

THD1382- New Product Development Report

Final Year

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Executive summary

This report will cover the commercial arguments for the Zephyrus leaf blower. It will discuss the market, design, manufacturing considerations and the end-of-life considerations.

1.0-Product overview

1.1-Product visuals

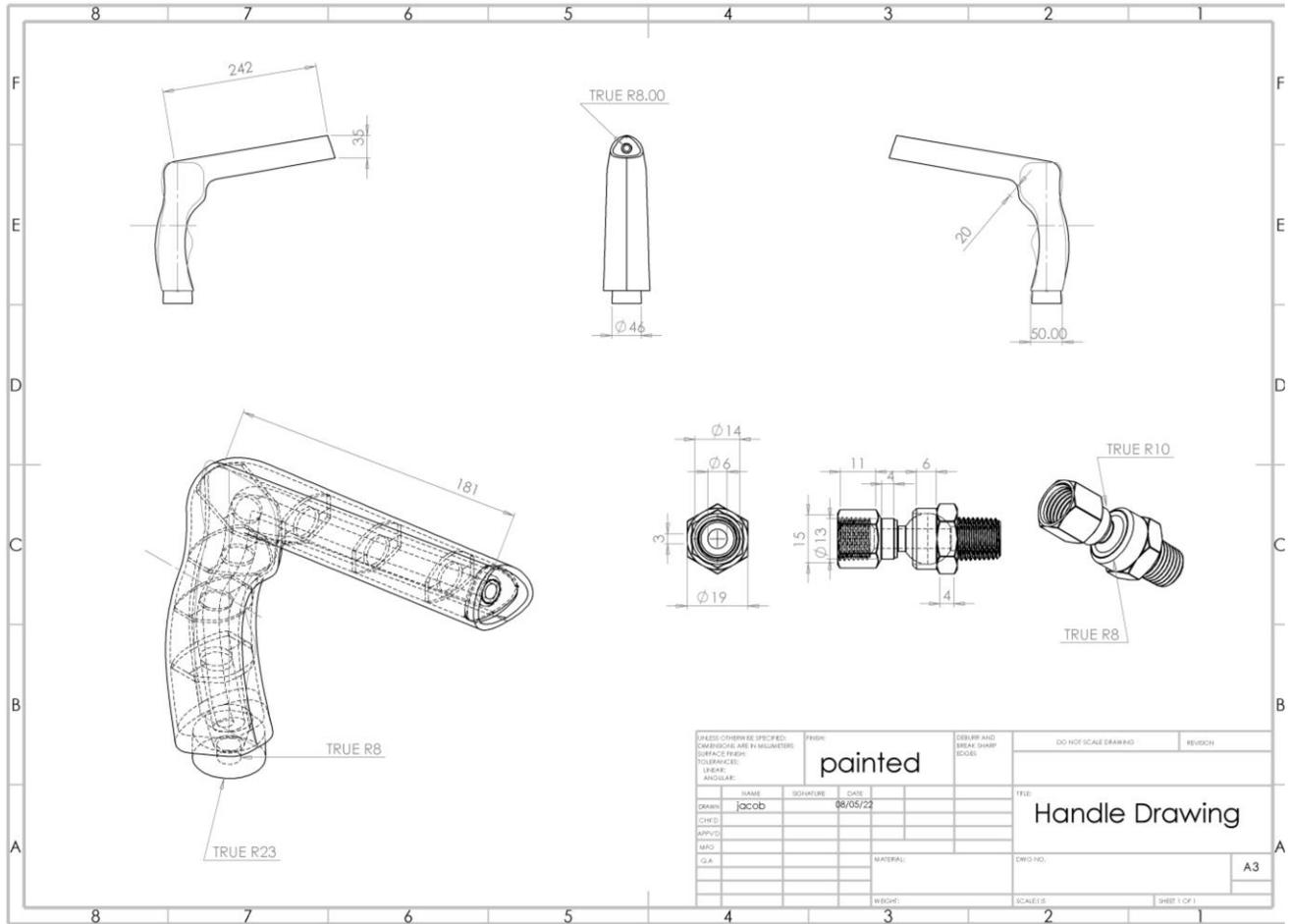
This will show the end result of all the processes and what the end product will hopefully appear like before going onto the market

