BLÜHEN

INTRODUCTION

Bluhen is a sub-brand of Bosch which creates gardening products for people with mild to serious physical impairments. We were given the brief of designing either mechanical or electronically powered tools using either already existing mechanisms or orignal ones as well as the use of commonly selected components such as motors/switches. Our brand aims are to create a range of products which make the process of completing a gardening task easier for the user.

This report contains information about each member's product and how it would be made on an industrial scale. The unit scale is between 50'000-100'000 units, however most of us aimed for 100'000 units. Each chapter contains information about the product overview, manufacturing processes and their settings, stress analysis, costings as well as a flow diagram showing the chronological order of how the product would be manufactured and assembled ready for testing/use.

GROUP MEMBERS

Katie Price	1606285
Andrew Gardener	1603887
Jack Day	1602243
Luke Tolchard	1612312
Ben Younger	1610003

PROJECTS

Grass Seed Broadcaster

Bluhen Wrotter

Automatic Cultivator

Weeder

Dibber

BLÜHEN

WEED REMOVAL TOOL

INTRODUCTION

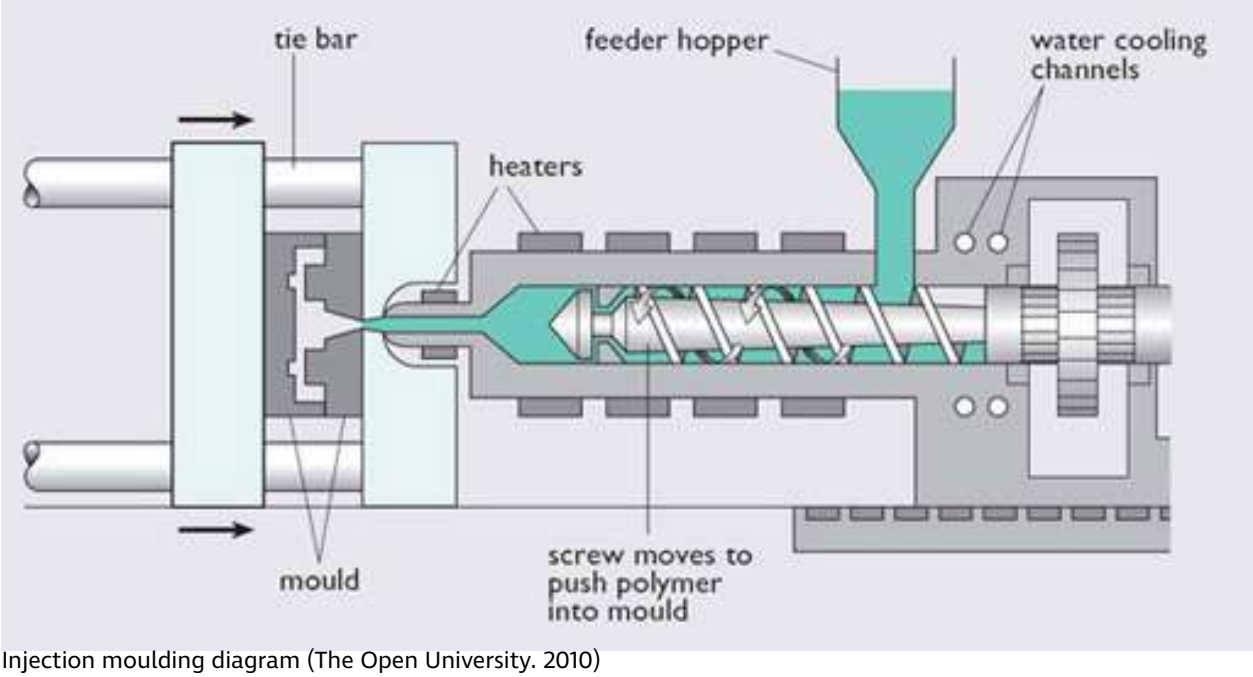
LUKE TOLCHARD - 1612302

The product that I'm creating is a Weeder. The purpose behind this product it to make gardening fun and engaging again for the older generation who may or are limited by their motor movement (whether that's joint and muscle pain) or limitations physically i.e. disabilities. The function of the product consists of two handles, a housing for the motor and gear box which in turn, turns a coil (something similar to an auger bit). In this DFM report I shall be outlining the materials, manufacturing methods, costings, and more to reflect my product and the features that go into making it.

The core function behind this product is to aid/assist the user in gardening. The general idea behind such product is to remove the physical barriers that limit the person(s) from gardening. The product intent is to help with the removal of weeds. (It's important to note that the most efficient way to completely remove weeds is by either removing the soil and surrounding area or by using flames (i.e. a blow torch) to burn the vegetation). This product like all other 'weed removal tools' are only a temporary solution, however, this product is intended to remove as much of the weed as possible by genially gripping the soil and thus the plant and then by pulling up, non-aggressively, you maximise the amount of plant you pull out.

MANUFACTURING PROCESSES

My product will be utilising the same manufacturing process for a large portion of its components. This should help to simplify the manufacturing process as well as material requirements.



Injection moulding diagram (The Open University. 2010)

All the plastic components of my product are **injection moulded** [**IJM**]; the rubber grips will be **overmoulded** [**OVM**] it's basically the same process as IJM. each component that is manufactured should take within 10 seconds from injection to ejection. From this there shall be a basket next to the machine for the components to fall into to. This will then be transported to the next stage of manufacture which will be the assembly of the product.

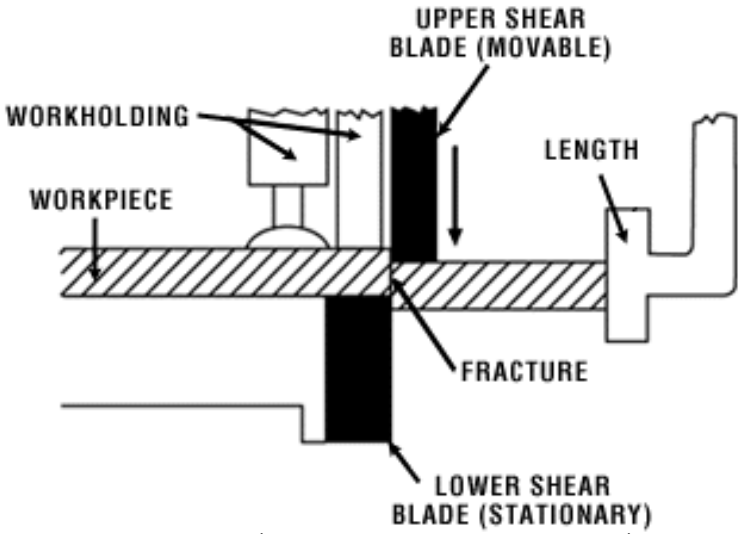
Sheet metal feeder (Alibaba. U.D) Stage 0

The **connectors** are the only in-house made components that require metal and thus the manufacturing of it requires a '**Sheet Metal Strip/Coil Feeder**'. This apparatus holds the metal sheet (several tonnes of it) already at the correct thickness and width and uncoils it into the first machine. By having an external company cut the sheet metal and wind it up removes many manufacturing processes that I would otherwise need. This easy and effective way of distributing the metal as it is needed removes the need for several employees to manually feed the metal into the first machine.

Lip formation process (KRRASS. U.D)

Stage 1

The '**Flange Forming Machine**' is the first stage of production for the **connectors**. This will create a continuous lip on one edge of the sheet metal that's being fed into it. The process of this is to create the lip which secures the connectors to their respected places (in the Weeder Body and the Weeder Handles). The beauty of this process is that over time the wheels which form the lip will wear out but as these are modular you can replace the fatigued component as needed.

