Laser Line Guidance Template

By ROONTECH

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Comprehensive Business Plan

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Summary

My name is Christopher John Rooney, an Electrician with a Degree in Mechanical Engineering. This skill set enables me to produce the Laser Line Guidance Template from idea to sales. As a Product Designer, both of these disciplines are very useful, the hands-on experience of an Electrician combined with the technical theory of Mechanical Engineering and Computer Aided Design (CAD), allow me to develop and implement this product.

This document is a Comprehensive Business Plan which highlights the reason and need for the Laser Line Guidance Template. It demonstrates how I was able to produce the product on a £3000 budget working from home. This path was chosen due to the expense of external manufacturing. I was quoted £12,000 for a single Mould, and £2 per unit. As a start-up company this was out of my budget. So through research, ability and perseverance I have overcome the obstacles that stop many people from bringing an idea to life. This report serves as a means to produce a product yourself as long as you remain within critical parameters. Every aspect from idea to design will be discussed and analysed. It is a technical report incorporating many attributes taken from Electrical and Mechanical disciplines and Degree level studies. However, it is slightly simplified for Non Engineers to understand. This report is the finalised Research & Development, which includes the idea, finished product, production costs, competitors, potential partners and sales tactics.

Note; This document refers only to me and my method, so the use of the word “I” and “we” are common terminologies. However, it does refer to “you” when explaining a process that somebody else may use.

My Path

The reason I am following this path is because of two major factors, one I need to work from home as I am my Dad's full-time carer, and secondly my Son is my STEM Apprentice. It is very important to me that I remain flexible in my approach to working where I am able to look after my dad and educate my Son who is very intelligent, and ultimately the successor of my business. It is not a fantastic story or position to be in, but it is what I have to work around. I hope you enjoy reading this document because I enjoyed making it, as difficult as it was. It serves a purpose to help others who may find themselves in a similar position to me.

Just Remember This!

“We never fail, we only fail forwards, never give up on your dreams, remain defiant and work hard, perseverance is the key to changing your life and those around you.”

~ROONTECH

Introduction

This report is based on the implementation of the small scale manufacture and production of the “Laser Line Guidance Template”. It details the initial idea, the design using CAD, the prototype using a 3D Printer, CNC of the Moulds for mass production, and the complex design of a bespoke Injection Mould Machine (IMM) that will produce the main component. It details the accurate cost of production and where that happens. Competitor Analysis, Procurement, Marketing Strategies and the overall ambition of the company are all detailed. The method shown throughout this report is a way to help small businesses remove external influence such as investors which helps maximise profit margins, but most importantly it helps you progress your business without relying on their say so as to whether it happens or not.

Funds raised from investors will normally go directly to a manufacturer who produces products and components on behalf of clients. It is expensive, they tend to be large companies using lots of energy with people travelling to and from, regarding this product, it is not a sustainable or efficient method. To overcome this barrier, thorough research, hand calculations, and technical knowledge will determine that the method I am to implement is viable. The Laser Line Guidance Template is a small product, simple to look at, but complex to produce as one man. The Laser Line Guidance Template (LLGT) is a great product of necessity, but it is just the starting point of my business empire, as the funds raised from sales will help me develop my other potential products which are a lot more expensive to produce.

About

The Laser Line Guidance Template is designed by an Electrician for Electricians who are installing single and double back boxes/pattresses into dry-line, breezeblock and brick walls. A tool that aids the marking out procedure with accuracy and speed.

Features

- Sturdy Compact Design
- Laser Line Guidance
- Improved Cut-Out Area
- Spacing Guidance
- Multifunctional Use
- Flexible
- Enhanced Grip
- Centre Marks

Innovation

Templates for cut-outs incorporating single and double sockets including a 50mm spacer are long and tend to bow after time which reduces the accuracy. They often snap under small amounts of pressure because of the elongated design, thin structures and cheap material. Bows and breaks tend to arise when these Templates are mixed with hard-wearing tools regarding work bags, back-packs and tooling satchels. There are two company designs that are similar to my style where they have reduced the overall size. However, they lack critical features that should be implemented, hence this redesign.

Robust Design

The Template offers a unique, sturdy compact design, using Virgin HDPE material, it has good gripping points designed for big and small hands, it is structurally sound, waterproof, impact resistant and flexible, which is important when storing this tool with other hard wearing tools.

Visibility

The Template designs currently available make it difficult to use with a Laser Level due to the lack of laser guidance cut-outs. The colour selection of these Templates such as red and black also limit the visibility of the Laser Lines.

Laser Level

Laser Levels are very common on sites amongst all trades and DIY projects. Laser Levels offer a quick and accurate straight line, they out-perform traditional chalk-lines and spirit-levels in many ways. For example, painted ceilings and walls would need to be cleaned and it would take too long to manually mark out the perimeter of a room using a spirit level. Most Laser Levels are self-levelling which helps reduce the set-up time. Speed is highly important these days, especially on sites where people are working on price and deadlines have to be met.

Uses

The Laser Level Guidance Template aids Electricians using Laser Levels who are installing switches, sockets, spurs, cooker-points and connection plates in rows or banks. Exact measuring is highly desired by both Electrician and client, this Laser Line Guidance Template increases the accuracy of cut-outs and quickly due to its innovative features.

Cut-Outs

Rival Templates cut-out areas are generally too tight; manufacturers are too precise when declaring this information and more often than not further cuts are required to fit dry-line and metal back boxes into walls. A dry-line single box has a cut-out area of (73 x 73mm). Manufacturers do not account for tool tolerances such as Pad-Saw, Multitool or Jig Saw blades. The Laser Level Guidance Template accounts for these tolerances by improving the cut-out area to (74 x 74mm), allowing a quick one-time cut. For example, the finished hole size regarding plasterboard would approximately be (75 x 75mm) using a 1mm Jig Saw Blade provided you cut central to the marked out-line. This method reduces time, manual labour and tooling wear.

Multifunction

The Laser Line Guidance Template incorporates a spirit level bubble designed for single uses, for instance a one off installation where a Laser Level is not required, thus it is multi-functional, covering all types of cut-out scenarios an Electrician faces.

Target Market

This tool is predominantly aimed at UK Electricians but not limited to, there are over 200,000 registered Electricians. However, other types and trades to which it may aid include Electrical Apprentices, Skilled Persons and Labourers, Fire Alarm Engineers, Air-Conditioning Engineers, DIY projects and also Kitchen Fitters. Therefore, a wider market sector is approachable than just Electricians, estimated to be about 500,000.

Sustainability

A sustainable approach and design technique has been fully implemented from idea to manufacture, sustainability is a fundamental pillar that upholds the companies beliefs that everything designed to this day takes into account sustainability. The following list expresses a sustainable approach to producing this product.

- 100% recyclable material
- No plastic packaging
- Local material suppliers
- Ultra Low embedded energy
- Non pigmented

CAD Design

Using the basic parameters of Socket and switch Patresses, the internal dimensions of the Template can be derived. Adding to this innovation, a 1mm increase regarding the cut-out area of the finished product size is applied.

Cut-Out Area

- Length = 134mm
- Width = 74mm

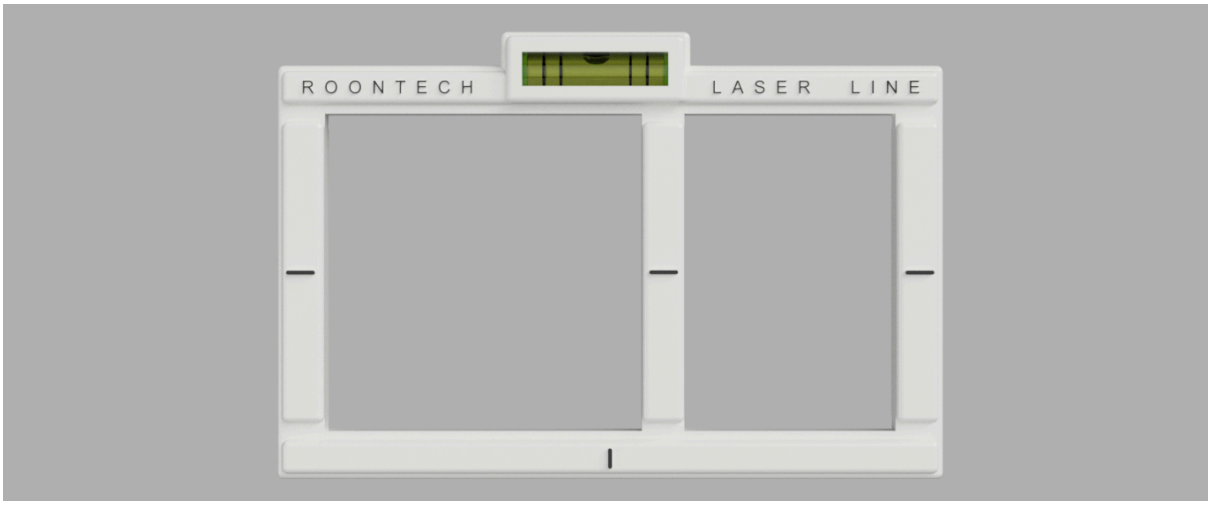

Fig 1a, Laser Line Guidance Template Design Front

Fig 1b, Laser Line Guidance Template Design Rear

Space Saving Design

For space saving and material efficiency whilst maintaining strength, the Template is split into two sections. First, the (74 x 74mm) cut-out is for a Single Pattress, and for a Double, (134 x 74mm). The spacer is 10mm, thus, (74 + 10 + 50 = 134mm). The spacer position is very important as the 50mm to the right side is the minimum distance sockets or switch banks can be situated. However, in some cases the front plates of sockets and switches can be slightly bigger. If this is the case, I would recommend using the left side of the spacer giving a 60mm spacing factor. To counter any shrinkage, the cut-out section will be (75 x 75mm) and (75 x 135mm).