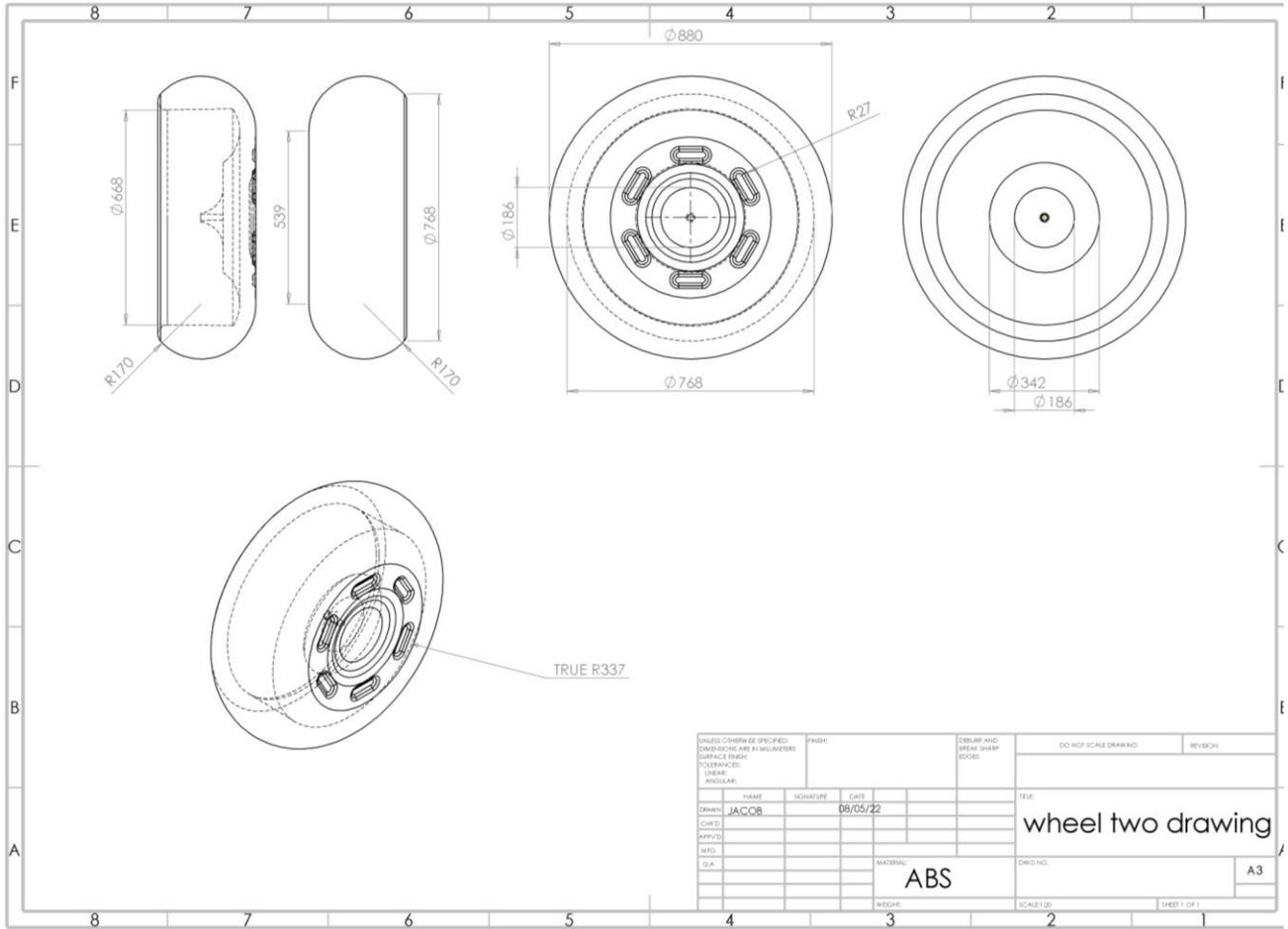