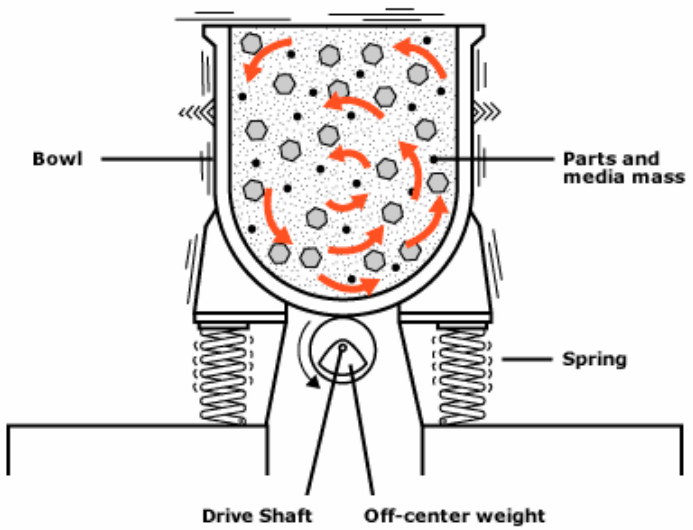


Metal shearing diagram (Advantage Fabricated Metals. U.D)

Stage 2

The second stage of production is the '**Shearing/Cutting**' process which does what it says on the tin. This machine will cut the continuous metal sheet into the desired length. This machine works by moving the cutting blade at the same speed that the '**Feeding Wheel**' (step 0) is feeding the material into the system i.e. if the sheet is being fed in at a rate of 3mph then the blade will horizontally move and therefore cut at 3mph. Like if the metal was stationary the metal still needs to be held in place when cutting which is the function of the '**Workholing**' pads.

The final stage before assembly for the connectors is to clean up the edges and polish them. This can be done in one machine which is a '**vibratory tub machine**'. This machine uses ceramic pieces and a cleaning agent which as the machine vibrates this shakes everything inside the tub and, therefore, the **connectors** and ceramic make contact. As the ceramic is harder than metal the ceramic act the same as sandpaper and removes of any burs and polishes at the same time. This process doesn't alter the dimensions of the component, to make it so you have to experiment with time the components are left in the tub before you can guarantee complete deburing and polished. After this process the components would be left to dry in a drying rack.



Cleaning of parts (Product Finishing. 2001)

Stage 3

MATERIAL SELECTION

WHAT MATERIAL FOR THE ELECTRICAL CONNECTORS?

A PDF from '**elandcables.com**' (Eland Cables) describes the best type of aluminium for conducting electricity. The PDF lists all the general information that one would expect from cables like 'Electrical Resistance' over a given distance, however I can ignore this as I don't need a lot. The one from the PDF that stands out for me it's code word is '**Peachbell**' this is because it will be the cheapest material from the **ASTM - B 231** list due to it having the lowest allowed ampancity = 103, but it's still an '**A**' classed material. **AAC–ASTM-B 231 Aluminium** for best electrical conductance with high resistance to weathering - this material is used in cabling mainly in urban areas also used in coastal regions due to its high degree of corrosion resistance. This is what I need as it's a requirement for garden electrics to have good weather resistance.

WHAT MATERIAL FOR THE BODY AND HANDLES?

Creative Mechanisms have a great segment on ABS. What's important to recognise from this that the shrinkage of ABS is 0.50% - 0.70% (**SI Metric**) so moulds will have to account for this. Furthermore, ABS is standardised so the properties will near-enough be the same from every manufacturer of this material so I can go with the cheapest at the time to same money.
ABS has a good tensile strength at 46 MPa and flexural strength which is 74 MPa, moreover, the weather resistance is fantastic with it also being non-toxic which is why the DIY industry use so much of it instead of exposed metal. The melting temperature is low (compared to other materials) which means the injection moulding machine doesn't have to work as hard to get it to its plastic state (where the screw widens) and the cost of keeping the injection unit warm/hot won't be as expensive to keep reducing energy bills.

WHAT MATERIAL FOR THE GRIPS?

Custom Rubber Corp have a list describing the different materials for grips and by looking at the table they have created I can easily distinguish that '**Silicone**' is the best option for the fact that it has 'Good' abrasion resistance and the grip/feel is 'Excellent'. Silicone also as the benefit of being suitable for **injection moulded** which helps to simplify the manufacturing process and moudling as it can be **overmoulded** onto the handles. Finally, it's also weather resistant along with being Ozone, Ultraviolet, and abrasion resistant.

COMPONENT	MATERIAL	PROCESS	REASON
Handle	ABS	Injection Moulding	Quickest and most efficient way of manufacture for these parts. Also repeatability and accuracy is extremely consistent
Body			
Trigger			
Release			
Coil holder			
Motor holder			
Gearbox casing			
Coil cover			
Grip	Silicone	Overmoulding	Best way to form the grip
Power connector	Aluminium ASTM - B 231	Cutting & Flanging	First need to cut the shape out and then role-over the one end
Coil	High Carbon Steel	n/a	Bought in components. No need to invest resources into this process
M3 Screws (20mm)	Low Carbon Steel	n/a	
Bearing	Stainless steel	n/a	
Switches	n/a	n/a	

SPECIFICATION

1. PERFORMANCE

1.1 The product must be ergonomic and comfortable for extended use
1.2 To be able to perform at the same standard throughout it's service life
1.3 To be easily understood with useful semantics
1.4 Must be portable
1.5 Have replaceable components for quick maintenance without the need for a professional
1.6 Electronics shall not fail with expected use of the tool

2. ENVIRONMENT

2.1 The product will be used outdoors.
2.2 The product will be able to function in all weather conditions
2.3 The withstand being left in damp and cold conditions for prolonged periods
2.4 Must work in mud (dry or wet)
2.5 Must not be toxic

3. SERVICE LIFE

3.1 A average power tool which is well maintained and from a reputed brand should last between 10 - 13 Years
3.2 Depending on how often the user cares for their garden the product could be used once a week for 1 - 3 hours at a time. This equates to a minimum of 520 hours of use, or, a maximum of 2,028 hours of use
3.3 The corkscrew should last the user a minimum of 2 - 3 years with proper maintenance and care
3.4 Batteries will need to be changed every 2 - 3 years for maximum efficiency

4. PRODUCT LIFE SPAN

4.1 A average power tool which is well maintained and from a reputed brand should last between 10 - 13 Years
4.2 Depending on how often the user cares for their garden the product could be used once a week for 1 - 3 hours at a time. This equates to a minimum of 520 hours of use, or, a maximum of 2,028 hours of use
4.3 The corkscrew should last the user a minimum of 2 - 3 years with proper maintenance and care
4.4 Batteries will need to be changed every 2 - 3 years for maximum efficiency

5. MARKET PRICE

5.1 bosch sell their products at x4 the cost of manufacturing. I will aim for something lower (2 - 3 times the manufacturing costs). This is because it's a sub-brand and not a Bosch named product`
5.2 Raw materials + Processing + Fabrication = Manufactured Cost (No more than 50% of retail cost)

6. MANUFACTURING

6.1 The materials that are used in the manufacturing stage shall come reliable sources
6.2 Materials must have recycled components in them to help save the environment

7. SAFETY

7.1 The product will have a built in safety feature that detects electrical faults
7.2 A way to protect the tip of the corkscrew when it's not in use
7.3 Be able to withstand hard impacts - be dropped from 1.5 meters
7.4 Protect the user from electrical components and a way to protect the battery from overcharging
7.5 If motor breaks the casing must contain any high velocity fragments

8. PAYBACK PERIOD

8.1 An expected payback period of 3 years with the current market and efficient advertisement

9. DISPOSAL

9.1 The product will have a disposal section within a manual that comes with the product on how to properly dispose of individual parts

10. WEIGHT AND SIZE

10.1 Not to be larger than a standard cordless power drill
10.2 Body to be no smaller than 120mm x 80mm
10.3 Weigh no more than 1.5Kg

11. ELECTRONICS

11.1 Not to be larger than a standard cordless power drill
11.2 Body to be no smaller than 120mm x 80mm
11.3 Weigh no more than 1.5Kg

12. QUALITY CONTROL

12.1 Every 1,000 component assemblies shall be subject to testing (BSI and CE)

13. STANDARDS AND LEGISLATIONS

13.1 Will conform to the relevant standards that outlines power tools, batteries, motors, manufacturing, etc.
13.2 IP Protection 65 for dust and water protection

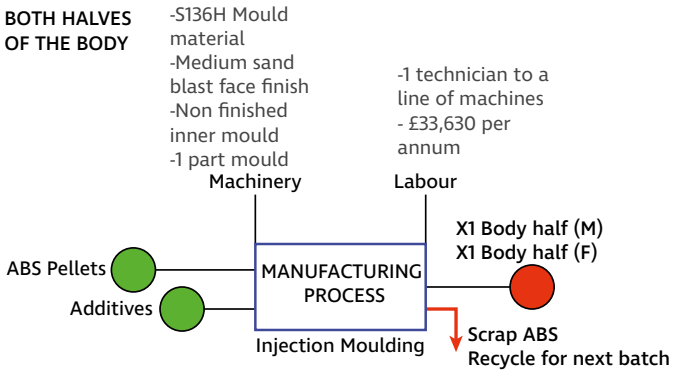
14. HUMAN FACTORS

14.1 To fit the 50th and 5th & 95th percentile hand size category
14.2 The materials that are used must be non-toxic
14.3 Shall be light enough for users ages 50+ to hold the product for a sustained period of time

