainless Steel

'Stainless' was adopted as a generic name for these steels and now the title Stainless steels is now used for iron alloys with a minimum of 10.5% chromium.

How are they enhanced to make them better to other metals:
Other alloying elements are added to their structure to increase formability, strength and toughness. These include metals such as: Nickel. Non-Metal additions are also made, the main ones being: Carbon and Nitrogen

Main Requirement: It should be corrosion resistant for a specified application or environment. The selection of a particular "type" and "grade" of stainless steel must initially meet the corrosion resistance requirements. Additional mechanical or physical properties may also need to be considered to achieve the overall service performance requirements. In this case the Stainless steel must be cleanable, rigid and tough incase of being dropped because it is to be used in catering environments.

Stainless steel is one of the only hard, rigid materials that could be used in this instance as it is shiny (therefore aesthetically pleasing) and it is also capable of withstanding force when being twisted and turned insitue with the ceramic grinding mechanism.

Finally, Stainless steel was also chosen over any other metal because it is easier to clean and therefore better to use in a cooking environments it is more hygienic.

More on 'Manufacture.. Page.'

Alternative Material's: Instead of a ceramic grinding mechanism zinc rasps could be used, however these are predominantly used for grinding pepper rather than salt and are therefore more expensive to make. This would effect performance by giving a more coarse substance but is unnecessary for this example.

Instead of acrylic other thermoplastics could be used but we would have to ensure that these are also recyclable as if not then the environment is effected in its production and destruction and therefore if it is recyclable it can be used again. There are many plastic out on the market and some of these are more suited in terms of recycling however they may not give the same aesthetic form and may lead to a poorer quality product.

Instead of Stainless Steel copper could have been used. Although more expensive in the long run copper has been proved to kill off all bacterial virus that can survive in food environment and therefore having a copper grinding mechanism would mean a safer food environment as the risk of germs and bacteria has been eliminated. However, it does not react well with water and is susceptible to corrosion.

Why do we want the materials to be recyclable?

Recycling materials reduces the need to dig up or mine new raw materials, which often damage the surrounding environment. It is important to make use of materials like plastics that can be recycled and re-used, rather than continually exploiting the fossil fuels used to make them in the first place.

It is even possible to recycle stainless steel! However, this process can be expensive and is not yet ready to your everyday household it is possible and one day hopefully this entire product will be recyclable. The product it self is about 70% recyclable as the plastic can be re-used and this covers about 70% of the overall product.

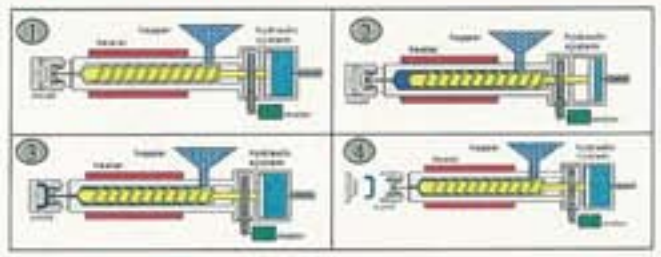
Possible impacts on the environment of this product?

In today's world it is sometimes easier to buy the product again then to repair the product if broken. This means that if the grinder was to break then the user would go buy a new one and throw the other one away, unfortunately if this is to be the case then excess waste is produced and this is bad for the environment. Therefore it is key that recycle plants are used when disposal is necessary and fortunately in this case the product is recyclable.

However in the manufacture many of the machinery when used in mass production gives off greenhouse gases which are un-environmentally friendly to the environment contributing to factors such as global warming.

Manufacture

Injection Moulding



The acrylic casing would have been injection moulded. The process involves a screw being forced back as the melted plastic collects at the end of a barrel, a consistent and steady pressure is applied forcing the plastic through into the desired mould, this technique generally increasing the quality of the finished product. This would be important as the acrylic casing would be mass produced making it even more important to maintain quality throughout so many products.

The mould in this case will be of the outside casing of the salt grinder. Although making the moulds is expensive once made the overall process is very cheap and as it is a highly automated production process it will require less skilled workers to maintain the production line therefore keeping production costs down for Morrisons.

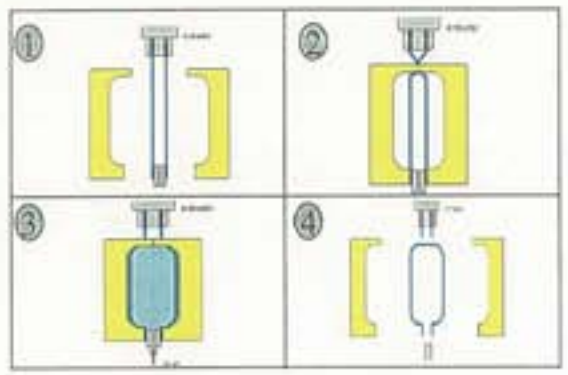
Cons- The machinery is very expensive along with the main mould and therefore it is only good when doing mass or batch production.

Pros- Cheap after the mould has been produced. Quick to manufacture the case. It is a very precise process ensuring each case is the same.

This is one of the main processes in the production of this salt grinder along with the production of the stainless steel.

An alternative- Blow Moulding

What is it? Blow moulding could have been used to make the acrylic casing as the process would give the same overall effect. Although generally blow would use plastics like polythene, PVC and polypropylene. The process would be good at producing lightweight , hollow parts from thermoplastic materials. Although a different type of process to injection moulding the results could be similar and therefore can be used in this production.



Manufacturing Process: This process is mass produced, this is when hundreds of identical products are made usually on a production line. Mass production is the creation of many products in a short period of time using time-saving techniques such as assembly lines and specialisation. It allows a manufacturer to produce more per worker-hour, and to lower the labour cost of the end product. This in turn allows the product to be sold for a lower cost.

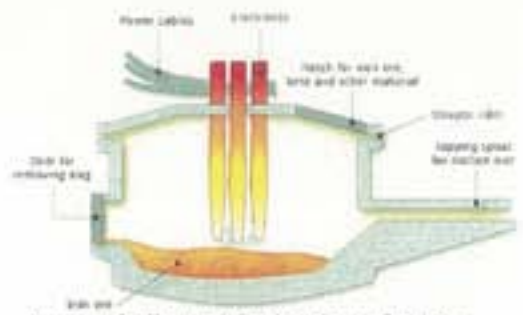
Manufacture..

Stainless Steel:

How is it made?

Stainless steel itself is made in an electric arc furnace. Within the furnace, carbon electrodes are positioned to make contact with scraps of steel and they blast currents through them. The scraps of steel do not only have to be mixed with chromium other elements can be added to enhance the properties of stainless steel, such as nickel and nitrogen. This takes place at a very high temperature.

This make the steel less likely to stain and aesthetically more attractive. As the salt grinder is in a hygienic environment it is important for the product to be easy to clean and non corrosive so it does not harm or pollute the users food. A downfall of this material is that it is hard to cut and shape therefore a simplistic design has been used on this product to make it easier to produce

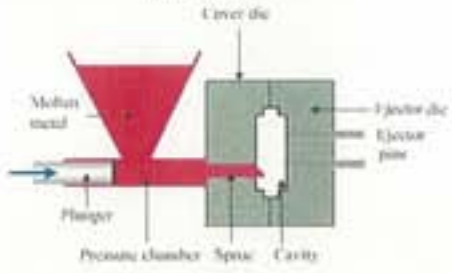


An example diagram of a **electric arc furnace**.

Environmental Impacts? As you can see in the early pages having a product that is environmentally friendly is key to creating a good product and as you can see this product has been created around recyclable materials and eco-friendly techniques where possible. However, when manufacturing stainless steel poisonous gases such as carbon monoxide are given off along with CCF gases which contribute heavily to global warming. Creating a product using injection moulding can produce gases from the melting of the product and therefore a vacuum is used in industry.

What is die-casting? Die casting is the process of forcing molten metal under high pressure into mould cavities. The die casting method is especially suited for applications where a large quantity of small to medium sized parts are needed with good detail, a fine surface quality and exact dimensions are needed. In this case the stainless steel would have been die cast to form the shape of the top of the grinder.

Die casting



Quality Analysis

To achieve quality control- You should probably have a magnifying glass to check for cracks and imperfections. This job has to be done by hand and therefore is a) very expensive and b) time consuming which means the manufacturer will take random samples along the production line to ensure quality is carried out throughout the whole product. There is really only one way to achieve full quality checks and that is to do it by eye and feel one by one.

The kite mark and CE mark show that the manufacturers have satisfied the most rigorous of quality processes. This is put on a product to reassure the customers it has been checked thoroughly.

Quality checks must be carried out by a human inspector however unfortunately these inspections cannot be 100% reliable. Most inspection relies on the human judgment of the inspector and human judgment can be affected by many factors some of which are outside our control such as the private life, health or mood of the inspector.

Testing is an important part of the manufacture and can take place any time during production e.g. in this product it would be necessary to check the components fit correctly so that it meets the standards the user is looking for along with checking the acrylic casing is smooth so it is nice for the holder to handle.

Quality Standards: The ISO 9000 is an award given to firms that can demonstrate that they have a quality assurance system in place which allows for quality to be regularly measured and for corrective action to be taken if quality falls below these levels. It is an indication that a business relevant targets set and activities to deal with a quality problem.

In this product to ensure the hole in the stainless steel top in exactly the same place each time a hole is punched using a jig will be used to ensure each hole is in exactly in the same place each time it is created to ensure no faults are in the product.

This is the punched hole created using a jig.

Jig Drilling

CE

These are the typical symbols on a product to show it has had a quality assurance analysis. However in my salt grinder these symbols are not needed on the product however on the box it proved the product has been checked and was suitable to be used by young children, however under 3's are not allowed to use it due to small parts.

Quality Control- This is about ensuring products are manufactured to meet a high standard. Once the Grinder has been made for example, you start carrying out quality control on it. This is an inspection of the casing looking for cracks in the casing, missing parts and any other defaults that may occur and overall making sure that the product (salt grinder) is ready to be sold to the customer.

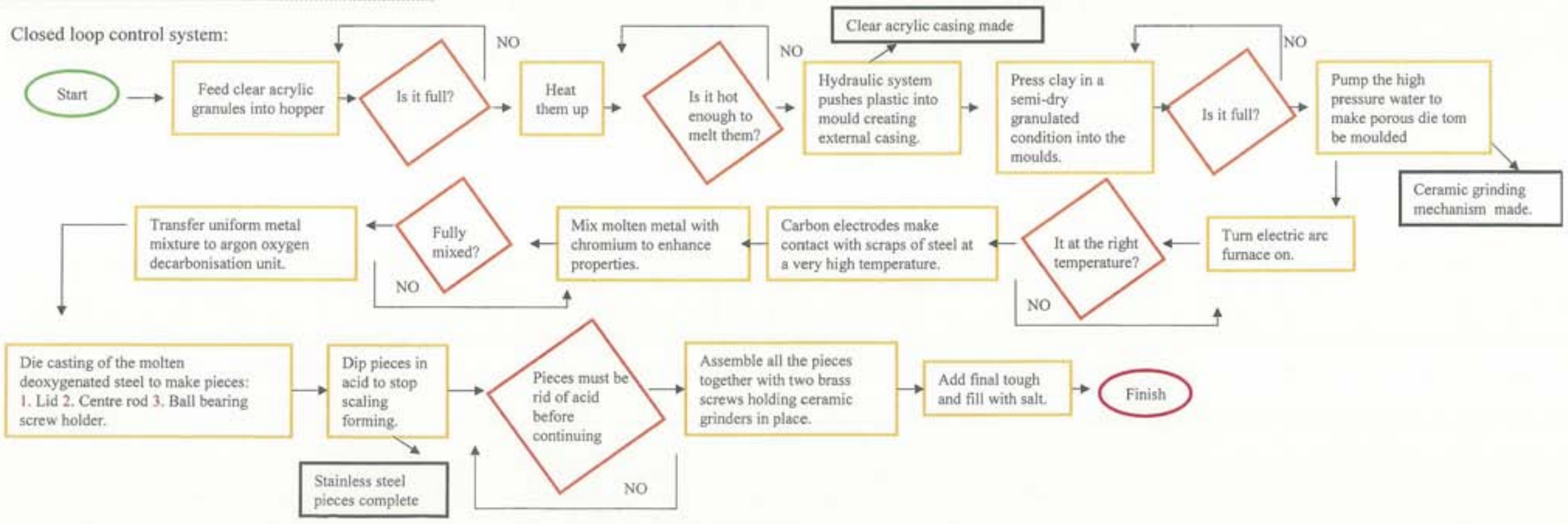
Quality control can also be used on the casing to ensure that the stainless steel lid fits correctly and to check if there are any unfinished/sharp edges.

VS

Quality Assurance- Quality assurance checks the systems that are used to make the product before, during and after manufacture. In the major industries factors such as equipment, materials, processes and staff training need to be constantly monitored. The customer is very important in the quality assurance stage. Two key principles characterise quality assurance: a) "fit for purpose" (the product should be suitable for the intended purpose) and b) it must be "right first time" (mistakes should be eliminated).

Whereas Quality Control emphasises testing and blocking the release of defective products, Quality Assurance is about improving and stabilizing production and associated processes to avoid or at least minimize issues that led to the defects in the first place.

Closed loop control system:



Section 2

Design Brief

Storage and Display of an Apple Storage System

- Lighting
  - Mains or battery?
    - Battery needed if portable.
    - Battery is a hassle to change
    - Mains is more reliable?
    - both?
  - How can I make it lighter?
    - Lighter wood
    - Less components inside
  - May be to heavy..
    - As a briefcase
      - Drawer used for travel?
  - Used
    - Office?
    - Bedroom?
    - Security?
  - Colour?
    - Standard
    - NEON
  - Fitted?
    - Moveable?
  - Desk lamp if creating a desk
  - Will it light up the storage box when opened?
  - How?
    - What type of switch will be needed?
- Materials
  - Wood
    - Pine
      - Good material for a finger jointed box
    - MDF
      - Possibly veneered for curve?
    - Plywood
    - Chipwood
    - Not very good for manufacturing
  - Plastics
    - PVC
    - Acrylic
    - ABS
    - All could be used for various processes
  - Metal
    - Mild steel for framework or runners on a chest of drawers
  - Colour?
    - White
    - Black
- Design
  - Desk?
    - Modern metal/tempered glass
  - Standard chest, maybe bedside table
    - 3 drawers?
    - 2 drawers?
    - Which is most beneficial to design?
  - Apple logo chest or similar?
    - Light incorporated?
- Safety
  - Quality Assurance system in place?
  - Clean surface
  - Hygeine
  - Is there a slow closing mechanism to stop trapped fingers?
  - Weight
  - Electrical wiring
    - Checked by who?
      - Teacher
      - Me
      - Another student
  - Clothes
  - What to store?
    - If desk.. any other drawers?
      - Sports Equipment
      - Books
      - CD's
    - Various things apple related
      - Chargers
      - Laptop
      - iPod
      - Headphones
- If not a drawer inside a desk how can I store the products?
  - Strength is vital!
  - Single light draw
    - Briefcase
      - light
      - Bulky
    - May get in the way
  - Specialised Table?
    - Embedded areas in the table top.
  - Necessary to have space for all?
    - Weight problems?
    - Possible to only have essentials
      - Laptop
      - iPod

Design an apple storage system to be used by certain apple products it is to be as a portable draw/briefcase than can be transported when moving or travelling and keep products safe, however due to its bulk it is mainly to be used as a tidy away compartment for cables so you can access them easily and in general stay neat.

Criteria:
1. Be portable
2. Able to tidy products into case.
3. Able to fit into an integrated desk/bedside table.
4. Store some of the following: iPod, Mac, chargers, headphones etc.
5. Have the trademark 'apple' logo.
6. Product to have no sharp edges.
7. Must link with the modern/futuristic look of apple products.
8. Strong case so can be knocked around.

Initial Ideas

This page is based on the windows logo rather than the intended apple logo.

Mild steel supports made on the centre lathe. The mild steel will be galvanised and powder dipped to finish.

Wheels are on mild steel poles for easy moving.

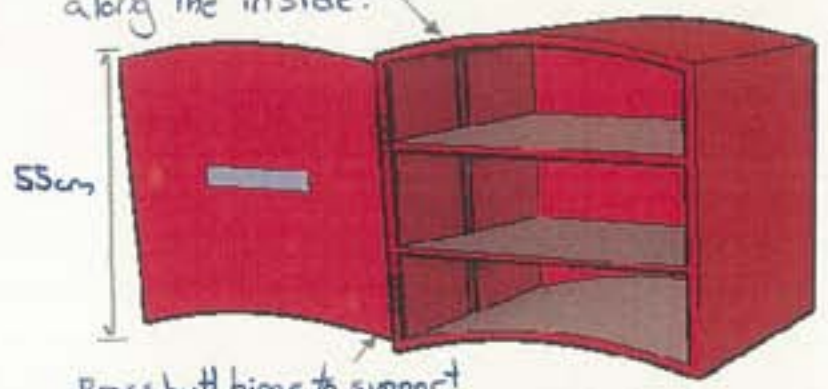
Curves could be created using laminated veneer. Whilst the support legs will be mild steel.

Open area for books, clothes etc to be stored on shelves

This design shows how the shape of windows logo's can be used in a different scenario and in this case they are building up the basis of the desk along with room for a laptop.

Non structural supports for shelves. The clips allow it to be placed at any height along the inside.

Lap joint or possible biscuit joint?