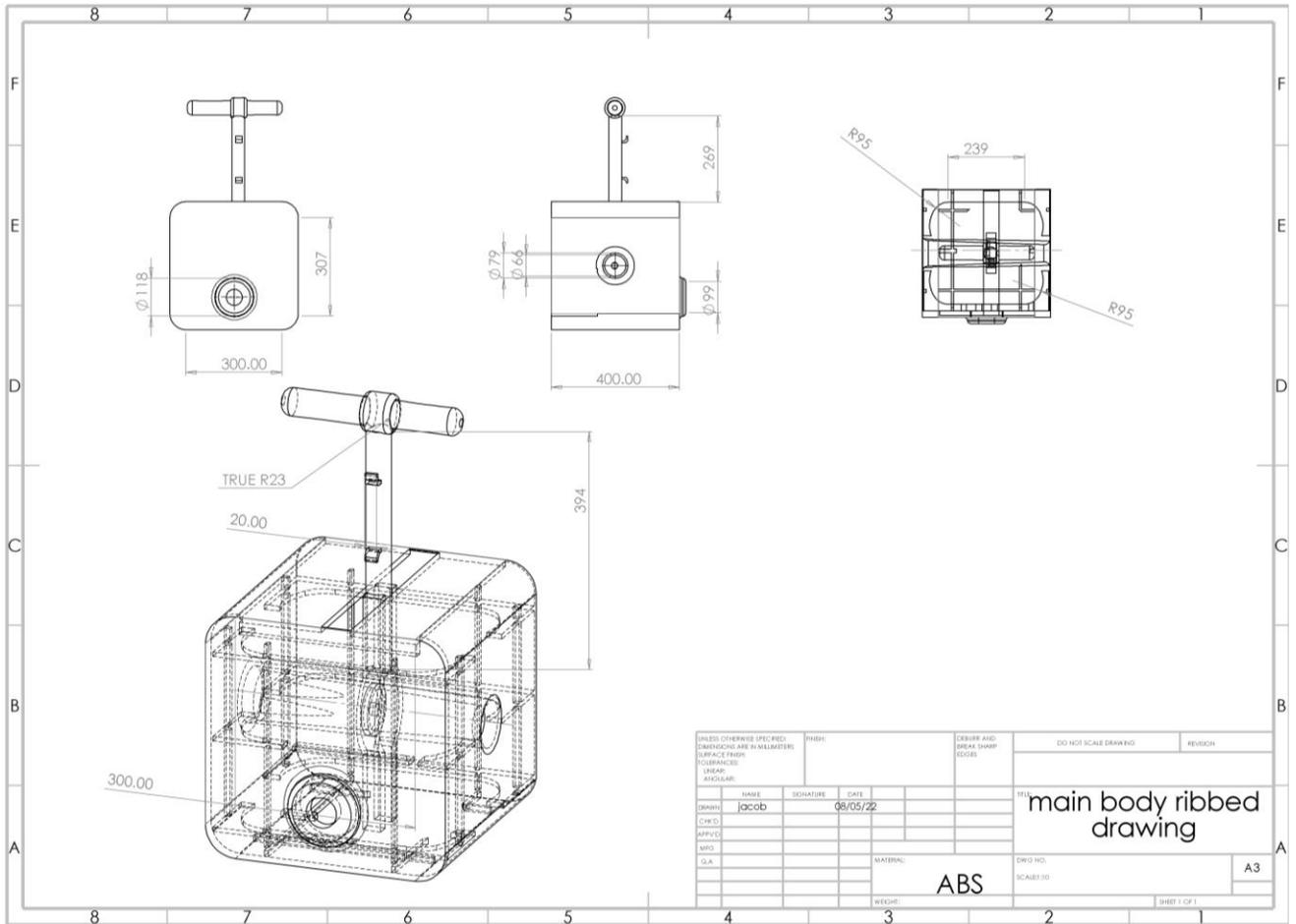