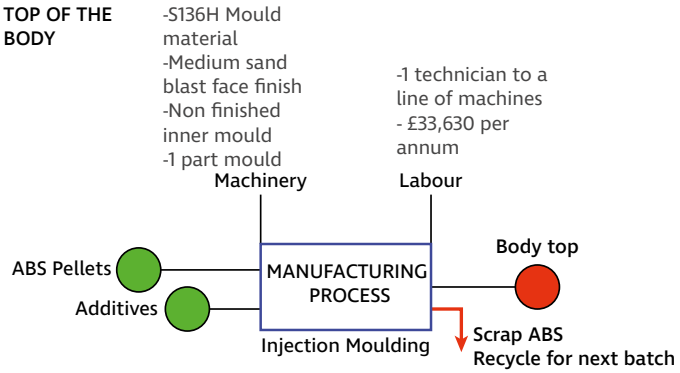
MANUFACTURING PROCESS

Manufacturing of the Body

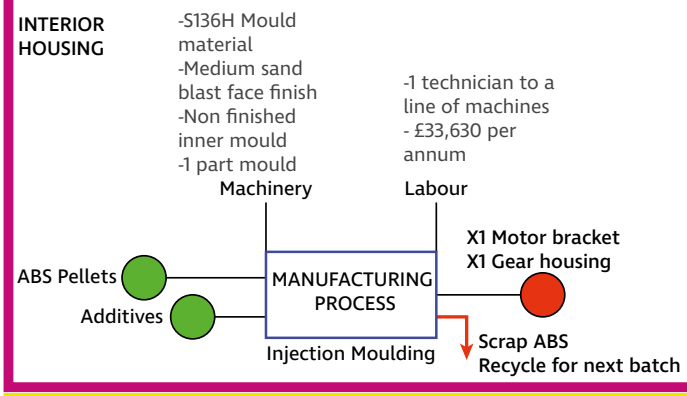
BOTH HALVES OF THE BODY



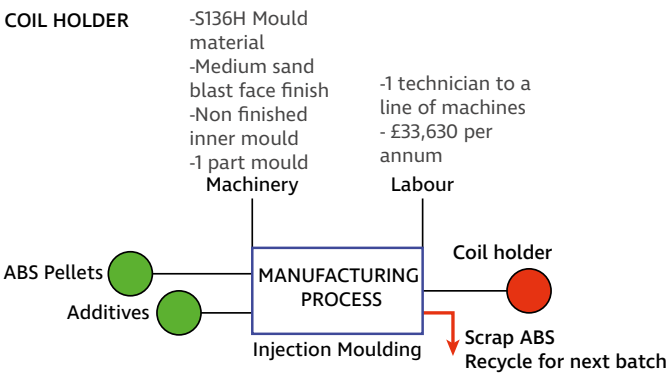
TOP OF THE BODY



INTERIOR HOUSING

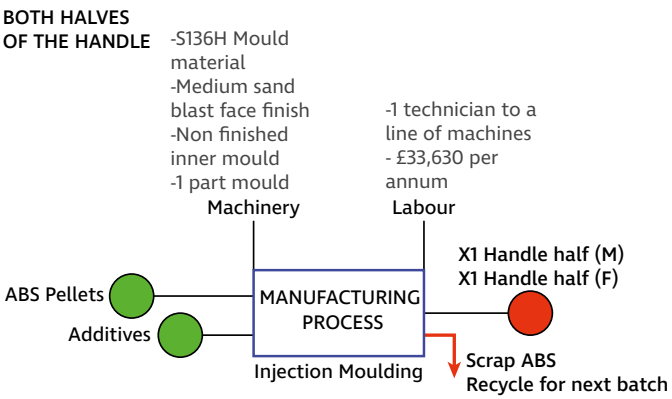


COIL HOLDER

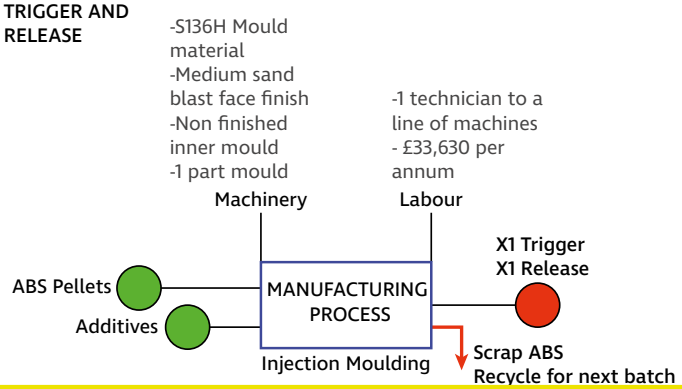


Manufacturing of the Handles

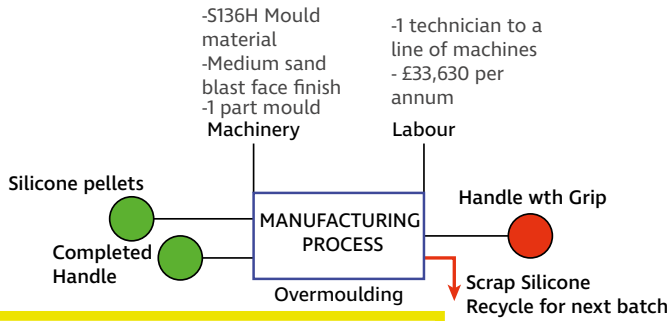
BOTH HALVES OF THE HANDLE



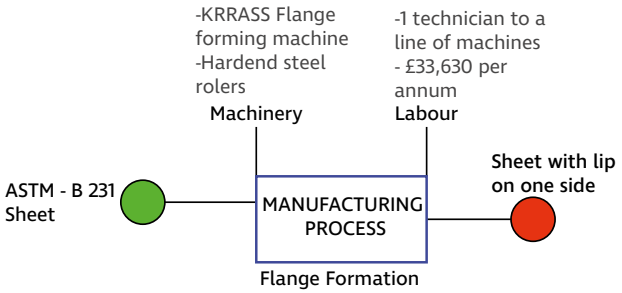
TRIGGER AND RELEASE



GRIPS

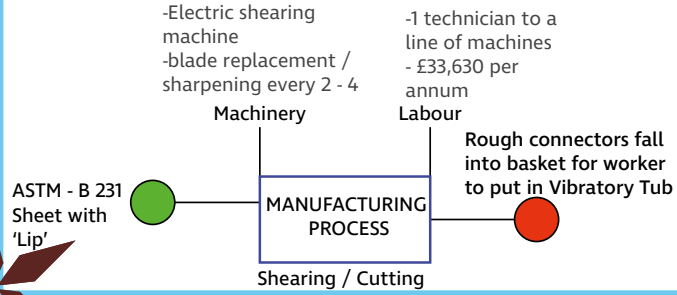


POWER CONNECTORS STAGE 1

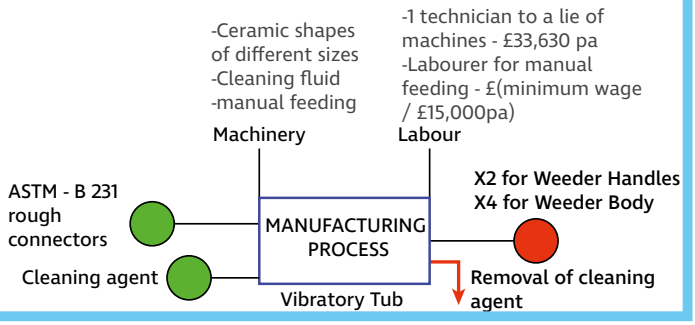