Dimensions

Front View

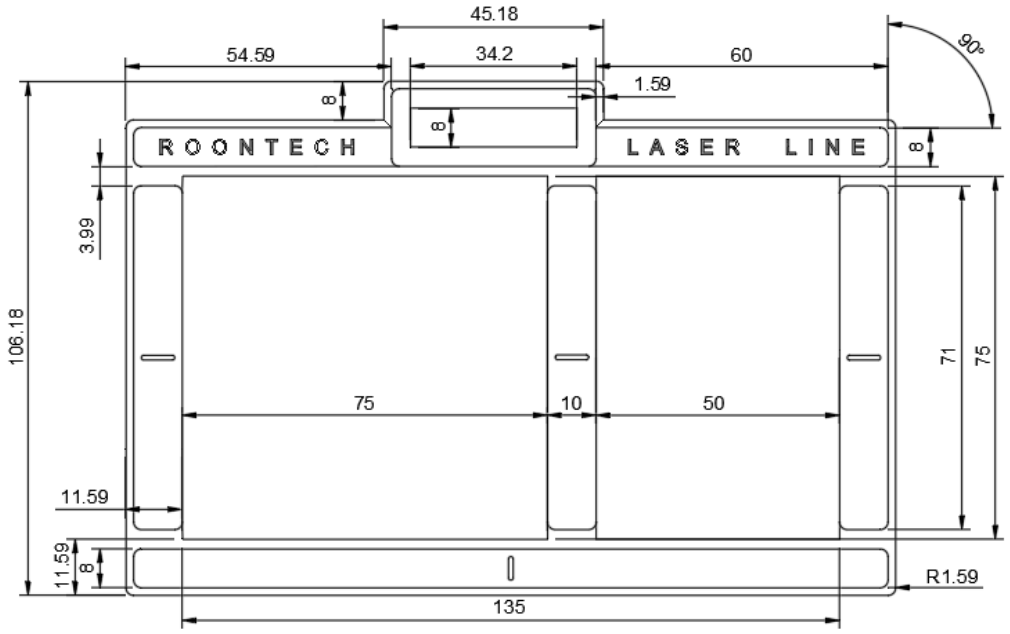

Fig 2, Dimensions Front View

Side View

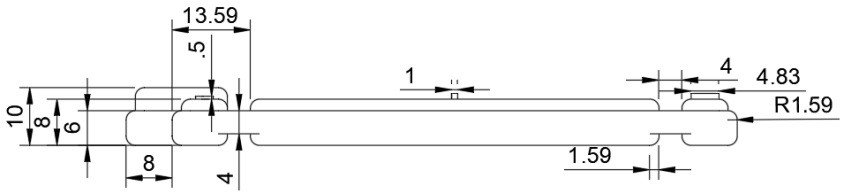

Fig 3, Dimensions Side View

Rear View

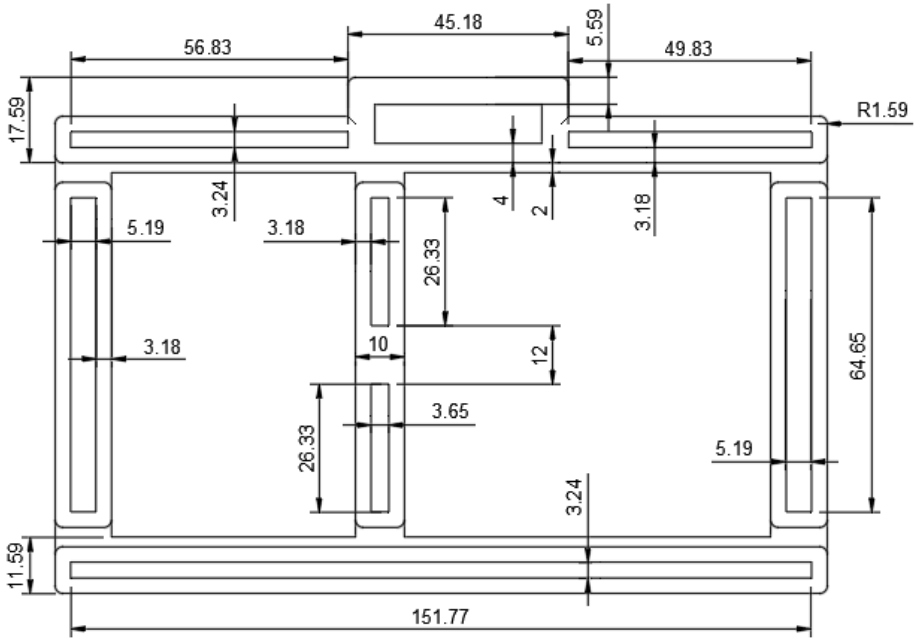

Fig 4, Dimensions Rear View

3D Printed Prototype

The best way to produce this potential product is to 3D print it. 3D printing aids rapid prototyping. Using Fusion360 CAD software, a design can be downloaded as an STL file and by using a Slicer programme the STL file can be uploaded and converted into a G-code file type to which a 3D printer understands (XYZ) coordinates. Given the dimensions of the prototype, a 3D printer has to have the capacity to fit the product on its bed. This product has to be made as one part to retain strength and reduce manufacture time. Therefore the Creality Ender 3 (V2) has been selected based on parameters and cost. A grey filament (0.2mm diameter) is to be used as this colour allows for decent visibility regarding a laser colour (Green/Red). This filament has a tolerance of ±0.02 and a bedspread tolerance of ±0.5mm which means the CAD design has to include these tolerances for accuracy.

For perfection the 3D printers' bed, which is Carborundum Glass, has to be heated to 70℃, and the filament heated to 205℃ prior to printing as the bed glass can expand slightly and the filament will not be released smoothly. The Z-axis position of the extruder nozzle has to be in the sweet spot, too close to the bed means the filament will not be layer onto the bed, too far from the extruder nozzle the filament will not stick. Depending on the 3D printer the distance between bed and nozzle should be 0.06 – 0.2mm. To be able to print correctly always use the raft and support tools given via the slicer programme. The slicer programme is the key link between CAD and 3D Print. The slicer is a great tool for information and additional tooling, as Support and Adhesion are important for printing correctly. The slicer shows the product weight is 40 grams including supports/raft at a 40% infill, it will use 13.44 metres of filament and will take 5 hours and 30 minutes to print. It also shows the dimensions of the design and gives a preview to the layering effect. All you do now is save the STL file as a G-code and upload onto a USB, ready for the 3D printer.

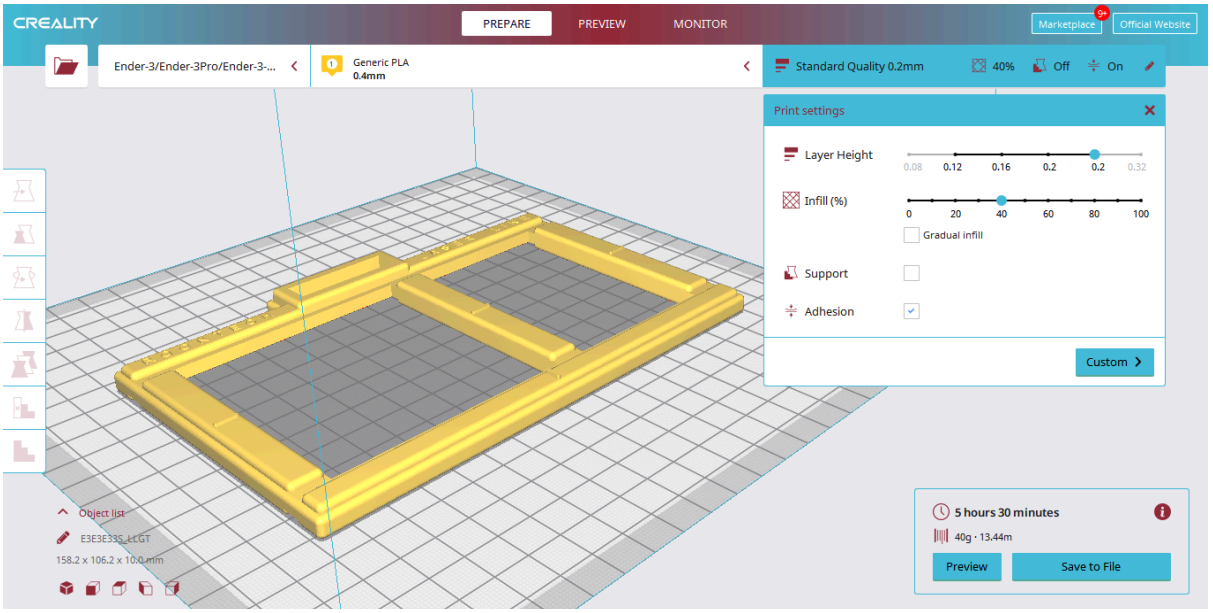

Fig 5, Creality Slicer

G-code file sent to the 3D printer and printing begins, PLA temperature 205℃ with a bed temperature of 70℃. Raft support technique guarantees PLA sticks to the bed.

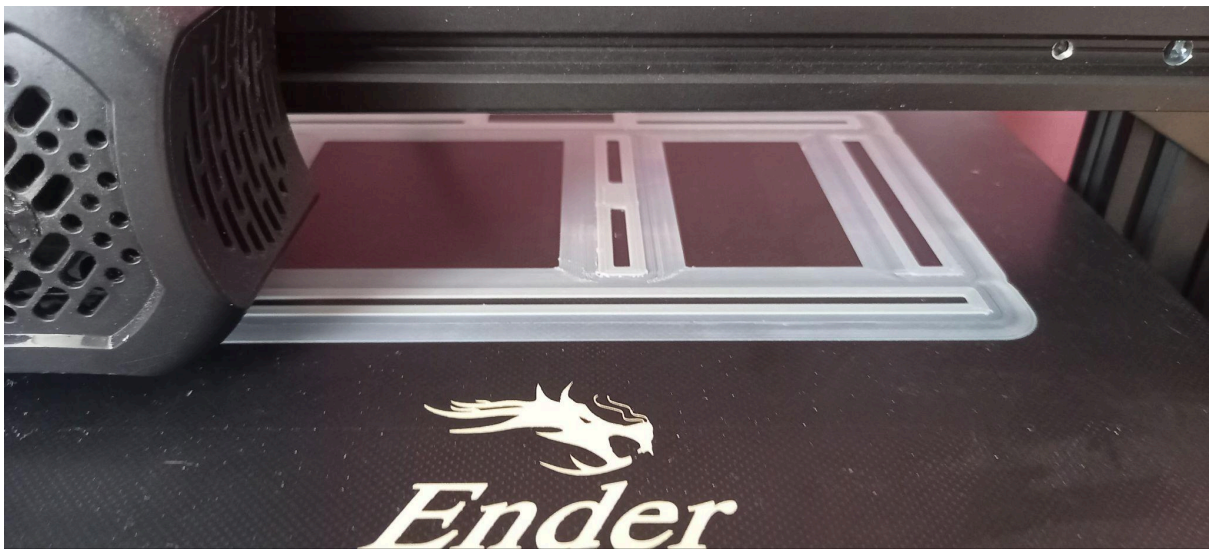

Fig 6, 3D Printing

Printing finished after 5 hours and 30 minutes and the spirit level bubble was pressed and fitted into position. A Laser Level was put across the Guidance grooves hence the finished prototype. No shrinkage occurred using the 3D Printer, the dimensions retained the initial (75 x 75mm) and (75 x 135mm) criteria.

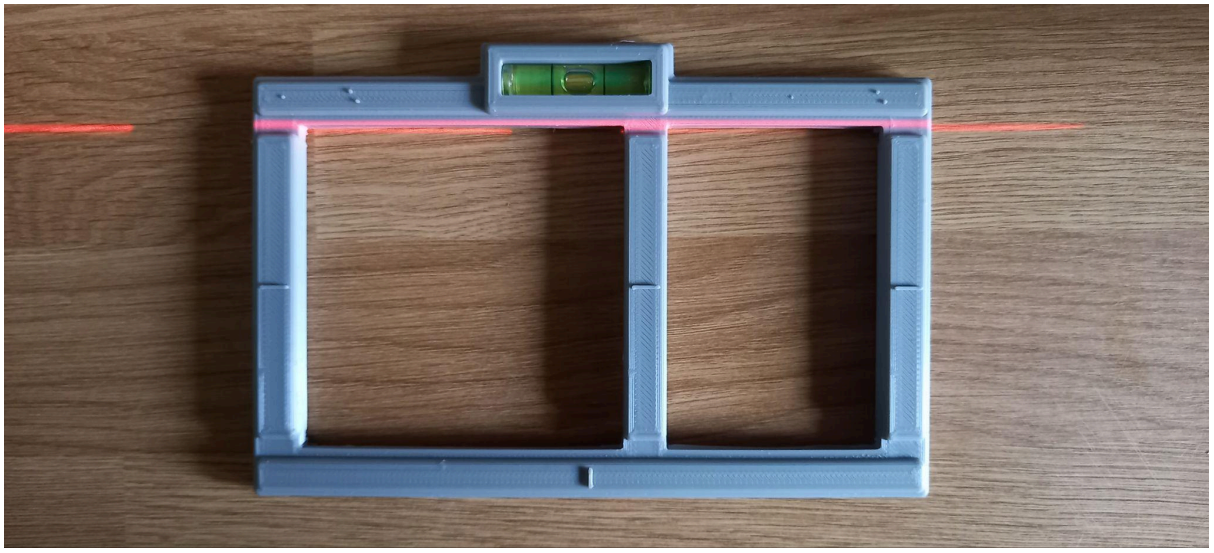

Fig 7, 3D Printed Prototype

The prototype It is accurate in terms of dimensions but not perfect due to thousands of thousands of layers of PLA, giving it a layered look affecting the surface finish. Also, the Logo and Branding never came through due to its small size, the extruder nozzle parameters will not allow filament to be applied that small, this was expected.

Production Process

When I consider the amount of time taken to produce just one and the energy costs, 3D printing is not an effective method to mass produce this potential product. In order to mass market you would need a different setup; you would need to manufacture Moulds via a CNC Machine, and for quick replication an Injection Mould Machine (IMM). This is where it gets expensive and complex. First I will research the Injection Mould Process, CNC, and material. For testing purposes and the machine design, High Density Polyethylene (HDPE) is the material to be used.