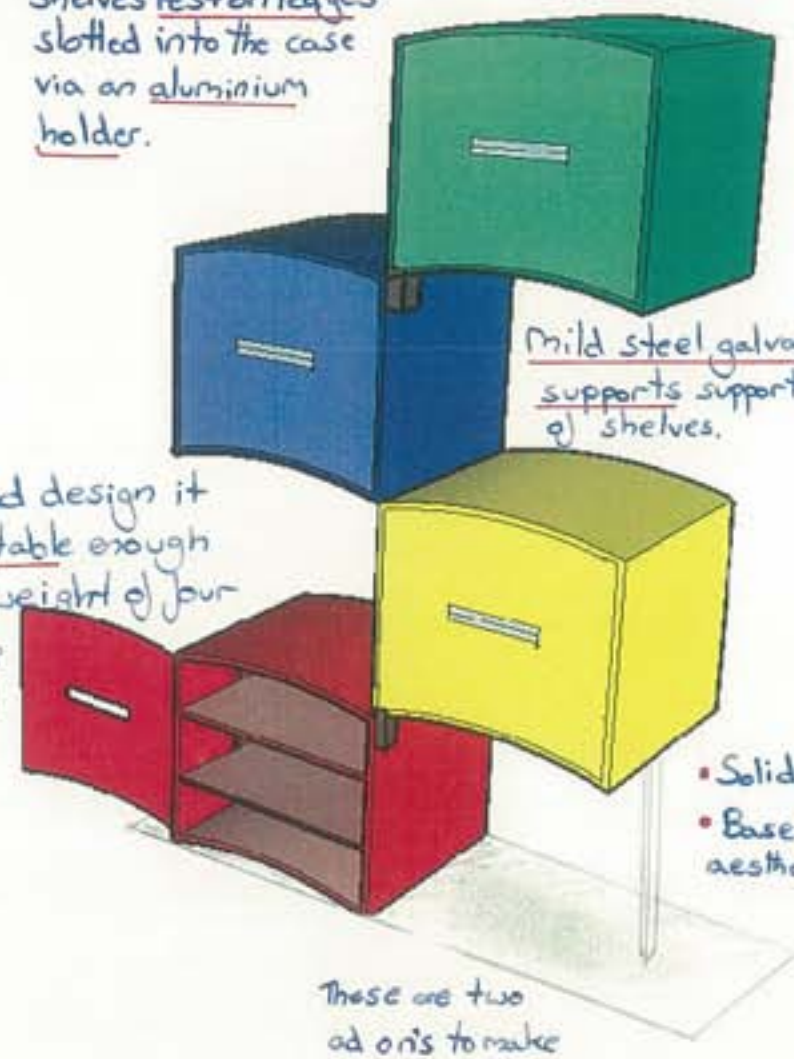
This is one of the boxes separated to show it more clearly with the door opening to the left.

This can store anything and everything securely, criteria point 2

Brass butt hinge to support door of box

15mm Hardwood.

Shelves rest on ledges slotted into the case via an aluminium holder.



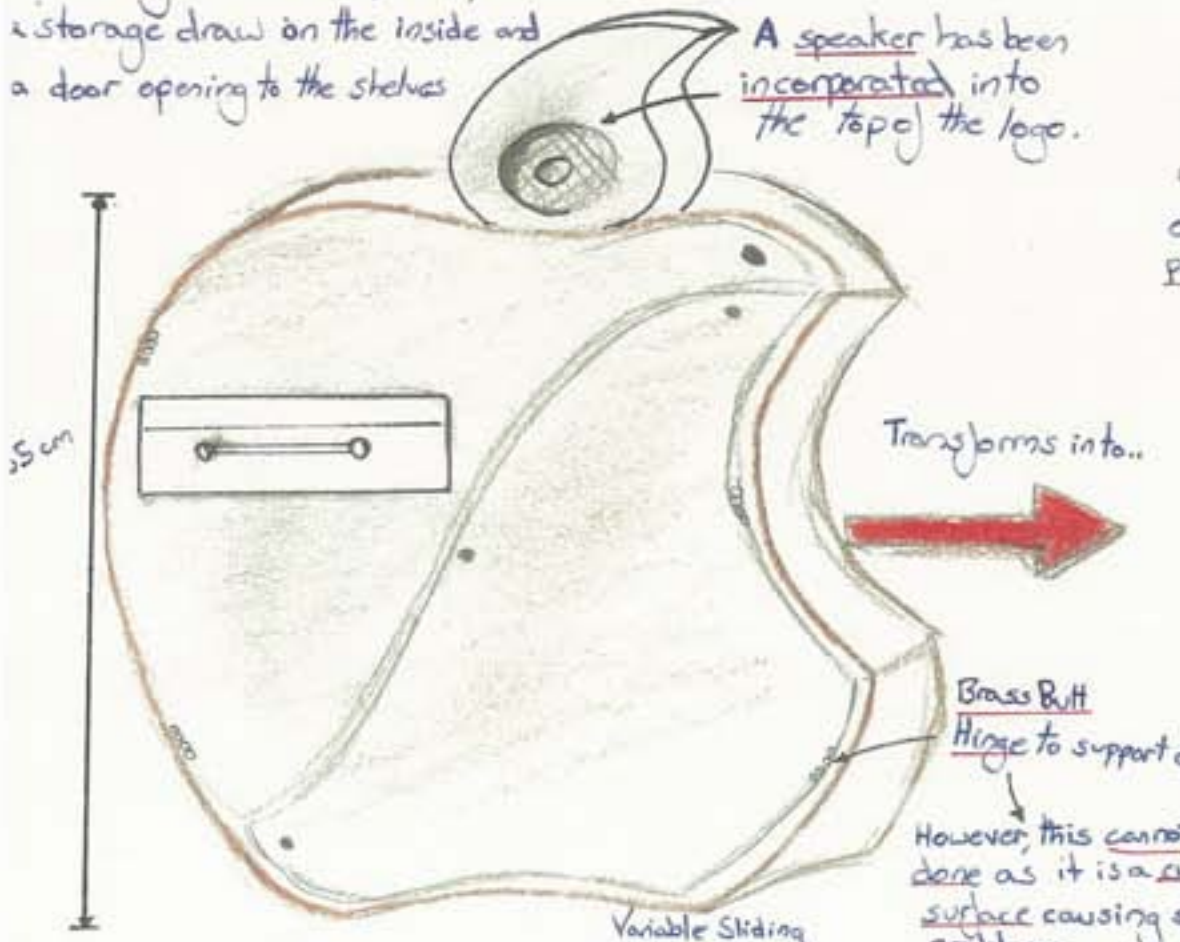
Mild steel galvanised supports supporting weight of shelves.

Although a good design it may not be stable enough to support the weight of four boxes and therefore may need a few more structural supports.

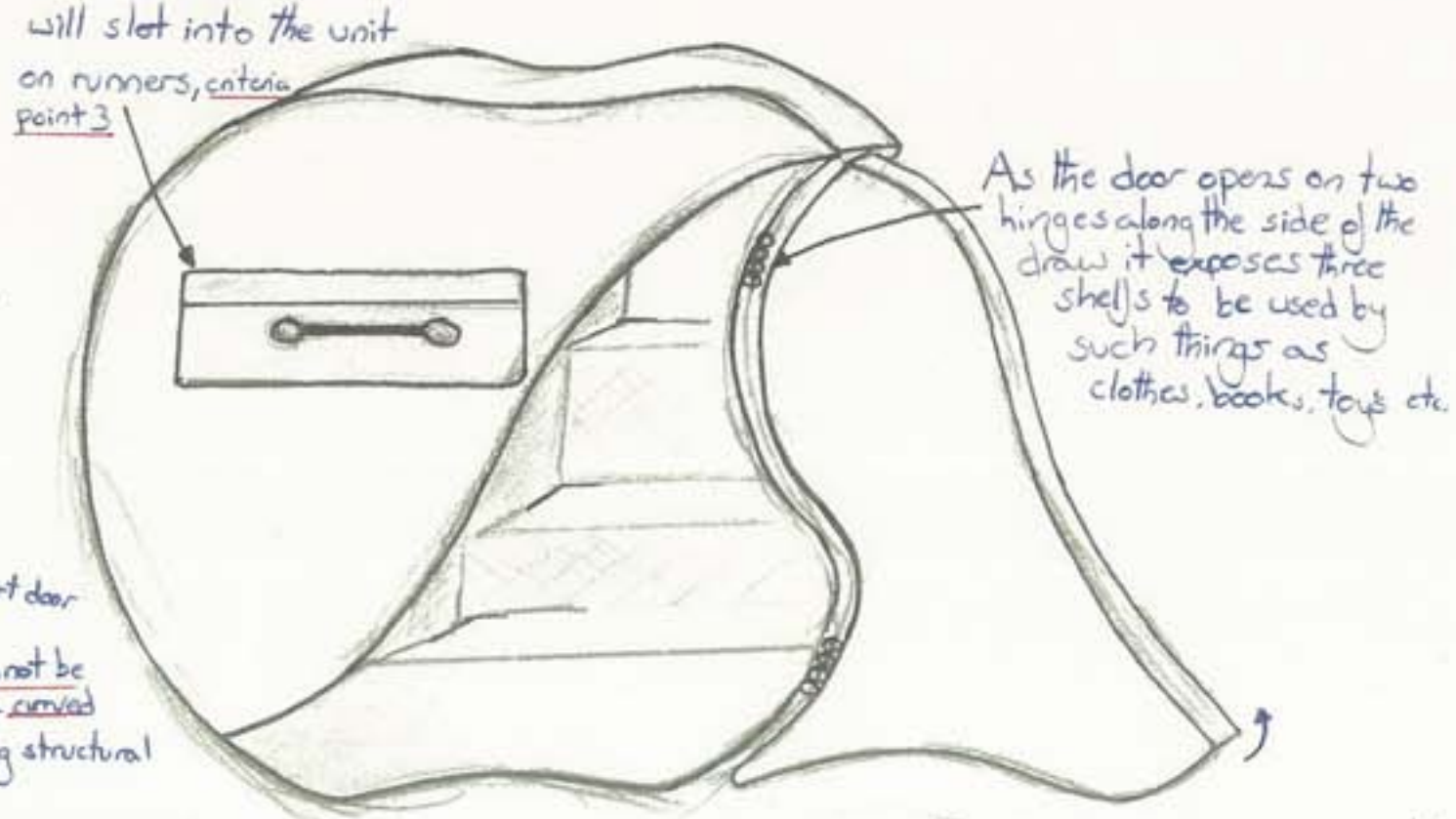
- Solid mild steel support
- Base, thinly made, providing aesthetic qualities.

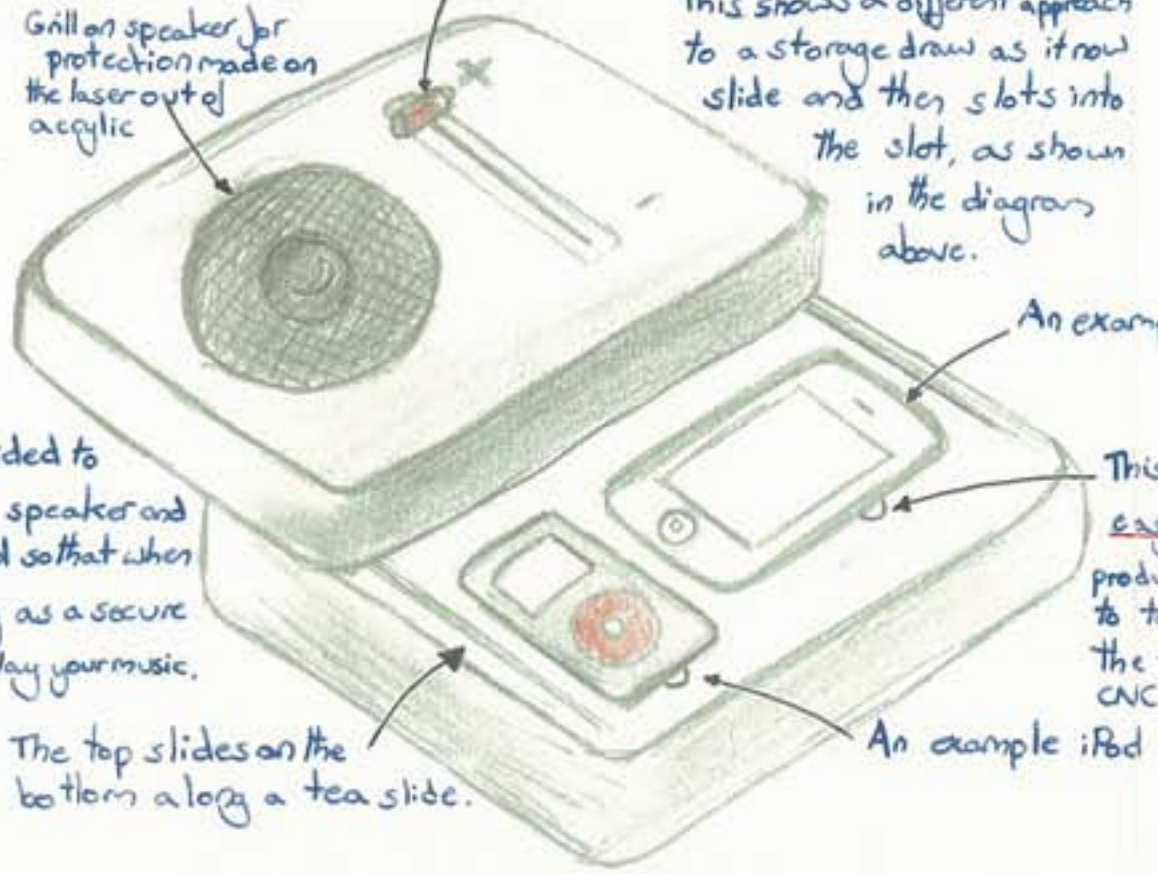
These are two add on's to make it more stable.

his design takes the overall apple logo and expands it turning it into a cupboard/bedside table with a storage draw on the inside and a door opening to the shelves



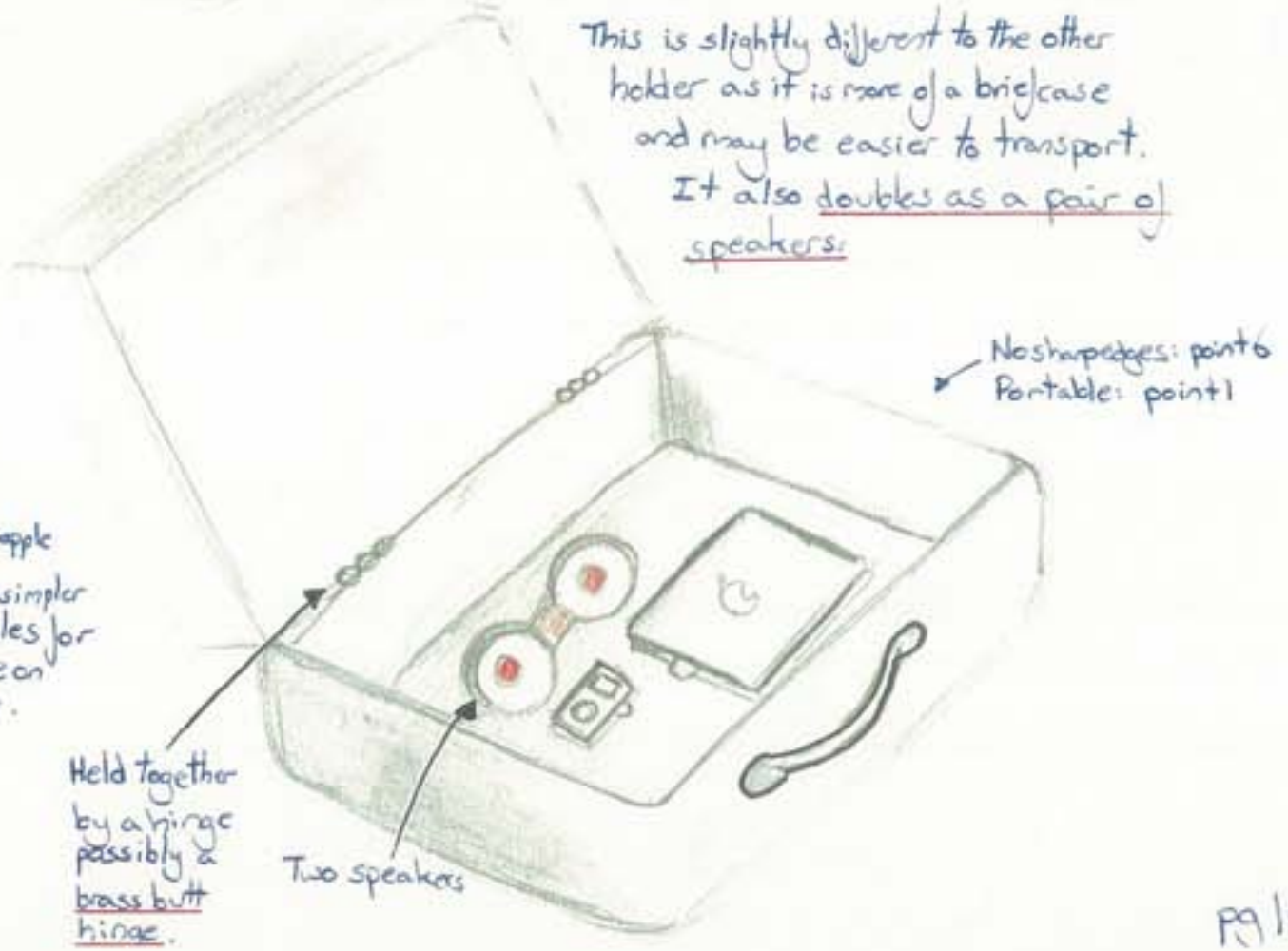
However, this cannot be done as it is a curved surface causing structural problems.