Manufacturing of the Power Connectors

POWER CONNECTORS STAGE 2

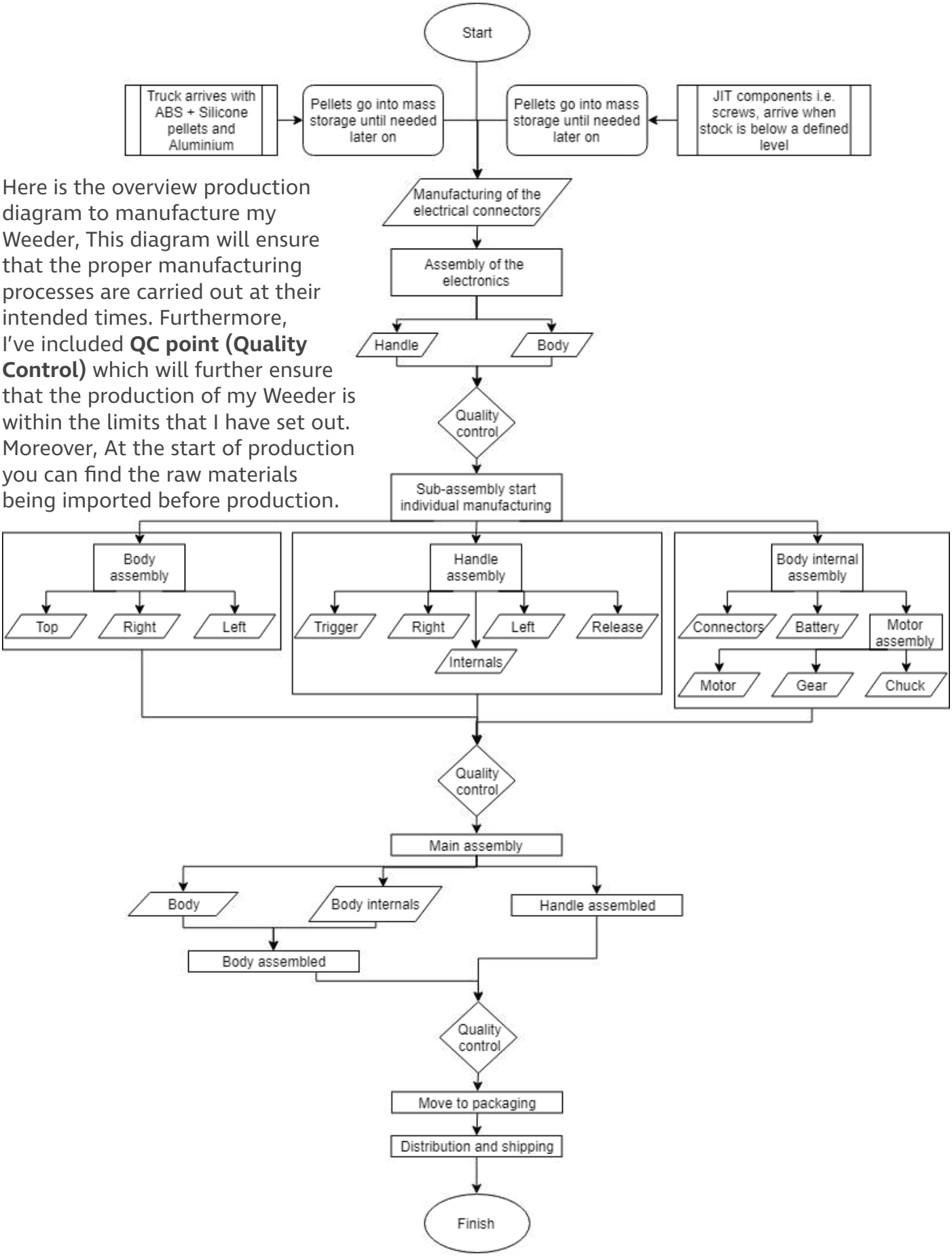


POWER CONNECTORS STAGE 3

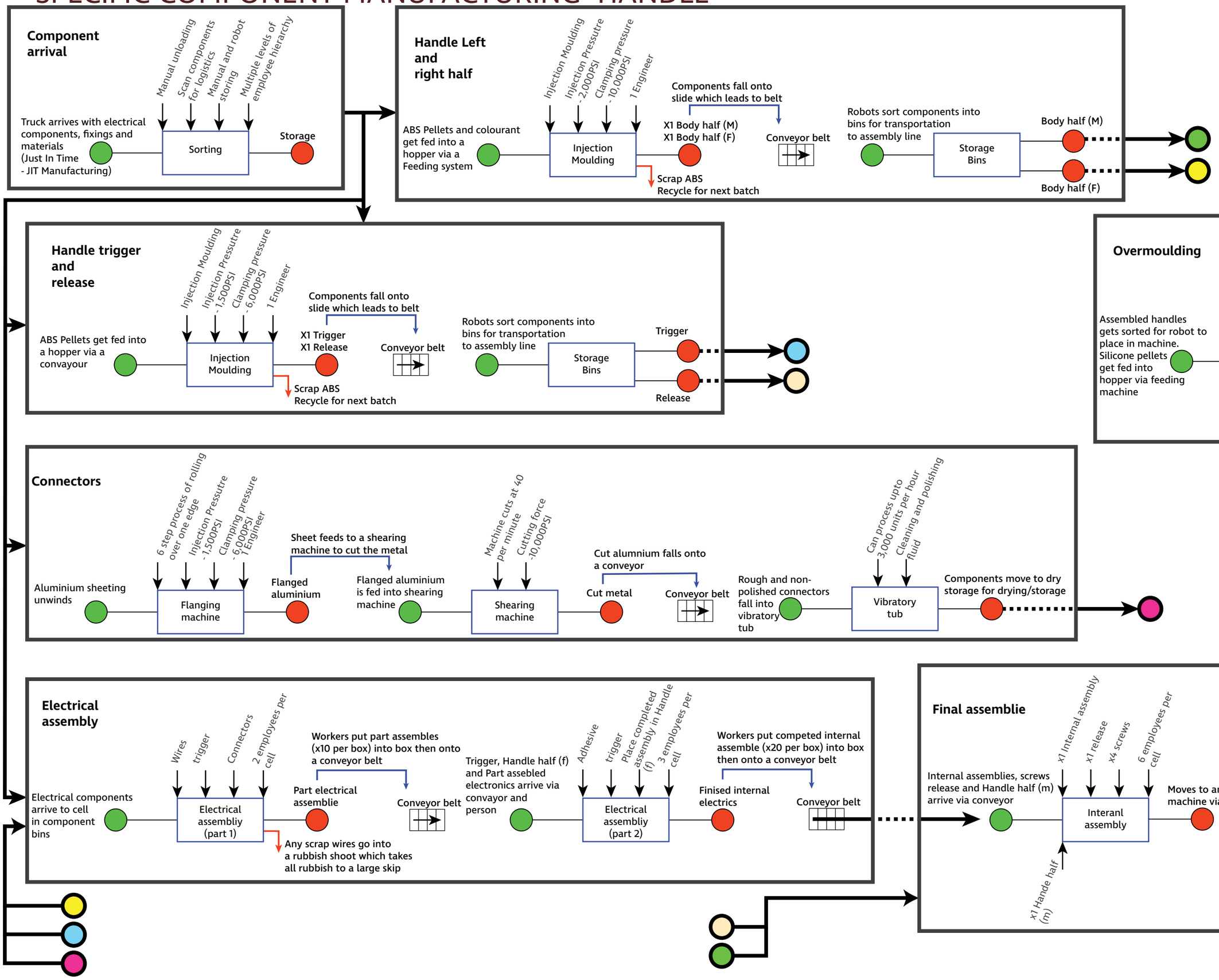


FINAL ASSEMBLY

Here is the overview production diagram to manufacture my Weeder, This diagram will ensure that the proper manufacturing processes are carried out at their intended times. Furthermore, I've included **QC point (Quality Control)** which will further ensure that the production of my Weeder is within the limits that I have set out. Moreover, At the start of production you can find the raw materials being imported before production.