HDPE Material

Properties

Table 1, HDPE Properties

Density	0.97 g/cm^3
Shrinkage	1.55%
Melting Point	130.8 °C.
Crystallisation	111.9 °C
Latent Heat	178.6 kJ/kg.
Specific Heat Capacity	1330 to 2400 J/kg-K
Specific Heat (Solid)	1.9 kJ/kg. °C.
Crystallinity	60%

Virgin HDPE extrusion temperatures range from 140 - 200℃. The use of raw HDPE Pellets/Granules has five benefits.

1. At high temperatures, virgin HDPE is translucent so you can visually see the material and check for imperfections aiding problem solving.
2. It is sustainable as no further processing “Master Batch” regarding colour has been added, which also means waste material can be recycled.
3. When it is cooled, it turns almost white which really helps the Laser Levels visibility projecting onto the Laser Line Guidance Template.
4. HDPE produces non-toxic fumes and the least amount of smoke/vapours of all plastics at high temperatures.
5. Physical properties suggest it is strong, flexible, weatherproof with a gloss like finish and quality feel

Injection Mould Machine

When using an IMM as the means to produce the final product there are a few things to consider when selecting machine type.

- Shrinkage
- Mould Material
- Platen Size
- Cost
- Shot Volume
- Tonnage

Shrinkage

Shrinkage happens when a Mould has been injected under intense pressure with molten plastic to which is rapidly cooled. The contraction factor in this instance using HDPE has a shrinkage factor of 1.55%. Therefore a cut-out dimension adjustment of 1mm has been included giving (75 x 75mm) and (75 x 135mm), this is expected to reduce to (74 x 74mm) and (74 x 134mm) regarding the final cut-out dimensions of the finished product. To counter shrinkage two methods could be implemented.

- Scale the model at the design stage to +1.55% to counter the shrinkage.
- Increase the pressure/tonnage of the machine to reduce the shrinkage effect.

Shrinkage regarding this design will definitely not be uniform, so the +1.55% overall assumption is not a valid option. Also by increasing pressure, you would have to still compensate for a shrinkage factor, albeit lower than +1.55, so this is not an option. The best method would be to mill a Mould at the given dimensions (75 x 75mm) and (75 x 135mm). If shrinkage does occur beyond the (74 x 74mm) and (74 x 134mm) regarding the actual components cut-out area, then adjustments need to be made to the design in the areas where shrinkage has taken place.

Mould Material

Mould material is highly important to the manufacturing process. This depends on how many units you are to produce and for what purpose. For instance, a 1000 parts may only require a lower graded material. Whilst 1,000,000 requires a higher grade. Selecting the best material is not an issue here as you could make a number of Moulds of the lower grade to compensate, but most importantly materials such as Aluminium can be machined on a Desktop CNC which is highly desirable.

Note; A good all-round material to use for Moulding HDPE is 6082 grade Aluminium.

Platen Size

Platen size determines the size of the Mould, the Platen should always be bigger so the correct pressure is evenly distributed. This may cause a problem as research suggests smaller machines have small Platens and I may well have to CNC a new Platen to suit the Laser Line Guidance Template Mould.

Budgeted Cost

The most important aspect before we go any further is cost, I am not rich and therefore on a budget of £3000, this dictates the machine size. Machines in this range have a volume shot size of 30 grams max. Having weighed my product using HDPE material prior to 3D printing, as a solid body, using CAD it weighs 36 grams, and even more so as a 3D printed prototype due to the density of PLA.

Table 2, Product Weights

CAD, Solid Part (HDPE)	Slicer 100% Infill (PLA)	Slicer 100% with Supports (PLA)	Slicer 40% Infill (PLA)	Slicer 40% with Supports (PLA\)
36 grams	53 Grams	60 Grams	33 Grams	40 Grams

The difference here is material density, the 3D printer is using PLA 1.25 g/cm^3 and CAD is using HDPE 0.97 g/cm^3. After 3D printing at a 40% infill the actual weight of the prototype once the supports/raft were removed was 33 grams, as shown in the table. Slightly less than the weight of the HDPE version. Here lies a big problem, the problem that a 3D printer is capable of adjusting infill, an IMM cannot do this, it has to be a solid part. 36 grams is too much material for the machines within my budget. To prove this is the case, see the following information and shot volume calculations.

Shot Volume

The shot refers to the size and weight of material added to the IMM. Say for example you use the CAD design version and implement material properties to be HDPE. The material selected has a mass associated with it. In this case 36 grams for the entire product. It is recommended that you would need a shot volume capable of holding at least 20-80% more material than that to be extruded. This ensures you do not run dry avoiding air locks. For a more accurate percentage see the following calculation.

CAD Design HDPE Volume Calculation

$Unit\ Weight = 36g$

$HDPE\ Density = 0.97$

$r^2 = radius\ of\ the\ screw = 1.3$

$36 \div 0.97 = 37.11cm^3$

$HDPE\ Volume = 37.11cm^3$

$A = \pi r^2$

$V = 37.11 \div (\pi\, x\, 1.3^2) = 70cm^3$

$37.11 + 70\% = 63\ grams$

Machine Shot Volume should be 70% greater than the required amount of material per shot given which would hold 63 grams of material, this is over double my limit according to machine prices within my budget. This combined with small platent sizes means there are no machines I could purchase. It may look like doom and gloom at this point, however, after studying IMM's I understand the basic operation

and having looked at blue prints online from www.preciousplastics.com, there may be an option to design and build one myself that is within my budget.

Injection Mould Machine Concept

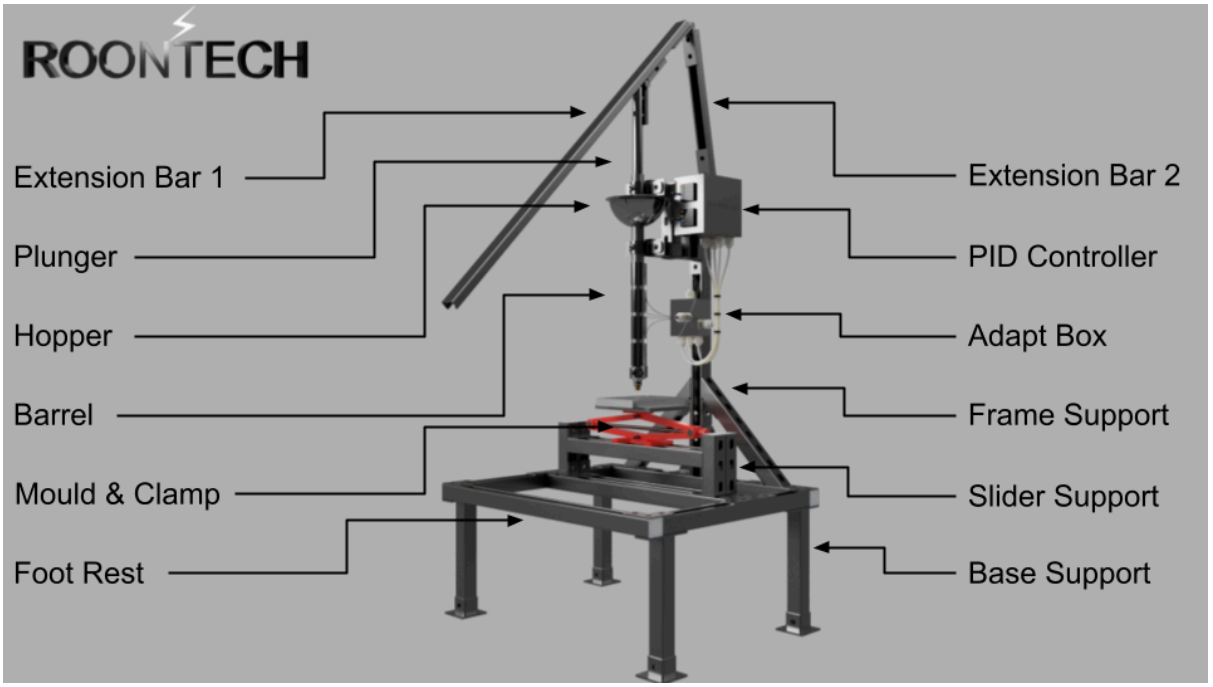

Fig 8, Injection Mould Machine Concept

After a little research I have designed an IMM, it is manual and it should produce a reasonable amount of force. The good thing about a manual IMM is that you do not require high pressure, the bad thing is that units take a bit longer to produce.

ROONTECH IMM Components

Table 3, IMM Components List

Component	Specification	Quantity	Cost
Band Heaters	200 Watt	4	£35
500mm Steel Tube (CDS)	O/D = 33.34mm Wall = 3.25mm	1	£13.50
700mm Steel Bar	D = 26mm	1	£25
Car Jack	1 Tonne	1	£7
Extrude Nozzle A	1” to ½ 2 (BSPT)	1	£5
Extrude Nozzle B	½” to 10mm	1	£2
PID	0 - 400℃	2	£20

SSR	2-24v	2	£10
Thermocouple	K-Type	2	£4
Control Switch	220v	2	£5
Power Cord/Plug	220v, 2.5mm, (HR)	1	£5
PID Housing	200 x 200 x 100	1	£12
BH Cable Housing	100 x 100 x 50	1	£5
Stuffing Glands	20mm (White)	10	£7
Hopper Dish	150mm	1	£2
Unistrut (HG)	3M, (Slotted)	3	£120
Unistrut (LG)	3M, (Solid)	1	£30
L Plate	Flat	4	£8
L Plate	90°	14	£40
T Plate	Flat	4	£8
T Plate	90°	2	£8
Gusset	Frame Support	1	£30
Angled Plate	45°	4	£8
Hinge Bracket	Flat	3	£30
Tube Brackets	34mm	2	£10
Support Leg	Frame Support	4	£25
Base Plate	Frame Support	4	£15
Bolts	M8	100	£10
Zebedees	M8	100	£40
Washers	M8	100	£5
Earth Clamp	K-Type Clamp	1	£1
End Caps	HG White Plastic	10	£2.50
			Total £550

Frame Support Dimensions

Note; Built to my height and assembled from the first listed component to the last. All components are metal, exposed conductive components are bonded to the CPC.

Table 4, Frame support Dimensions

Component	Specification	Quantity	Dimension (mm)
Unistrut Frame	Heavy Gauge	2	760 (L)
Unistrut Frame	Heavy Gauge	2	580 (W)
Upright Frame	Heavy Gauge	1	800 (H)
Frame Support	Heavy Gauge	4	300
Angled Strut	Heavy Gauge	1	370
Wall Support	Heavy Gauge	1	445
Extension Support	Heavy Gauge	2	200
Extension Support	Heavy Gauge	1	115
Extension Bar 1	Shallow Gauge	1	420
Extension Bar 2	Shallow Gauge	1	1100

Specification

Table 5, IMM Specification

Height (mm)	V	Power (Kw)	bar/psi	Capacity (g)	Temp ℃	Clamp
1500 - 2235	230	0.8 - 1	45/650	120	140 - 200	1, t Jack

Operation

1. Turn on IMM
2. Set desired temperature
3. Prepare and wear PPE
4. Leave for 15 minutes
5. Add HDPE to hopper
6. Wait 10 Minutes to melt
7. Place Mould on platform
8. Slide into position
9. Clamp the Mould
10. Pull extension bar down
11. Inject into the Mould

12. Hold extension bar for 20 seconds
13. Raise extension bar
14. Add HDPE to the hopper
15. Slide the Mould away
16. Open Mould and remove part
17. Close Mould
18. Repeat steps 7-17

Note; The Extension Bar should always be at the highest point before turning on, this ensures zero molten plastic friction along the walls of the Chamber. The Plunger should remain cooler than the Chamber so when fresh HDPE is added to the barrel it does not get hot. This technique prevents sticking, molten plastic sticking to the internal wall will 100% result in visible burn marks regarding the component. The Chamber/Barrel can hold 3 x the initial shot volume, when you inject and replace the HDPE you still have 2 x the volume shot available. 1 is half-cooked in the middle, the 1 at the bottom is ready to be injected. It is very important to refill the barrell after every injection as test runs show that burn marks will appear if you run it near empty. This is due to the friction between the Bar, Chamber and HDPE, at any temperature.