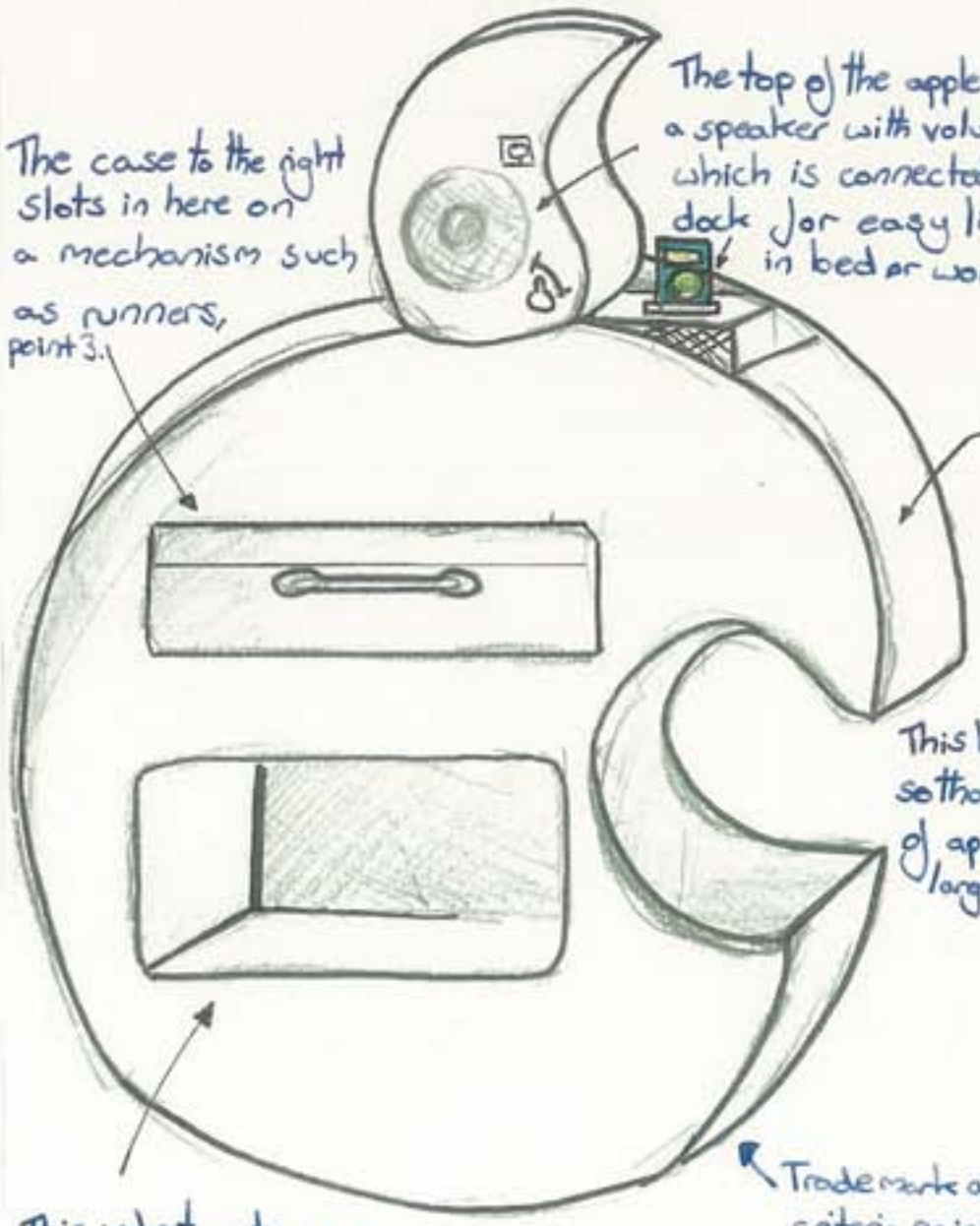
This shows a different approach to a storage draw as it now slide and then slots into the slot, as shown in the diagram above.

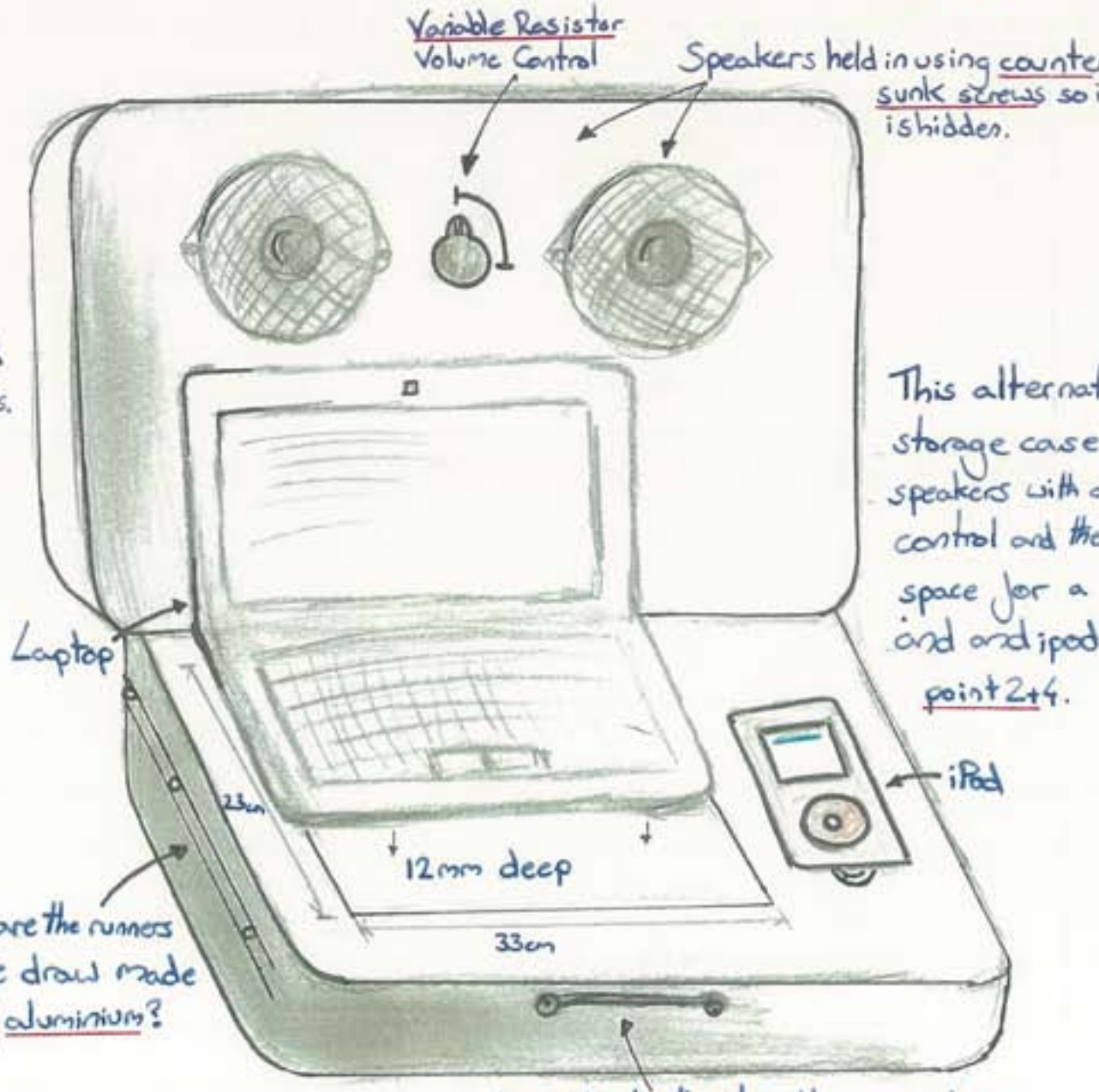
I have decided to incorporate a speaker and volume control so that when portable acting as a secure case you can play your music.



This is slightly different to the other holder as it is more of a briefcase and may be easier to transport. It also doubles as a pair of speakers.

Initial Ideas

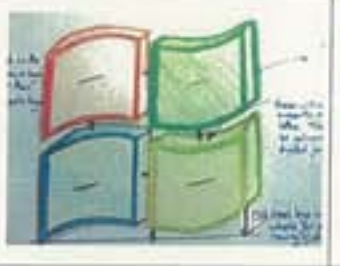
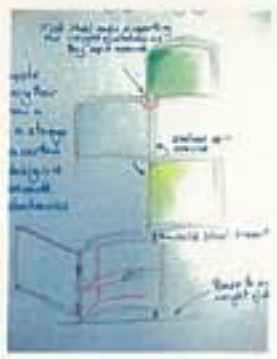
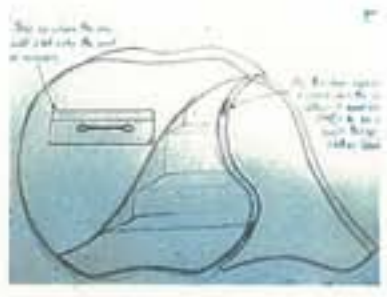




This alternative to the storage case has two speakers with a volume control and then has two space for a macbook and and ipod, criteria point 2+4.

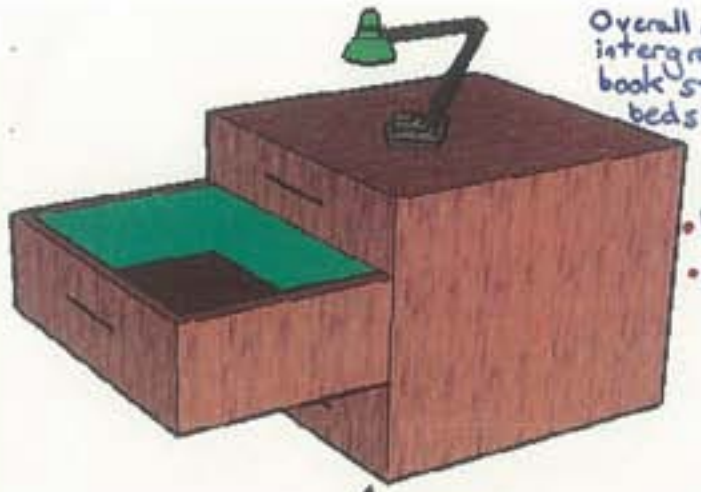
Possible leather handle or metal? However I feel a stainless steel or aluminium handle may suit the look better!

Design Analysis

Design Number	Comment	Mark out of 10	Design Number	Comment	Mark out of 10
Design 1 	This design is a good design because it allows a large storage area. However, it is rather dull and does not have much appeal.	3	Design 5 	This design follows the trend of the apple storage case. Although following the trend it varies in such that the speaker is inside. I like the idea of speakers but the inside will be to cramped as it also has an iPod and a laptop inside aswell.	8
Design 2 	This incorporates the idea of design 1 but changes the format so it is more appealing. I like the idea of twirling shelves, however this may cause problems with balance and potentially difficult to create.	3	Design 6 	This holder provides storage for the iPod and the iPhone. Although no laptop holder it still provides some basics. It is smaller than previous design and still has a speaker. However, the speaker is not protected and could get easily damaged. Finally, there is no real carrying mechanism and it therefore fails to be fully portable.	7
Design 3	This design incorporates the windows logo with a desk. This design is preferable as it has many uses and is more aesthetically pleasing for the customer.	4	Design 7 	This design follows the theme of the apple logo. The manufacture process would be difficult as there are so many different compartments within the product. I like the iPod dock and the incorporated speaker within the chest which makes the product stand out from its competitors.	8
Design 4 	This design included both my apple idea along with the actual ipod + laptop storage unit on the left hand side. The design provided large areas of space for other possibilities such as books etc. This design was the best and most appealing.	10	Design 8 	This is also one of my favourite designs as it follows my main pattern but is portable, briefcase shaped, has a speaker system and only holds two products making it lightweight and therefore perfect for transporting.	9

Conclusion: I plan to expand on design 8 without the speakers as i feel this adds to much weight to the product. I also like the idea of design 4 and wish to expand on this possibly integrating a desk aswell.

Evaluation of Initial Ideas



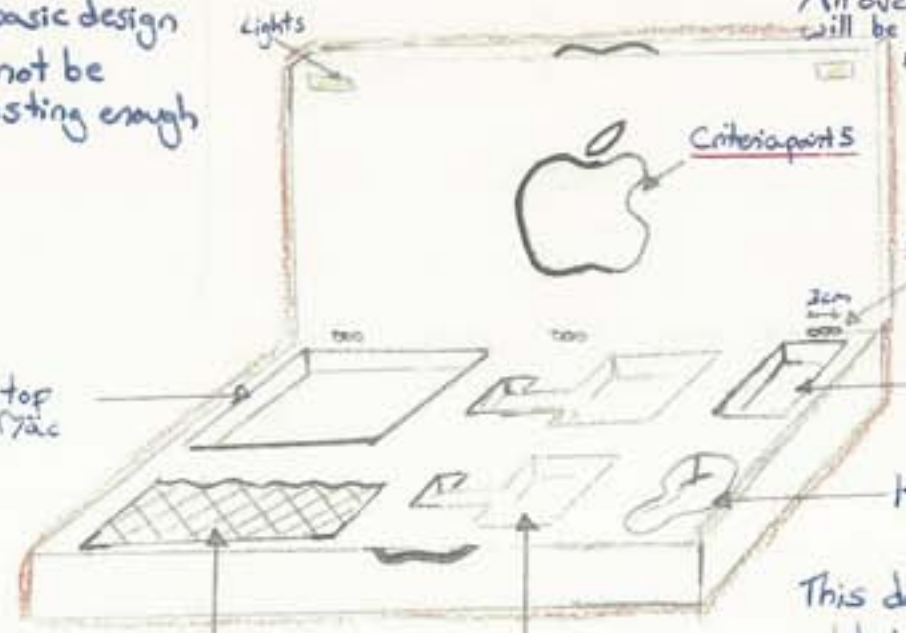
Overall draw design intergrated with light and book stands to keep bedside tidy.

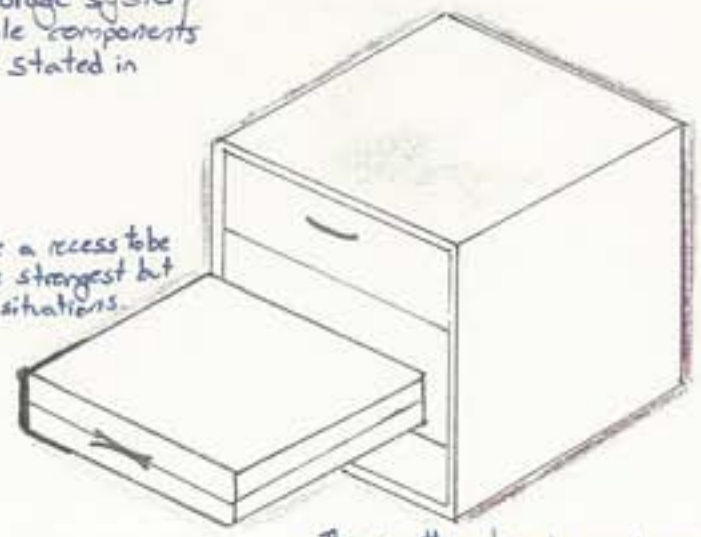
- Very basic design
- May not be interesting enough

Various Options

must be produced by apple so can use trademarks logo.

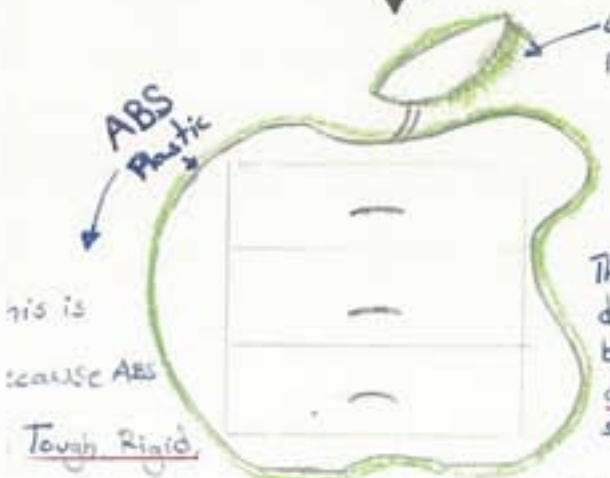
An overview of how the Apple Storage system will be laid out and which Apple components it will be able to store, as stated in criteria point 4.





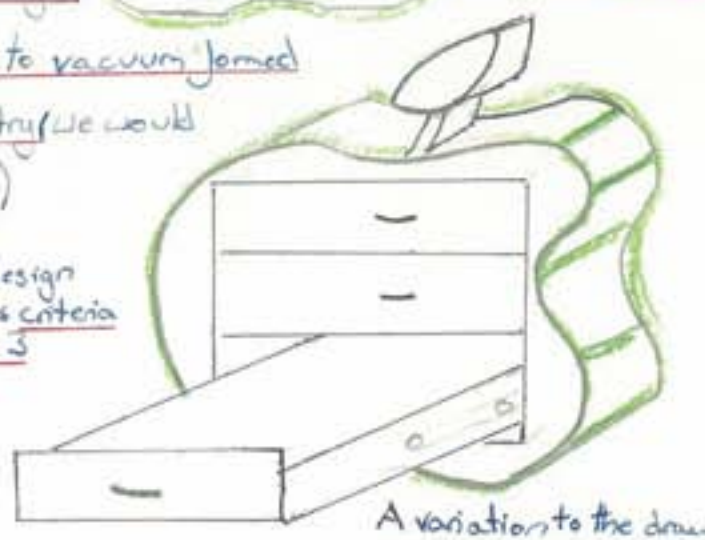
This is the closed version of the storage draw which slots in and out of the intergrated draw unit.

This design for the storage would slot into specially designed storage system. It slides in and out whilst the other draws work as follows:



his is
ecause ABS
Tough Rigid.
ossible to vacuum formed
industry (we would
abricate)

This is a simple design that could be made in many different colours. Plastic such as ABS would be ideal.

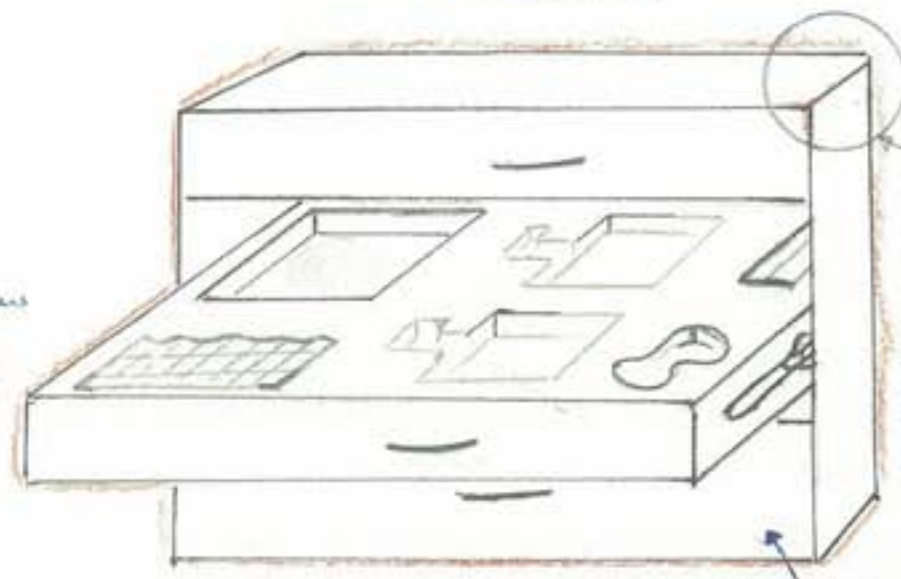


This design follows criteria point 3

A variation to the draws mechanism for the apple designed chest of draws.