SPECIFIC COMPONENT MANUFACTURING- HANDLE



COSTING

Number of units being produced	100000.00

Manufacture - Injection Moulded - Included material costing (ABS & Silicone)					
Part	**Production cost (£)**	**Tooling cost (£)**	**Number of units**	**Total price (£)**	**Price per part (£)**
Handle (m)	£1.91	£4,362.00	200000.00	£386,362.00	£1.93
Handle (f)	£1.98	£3,331.00	200000.00	£399,331.00	£2.00
Body top	£3.94	£7,553.00	100000.00	£401,553.00	£4.02
Body left	£2.00	£4,881.00	100000.00	£204,881.00	£2.05
Body right	£2.00	£4,945.00	100000.00	£204,945.00	£2.05
Coil holder	£1.50	£1,645.00	100000.00	£151,645.00	£1.52
Motor bracket	£1.56	£1,230.00	100000.00	£157,230.00	£1.57
Gear housing	£1.52	£1,200.00	100000.00	£153,200.00	£1.53
Trigger	£1.58	£1,689.00	200000.00	£317,689.00	£1.59
Release	£1.42	£1,105.00	200000.00	£285,105.00	£1.43
Grip	£2.00	£2,000.00	200000.00	£402,000.00	£2.01
TOTAL					**£21.69**

Alumnium					
Materials	**Price per metric ton (£)**	**Amount per year**	**Total (£)**	**Price per part (£)**	**Price per Weeder (£)**
AAC–ASTM-B 231	£2,000.00	30	**£60,000.00**	£0.08	£0.60

Bought in components				
Part	**Price (£)**	**Number of units**	**Total Price (£)**	**Price per Weeder (£)**
Coil	£3.42	100000.00	£342,000.00	£3.42
Motor and Gear	£9.88	100000.00	£988,000.00	£9.88
Switch	£0.83	200000.00	£166,000.00	£0.83
Batteries	£0.38	100000.00	£380,000.00	£3.80
Bolts	£0.02	100000.00	£23,800.00	£0.24
TOTAL			**£1,899,800.00**	£18.17

Employees			
Job Type	**Wage per annum (£)**	**Amount**	**Total (£)**
Engineer	£33,630.00	12	£403,560.00
Technician	£22,884.00	5	£114,420.00
Labourer	£15,000.00	5	£75,000.00
Manager	£35,513.00	3	£106,539.00
Cleaner	£12,000.00	6	£72,000.00
TOTAL			**£771,519.00**

Warehouse - Location - FIFE, Scotland			
Price Per Square Foot (£)	**Amount needed (sqf)**	**Land per acre (£)**	**Total annum (£)**
£2.00	10,000.00	£50,000.00	**£70,000.00**

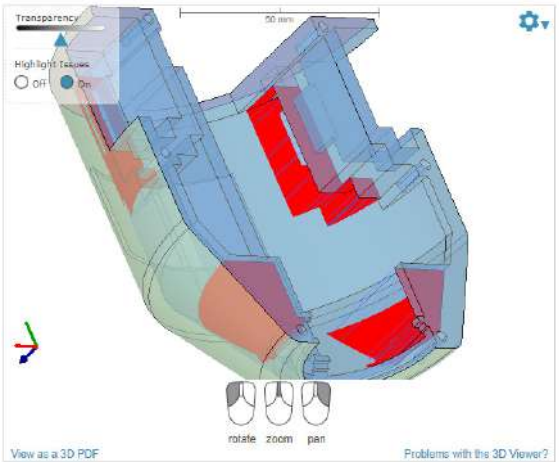
Utilities			
Water and sewerage (£)	**Electricity (£)**	**Gas (£)**	**FINAL PRICE (£)**
£3,035.97	£7,250.00	£1,450.00	**£11,735.97**

Totals			
GRAND TOTAL	£2,813,054.97	£1,084,348.75	**£3,897,403.72**
Selling price per unit			**£38.97**

Product selling price					
Manufacturing (£)	**Product mark-up (%)**	**Mark-up price (£)**	**FINAL PRICE (£)**	**PROFIT (£)**	**OVERALL PROFIT (£)**
£38.97	30.00%	£11.69	**£50.67**	**£11.69**	**£1,169,221.12**

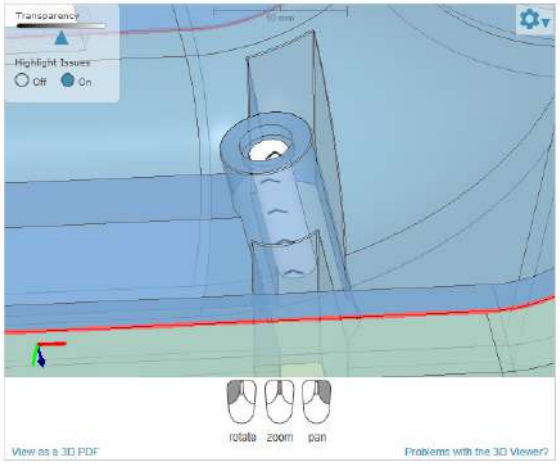
I'm planning on manufacturing 100,000 products and here is the costing of all that. The end manufacturing costing is **£38.86** which may seem like a lot but I'm purchasing a large amount of these components as a **general consumer** instead of a **business/industry consumer**. If I were to purchase most of these components as an industry consumer I would be looking at a reduced price for components like the **Motor and Gear** and **Coil**. I maybe looking at a reduced price of around 10% - 20% which in turn means my product could cost around **£35.07 (-10%)** or **£31.18 (-£20%)**.
My choice of location is very justified because **Fife, Scotland** is a coastal region along the East of Scotland. This makes it easy for shipping of products and materials to and from different countries and will help to reduce the environmental impact of my product as shipping products is more cost effective then flying. Also Fife has good roads and rail systems which can further help the importing and exporting of components/materials/products.

MANUFACTURING CORRESPONDENCE



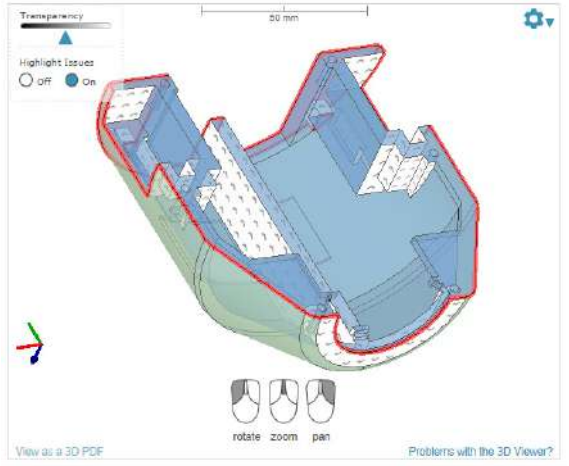
UNDERCUTS

The Weeders body has this issue with both halves. The product may need to be redesigned or if I increase the complexity of the mould (this will directly effect the costing of the product). To combat this I could do one of two things. Either redesign the entire body so that I don't have the effected areas, Or, I could include holes and cut away areas which make it easier for the mould to access these effected areas. The adjustment is fairly simple however this will add complexity to the model.