Speed is a crucial factor in successful operation, runs of approximately 6 minutes per injection are performed at 140℃. Injection speeds of 4 - 2 minute requires a higher temperature of 165℃ - 200℃. The Extension Bar on completion of injection should finish approximately at a 90° angle. Eddie Hall, (WSM 2017) determines positioning and technique delivers maximum applicable force. Lastly, always clean the barrel and nozzle after use, this also prevents burn marks appearing on future batch runs.

Rex C100 PID Commissioning

Proportional–Integral–Derivative Controller (PID), this is the brains of the operation, the device that maintains the temperature. It comes pre-programmed and has many functions for numerous control types. There are three settings to change regarding the IMM, the first is the (AR) setting. This setting controls the power delivered from 1-100%. Trial and era suggests that 10% solves for overshoot which is where the temperature goes far beyond the temperature selected over heating the HDPE and burns it. The PID then operates via a pulsing technique, gradually working its way up to temperature, when it hits the temperature an alarm signals the power to be cut. The alarm is the second setting to change and is set to ±1℃**.**

The third setting is Auto Tuning, the tuning algorithm aims to balance performance and robustness while achieving the control bandwidth and phase margin that you specify. With these three settings configured and locked in, absolute control of the temperature is maintained. The PID generally steps up the wattage from turning on the machine from 350, 480, 650, 780 and finally 900 watt. When the machine is up to temperature the PID sends a signal to the Solid State Relay (SSR) that energises the Band Heaters for 2 seconds, every 10 seconds. This technique is highly efficient regarding energy consumed. It approximately works out to use 5p per Kilowatt Hour, 8-hour day, over 5 days costs £2. Using 2 x PID's, 1 operates the Band Heaters via a Thermocouple (K-Type) attached to the Barrel, the second PID monitors ambient temperature and is also used to check the Band Heaters are working correctly.

Wiring Diagram

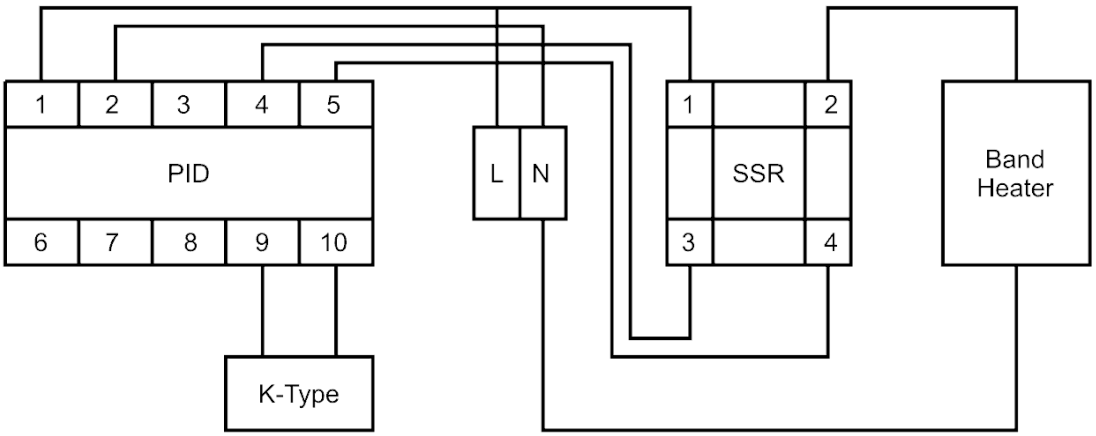

Fig 9, PID Wiring Diagram

Note: PID 1, SSR 1 are connected to L, everything else is independently connected.

Steel Tube Calculations

Technically the weakest part is the CDS Steel Tube, this is where the Band Heaters sit (4 x 200 watt) . They can heat up to 400℃, but will operate at less than half due to PID control. This section is where the solid steel bar drives through to press the HDPE, a lot of pressure is built up here (4.5 Mpa, 45 bar, 650 psi). Pressure was determined using a gauge screwed onto the barrel. Taking into account that approximately 200℃ and 4.5 Mpa of pressure are the main factors relating to life expectancy before rupture or deformation occurs. The following information can be used to estimate the life cycle of the Steel Tube. It was brought prior to the following calculations due to clamping compatibility and a known “Wall-Thickness” that retains heat increasing efficiency, but I need to be sure it is suitable and will last.

What we know:

- Mild Steel Tube
- Length = 500mm
- OD = 33.34mm
- ID = 26.84mm
- Wall Thickness = 3.25mm
- Pressure = 4.5 Mpa
- Temperature = 200℃
- BSPT Thread = 20mm
- Hopper Cut-Out = 40 x 33.4mm
- Band Heater Location

Steel Tube features Hopper cut-out situated 80mm from the top, cut exactly halfway through, it was BSPT threaded, 20mm up from the bottom using a 1" die threader.

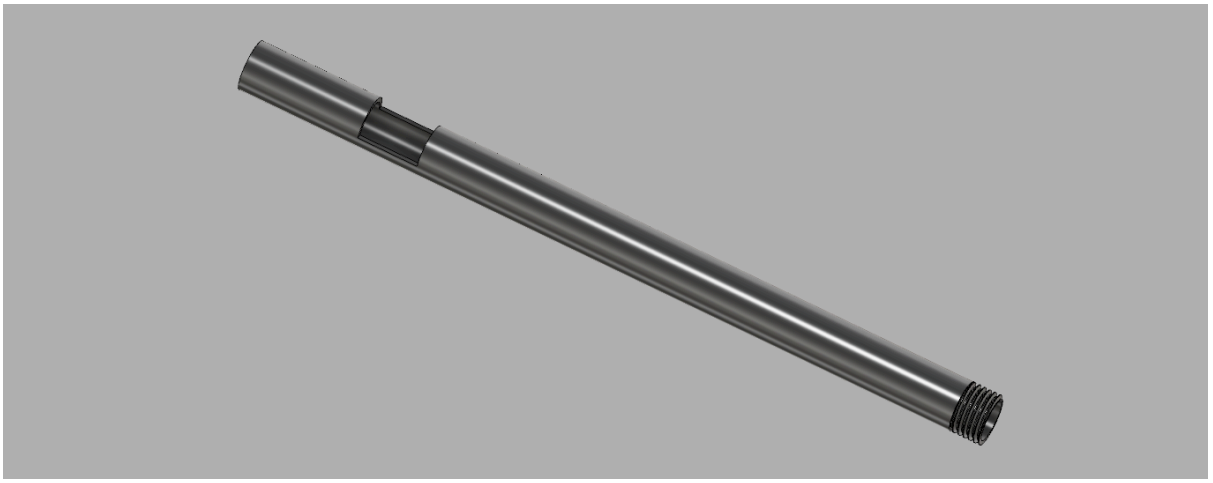

Fig 10, Barrel Design

For testing purposes we can neglect two sections, the hopper entry and the thread, this is due to being reinforced by the steel bar regarding the hopper cut-out and the extruder nozzle that threads onto the tube. From 500mm we neglect 120mm for the hopper and 20mm for the thread, leaving 360mm of material to be tested.

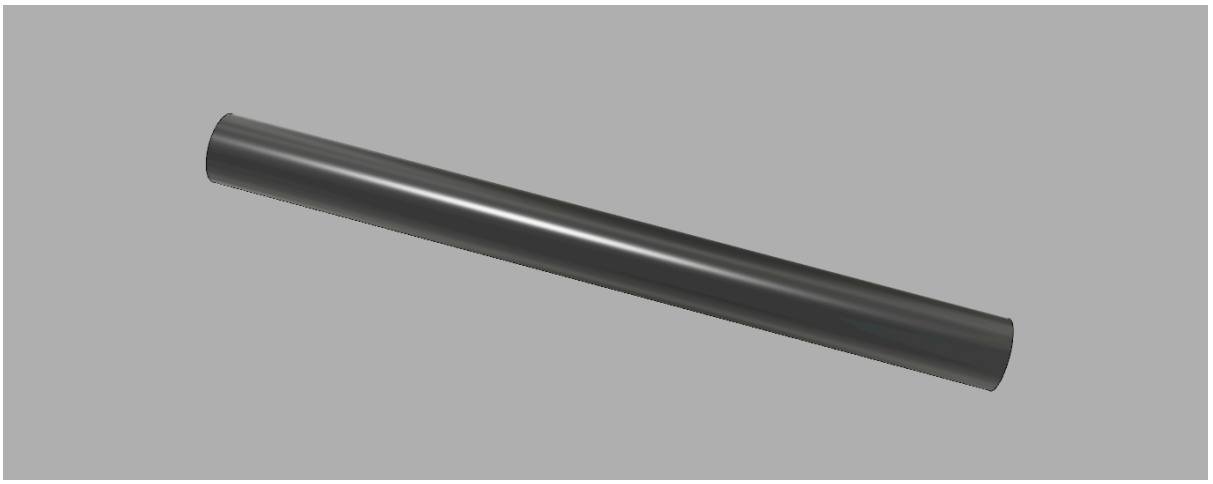

Fig 11, 360mm Barrel

Area	68676.425mm^2
Density	0.008 g/mm^3
Mass	868.216 g
Volume	1.106E + 05mm^3
Physical Material	Steel - Mild
Appearance	Steel - Satin

Fig 12, Fusion360 Material Properties

Fusion360 Material Properties

- $Area = 68676.425mm^2$
- $Density = 0.008g/mm^3$
- $Mass = 868.216g$
- $Volume = 110,600.71mm^3$
- $Specimen\ Length = 360mm$

General Material Properties

- $Tensile\ Strength = 485N/mm^2$
- $Yield\ Strength = 345N/mm^2$
- $Melting\ Point = 1400℃$
- $Modulus\ of\ Elasticity = 200\ Gpa$
- $Endurance\ Limit = 242.5N/mm^2$
- $1\ N/mm^2 = 1\ Mpa$

Verified Volume Calculation

$V = \pi h\ (D^2 - d^2)/4$
$V = \pi$ x 360 $(33.34^2 - 26.84^2)/4 = 110600.7118mm^3$

Maximum Pressure Calculation

Note; Allowable stress is equal to half the Yield Strength.

T = Wall Thickness = 3.25mm
S = Allowable Stress = 345/2 = 172.5 Mpa
D = Outside Diameter = 33.34mm

P = 2ST/D
(2 x $(172.5x10^6)$ x 3.25)/33.34 = 33.6 Mpa

Maximum Working Pressure = 33.6 Mpa
Normal Working Pressure = 4.5 Mpa

Safety Factor

SF = 33.6/4.5 = 7.46 times stronger, minimum acceptance is = 2.5

Wall Thickness Calculation

For testing purposes the Mild Steel Tube will be calculated as if both ends are closed. First with the normal operating pressure rated at 4.5 MPa, then at maximum pressure 33.6 Mpa, both methods will use the mean radius 30.1mm. The third will use max pressure and the outside diameter of 33.34mm to clarify the actual wall thickness requirement. All calculations are derived from Yield Strength = 345 Mpa.