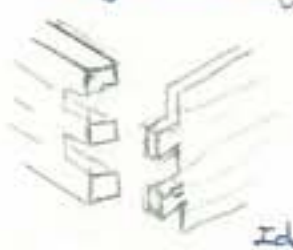
OR

Instead of having an opening sort of skilled brief case it is a draw that has the same features just doesn't need to be taken out.



This would be joined using a finger joint. This is because simple, easy to use + tough.

If made out of wood a hard wood such as ash would be neccessary



Ideal for industrial situations where it is produced using machine tools.

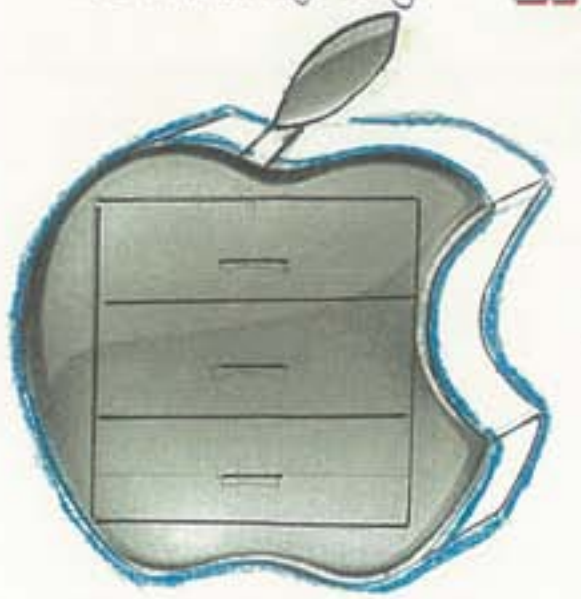
The sliding draws could be made out of aluminium or mild steel. Aluminium because it has a high strength to weight ratio, it is light and therefore ideal. Mild steel because it has high tensile strength, its easily joined and is tough.

This joint would be done using a dove tail joint. Ideal for the corner joints on draws. Very strong joint.

Lapped Dovetail Joint

Evaluation of Initial Ideas

This is a simple design that would be cheap to produce, however it is not very exciting.



This shows the basic design expanded into an apple logo with the draw at the bottom and a light. This idea is an expansion from the original box shaped idea yet it doesn't have much functionality. This has led me to develop further, as seen on the rest of this page.

I feel that everydesk needs a good light so I have chosen to keep the light in the same space.

This is the cable slot to help tidy wires. I have shown an example of how it could work with speakers.

Tempered Glass desk top.

Storage draw, point 3

75cm

This must be a fabricated frame as cutting a groove in the glass will cause a weak spot causing it to lose its strength.

Laminated

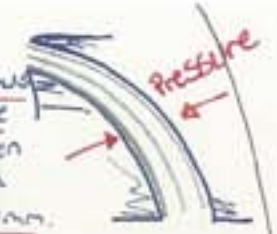
Thin laminated wood in between two profiles

Open display shelf storing items such as books and shoes.

Tempered glass is good as it is tough, hard and strong. It is tempered in a way that if it breakes it does so in big chunks rather than tiny sharp pieces.

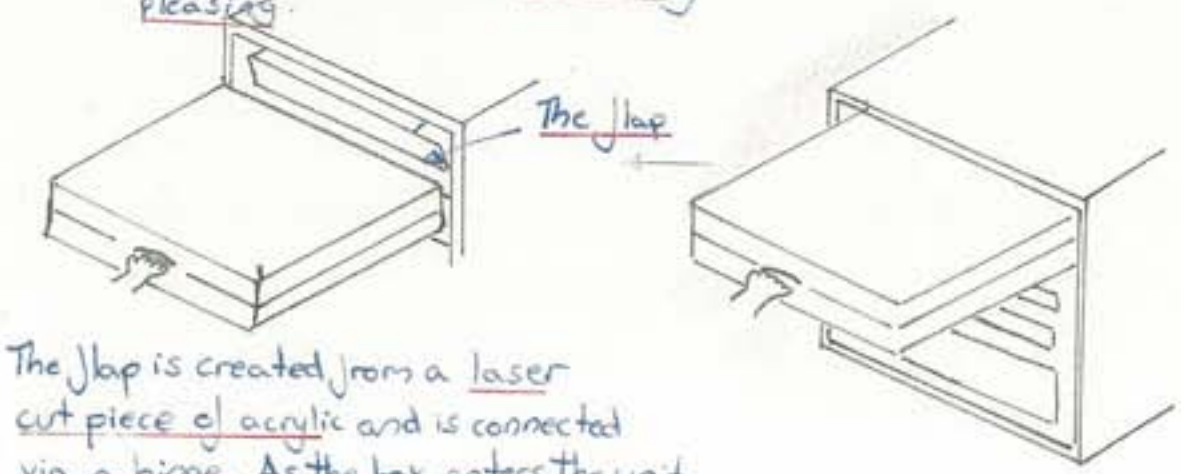
Laminated:

Compress various veneer and glue together and then clamp in mould with a vacuum.

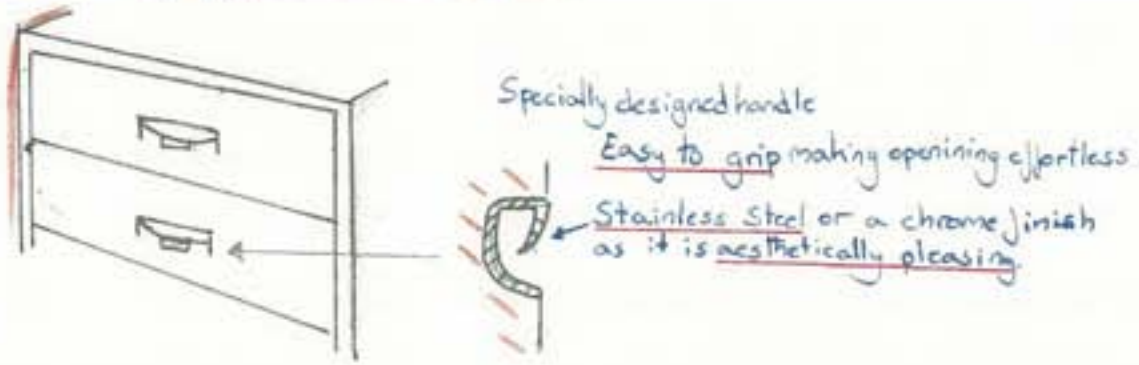


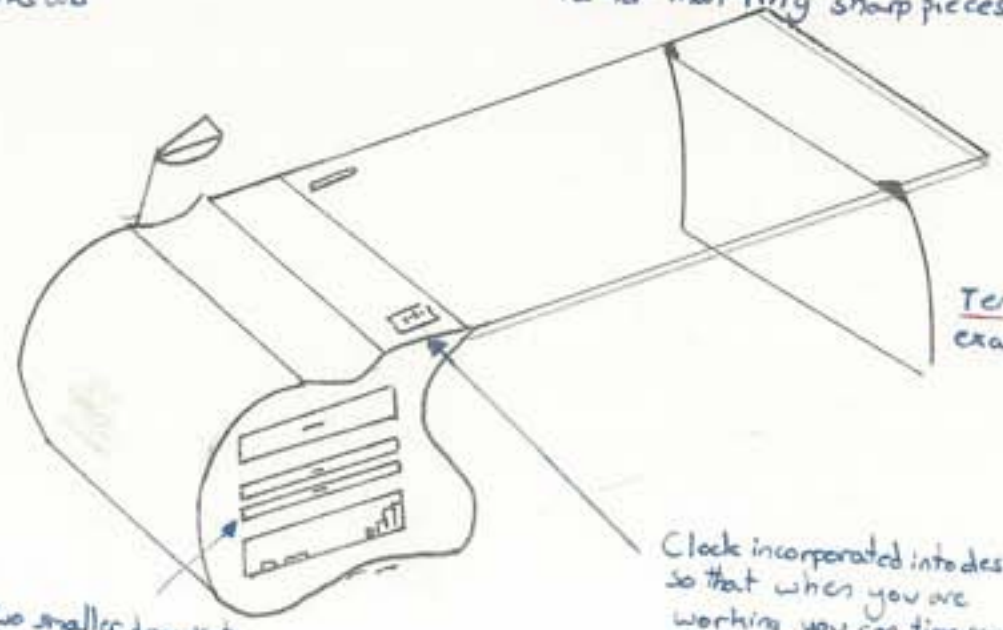
This is the expanded design of the bedside storage system and has now been remodelled using a similar design to form a more functional product. This desk has new features to make it more stylish and a multipurpose product.

As the apple storage draw is pulled out a flap comes down to cover the hole and make it look aesthetically pleasing.



How? The flap is created from a laser cut piece of acrylic and is connected via a hinge. As the box enters the unit it pushes the flap upwards and when taken out the flap falls back into place.





This isometric view shows how the possible glass surface will sit in the product.

Tempered glass ordered to exact size needed.

Two smaller draws to store other products the user wishes.

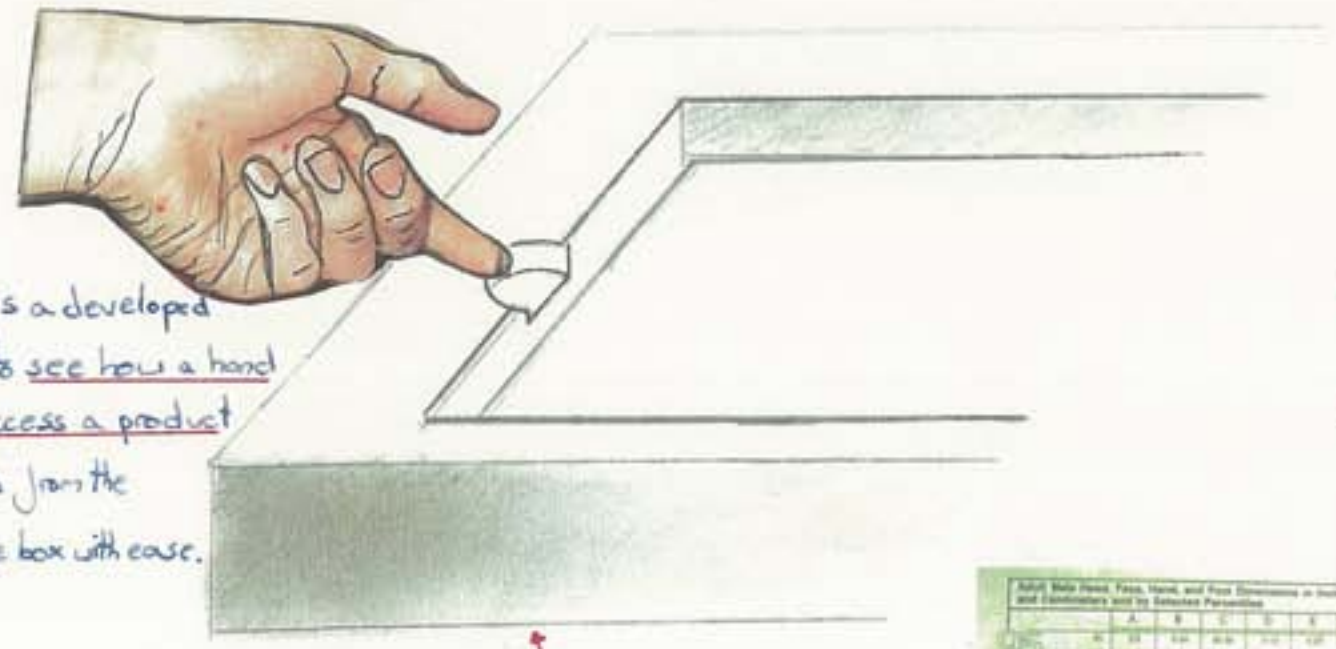
I would use ash hardwood as it is tough and flexible along with the fact it works and finishes well.

Clock incorporated into desk so that when you are working you can time manage.

Sits facing upwards so it can be seen and is luminious for effect.

However this clock could become chaotic amongst the manufacturing of the desk.

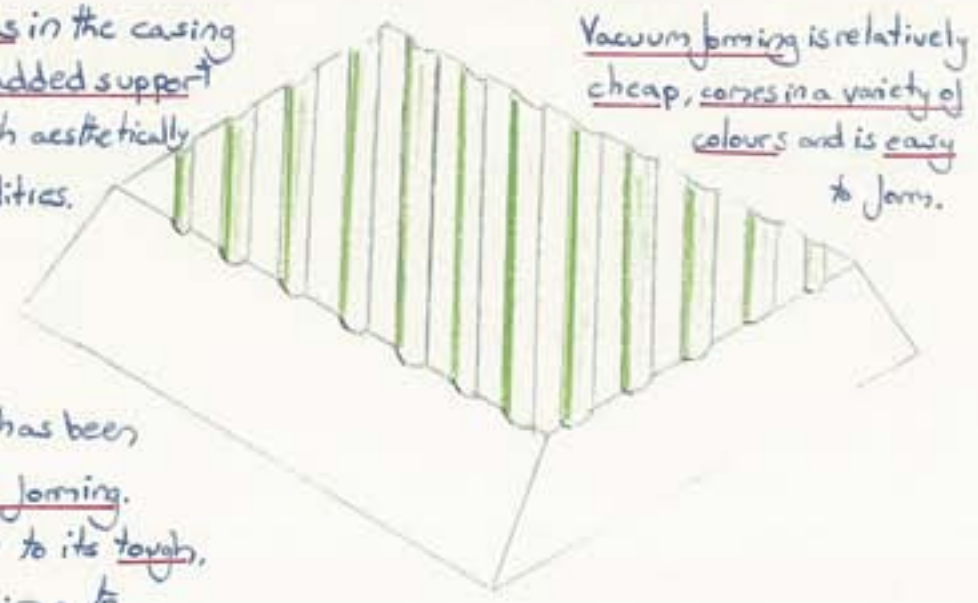
Advances in Design



This is a developed idea to see how a hand can access a product eg iPad from the storage box with ease.

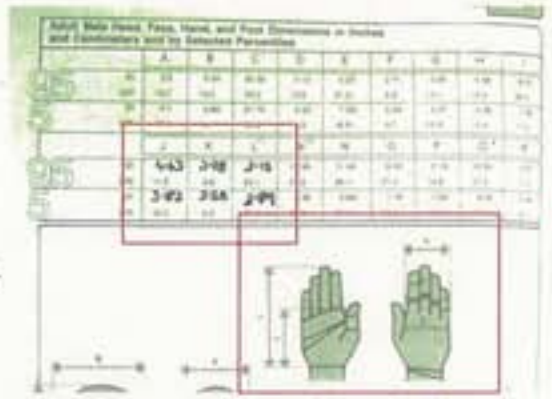
This is my chosen idea to get the laptop out of the case. Another idea would be to have slots to slide the laptops inside.

The grooves in the casing provided added support along with aesthetically pleasing qualities.



Vacuum forming is relatively cheap, comes in a variety of colours and is easy to form.

- This alternative casing has been created using vacuum forming.
- Possibly out of ABS due to its tough, rigid qualities sticking to criteria point 8.

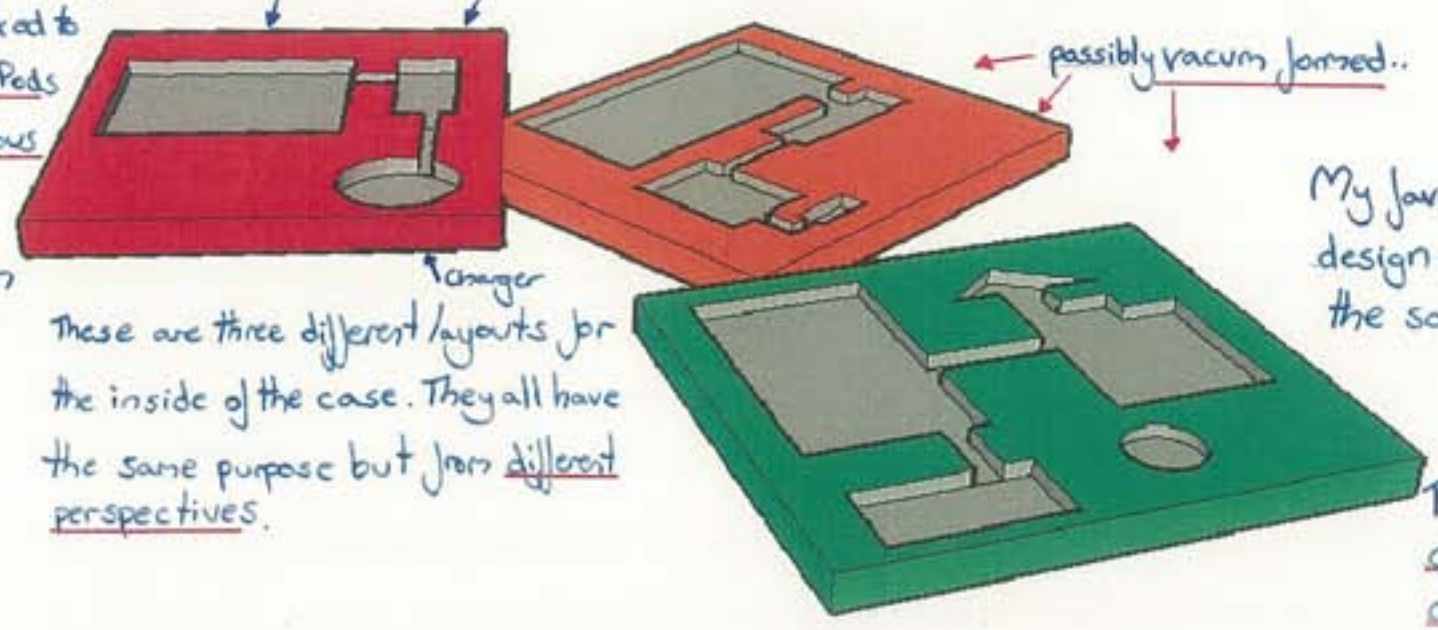


This diagram shows the ergonomics of a hand and the dimensions of the average persons hand.