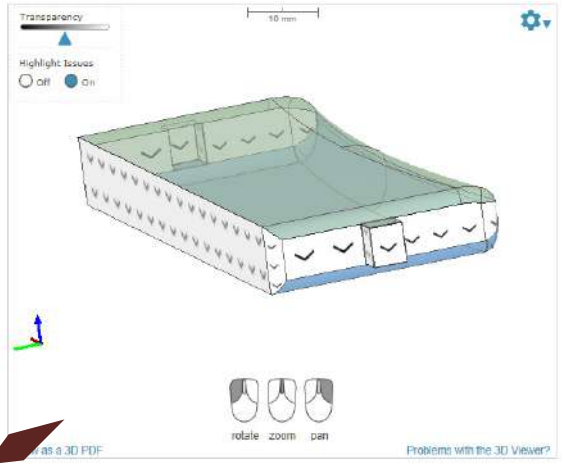


DRAFT ANGLES

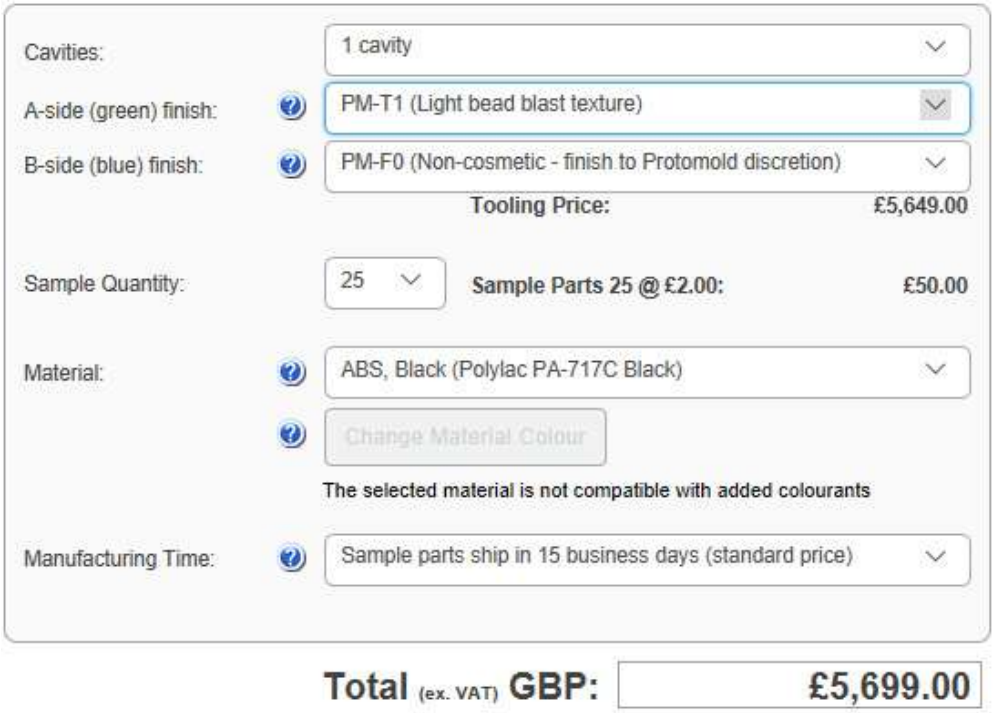
The handle and body are connected via M3 Screws and they need to have enough material to grip onto. I can't have too steep of a draft angle as then the screws wont go all the way in. This will eliminate any draft angle over 1° so to be safe I'll be using an draft angle of 0.5°. This should give the screws enough material to tap into whilst also allowing the screws to go as deep into the hole as it needs to for a secure fit.



The body again as an issue with draft angles which are all the areas where it's straight (mainly the centre rib and the areas where the handles go into). These are easy fixes by adding the steeper draft angle, something like 1° - 2°. The exterior facing surfaces will have to have a shallower draft angle, something like 0.5°. This is because I need a tight fit between the handle and the socket that it fits into (because of IP Protection 65). The bottom of the housing (the area where the coil holder fits) will also need to be a very shallow angle as I need this area to be as flat a possible. I should be able to get away with a maximum draft angle of 0.5°.



The trigger is another example of draft angles. Ideally I would like this as flat as possible so a suitable draft angle of 0.5° should do the trick. The extruded parts on either side can have a higher draft as they are hidden within the handle, same goes for the top of the trigger where a steeper draft angle can be used thanks to it being hidden. The only area that needs to be cosmetically correct is the lower half (under the extrusions where the fingers go). This will need as previously stated a shallow draft angle of 0.5°.

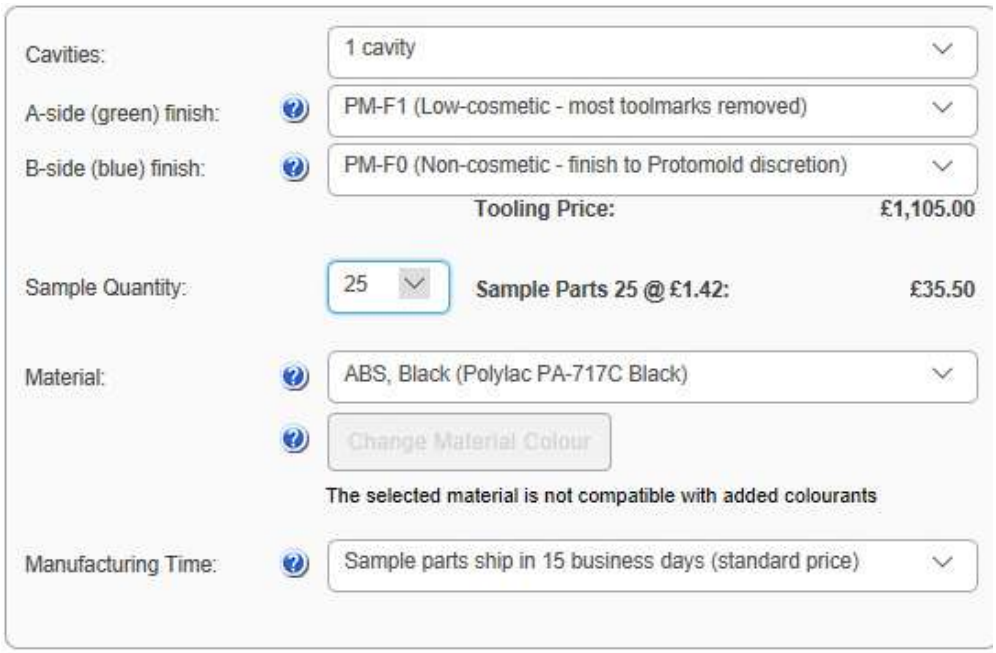


Production Parts Calculator

This calculator shows estimated piece part pricing for future production orders.

Qty 1,000:	£2.00 ea	Custom Lot Size Pricing		
Qty 3,500:	£2.00 ea	Enter Lot Size:	5000	Go
Qty 5,000:	£2.00 ea	Qty 5000:	£2.00 ea	

Add £333.00 setup charge to each lot of production parts.



Production Parts Calculator

This calculator shows estimated piece part pricing for future production orders.

Qty 1,000:	£1.42 ea	Custom Lot Size Pricing		
Qty 3,500:	£1.20 ea	Enter Lot Size:	5000	Go
Qty 5,000:	£0.98 ea	Qty 5000:	£0.98 ea	

Add £333.00 setup charge to each lot of production parts.

COSTING OF MAJOR COMPONENTS

I was presently suppressed to see that the body came in at £2.00 per unit (the same apples for the other half of the body.

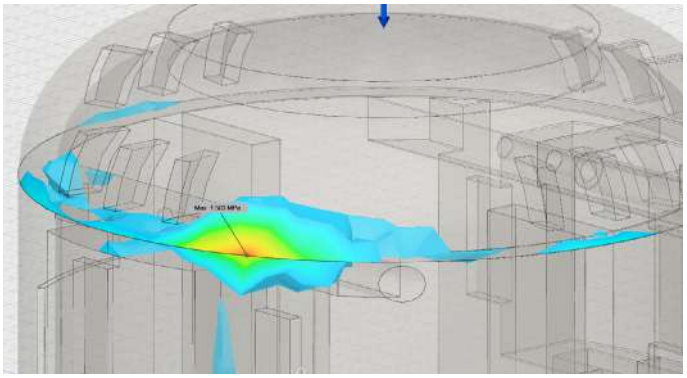
I have decided the following finish will suit the product as most garden tools are textured. This helps to hide scratches and gives the product a more premium feel to it. I have also applied the same to the handles for consistency. Both components have the same finish. I decided on a non-cosmetic finish for the interior as noone is going to see it (this saves money).

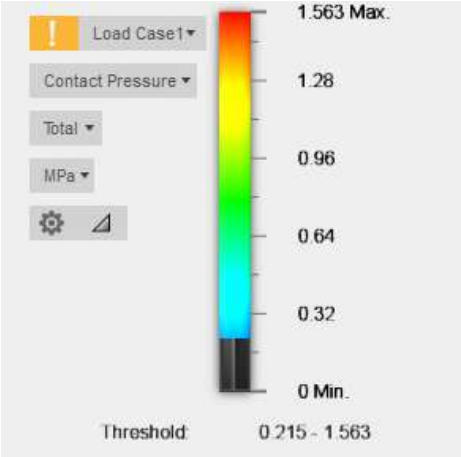
COSTING - TRIGGER

I was shocked to see the amount that a small component like the trigger release costs to manufacture. Even with low and non-cosmetic finishes it still costs £1.42 per component which is unsuitable for mass manufacturing.
I believe that Protomold is putting a high tax on the creation of this product as I believe it should cost between 5p - 15p per product. Also I cannot seem to adjust the number of products being produced with each cycle. Finally, I would have to adjust the design so that I can reduce the costs of the manufacturing.