Yield Strength 4.5 Mpa

$$t = \frac{4.5\ x\ 30.1}{t}$$

$$t = \frac{4.5\ x\ 30.1}{345} = 0.4mm$$

Minimum Wall thickness $= 0.4$mm

Yield Strength 33.6 Mpa

$$t = \frac{33.6\ x\ 30.1}{t}$$

$$t = \frac{33.6\ x\ 30.1}{345} = 2.93mm$$

Minimum Wall thickness $= 2.93$mm

Yield Strength 33.6 Mpa

$$t = \frac{33.6\ x\ 3.34}{t}$$

$$t = \frac{33.6\ x\ 33.34}{345} = 3.25mm$$

Minimum Wall thickness $= 3.25$ mm

Creep Calculation

Operating Temperature $= 200$℃

QC Activation $= 240\ kJ/mol$

Gas Constant $= 8.314$

Temperature $= 273$ k

Working Pressure $= 4.5$ Mpa

Max Pressure $= 33.6$ Mpa

Stress Exponent Metal $= 5$

$$\dot{\varepsilon}_{ss} = \dot{\varepsilon}_0 (\frac{\sigma}{\sigma_0})^n \exp exp\ (-\frac{Q_c}{RT})$$

$$For\ \sigma = 33.6\ Mpa$$

$$\dot{\varepsilon}_{ss1} = \dot{\varepsilon}_0 (\frac{\sigma_1}{\sigma_0})^n (\left(-\frac{Q_c}{RT_1}\right))$$

$$10^6\ x\ (\frac{33.6x10^6}{4.5x10^6})^5 = 2320779171\ pa$$

$$Exp\ (-\frac{240x10^3}{8.314x(200+273)}) = e^{61} = 3.10$$

$$\frac{\sigma_1}{exp} = \frac{2320779171}{3.10} = 748638442.3\ \frac{1}{s}$$

Ductility

Engineers Rule, 0.2% of Original Length.

$$\varepsilon = \frac{\Delta L}{L_O} = \frac{0.72}{360} = 0.002$$

$$t = \frac{\varepsilon}{\dot{\varepsilon}_{ss}} = \frac{0.002}{748638442.3} = \frac{\frac{2.67x10^{-12}(Sec)}{60\ (Min)}}{60\ (Hour)} = \frac{3.092033062\ x\ 10^{-17}(Days)}{365(1\ Year)}$$

8.5 years creep proof at 200℃ and a pressure of 4.5 Mpa, however, it will only be in operation for 8 hours a day over 313 days.

$$t = \frac{\varepsilon}{\dot{\varepsilon}_{ss}} = \frac{0.002}{748638442.3} = \frac{\frac{2.67x10^{-12}(Sec)}{60\ (Min)}}{8\ (Day)} = \frac{9.276099185\ x\ 10^{-19}(Days)}{313(1\ Year - Weekends)}$$

30 years at 8 hours a day over 313 days, although it is only under pressure for 30 seconds every 6 minutes. However, temperature remains constant. Creep is a time dependent deformation which occurs when materials are subjected to force and heat. The life cycle of materials can be limited regarding creep in two ways, low and high temperatures. In this scenario QC activation is low, and barely triggered due to just 200℃. This has an effect that reduces life expectancy and is somewhat difficult to understand because at 400℃ regarding the first calculation, a life expectancy of 11.6 years was determined. But think of it like this, a formula one car has to get its tyres up to temperature before they work correctly, absorbing and flexing under impact. It means the Steel Tube will succumb to brittleness rather than deformation.

Conclusion

Wall Thickness and strength under temperature and pressure has been determined that a Mild steel Tube is sufficient to house the HDPE in both solid and liquid form whilst the solid steel bar applies the work done.

IMM Build

The IMM is built for disassembly so part replacement is easy and cost effective.

Fig 13, IMM Built

Electrical Compliance

Table 6a, BS EN Electrical

BS EN	Component
7671	Wiring Regs
50525-2-21	3 Core Flex
1363	Plug (5A)
60669-1	Toggle Switch
4293	RCD 63A 30mA

Mechanical Compliance

Table 6b, BS EN Mechanical

BS EN	Component
6946	Unistrut
10305-4	Steel Tube
3B	Steel Bar
10242	Extrude Nozzle
864-2	Sprue
573-3	Moulds
520-14	HDPE

ISO 9001 certificate and Trade Mark (ROONTECH $_{TM}$) will be obtained as soon as feasible.

Computer Numerical Control

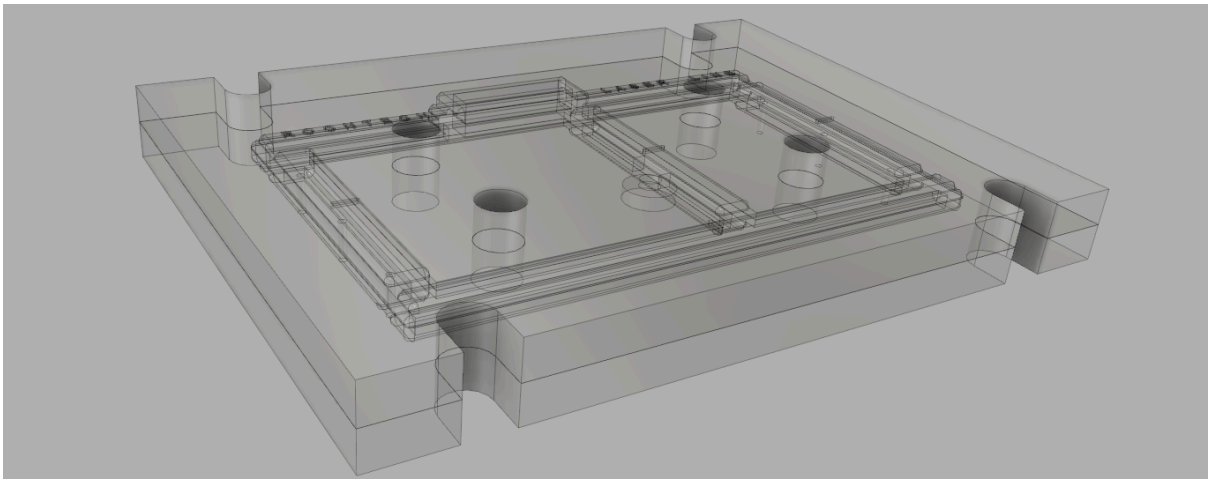

Fig 14, Transparent Mould Design

With the IMM built, specified and calculated we can now design the Moulds using the parameters and dimensions of the IMM. When you design a part or product you should design it to the requirements of the machine you are going to use to produce it on. I have bought myself a desktop CNC, 3018 Prover from Genmitsu, it has been slightly adapted to run a 20,000 rpm spindle. Desktop CNC's are not normally used for metal work as they lack rigidity, however, I have a good understanding of how to overcome the problems of chatter and vibration. The dictating factor of Mould design is that this machine regarding milling Aluminium, has a Maximum depth cut of 10mm.

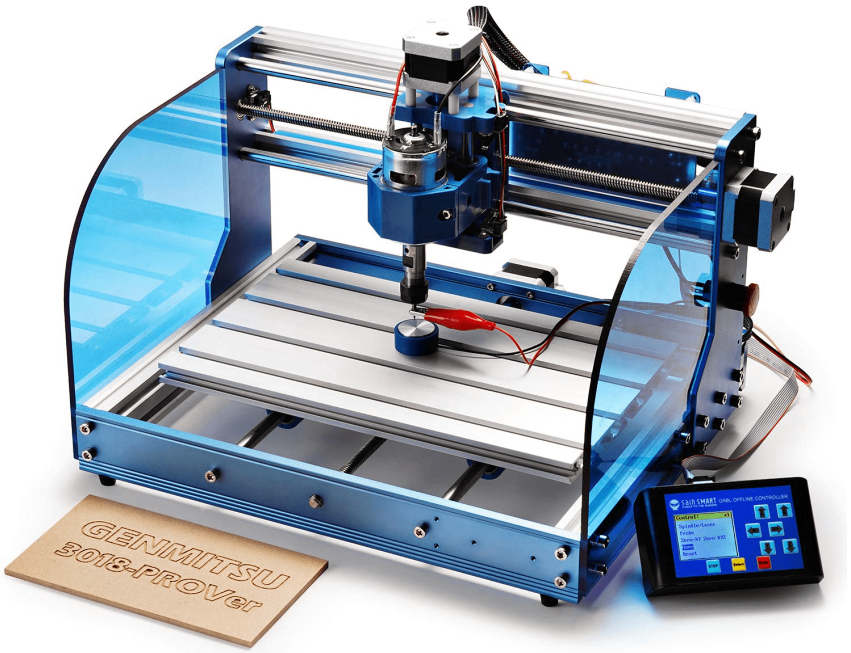

Fig 15, Genmitsu 3018

First, additional supports and damping methods will be used to cut down vibration, a slow steady feed and speed, step down and step over method will be implemented. Highly machinable Aluminium 6082 plates (200 x 150 x 10) and using a ball nose 3.175mm End Mill to complete the milling process. The ball nose reduces the surface contact as it gradually enters material at a steady rate. A flat nose 3.175mm End Mill will hit the surface at full diameter, and it will break. These parameters aid the design of the Laser Line Guidance Template, specifically the 3.175mm End Mill at a maximum depth of cut (10mm), which pushes this machine to its limit. To make the Mould we use the combine and split tools in Fusion 360, creating a body around the CAD designed product and then use the Template design as the cutting tool. This then leaves two bodies that are sent to the free Manufacturing Programme within Fusion360 where the Mould Cavity Tool Paths are created.

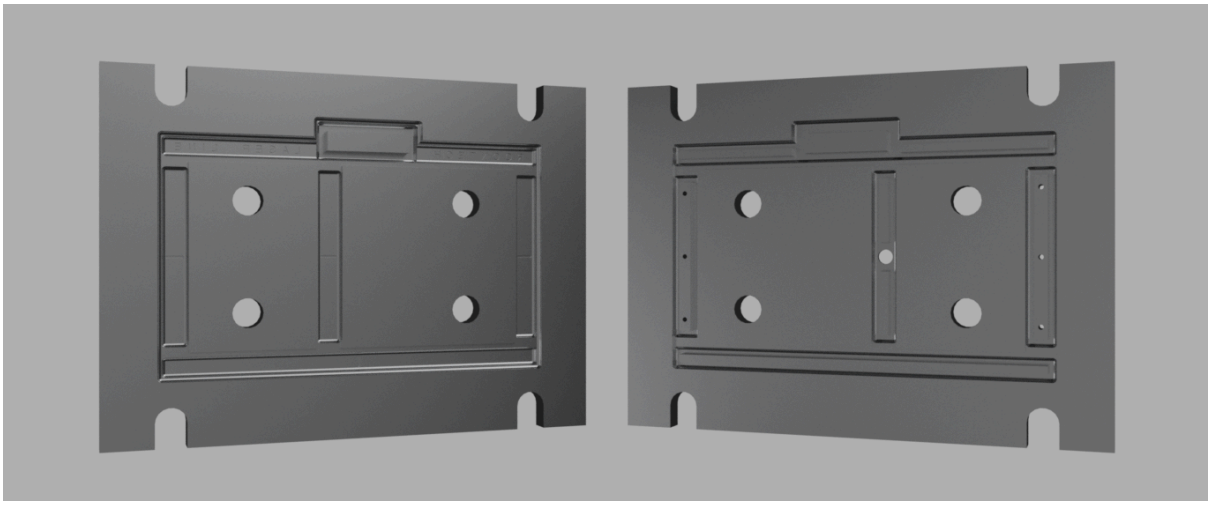

Fig 16, CAD Designed Moulds

Almost all paths created in Manufacturing Mode incorporate the following data.

- Step Downs = 0.1mm
- Step Overs = 0.15875mm
- Spindle Speed = 20,000 RPM
- End Mill = 3.175mm
- SFM = 300m
- Retract Heights = 25mm (Clamp Avoidance)

It is also important to understand climb and conventional meanings, degree of angles and entrance and exit points of the End Mill, flute type is irrelevant as the chip loads are tiny using a Desktop CNC. Simulation is your best friend and saves making mistakes further down the line. To harmonise the CNC machine to Fusion360 a third programme is necessary “Candle”, once you “post process” an NC file, you upload that data to Candle where further commands and controls are available. Keep it simple and just use the $ commands to relocate your position/Start point of your stock material and to increase the spindle speed from 10,000 to 20,000 RPM.