Side on view:

The different finishes (red, green and orange) can be linked to the fact nowadays iPods can be bought in various colours.

interchangable design → opens itself to be mass produced



These are three different layouts for the inside of the case. They all have the same purpose but from different perspectives.

possibly vacum formed..

My favourite design is the red design as it is simple but provides the same services as the others.

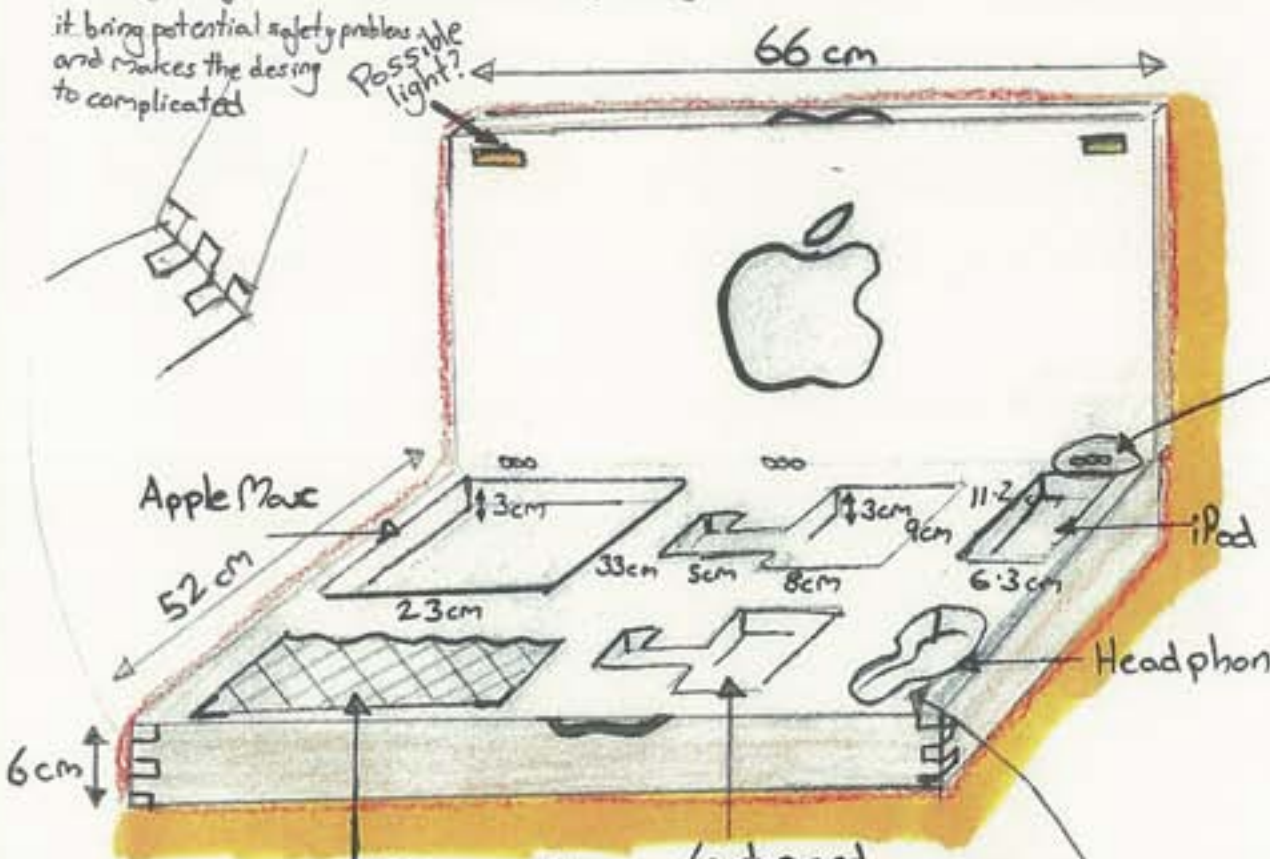
The boxes have different channels as this is aesthetically pleasing but it also has a beneficial factor making it easier to remove the products

Advances in Design

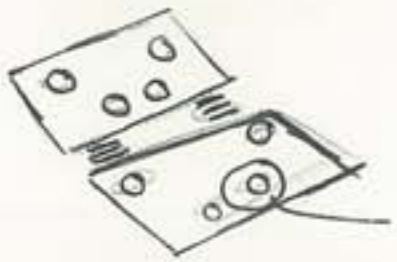
Although a light would be good it bring potential safety problems and makes the desing to complicated

Possible light?

Dimensions of design:



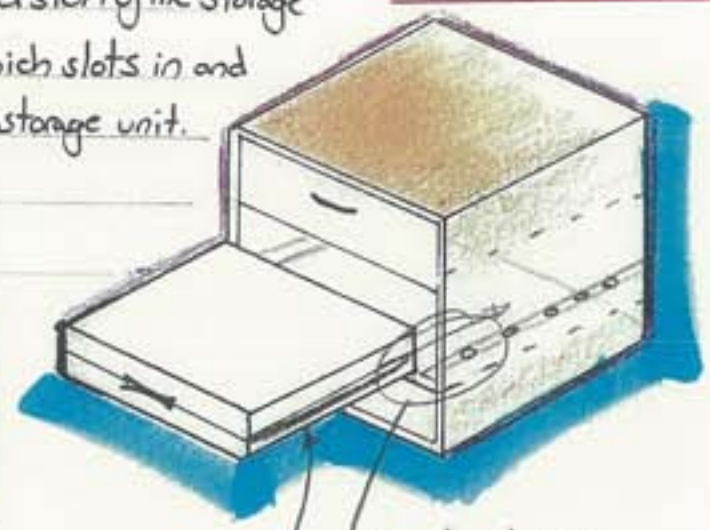
FLUSH HINGE



Does it need a rebate?

Initial Idea Expanded

Closed version of the storage draw which slots in and out of the storage unit.



Reston ball bearings

However it could be done using steel runners but these would not be very effective as it would stop it being portable.

Very elastic and used lots in modern furniture

I will be using ash as it provides a light colour and is a wood with very few knots therefore making it suitable for joints

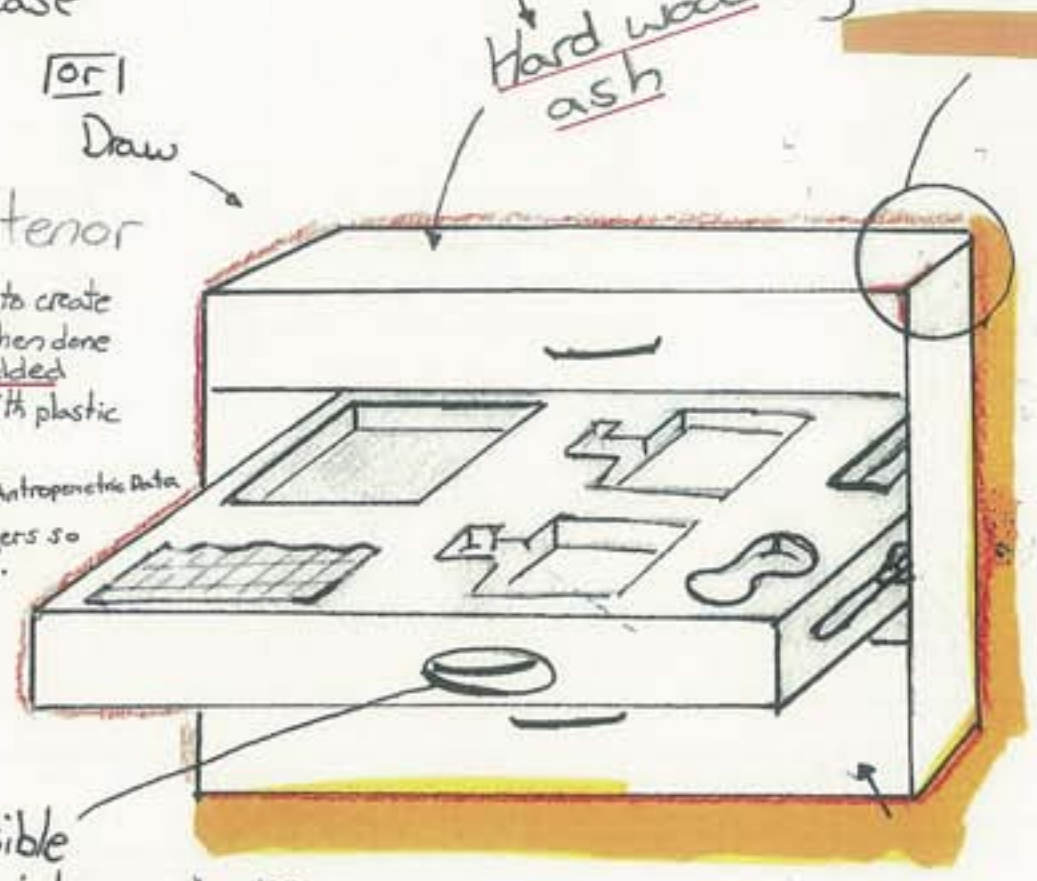
Turns into:

Briefcase

[or]

Draw

Hard wood e.g ash



Lap Joints are much stronger than butt joints as they increase the area being glued. Therefore more reliable for my project.

Foam/padded interior

- Foam can be very difficult to create accurately, however when done it provides very good padded protection. Covered up with plastic cut to size on the laser?

This picture of my model was created using card and masking tape. It shows a possible, simpler, layout design.

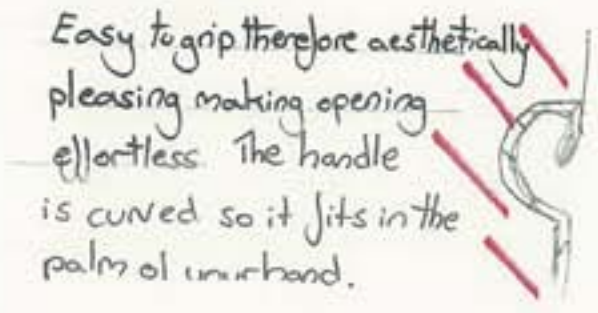
Anthropometric Data

1½inch for fingers so easily opened.

I can easily knurl a grip onto the handle and then press form it

[or]

Made on the lathe and bent in the workshop?



Easy to grip therefore aesthetically pleasing making opening effortless. The handle is curved so it fits in the palm of your hand.

Possible stainless steel?

Made using the lathe. However this would be out of my limit in the workshop. It may

pg 20

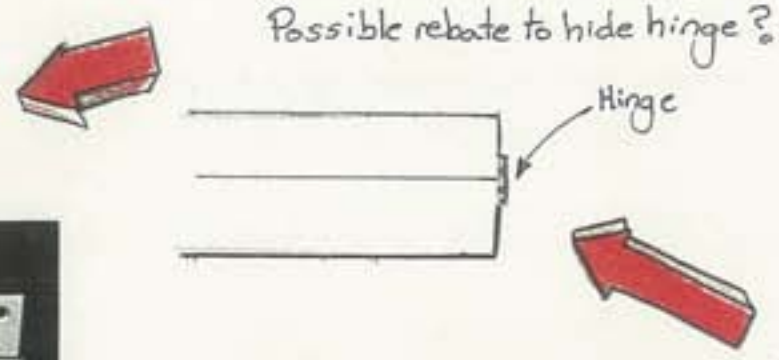
- Aluminium or brass.
- Centre lathe
- Diamond knurle for a good finish

Advances in Design

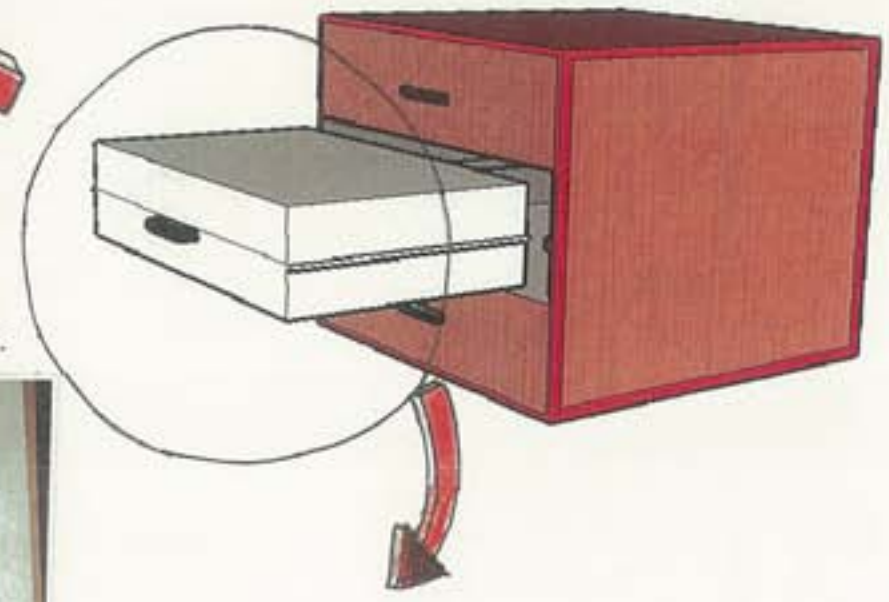
This is a view from the back of the case using a standard stainless steel domestic door hinge.

Possible rebate to hide hinge?

Hinge



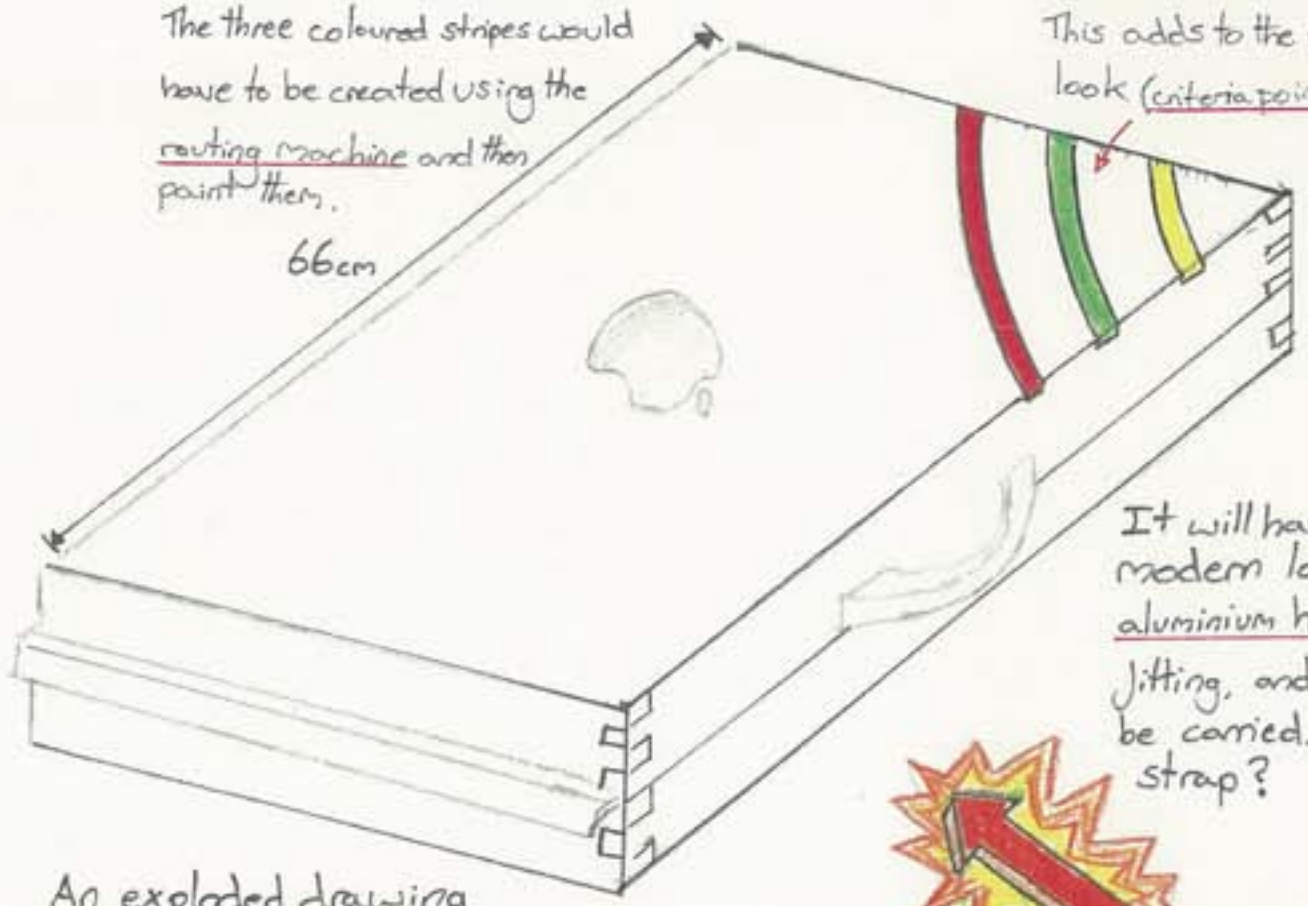
The model below shows the most sensible layout possible along with a basic view of how the overall product will look.



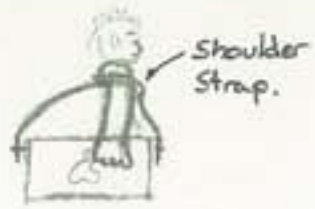
The three coloured stripes would have to be created using the routing machine and then paint them.