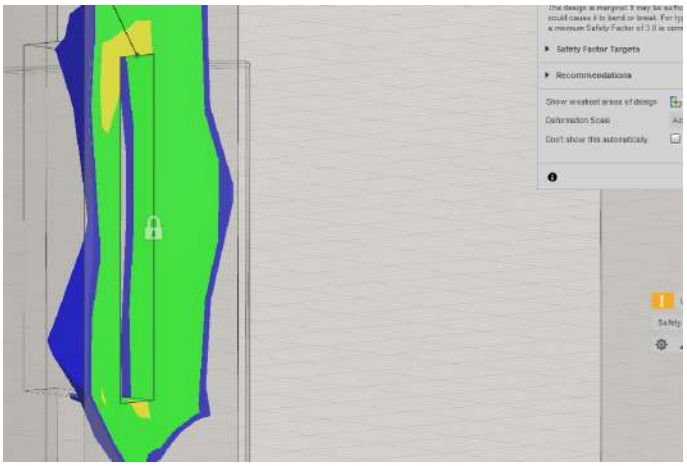
VIRTUAL TESTING

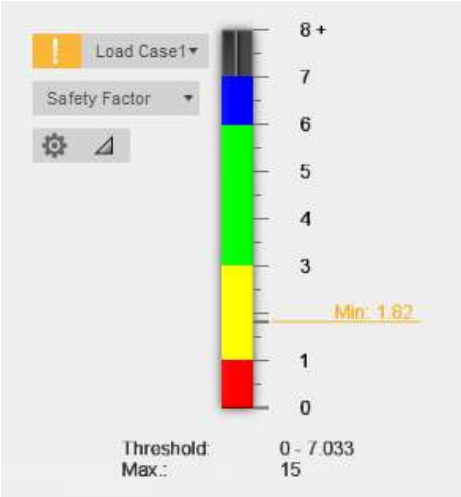
All of the following testing uses 100N as the standard force; the force is coming down from the top and from either side of the body. This is to simulate maximum expected forces.



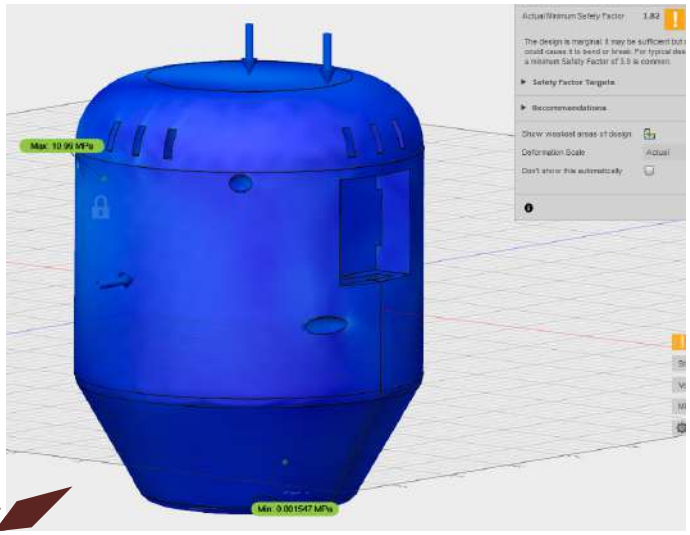


The image above shows the localised '**Pressure**' starting at a single point where the Top and the Right half of the body make contact. This pressure area is over a socket for the handle so there's potential for a failure to occur so I may have to add some extra strength in the form of ribs.





The dark blue has a '**Safety Factor**' of 8+ (i.e. it can withstand upwards of 800N (≈ 81.5773Kg) which is the weight of an average human male - This is over engineered and thus I could save some money by reducing wall thickness). I have only highlighted the areas of lower safety factor. What's important to take away from this is that the area that has the lowest safety factor rating (**1.82**) is the corner of the Weeder body power connector; this is due to a 90° corner.



The dark blue represents low stress/well designed areas to combat '**Stress**'. The slight discolouration provides insight into what's getting compressed. As shown on the image, the sides are flexing slightly as is the Top. This displacement is very small but shows that if I needed to I would have to add support in those areas.
The **Body** is over-engineered and this is shown by its superior strength. Reducing wall thickness's would be advised.

TECHNICAL DOCUMENTATION

18/30366501 DC

BS 8887-3. Design for manufacture, assembly, disassembly and end-of-life processing. Part 3. Guide to choosing an appropriate end-of-life strategy

ISO 9000

Harmonised standards

Ensures that all manufacturers, economic operators and conformity assessment bodies comply with relevant EU legislation

General Product Safety

Directive 2001/95/EC – OJ 11

The General Product Safety Regulations 2005 – The National Archives

Ecodesign and Energy Labelling

Directive 2009/125/EC – framework for the setting of ecodesign requirements for energy related products – OJ 285

Directive 2010/30/EU – indication by labelling and standard product information of the consumption energy and/or other resources by energy-related products – OJ 153

Packaging and Packaging Waste

Directive 94/62/EC – Packaging and Packaging waste of products -OJ 365

Material Safety

Directive 2009/48/EC – limits the amounts of certain chemicals that may be contained in materials for production

Electronic Safety

17/30365805 DC

BS IEC 60194-1. Printed boards design, manufacture and assembly. Vocabulary. Part 1. Common usage in printed board and electronic assembly technologies.

BS EN 61508-2:2010 - Functional safety of electrical/ electronic/ programmable electronic safety-related systems. Requirements for electrical/electronic/ programmable electronic safety-related systems

Outdoor Products

BS EN 62841-2-1:2018 - Electric motor-operated hand-held tools, transportable tools and lawn and garden machinery. Safety. Particular requirements for hand-held drills and impact drills View details

BS EN 62841-2-17:2017 - Electric motor-operated hand-held tools, transportable tools and lawn and garden machinery. Safety. Particular requirements for hand-held routers

Directive 2000/14/EC – Outdoor Noise Directive – tackles the problem of noisy products causing distress to the general public.

The Noise Emission in the Environment by Equipment for Use Outdoors (Amendment) Regulations 2005

Power Consumption and Energy Use

Ecodesign – Standby and off mode – Regulation (EC) No 1275/2008 and Regualtion (EC) No 801/2013

Ecodesign for Energy-Related Products Regulations 2010 – ensure that energy regulations and standards are met by manufacturers, sellers, representatives.

Products for the physically impaired

BS 18477:2010 – Requirements for identifying and responding to consumer vulnerability

BS 7000-6:2005 – Design management systems. Managing inclusive design.

IP (Ingress Protection)

DSMT – IP code for products. The IP code for products consists of the letters IP followed by two digits to define how resistant the product is to solid objects (hands/fingers), dust, accidental contact, water and electrical enclosures. It provides a more meaningful and detailed explanation to vague marketing terms such as “waterproof”.

DATA SHEETS

Mechanical properties (*)	Injection molding		3D printing	
	Typical value	Test method	Typical value	Test method
Tensile modulus	2030 MPa	ISO 527	1681.5 MPa	ISO 527
Tensile stress at yield	43.6 MPa	ISO 527	39.0 MPa	ISO 527
Tensile stress at break	-	-	33.9 MPa	ISO 527
Elongation at yield	4.8 %	ISO 527	3.5 %	ISO 527
Elongation at break	34 %	ISO 527	4.8 %	ISO 527
Flexural strength	-	-	70.5 MPa	ISO 178
Flexural modulus	-	-	2070.0 MPa	ISO 178
Izod impact strength, notched (at 23°C)	-	-	10.5 kJ/m²	ISO 180
Charpy impact strength (at 23°C)	58 kJ/m²	ISO 179	-	-
Hardness	97 (Shore A)	-	-	-

Thermal properties	Typical value	Test method
Melt mass-flow rate (MFR)	41 g/10 min	ISO 1133 (265 °C/5 kg)
Heat deflection (HDT) at 0.455 MPa	-	-
Heat deflection (HDT) at 1.82 MPa	-	-
Glass transition	97 °C	ISO 306
Coefficient of thermal expansion (flow)	-	-
Coefficient of thermal expansion (xflow)	-	-
Melting temperature	225-245 °C	ISO 294
Thermal shrinkage	-	-

Other properties	Typical value	Test method
Specific gravity	1.10	ISO 1183
Flame classification	-	-

(*) See notes

primasil silicones

PR 810/70 Moulding Grade
High Consistency Fluorosilicone Rubber (HCR)

Characteristics

Vulcanised articles manufactured from PR810/70 moulding grade fluorosilicone rubber exhibit a unique combination of characteristics and properties. They are noted for their good flexibility and mechanical properties, together with excellent chemical resistance to many kinds of organic solvents and petroleum based fluids. PR810/70 has good processing characteristics and can be pigmented.