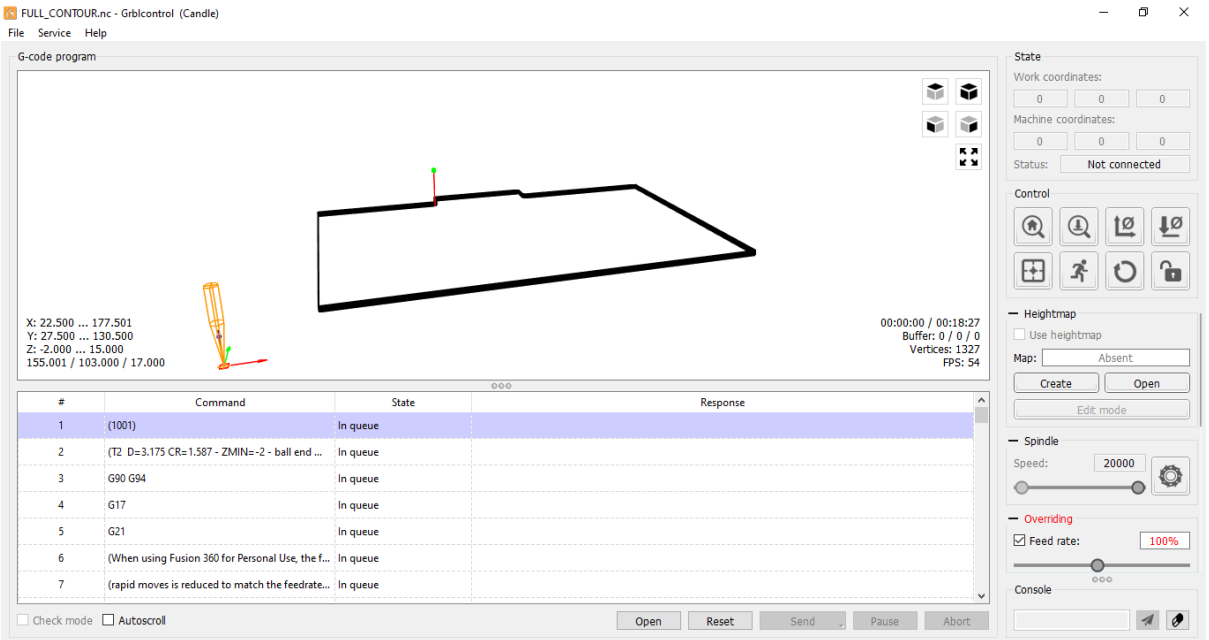

Fig 17, Candle Programme Contour Path

Additional to the above information the Nozzle of the IMM and (4 x 12mm) holes are added after the CAD Moulds have been created. The holes are designed for the pins to aid lining up and a (14.75mm, 4mm deep semi blind hole) is cut into the outside rear Mould and is used to marry the Mould to the IMM. A (6mm hole, 2mm) deep Sprue is used as the injection path central to the design. The pin holes also act as clamping positions which significantly reduce vibration whilst using the CNC. By manual drill, (4 x 12mm) holes are bored and (4 x 12mm) grooves are grinded to create a slot with a semi circle so that (4 x 10mm rods 50mm) in length with washers and wingnuts can be used to clamp the Moulds together. These are approximately situated (30mm x 25mm) from each edge. Whilst milling be sure to blow your chips away and use cutting lubricant to reduce heat prolonging End Mill life. Remember to remove interfering clamps on tooling paths and reposition as necessary.

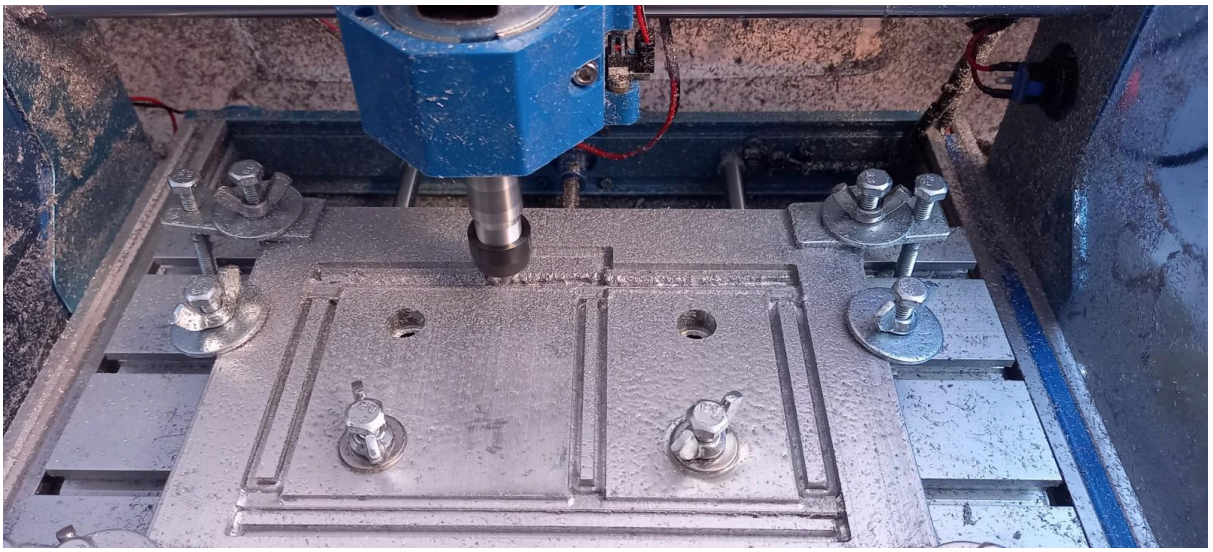

Fig 18, Mould Milling

Fig 19, Moulds Complete

Fig 20, Moulds Bolted

Once the Moulds are machined, wet stone and sanding is necessary to smooth over any rough surfaces within those Moulds. Then we can finally use the IMM to inject into the Moulds. Once the component is removed from the Moulds all that remains to complete the product is to press-fit and glue the spirit level bubbles .

Health & Safety

- Always wear heat protective clothing, goggles and gloves (PPE)
- Remove all obstacles and barriers preventing emergency exit
- Never touch the Barrel or Band Heaters whilst the machine is on
- Localise Safe Isolation, never work Live
- Use a Carbon Filter to cleanse the air
- Torque bolts weekly
- Visual inspection daily
- Competent Person/Operative Only

Weight

The only thing to determine now is the weight and this is done by comparing the CAD designs properties regarding mass and then by weighing the product. Aiming for 36 grams or slightly over would mean 100% success and a viable product to sell.

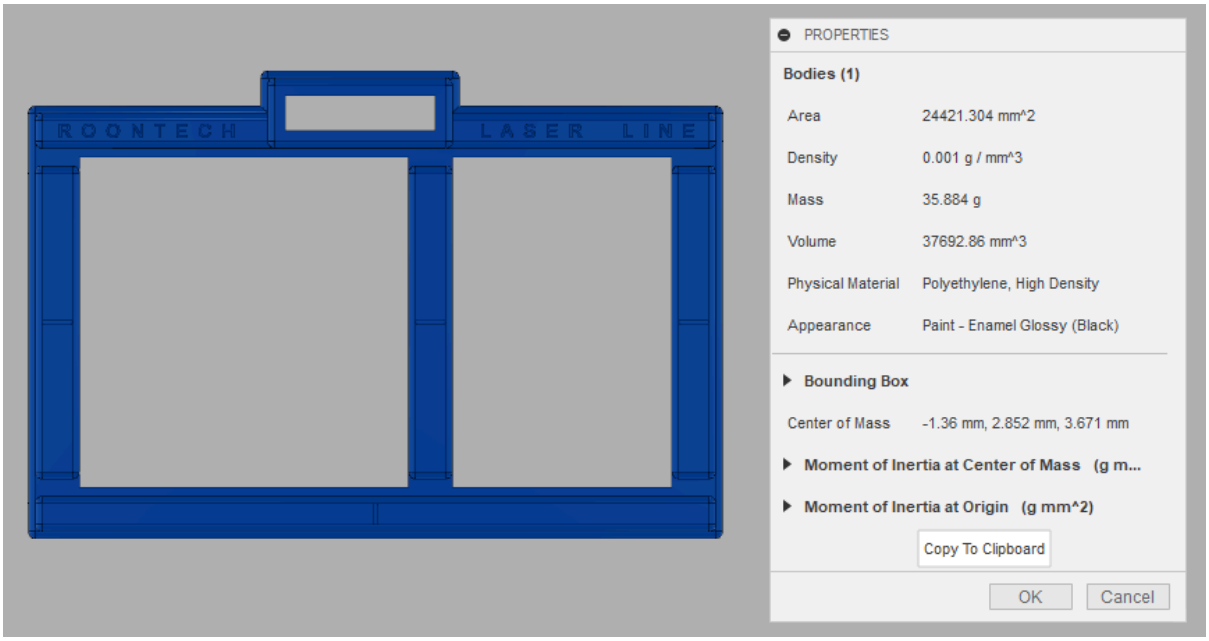

Fig 21, Ideal CAD Mass

Fig 22, Actual Mass

Conclusion

The weight is 38 grams, this means all the above work is correct and that the IMM designed and built was fully justified and was able to produce enough force to fill the Mould cavity, slightly over the ideal mass properties according to Fusion360 data (36 gram). Slight Flash did occur during sample runs as intense pressure separated the Moulds. This problem has been overcome using a higher molten plastic temperature, controlled flow rate, and correct clamp positioning of the Moulds.

Spirit Level Bubbles

Table 7, Spirit Level Bubble

Specification	Method	Required Size	Application	Additional Support
35 x 8mm	Press Fit	34.2mm	Remove 0.8mm of material to suit dimensions	Gorilla Glue

Paint

Logo, Branding and centre marks can be highlighted by the customer if they choose, using plastic specific paint or marker pens. The reason this company is not doing so is because paints tend to fade or peel over time. I have shown previously the above mentioned which includes highlights via CAD design.

Finished Product

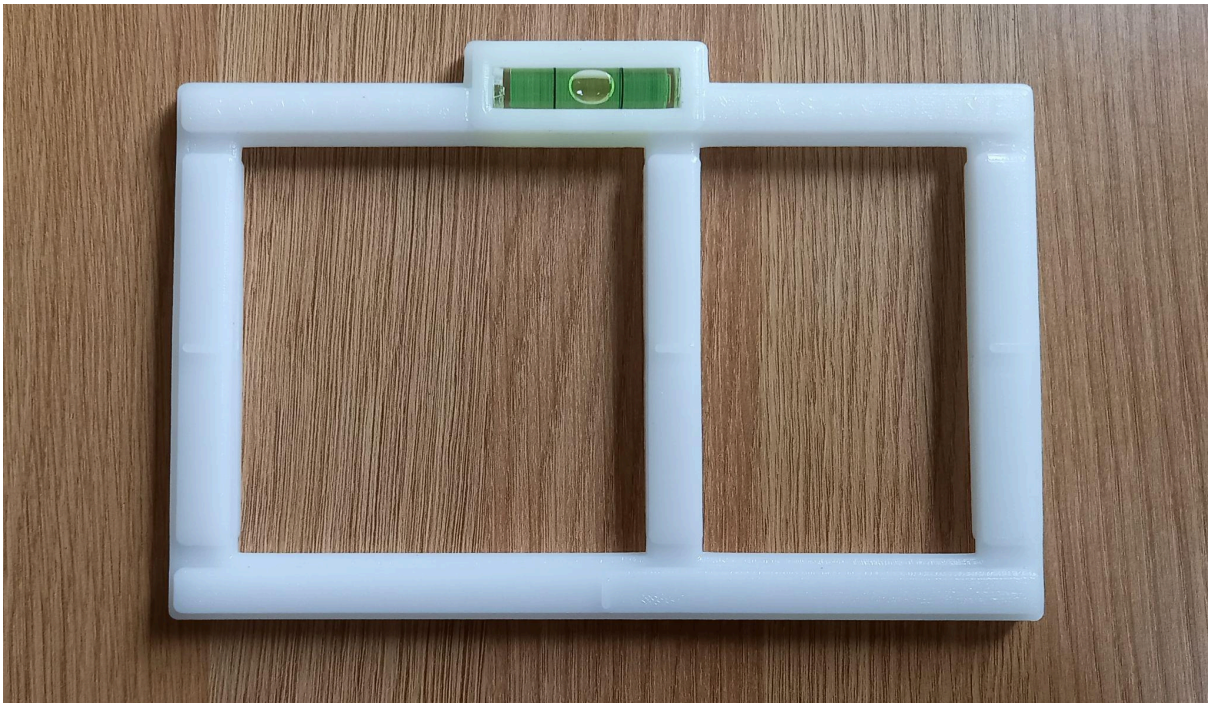

Fig 23 Finished Product

The Final Product, aesthetically pleasing, zero defects and fit for purpose. Shrinkage did occur, but as predicted only by 1mm regarding the cut-out areas. Which was guesstimated at first, and officially concluded here. It meets the target dimensions of (74 x 74mm) and (74 x 134mm). It means the whole process was valid from start to finish. From Idea to Prototype, to the build of the IMM and the design of the Moulds which took 8 months to produce, and 2 weeks of commissioning to obtain this result.