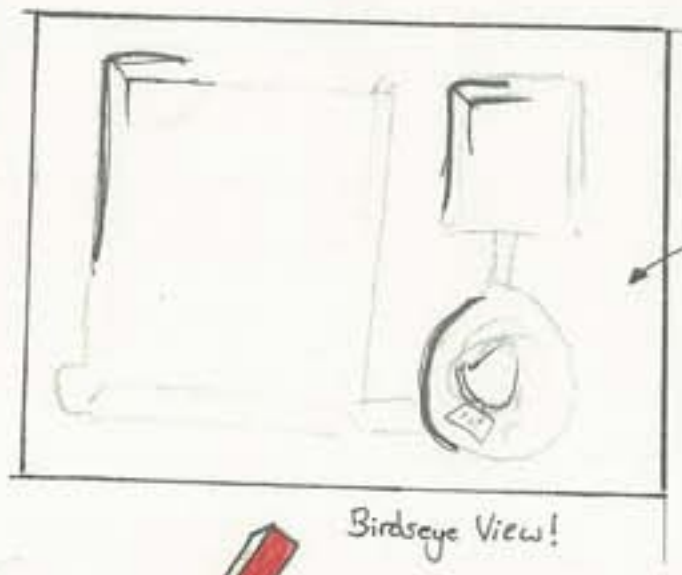
66cm

This adds to the modern look (criteria point 7).



It will have an elegant but modern look to it with an aluminium handle, ergonomically fitting, and will be able to be carried. Possible shoulder strap?





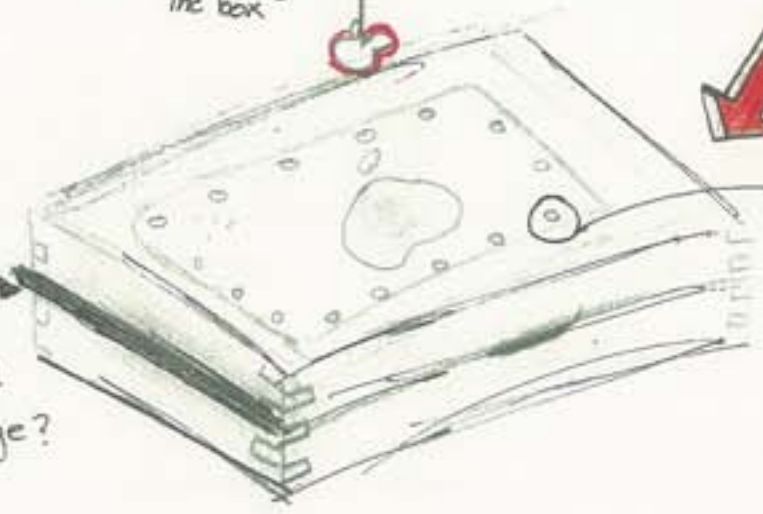
Birdseye View!

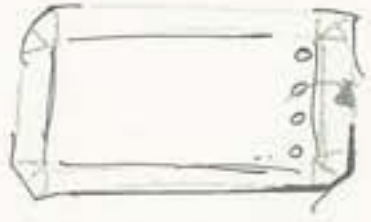
An exploded drawing showing the ledge in more detail and a more precise overall design.

Rolls along ball bearings inside the bedside table.

However this could just rest on a padded ledge?

Brand the apple logo onto the box





Fold flaps down then rivet

Advances in Design

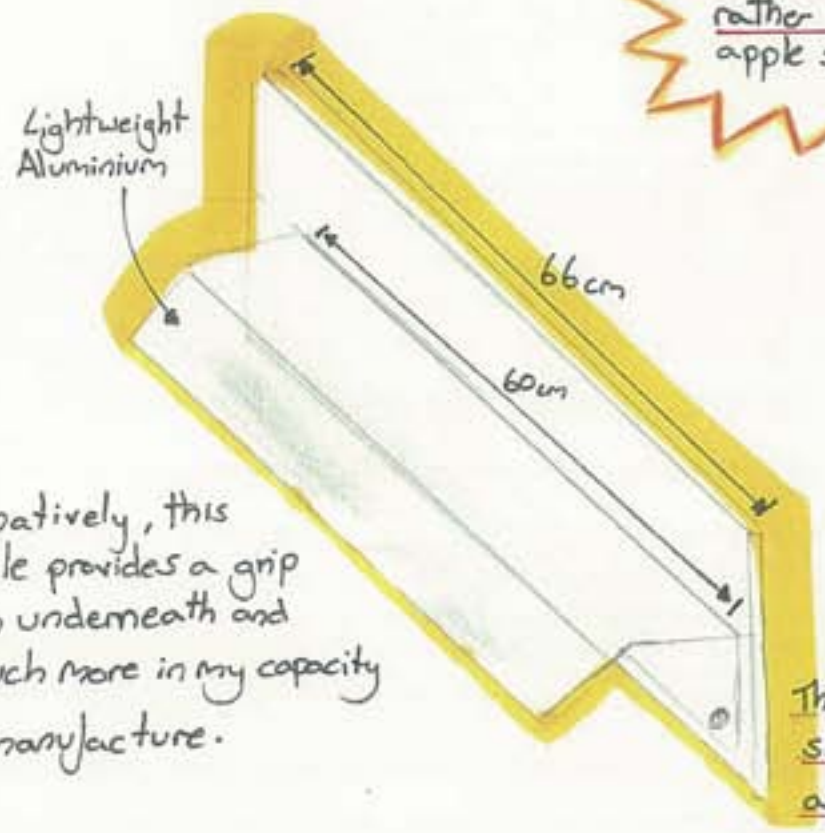
This is to be made out of extrusion when the bedside table is mass produced. This is because it is good for working with brittle material along with complex shapes.

- This is easy to shape and manufacture
- Quick to cut to length
- Quick to finish

This idea of draw shape involves two elements of design and combining them to make something unique. Mahogany combined with modern!

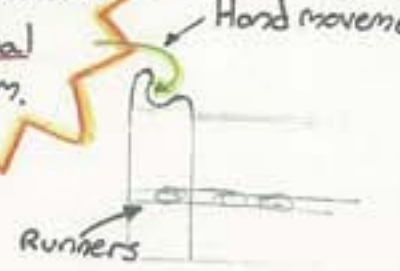
The way the handle is developed it can be ergonomicall and aesthetically pleasing for the user.

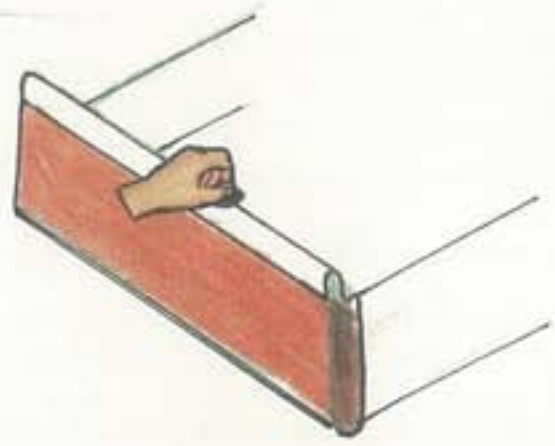
This page focuses on the external aspects of the draw rather than the internal apple storage system.



Alternatively, this handle provides a grip from underneath and is much more in my capacity for manufacture.

The handle is made from a sheet of thin, lightweight aluminium bent and then screwed onto the front of the draw.





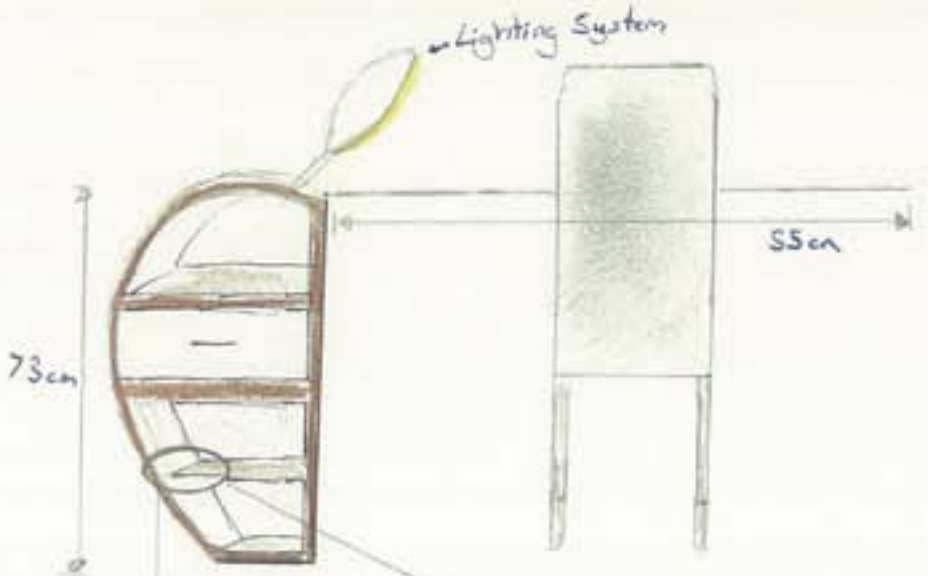
This is a model finger joint made from pine. Obviously using mahogany will be more challenging as its a hardwood

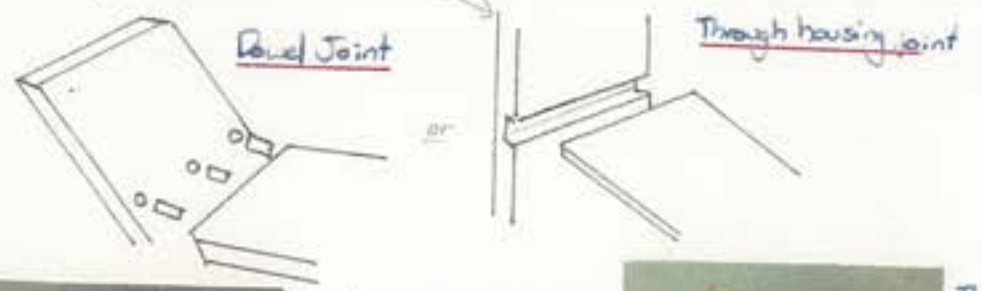
I have chosen finger joints because they are rigid, have a large glueing area, are easy to manufacture and generally look good when manufactured

The fronting of the box will be screwed to the draw front using cross-headed screws from the inside.

CAD Drawing of basic design

Advances in Design





Dowel joints are generally made from hardwood, and in this model I created a jig to ensure the accuracy of the holes and once I had created the jig I used it to help me drill exact holes.

Model dowel joint

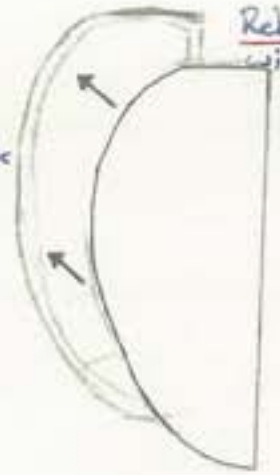
Model through housing joint

This joint is easier to create than a stopped housing joint as they are cut across the whole width of the board.

Having a jig ensures quality throughout the joint meaning less mistakes are possible.

Model dowel joint with jig used to create it to ensure it is the same holes on each piece.

This piece will be made out of laminated plywood due to the curve and will be veneered with a mahogany finish.

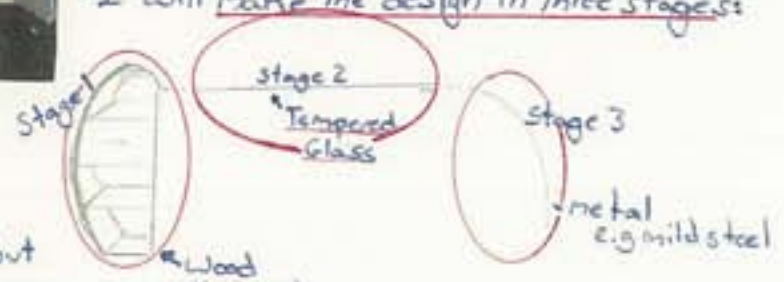


Rebate joint showing how the back of the chest will be attached. This joint is good because a rebate joint allows a panel to be easily inserted into a door or cabinet after the frame has been assembled. ∴ easy assembly

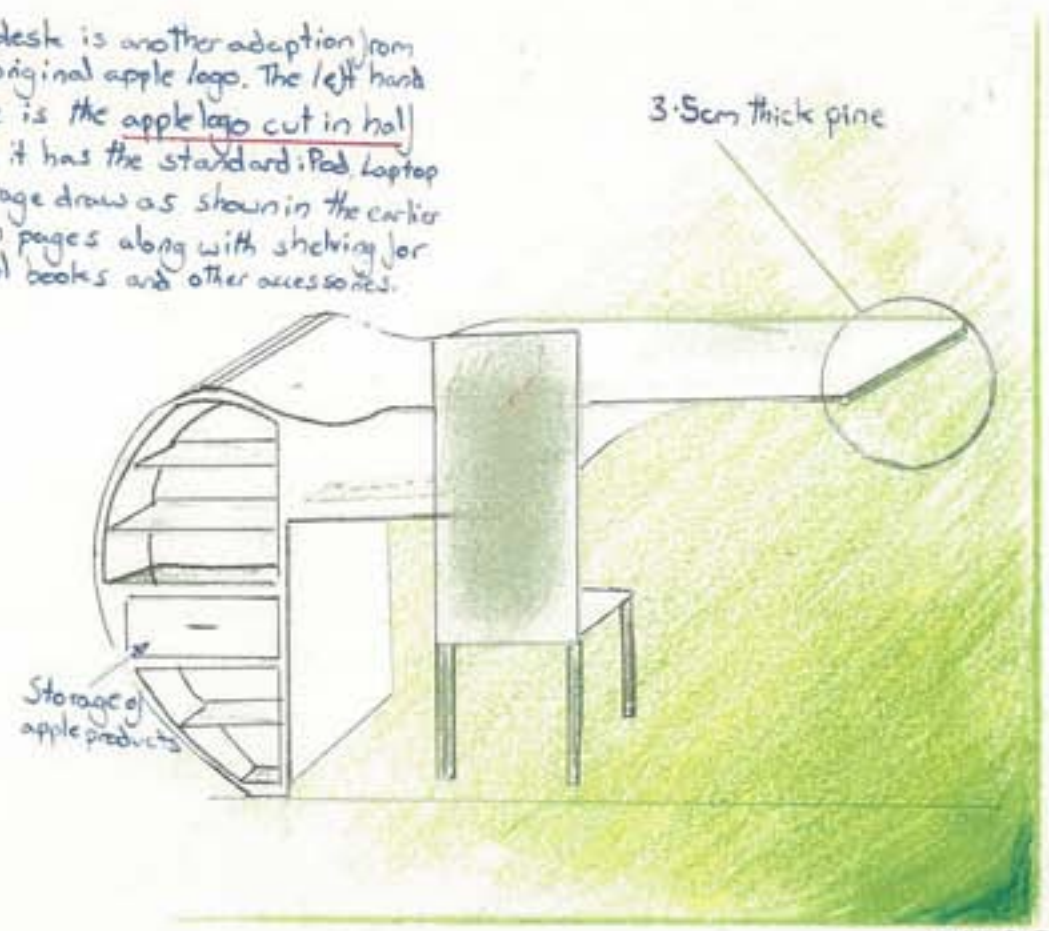
The mould. The wood layered up cross grain and placed inside the mould and clamped is protected using cling film to ensure that it doesn't stick to the mould.

In this model I laminated the curve to get the effect wanted. However it was very difficult to do and therefore has made me realise if this is the process needed I will make the design in three stages:

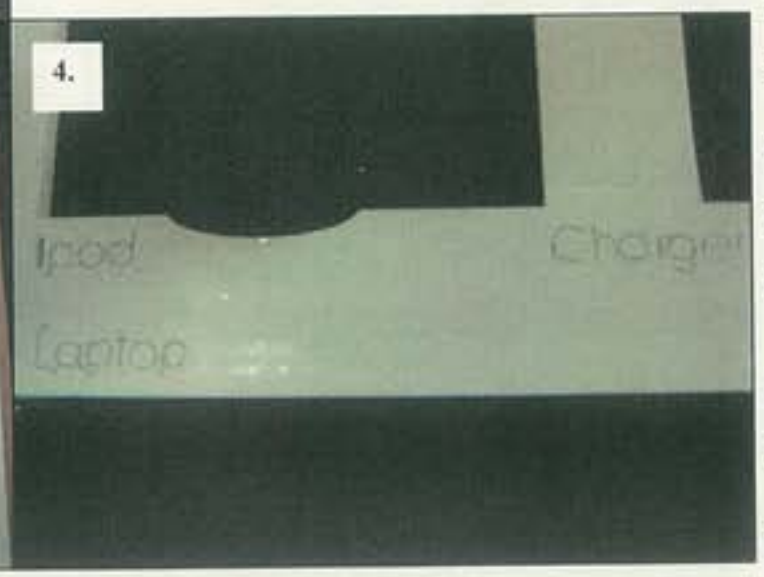
Laminated wood not only introduces interesting aesthetic possibilities, but laminated wooden forms are also very strong mechanically.