Product Data

Material Reference: PR 810 / 70 (Fluorosilicone HCR Moulding Grade)

Special Features:
- Temperature range from -55 °C to 200 °C
- Excellent resistance to many solvents, lubricants, petrol's, oils, ATF fluids or other, aggressive fluids / greases that have an 'un-polar' chemical nature

Colour: Off-white

Safety Information

Detailed safety specific information can be obtained from the Material Safety Data Sheets (MSDS), which are available upon request

Physical Properties

Test	Standard	Units	Typical Values
Hardness	ISO 7619-1	Shore A	70
Density	ISO 2781	g/cm³	1.06
Tensile Strength	ISO 37	MPa	8.7
Elongation @ Break	ISO 37	%	285
Tear Strength	ASTM D 624 B	kN/m	21
Compression Set: (22 Hrs @ 175 °C)	ISO 815-1	%	12

Fluid Resistance

IRM 903 Oil (70 Hrs @ 150 °C):			
Hardness	ISO 7619-1	Shore A	-6
Tensile Strength	ISO 37	%	-10
Elongation @ Break	ISO 37	%	-12
Volume Swell	ISO 1817	%	+3.8
Fuel C (72 Hrs @ 23 °C):			
Hardness	ISO 7619-1	Shore A	-9
Tensile Strength	ISO 37	%	-28
Elongation @ Break	ISO 37	%	-36
Volume Swell	ISO 1817	%	+19.5

(Farnell, 2017) (Primasil, U,D)

ASTM - B 231

CODE	SIZE AWG-MCM	STRANDING N2 X Ø mm	SECTION mm²	OVERALL DIAMETER mm	CABLE WEIGHT kg/km	RATED STRENGTH N	ELECTRICAL RESISTANCE DC 20°C / km	ELECTRICAL RESISTANCE AC CC 25°C / km	ELECTRICAL RESISTANCE AC CC 25°C / km	CURRENT CARRYING CAPACITY (1) A
PEACHBELL	6	7 x 1.55	13.21	4.65	36.6	2.5	1.1702	2.2129	2.6499	110
ROSE	4	7 x 1.96	21.12	5.88	58.3	3.92	1.3638	1.3914	1.6663	145
IRIS	2	7 x 2.47	33.54	7.41	92.7	6.01	0.0857	0.855	1.0486	195
PANSY	1	7 x 2.78	42.49	8.34	116.8	7.3	0.6801	0.6942	0.831	225
POPPY	1/0	7 x 3.12	53.52	9.36	147.5	8.86	0.539	0.5499	0.6588	260
ASTER	2/0	7 x 3.5	67.34	10.5	185.9	11.17	0.4275	0.4374	0.5226	305
PHLOX	3/0	7 x 3.93	84.91	11.79	234.4	13.35	0.3392	0.3468	0.415	350
OXLIP	4/0	7 x 4.42	107.4	13.26	295.6	17.05	0.2689	0.2747	0.3288	410
SNEEZEWORTH	250	7 x 4.8	127.6	14.4	349.3	20.12	0.2273	0.2324	0.2784	455
VALERIAN	250	17 x 2.91	126.4	14.55	349.3	20.74	0.2273	0.2324	0.2784	455
DAISY	266.8	7 x 4.96	135.3	14.88	327.8	21.5	0.2133	0.2181	0.261	475
LAUREL	266.8	19 x 3.01	135.2	15.05	327.8	22.12	0.2133	0.2181	0.261	475
PEONY	300	19 x 3.19	151.9	15.95	419.1	24.38	0.1897	0.1945	0.2324	515
TULIP	336.4	19 x 3.38	170.5	16.9	470	27.37	0.1691	0.1734	0.2076	555
DAFFODIL	350	19 x 3.45	177.6	17.25	489	28.45	0.1626	0.1666	0.1995	565
CANNA	397.5	19 x 3.68	202.1	18.4	55.4	31.64	0.1431	0.1473	0.1659	615

(Eland Cables, U.D)

(UL Library, 2013)

UL 62841-1

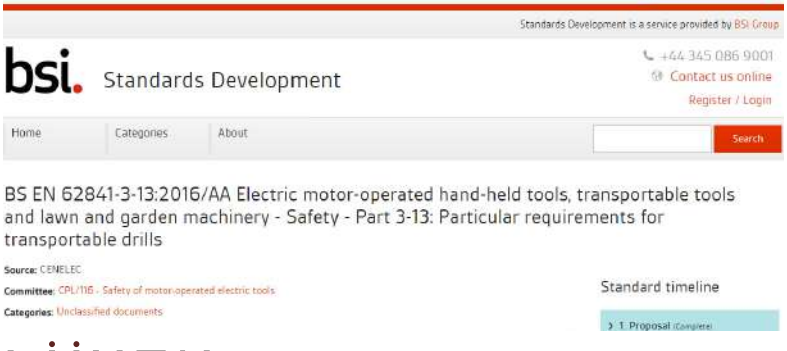
Electric Motor-Operated Hand-Held Tools, Transportable Tools And Lawn And Garden Machinery - Safety - Part 1: General Requirements

Purchase UL 62841-1

DETAILS

Edition Number:	1	SCC Approved:	--
Edition Date:	2015-02-20	DOD Approved:	--
Price Code:	E	ANSI Approved:	2016-02-17
Type:	ulcsaiec		

(British Standards Institution, 2016)



BLÜHEN

REFLECTION

Throughout this project I have experienced several highs and lows. The main issue with this entire project was that the FEA testing wasn't working on SolidWorks (this is just for me). My computer is more than powerful enough to run these simulations, however, they would take several hours just to reach a couple percentages up from 0%. Though I was able to complete several different tests within fusion - although not as detailed you can see them in the '**Appendix**' folder of my USB/PEN DRIVE.

I also struggled with finding the correct data for my materials, after hours of searching I was able to eventually find them but this was wasted time in hindsight where I could have been doing something else with my time i.e. figuring out FEA Testing and so on...

What I believe I did well though was the understanding and creation of this product. I originally designed my Weeder for DP2 with the intent that this was to be mass manufactured (as I needed to CNC and 3D Print many of the components). I therefore, didn't have much improving of the CAD models like wall thickness's were in general okay as were thin features. (I'm not saying that it was perfect as I didn't include any draft angles or think of a more viable way to manufacture some components).

I also believe that my technical knowledge has shown in this project thanks to '**Specific Component Manufacturing**' as well as any other mass manufacturing flow diagram. I also believe that my costings and the thorough research can be justified through reasoning and logic.

Furthermore, the costings of manufacturing my product are correct for the fact that I'm a consumer and not in the industry which I've talked about on page '**9 - Costing**'. To further this discussion of costing I'm personally unhappy with the quotes that I have received from **Protomold / Protolabs** as they have marked up the price of manufacturing all the components - I again talk about this on page '**9 - Costing**', taking the example of the '**Release**'.

Not on this document but in the **Log Book** I feel like I have done a lot for this group in finding information about different things outside what I was meant to even research. However, as a team player this saved my team having to do the research which is obvious by the observations that I have made. I'm not saying that I have done all the research; like for instance the **Technical Documentation** was very well done and it saved me so much time.
As a member of this group I feel like I have done more than others in the sense of dedication to this and actually doing the work. Again, not the only person like this in my group and this will be discussed in the '**Peer Review**' section on my USB/PEN DRIVE.

Finally to conclude everything, I have actually enjoyed this, it's been a challenge but I have definitely learnt many things from watching more of my favourite T.V show '**How It's Made**' and learning things which will in future make me a better designer like thinking about the potential manufacturability of my design to material choices (not just saying its metal). I have preformed will in my group and have supplied a lot of information which is evident from my research in the **Log Book** and as a group we preformed to what I believe to be around 70% - 80% efficient which is just a personal opinion but I give us that grade due to the fact that we have had struggles with persons from the group not being able to complete the work on time or even compete it in general. This isn't to say that we haven't accomplished anything though, in fact I think we have functioned very well, it's just a shame that not everyone was as keen with this project as myself and one or two others in the group.

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The Open University (2010) Manufacturing Processes. [Online] Available at: http://core.materials.ac.uk/search/detail.php?id=3265 [Accessed: 14 March 2018].

CONCLUSION

Throughout this project we have discovered numerous solutions to a very challenging problem. This was achieved through teamwork and functional delegation of tasks and issues to research in-depth.

Through thorough research, we have found the best materials, components and manufacturing techniques commonly used in professional industrial practice, therefore allowing us, as a group to produce authentic, and original products, which can be sold at market.

Through this group project we have had two unexpected cases where our members have unfortunately not been able to accomplish/complete the development of their product due to person individual reasons. Therefore, we, as a group, have had to readjust our strategies through problem solving and reassessment of the everchanging state of affairs. We believe that we have definitely accomplished all tasks set out via our group meetings and our endeavour to effectively create a manufacturable product for the mass market.

As a group we have followed the ethos of the sub-brand we created to produce tools which are sympathetic to the users, able bodied, or otherwise.