Features

- Laser Line Guidance
- Increased tooling tolerance
- Sustainable Design
- Robust
- Weatherproof
- Flexible
- Compact
- Enhanced Gripping points

Project Cost

Table 8, Project Cost

Part	Specification	Amount	Cost
Laptop	Acer	1	£0
Fusion360	CAD	1	£0
3D Printer	Creality	1	£0
Print Filament	0.2mm	13.44M	£0
IMM	ROONTECH	1	£550
Prover 3018	Desktop CNC	1	£350
CNC Tools	CNC	Variable	£200
Aluminium Plate	6082	10	£200
Plastic Pellets	Virgin HDPE	15Kg	£100
Spirit Bubbles	Green	500	£100
Glue	Gorilla	15g	£5
Paint	Plastic Coating	1 Litre	£20
Label Machine	Address Posting	1	£100
			Total £1,625

Conclusion

Considering I personally own many tools prior to this project the cost of what I need to spend to produce a small quantity of units (250) = £1625, just over half the budget. However, there are other unknown costs such as power used, website, bank and accountancy fees, marketing and post and packaging.

Production Cost & Forecast

Manufacturing 100,000 Units over 4 years, 25,000 per year, operating 313 days per year manufacturing 80 units per day, 10 units per hour.

1 kg HDPE

£6

Amount

1000g/36 =27.7 units

£6/27.7 = 22p per unit

36g x 80 = 3Kg (Day)

3kg x 313 = 939Kg (Year)

939Kg x £6 = £5,634

Waste Allowance 25%

£5,634 + 25% = £7,043

500 Spirit Level Bubbles

£100/500 = 20p

80 x 20p = £16 (Day)

£16 x 313 = £5008 (Year)

Material cost per year

£7,043 + £5008 = £12,051

Post and Packaging

£1.15 per unit

Material Cost per Unit

£1.15 + 22p +20p = £1.57

Market Price

£12

Income per year

£12 x 25,000 = £300,000

VAT

£300,000/ 20% = £60,000

Sales/Costs/Profitability Forecast Table

Forecast for 12 Months from	November 2022		To	November 2023	
INCOME	**1st Qtr £**	**2nd Qtr £**	**3rd Qtr £**	**4th Qtr £**	**Annual Totals £**
Sales	£75,000	£75,000	£75,000	£75,000	£300,000
Other income	£0	£0	£0	£0	£0
TOTAL INCOME (a)	£75,000	£75,000	£75,000	£75,000	£300,000
DIRECT COSTS					
Materials	£3,012.75	£3,012.75	£3,012.75	£3,012.75	£12,051
Other direct costs	£0	£0	£0	£0	£0
Direct labour	£0	£0	£0	£0	£0
TOTAL DIRECT COSTS (b)	£3,012.75	£3,012.75	£3,012.75	£3,012.75	£12,051
GROSS PROFIT (a – b = c)	£71,987.25	£71,987.25	£71,987.25	£71,987.25	£287,949
INDIRECT COSTS					
Indirect wages (office wages)	£0	£0	£0	£0	£0
Rent / Mortgage int for business	£0	£0	£0	£0	£0
Council tax for business	£0	£0	£0	£0	£0
Power and heat	£31.3	£31.3	£31.3	£31.3	£125.2
Repairs and maintenance	£453.7	£453.7	£453.7	£453.7	£1,814.8
Insurance	£15	£15	£15	£15	£60
Travel/car costs	£250	£250	£250	£250	£1000
Postage & Packaging	£7,187.5	£7,187.5	£7,187.5	£7,187.5	£28,750
Delivery / carriage (inc van)	£0	£0	£0	£0	£0
Printing, stationery and computer	£1,500	£500	£500	£500	£3,000
Advertising	£2,500	£1,250	£750	£500	£5,000
Marketing / promotions / networking	£2,500	£1,250	£750	£500	£5,000
Website development and hosting	£900	£900	£900	£900	£3,600
Accountancy / legal	£240	£240	£240	£240	£960
Development / training	£0	£0	£2,000	£0	£2,000
Professional fees	£4,000	£0	£0	£0	£4,000
Equipment	£3,000	£0	£0	£0	£3,000
Bank charges	£1,250	£1,250	£1,250	£1,250	£5,000
Bank / finance interest	£0	£0	£0	£0	£0
Depreciation	£0	£0	£0	£0	£0
TOTAL INDIRECT COSTS (d)	£23,827.5	£13,327.5	£14,327.5	£11,827.5	£63,310
NET PROFIT/(LOSS) (c – d)	£48,159.75	£58,659.75	£57,659.75	£60,159.75	£224,639
PERSONAL DRAWINGS	£5,967	£5,967	£5,967	£5,967	£23,868
CUMULATIVE PROFIT/(LOSS)	£48,159.75	£106,819.50	£164,479.25	£224,639	

Cash Flow Forecast Using Criteria Table

Forecast for 12 Months from	November 2022		To	November 2023	
CASH RECEIVED	**1st Qtr £**	**2nd Qtr £**	**3rd Qtr £**	**4th Qtr £**	**Annual Totals £**
Sales	£75,000	£75,000	£75,000	£75,000	£300,000
Personal Capital put in	£0	£0	£0	£0	£0
Partner's Capital put in	£0	£0	£0	£0	£0
Sir Thomas White loan requested	£10,000	£0	£0	£0	£10,000
Other bank loans requested	£0	£0	£0	£0	£0
VAT - Output tax collected on sales					
VAT - Rec'd from HMRC	£5,761.45	£4,461.45	£4,661.45	£4161.45	£19,045.80
TOTAL RECEIPTS (a)	£90,761.45	£79,461.45	£79,661.45	£79,161.45	£329,045.80
PAYMENTS					
Materials	£3,012.75	£3,012.75	£3,012.75	£3,012.75	£12,051
Other direct costs	£0	£0	£0	£0	£0
Direct labour	£0	£0	£0	£0	£0
Indirect wages (office wages)	£0	£0	£0	£0	£0
PAYE/National Insurance Contributions	£0	£0	£0	£0	£0
Rent/Mortgage int for business	£0	£0	£0	£0	£0
Council tax	£0	£0	£0	£0	£0
Power and heat	£31.30	£31.30	£31.30	£31.30	£125.20
Repairs and maintenance	£453.70	£453.70	£453.70	£453.70	£1,814.80
Insurance	£15	£15	£15	£15	£60
Travel / car costs	£250	£250	£250	£250	£1000
Postage & Packaging	£7,187.50	£7,187.50	£7,187.50	£7,187.50	£28,750
Delivery / carriage (inc van costs)	£0	£0	£0	£0	£0
Printing, stationery and computer	£1,500	£500	£500	£500	£3,000
Advertising	£2,500	£1,250	£750	£500	£5,000
Marketing / Promotions / Networking	£2,500	£1,250	£750	£500	£5,000
Website development and hosting	£900	£900	£900	£900	£3,600
Accountancy / legal	£240	£240	£240	£240	£960
Development / training	£0	£0	£2,000	£0	£2,000
Bank charges	£1,250	£1,250	£1,250	£1,250	£5,000
Bank / finance interest	£0	£0	£0	£0	£0
Working capital movements (extra stock/debtors/creditors etc)	£0	£0	£0	£0	£0
FIXED ASSETS PURCHASED	£3,000	£0	£0	£0	£3,000
Personal drawings	£5,967	£5,967	£5,967	£5,967	£23,868
VAT – Paid to HMRC	£15,000	£15,000	£15,000	£15,000	£60,000
TOTAL PAYMENTS (b)	£43,807.25	£37,307.25	£38,307.25	£35,807.25	£155,229
NET INFLOW/ (OUTFLOW) (a –b)	£46,954.20	£42,154.20	£41,354.20	£43,354.20	£173,816.8
CUMULATIVE CASH FLOW	£46,954.20	£89,108.40	130,462.60	£173,816.8	

Business Plan

Marketing Strategy

200,000 Registered Electricians, Labourers, Apprentices, Fire Alarm Engineers, DIY and Kitchen Fitters, 100,000 units produced over 4 years, 25,000 units per year.

Retail Price Website

£12

Warranty

2 Years

Wholesalers

I am willing to sell this product cheaper to wholesalers directly, the price I will accept is £9,50, this is due to neglected costs of posting, bank, and website charges. Wholesalers include the following.

- Edmundson Electrical
- CEF
- B&Q
- Wickes
- Screwfix
- Toolstation

I will openly contact the above and arrange meetings where I will present my product with openness and clarity and give away free samples for customer feedback.

Technology Adoption

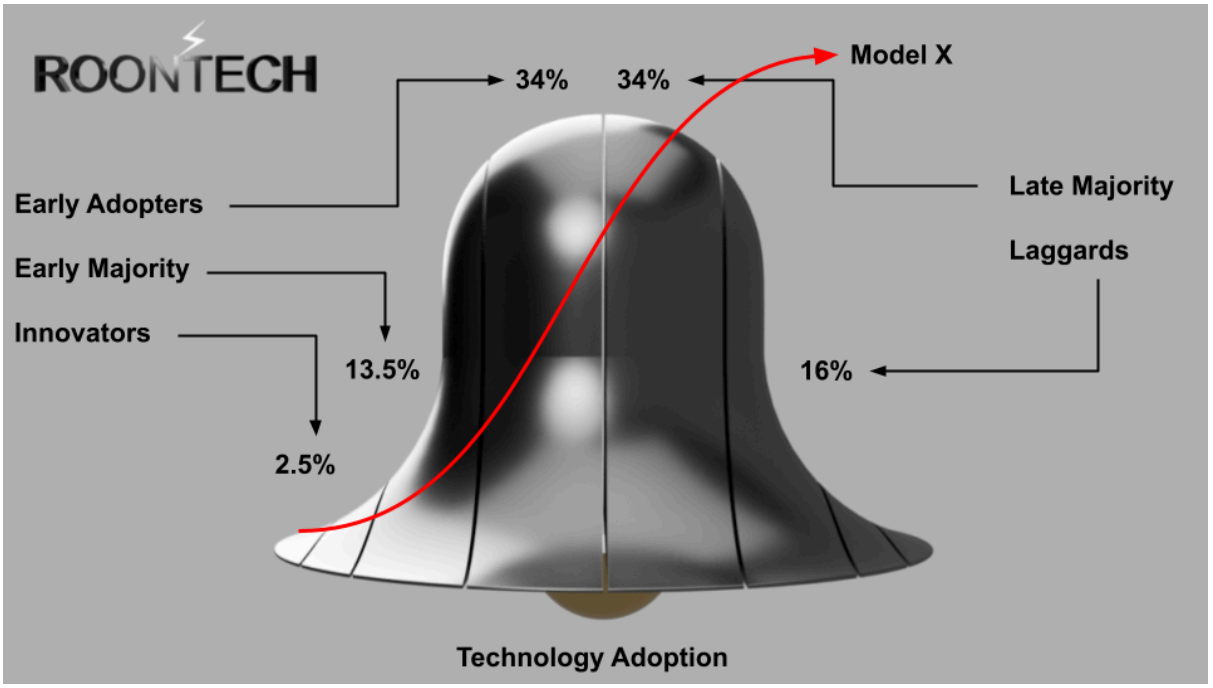

Fig 24, Technology Adoption

Targeting 20% of 500,000 potentials might seem ambitious but Electricians adapt quickly to new technology. I will use my own Social Media to post about the product, and word of mouth to begin. Early sales are predicted to be low, however, this gives me time to build my stock. When sales are frequent I will afford further marketing and start a new development unrelated to this product (Model X). I will use the following Social Media outlets to market my product.

- Facebook
- Linkedin
- Instagram
- TikTok
- Twitter

I will specifically target social media influencers regarding Electrical Installations, they will have a valid unbiased opinion and their reach and following would benefit sales. I am not just selling a product, I am selling the whole method and approach.