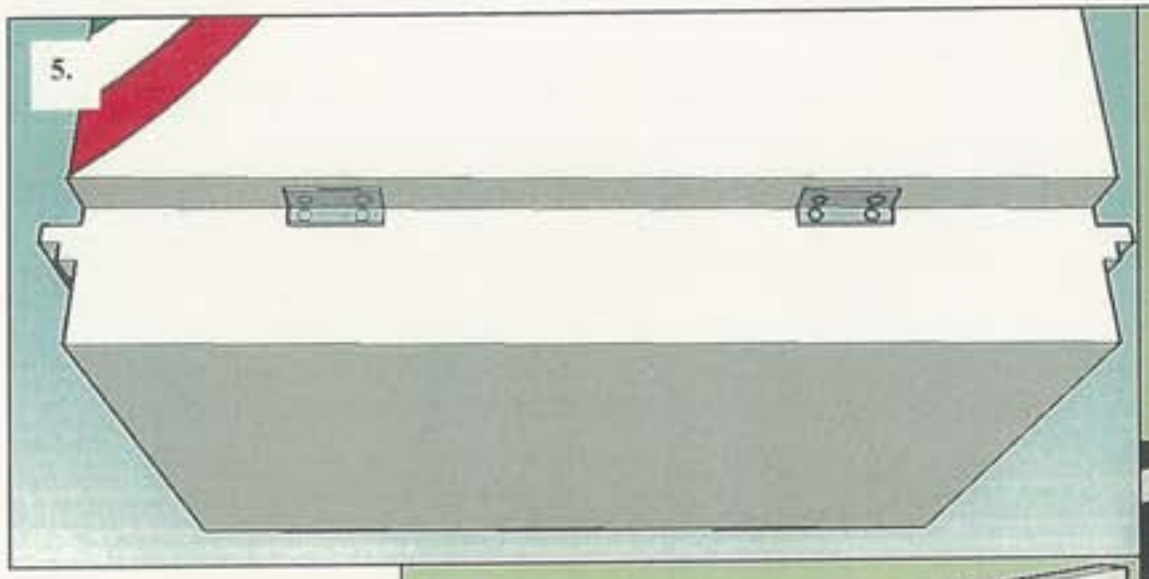


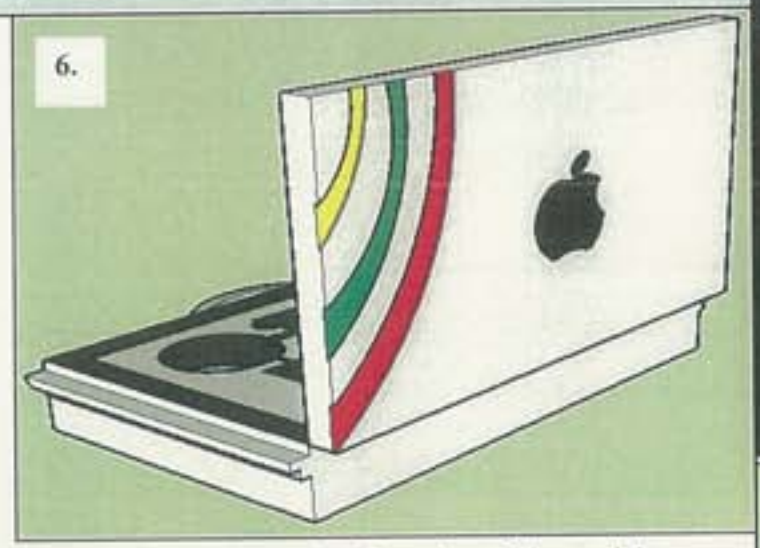
This desk is another adaption from my original apple logo. The left hand side is the apple logo cut in half and it has the standard iPad Laptop storage draw as shown in the earlier design pages along with shelving for school books and other accessories.

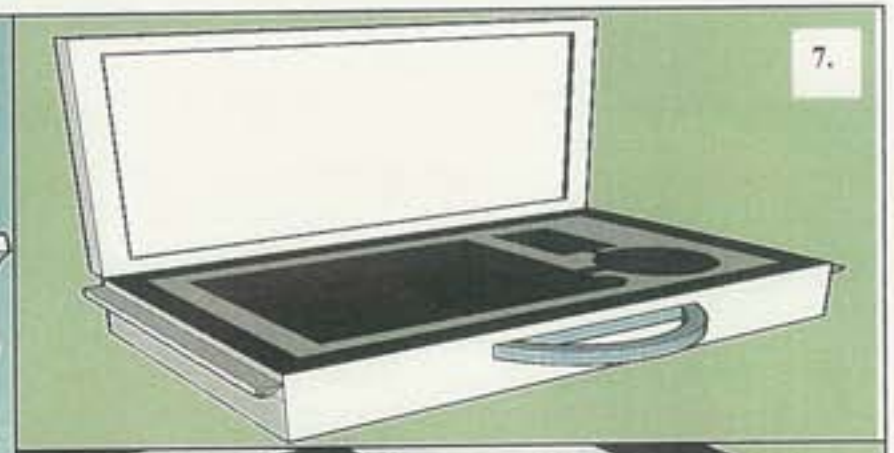


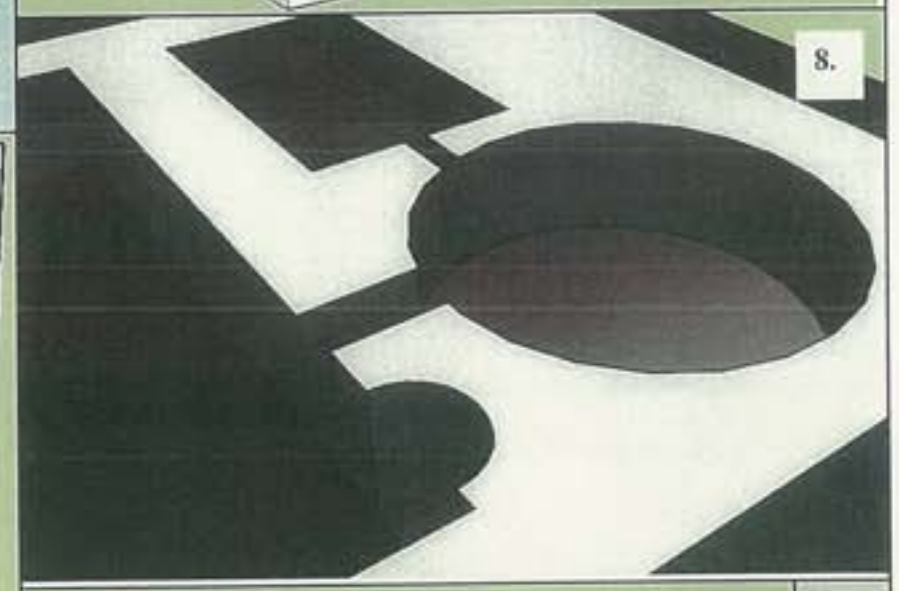
CAD and Final Model Photos

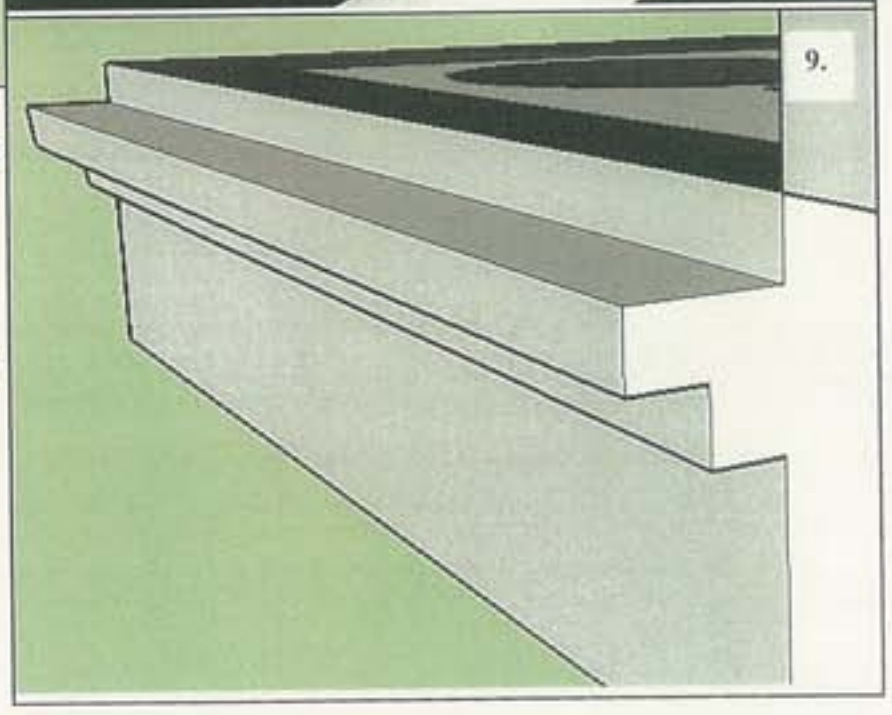






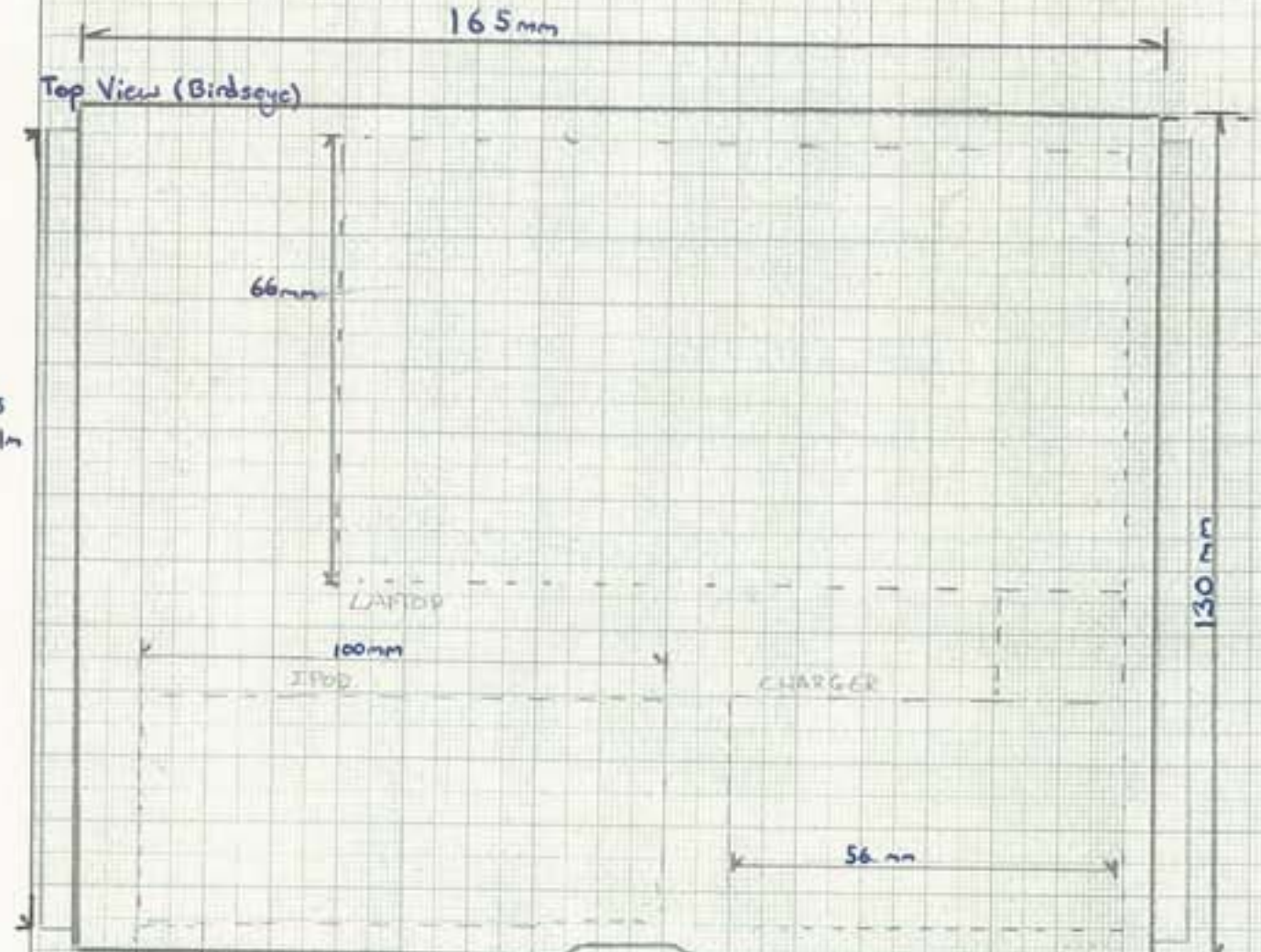






1. Overview of the model.
2. The lid of the model with apple logo engraved.
3. The layout of the inside to the box.
4. The engraved names of products to be stored.
5. The hinges shown on the CAD drawing.
6. The view from the back with the multicoloured stripes and an apple logo.
7. Front of the box with storage compartments.
8. Easy access places to retrieve products with indent.
9. Ledge to support box when stored in desk.

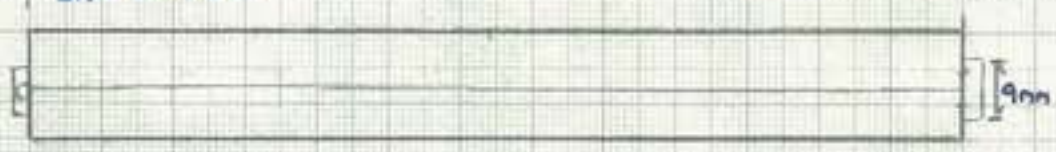
Top View (Birdseye)

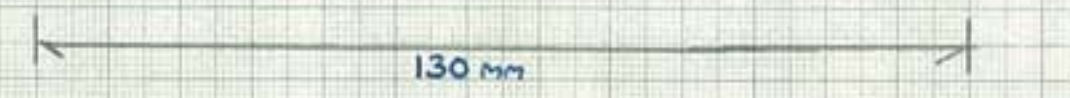


Ledges
= 12mm

Front on view.

Side on view.





Orthographic Symbol

Title: Apple Storage Box

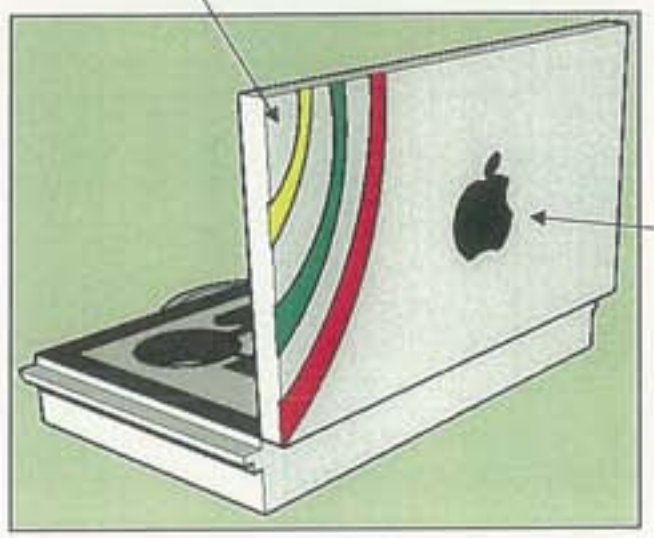
Materials:
3m Pine
ABS Plastic
Mild Steel
2 x Butterfly Hinges

Scale: 1:4

All dimensions in millimetres

Section 2- Evaluation of Final Idea

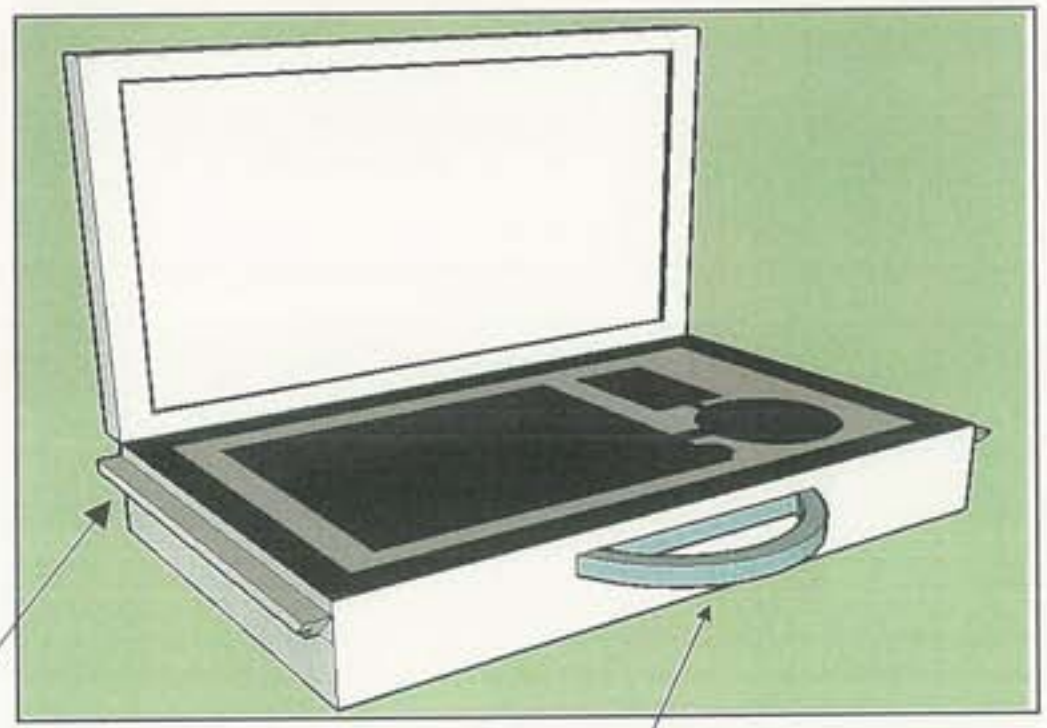
The back of the product has three indented stripes which are coloured and provide a more modern look to the storage system keeping in key with apples other products. This follows **criteria point 7** keeping with the modern look of apple products.



If mass produced the product would have to have apple's consent to be made and if this was the case the logo would be included on the box as shown here, following **criteria point 5.**

As you can see from the CAD there is a ledge on the side of the box which allows it to be integrated into a desk as it would rest on a ledge and act like a drawer. This follows **criteria point 3.**

The product has been created as a storage system which if necessary can be built to slot into a desk with the certain features for this added onto the box. **(Point 3).** It will also be designed to be tough and durable so the products do not get damaged. This could be done by a padded foam interior of strong metal casing depending on how it is manufactured. **(Point 8)**



The box stores many apple products and if made like this one it stores: laptop, charger, and an iPod. This follows **criteria point 4** which us for a certain amount of products to be stored. However, in reality this has to be the maximum amount due to weight issues. And following **criteria point 2** it is capable of tidying away products neatly rather than just any old box.

This briefcase storage product is portable and has a handle which allows it to be carried around. This follows **criteria point 1.**

I thought about integrating a light into the product during the design process however I feel that the light is not a necessity and is a possible danger risk along with the fact as it is not to be run on mains meaning it will be battery run which can be a hassle to change regularly and may also add to the weight issues. This means that I have not chosen to follow this path even though in the initial idea drawing I added it to the design.