- British Manufacture
- Sustainability
- Environmental Awareness
- Future Productions
- Employment Opportunities

Patent Protection

Idea, process and the tangible product is to be Patent protected to stop mimics, replicas and knock-offs, this is essential for security, sales and business expansion. Application to the GOV is currently in motion.

Fundamental Question

Why should anyone buy my product over anybody else's? The easiest way to clarify this is by a Competitor Analysis. So I will introduce my competitors.

Innox

Not a well known brand regarding Electrical Installation tools and equipment but they have developed a Socket/Switch Template and it retails for £10,49 via Amazon. It is longer than all other competitors as the switch and socket cut-outs are separate. They boast it is hard and flexible, but by design, experience suggests otherwise.

Draper

The Cheapest of all retailing at £9.99 but I have seen prices of up to £15.50, this unit is compact, Draper are fairly well known, but not renowned for quality tools. It comes in black and features a height guide and an off putting Logo.

CK

The most well known name amongst Electricians, and the most expensive, CEF stock this for £15. On average, it is the most expensive Template and this is my direct competitor. Ironically, the Draper and CK Templates are of similar designs. However, CK can charge more because of the impact of their brand on other tooling. This comes in grey and also features a height guide and handle.

Competitor Analysis

Using the Laser Line Guidance Template as the standard to adhere to and the ultimate difference of why my product is better than everyone else's.

Table 9, Competitor Analysis

Competitor	Rigidity	Flex	Cost	Aesthetics	Laser	British	Score
ROONTECH	5	5	3	3	5	5	26
CK	5	3	2	5	0	0	15
Draper	5	3	5	5	0	0	18
Innox	2	2	4	3	0	0	11

Scoring 1-5, a simple Tally chart is sufficient, there is no need for a Pugh Matrix or House of Quality Chart as the objective is simplified for Non Engineers. Having personally used competitors Templates the need for mine is a must. Laser Levels are very common and a Template that benefits the usage is a necessity. The Innox Template bows and will last 5 minutes before it snaps in a tool bag, also it is a Chinese production. CK and Draper both use a similar design which is imported from China, again, similar to mine in compactness but rigidity makes them brittle and prone to snapping, material selection is critical and their designs limit flexibility which is important for longevity especially when kept with other hard wearing tools.

Both CK and Draper can come with a height guide and handle, the handle is unnecessary, but not as unnecessary as the height guide which can only measure from the floor to a socket (450mm), not up to or down to a switch. This measuring device is unnecessary because Electricians have a thing called a “Tape Measure”. Storing the height guide is an issue and will definitely bow or not even be used. The problem with a height guide is if you have more than two sockets the floor may not be even, which is a problem,a difference in heights will happen. However, above all else the main difference is that mine features “Laser Guidance”.

Interestingly my product is not as aesthetically pleasing in my opinion compared to CK and Draper, there is a very good reason for that, sustainability and flexibility. Sustainability in my opinion is more important than aesthetics. CK, Draper and Innox have used the “Master Batch” process which consumes more energy pigmenting raw materials. Flexibility is an important aspect and a decision was made to use HDPE over any other plastic. When competitors Templates bow it is permanent, when mine does, it can be reshaped, thus, longevity, and using a Laser Level you can actually calibrate this.

I could introduce a colour range but to begin I want to bring out the most efficient version and at least have this as an option. Through my set-up, colour change is easy and can be done in less than a day whereas competitors would have to go off and queue in line for a manufacturer to change theirs costing a fortune. Other Key points to make are tooling tolerance allowance, centre markers, enhanced grip for small hands and sustainable packaging methodology.

Sales/Partners/Suppliers

Method & Approach

You can purchase through the website, or direct from the factory shop in person. You may also purchase from contracted wholesalers where you may pay more due to overheads and profits. Wholesalers hold bargaining power, However, bargaining power of the consumer will supersede them. It will be up to the consumer to decide where to buy from. Having wholesale partners is beneficial to me as work is relieved through online sales, they advertise for me, and by delivering large quantities to just one address. The issue that may arise from wholesalers is the fact they stock rival products.

Threat

Unfortunately for those competitors I will hold the Patent to this technology and design process, and take a huge proportion of their potential and existing customers. I would need to check if there are any contracts in place and if they contain any clauses stopping the wholesalers from selling my product. With the element of surprise and a Patent in place, the LLGT will sneak up from behind and become an absolute threat. Leading towards customers substituting competitors products, in favour of mine.

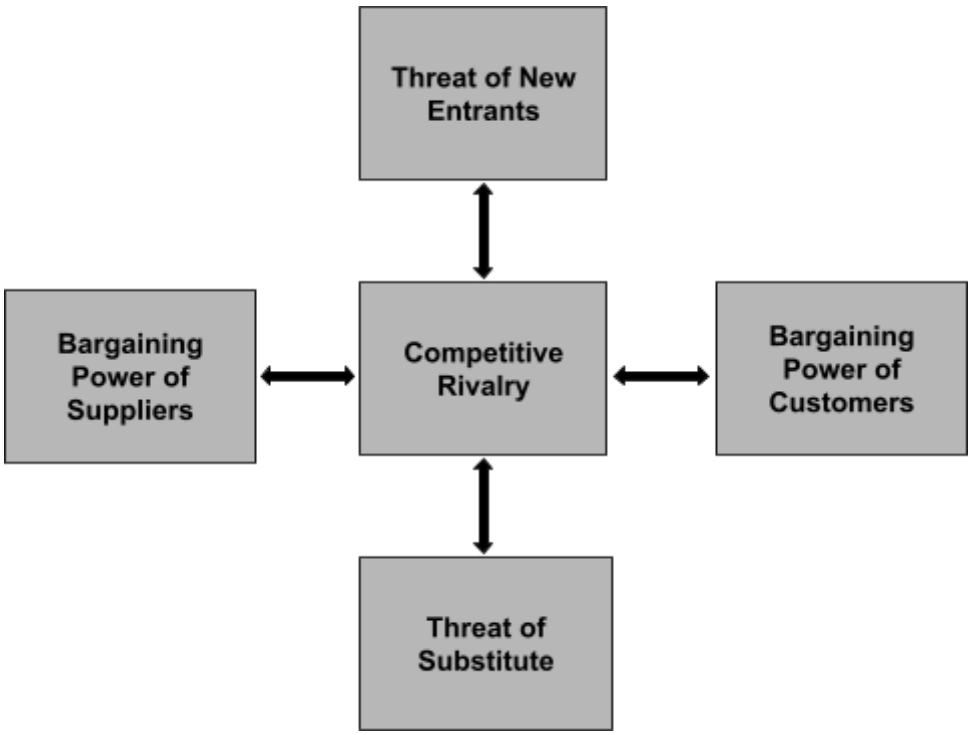

Fig 25, Bargaining Power

External Distribution Channel

National deliveries will be outsourced to courier services such as FED-Ex and Royal Mail. The cost for posting from my website is included within the retail cost of £12. Hopefully I will be able to negotiate with couriers on price and drop offs.

HDPE Suppliers

Suppliers for raw HDPE have been locally sourced using ebay, the main seller being “bybbubbledirect”. Due to small scale production, big manufacturing companies such as Plastribution refused business due to the mass of materials required. Only dealing in Tonnes, whereas I need kg’s, approximately 100kg per month. Smaller amounts of material are easier to store and maintain and also come with free delivery.

Spirit Level Bubbles

I have to import these as there are no suppliers within the UK, 500 SLB’s cost £100 and are sourced via website Grandado offering free delivery.

Packaging

Using “Large Cardboard Envelope Boxes”, (162 x 114 x 20mm), will be supplied by Smith Packaging, this method has 7 benefits.

1. The cardboard is recyclable.
2. It removes unsustainable plastic packaging.
3. Small enough to be posted through letter boxes.
4. Each box costs just 7.6p.
5. Hardly any material waste due to snug fitting of the product.
6. Aesthetically pleasing and professional appearance.
7. Lightweight packaging enables cheaper postage prices.

Postage Label Stamps

Labels will be paid for in bulk via “Royal Mail” or equivalent for delivery purposes. The website will ask for customers' details and address. This data is sent directly to a labelling machine and printed. The Cost of each 2nd class stamp is £1.05, cost is derived from the product's dimensions being less than (325 x 250 x 25mm) and the packaged weight, which has to be less than 100 grams to meet criteria.

Branding Labels

Designed by me, packaging will show my branding/Logo and a QR Code link to the website for instructions of use, (80 x 45mm), these labels will be externally printed by a company called “Discount Sticker Printing”. The cost is £38.85 for 1152 stickers saving 69.1% buying in bulk. This method of Branding/Marketing helps contribute towards sustainability. Using Cardboard, Stickers and a QR Code we can maintain quality and aesthetics, whilst removing plastic packaging and tangible instructions.

Terms of Material Supplier Trade

All payments are made prior to ownership and delivery, there are no accounts set up with these businesses as of yet. However, frequent use may help build relationships where price and delivery could be negotiated. A sustainable method of procurement has been utilised when selecting companies to do business with.

Business Model Canvas

Table 10, Business Model Canvas

Business Model Canvas		**Designed For** **Electricians**	**Designed By** **CJ Rooney**	**Date** **11/01/2022**
Key Partners	**Key Activities**	**Value Proposition**	**Customer Relationship**	**Customer Segments**
ebay for HDPE Smith Packaging for boxes Discount Sticker Printing for Logo Grandado.com for Spirit Level Bubbles Royal Mail Fed-Ex for delivery Wholesalers	Introducing a new Template for Electricians Production Sustainable ethics and procurement Impact Education Marketing Sales	Laser Line Guidance Compact Flexible Robust Sustainable product and methodology Efficient procurement Manufactured in the UK	Two Year Warranty Helpful guidance and instructions via ROONTECH website QR Code Ease of purchase Delivery on Payment	20% of the market, 100,000 Electricians Apprentice Labourers Competent Person Fire Alarm Engineers AC Engineers Kitchen Fitters DIY
Cost Structure	**Resources**	**Imported**	**Channels**	**Revenue**
Raw material Utilities Wages Machines Insurances	Raw materials from local companies Tools Components	Spirit Level Bubbles Tools Components	Word of mouth Website Facebook Instagram Twitter LinkedIn Tiktok YouTube	**Fixed Price** Website £12 **Factory Shop** £11 **Wholesalers** £9.50

Grants & Loans

I have been able to produce a product, however, there are instances where the lack of funds limit progression. Therefore, I will be seeking Grants or Loans to help me with marketing, patents and materials. Having done a lot of the work myself, I have been able to limit the amount required and I think £10,000 would solve all my issues. I am aware of Charities such as “Sir Thomas White Loan Charity” who I have spoken to and they may be able to help provided I give a good, valid reason. Amazingly, they offer an interest free loan, non payable up to 3 years.

Future Productions

The funds raised from this project will help my company produce another product, potentials are listed. However, for a clearer understanding visit www.roontech.co.uk.

- Compress-E-Bin
- MPCSO
- Vulnerable Persons Alarm
- Dual Edge Cutlery Knife
- Three Compartment Travel Mug
- Graphene Filter
- Sparkz Mini Spool
- Wellness Particle Dispersion
- Hot Melt Pen
- Sink Hugging Bowl
- Man Pan
- E-Vap
- LED Tech
- R&D Technical Studies

Depending on the funds raised one of the above, or others I have in mind will be selected based on production costs, once that is complete and selling, we implement another, and another and so forth.

Employment Opportunities

Hopefully the business will do well and there will be employment opportunities for a range of backgrounds from Assemblers, Maintenance to Managers. ROONTECH will be heavily reliant on R&D and creativity to out-design competitors. Not for glory, but for sustainability, and to help raise the standard of living for UK employees as the production is to be solely UK based. Materials are to be sourced from local suppliers boosting the economy and maybe ROONTECH leads the way as a unique versatile company with a wide variety of products to sell. The profit made will be put back into the business offering great wage packages, training and bonuses for employees whilst also expanding the business. Money and status are not my drive, being all I can be is. The company also aims to Research for problems externally put forward to the government by other Grant funded companies such as the KTN.

The End

This report was created by Christopher John Rooney

Director of ROONTECH LTD