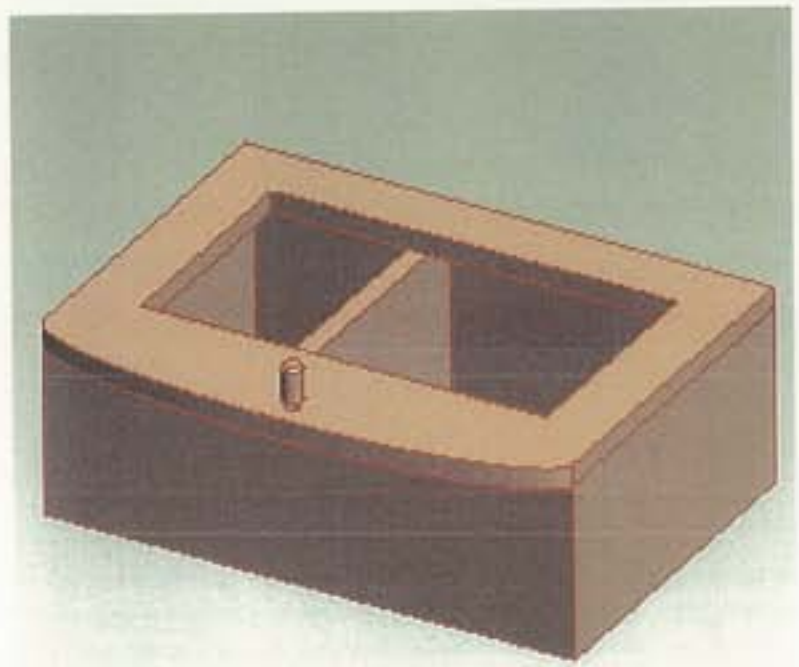
This storage case can tidy away all the products necessary into the case. However, the final idea developed in CAD only allows space for the Laptop, the iPod and room for extras such as a charger or headphones. As it has left out some of the unnecessary parts it allows the product to be lighter and easy to carry around if need be. Therefore it still meets the need of criteria point one to be portable and also follows point two of tidying products away.

Overall, the design follows 7/8 of the criteria points, therefore following the majority of the original idea. The missing point is smooth edges **(point 6)** which can be sorted in the manufacture process.

Section 3

Product Manufacture - Design Brief

You are to plan and manufacture a product provided for you in the form of a working drawing/s. Your manufactured product will be assessed to the following **criteria**, your box must be:



Criteria

- A rectangular 90o box
- Select and use a range of processes and materials
- Using working drawings, Built to a tolerance of 1mm (wood) and 0.5 (metal)
- Finished appropriately according to the materials selected

You should stick to the working drawings to produce the structure of the box, however, the design can be personalised and adapted to your tastes or the taste of a clients, as long as this does not jeopardise the original design of the box. For example :-

A toy box, an Ipod holder, a trophy box etc

On the following page is a set of working drawings, review these and use the table below to select appropriate materials and processes and justify why you will use them.

	Box structure	Lid	Handle	Interior of box	
Materials	Pine wood, 20mm thick. This is because it is very cheap and easier to machine.	3mm acrylic cut on the laser along with 20mm pine for outside structure.	Brass handle as it is easy to work and provides a nice aesthetic finish.	MDF for iPod holder Laser cut out to hold speaker Speaker cover 3mm acrylic	
Processes	Bon saw, sanding, tenon saw, chiselling, planing.	Laser cutting Engraving	Knurling, facing off, chamfering, parting off. Adding internal and exterior threads	Laser cutting Sand + Cut MDF to size + drill holes for pop riveting of holder.	
Finishes	Antique pine dye giving an old rustic image.	Antique pine dye	Laquer Spray to protect handle.	Make sure speaker circuit played correctly.	

Date	Mark out pieces of wood with dimensions of length	Cut down pieces to size of dimensions and now mark out the finger joints.	Chizle the finger joints down to length	Continue to chizle the finger joints and ensure that the pieces fit together.	Mark out the lid from the remaining wood and cut pieces usin ban-saw.	Cut 45 degree angular end to the lid and ensure it all fits together before continuing.	Using the milling machine to make rebate joint and other various joints.	Draw design on CAD along with creating lid insert using the laser and corel draw.	Mark out grooves on the lid pieces.	Use the circular saw to cut out grooves in the lid.
26th Jan										
2nd Feb										
9th Feb										
13th Feb	Half term	Half term	Half term	Half term	Half term	Half term	Half term	Half term	Half term	Half term
23rd Feb										

Date	Use the lathe to create the handle. Using parallel turning, chamferring, facing off, knurling and boring the hole.	Make internal thread in a brass tube to for handle.	Drill hole in the lid for the handle to be placed	Secure handle into tube using cut screw threads	PVA glue parts together and ensure gaps are filled, ensuring it is clamped.	Sand the final clued box and ensure it is completely smooth	Once the box has been sand fit rebate joint base and the insert in the centre from MDF.	Glue lid toegether with laser cut piece and ensure it is 90 degrees.	Fit all pieces together and add final touches to design and persolalisations such as a varnished finsih of mahogany.	After completion ensure it siuts the need wanted and evaluate.
23rd Feb										
2nd March										
9th March										
13th March	**Deadline**	**Deadline**	**Deadline**	**Deadline**	**Deadline**	**Deadline**	**Deadline**	**Deadline**	**Deadline**	

Gantt Chart

Production Plan

Operation Description	Process	Tools required	Materials	Quality Assurance Checks	Safety
Cut down pieces + finger joints.	Mark the pieces down to size and cut them and once they have been cut use a ruler to mark out 2x2 finger joints	Band-Saw to cut down pieces to size and then a chisel and hammer to create the finger joints	Wood- Pine	Check accuracy of joints and measure pieces to check they are correct size. Leave a little extra for error on ends.	Extractor fan for the band-saw along with safety goggles. For the chiselling ensure it is clamped and you chisel away from the body.
Making the lid.	Firstly, cut the lid pieces and mark out a 45° angle on each corner to ensure they fit correctly.	45° jig Band Saw	Wood- Pine	Make sure all corners and 90°	Extractor fan for the band-saw along with safety goggles. Use a 45° jig to push pieces into the saw to make sure fingers are kept safe.
Creating the groove on the lid pieces for the laser cut piece.	Mark the groove out using a ruler and then cut the slots using the circular saw.	Circular Saw Ruler	Wood- Pine	Make sure all pieces have the groove cut in the same place.	The technician must cut the pieces on the saw as to dangerous for a boy to use.
Making the laser cut insert	Create a drawing using Corel draw and then print it using the laser with a logo of choice.	Laser Computer	Acrylic Plastic 3mm	Make sure measurements are correct, do a possible test piece.	Make sure extractor fan is on when using the laser and the piece is focused.
Using the milling machine to make rebate joint and housing joint	Clamp the piece of wood onto the base of the milling machine using a T-Bar clamp and then accurately mill.	Clamps to secure wood. Milling machine	Wood- Pine		Make sure it is securely clamped in and wears safety goggles.
Use the lathe to create the handle: parallel turning, chamfering, facing off, knurling and boring the hole	Secure the brass into the lathe and turn the piece down to the correct size (12mm). Then diamond knurl the end for a nice finish and use other processes such as chamfering to make the final product look nice and then finally face off the piece for a smooth finish.	Centre Lathe	Brass	Make sure measurements are correct using the gauge on the lathe	Safety goggle must be worn.
PVA glue parts together	Apply clue to the insides of the finger joints evenly and then slot the pieces together using a clamp to apply pressure.	Clamp x 4 more if possible.	Tissue Paper Small piece of wood to apply glue.	Make sure any excess glue is wiped off and all gaps are filled, if need be fill any large gaps with a mixture of PVA and sawdust.	Wash hands after using the PVA
Sand the final clued box smooth	Use sand paper or the electric sander and sand the box to smoothed out and bumps etc. Box must be clamped into a vice.	Electric Sander Extractor	n/a	Have it level so all areas are covered equally.	If using an electric sander ensure the extractor fan is in use.
Fit rebate joint base with 3mm MDF	Use PVA clue and clamp the piece into place. Make sure it is cut perfectly to size.	Clamp	3mm MDF	Make sure the joint is equal and there are no gaps.	Wash hands after using the PVA
Glue lid together with laser cut piece and ensure it is 90°	This is very tricky and requires a special clamp and has to be done perfectly. Insert the lid piece and clue around it.	Tri-square to check 90° Band Clamp to make sure all pieces are tight when clued.	Laser cut piece from 3mm see through tinted blue plastic	HAS to be 90° so use a tri-square to make sure this is the case.	Wash hands after using the PVA
Apply an alpine finish to the final box.	Apply five coats to the box to give a nice alpine finish and remove any dirt.	Stain Disposable Cloth	n/a	Make sure box is clean before and it is not disturbed when drying.	Wash hands after using the stain, do not inhale fumes where possible and dispose of rag after.
Add final touches to design and personalisation's. e.g Creating speaker compartment and iPod holder along with speaker itself.	This involves screwing the lid to the box using a hinge and doing the final touches which involve a long process such as creating the speaker holder on the laser and then the speaker needs to be soldered together. The iPod holder must be riveted onto a piece of MDF and then sprayed with primer and then Gloss Black paint.	Soldering Iron Riveting gun	Solder MDF Acrylic Plastic 3mm	It is necessary to make sure it is aesthetically pleasing and suits the need for it.	When soldering ensure the extractor is on and that you are very careful when suing the soldering iron as it can burn easily.

Workshop jackets must be worn at all times in the workshop and be done up.

Making Diary

Marking out the wood for length and sizes of finger joints using a tri square and a 30cm ruler.

Cut the pine to the length of pieces needed using the band saw, wearing goggles and a safety jacket. Occasionally I used a guide to get perfect straight lines.

Clamp the pieces to the bench and cut using a tenon saw the end of the finger joints. I placed two pieces of MDF between the pine and the clamp to stop damage.

Dividing joint up into small pieces making it easy to chisel. I did this using a tenon saw.

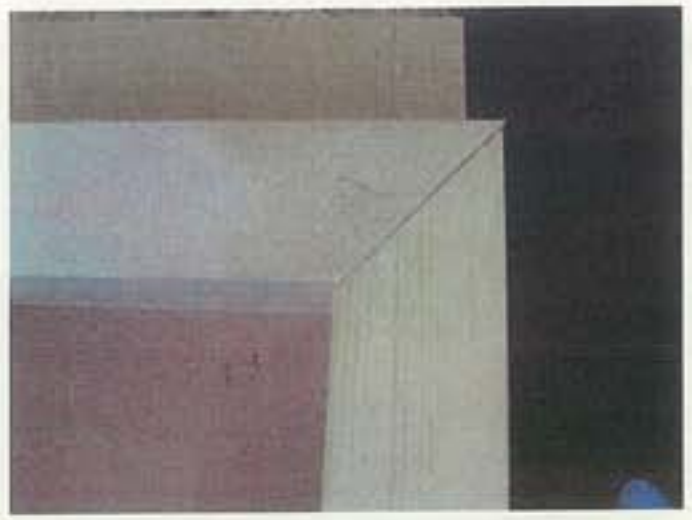
Clamp the piece of wood to the bench using MDF either side to ensure it doesn't get damaged. Then I chiselled the piece down to a flat finish.

Once all the finger joints were created I made sure all the pieces fitted together correctly. **This was very difficult and I had to redo a piece to ensure there were no gaps bigger than 1mm.**

I marked out the mitre joint using a mitre square to ensure the joint was 45° and marking the line on with a pencil.

Cut the mitre joint out using a 45° jig on the ban saw to ensure perfection with each piece. I did this because it prevented my fingers getting to close to the blade and also meant all my pieces followed the same line.

Using the 45° mitre joint I cut the pieces on the ban saw.



To ensure the lid fitted together correctly it was necessary to slot the pieces together to ensure the corners made 90°

I clamped the edges of my box to the milling machine to create my housing joint and my rebate joint. **For the rebate joint it was very easy to go to far and therefore I had to fill one end of the piece with a tiny piece of wood and sanded that down.**

I developed my ideas using a C.A.D program called Google sketch up. This was very tricky but after a while I got the hang of it and created lots of different angled drawings.

I then marked out the groove using a marking gauge and a tri square. This was easy as after I had marked one the other followed the same line on the circular saw so it was not necessary to mark them all.

I then asked the teacher to cut my groove using the circular saw as boys are not allowed to use this machine as it is to dangerous.

I went on to use the lathe to create my brass handle piece. Parallel turning is the correct name for this.

The diamond knurling was done with a knurling tool at a lower speed than before.

The last process is always parting off. We part off to divide the work from the rest of the material.

Before cluing the box together I made sure all the pieces fit together and it looked aesthetically pleasing.

I then clued the box together using PVA glue and clamped it together using an adjustable clamp, but made sure that the box was protected using MDF.

Once the box had dried I fitted the rebate joint with 3mm MDF cut to size. **This was tricky and involved using a chisel to level off some of the edges.**

An external thread was made using a split die in a die stock. **This was a very slow process as it could only be done once and had to be perfect**.

I then went on to use a Pillar drill to make the hole for the brass handle. I clamped the lid piece down but once again using MDF to stop damage.

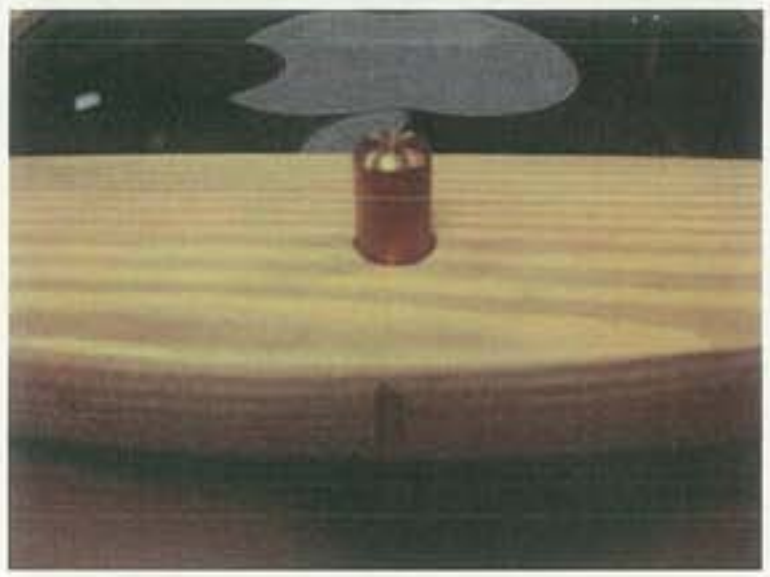
I cut the lid using the laser and engraved an apple logo on the dark blue piece**. This had to be cut twice as the first laser cut piece did not fit correctly.** Then again using the laser I cut the insert for the inside of the box which held the speaker and its components.

When cluing the lid I slotted the acrylic lid inside and used a band clamp to make sure it stayed tight when setting. I wiped off any excess glue for a smooth finish.

I sanded the box using two methods: Firstly by using an electric hand sander to make the ends of the finger joints level and get rid of any large unevenness and then once I had done that I sanded it by hand using normal sand paper and then wet and dry paper to provide a very smooth finish at then end. **I had to make sure if I was clamping it was protected by MDF as if not there would be dents and scratches.**

I then went on to creating the inside of the box and at this point decided to make a holder for my iPod. This consisted of making a slot in MDF and then pop riveting the plastic holder onto the MDF. I used this electric sander to angle the MDF so it slotted in nicely.

I went onto applying a stain to the box using an old rag and this was one of the final touches to the box. I rested the box on a piece of MDF to make sure that the chances of any more scratches was reduced.



After making the internal thread I clued that into the hole in the lid and made sure it was level before screwing in the brass handle.

I screwed the butterfly hinges onto the back of the project along with creating a hole for the battery compartment of the speaker to sit.

The box was completed and now I added the final touches of wiring up the speaker to make sure it worked and then produced the speaker cover and made sure the inside was to a high quality finish.

Section 3 - 3rd Party Evaluation and Evaluation of Product




Quality of Components

I feel the hinges work really well for the project and fit perfectly. I am pleased I used a butterfly hinge rather than a continuous hinge as it provides a more aesthetic feel to the box. The handle is smooth and has been diamond knurled to a good standard as there are no burrs, apart from one dent which happened when I clamped the project. The speaker components have been soldered to a high quality of safety and are hidden from view so they cannot be touched causing electric shocks.

Quality of Finish

I used wet and dry sand paper to finish the box to a smooth feel, which worked really apart from on the lid which had a slight indent which was impossible to smooth over. After this I used an antique fine stained finish which I am really pleased with as it gives an old style look to the edges of finger joints and to the overall box. I feel the laser cut piece in the lid looks really good with the stain, however unfortunately it has a few scratches due to it being moved around so much.

Dimensions and Accuracy

I used callipers and a tri square to check my box met the measurement in the working drawing. I checked the handle which fits the measurement perfectly however the box is slightly under the 30mm limit but is within the 1 to 2mm tolerance.

General Analysis

Overall I felt the box was a success with little flaws and if so they were very minimal. I felt the box was on overall success especially as i included a speaker into the design. As you can see below it was a success in my third party evaluation with Luke:

Material Changes?

If I was to redo the box I would use a hardwood such as oak or ash. This is because these are less prone to splitting in the chiselling process. Hardwoods provide a better finish with better aesthetic qualities and can be worked harder.

Luke testing the box as a whole thing to see if joint s were good etc.

How easy is it to store the iPod and play music?

Luke thought that product was capable of storing the iPod nicely and it fitted snug into the holder. He said that it was easy to play the music to a certain level when it started to crackle, but the level was high enough to enjoy the music being played.

Would there be anything you would like me to change?

Luke told me that if I was to redo it he would like it to be mains power so that he would not have to keep buying batteries and it would also mean the volume could be louder which he said he would prefer.

What did you think of the finish?

Luke told me he like the antique pine stained finish as it gave a rustic look to the box, he also felt it was very smooth round the edges as the finger joints slotted 'almost perfectly'.

Are there any safety issues with the box?

Luke thought the box was people friendly and all the electronics were hidden away so that they could not be damaging to human health and therefore he came to the conclusion that the box has no safety issues.

What is the best thing about the box?

Luke told me that he really like the way I incorporated a speaker into the project and he felt it makes it stand out from the rest.

Finally, do you think it will withstand everyday usage?

Luke thought the box was a bit weak at the hinges and was worried they may not support he use everyday, apart from that Luke listened to the music for a good period of time and felt it supported his needs.

Luke testing the speaker system for sound and to see if it actually worked for his needs..