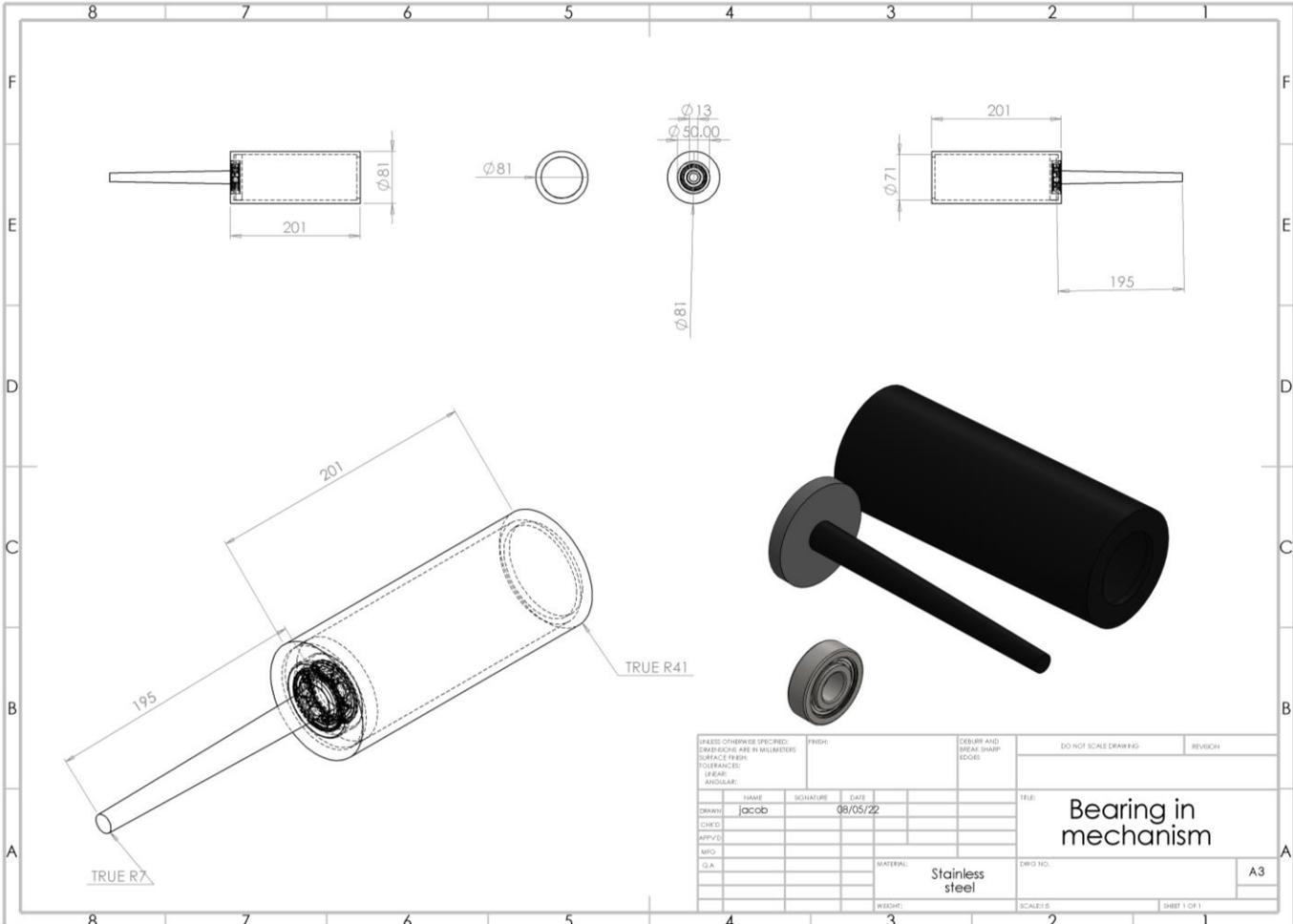
1.2-Technical drawings

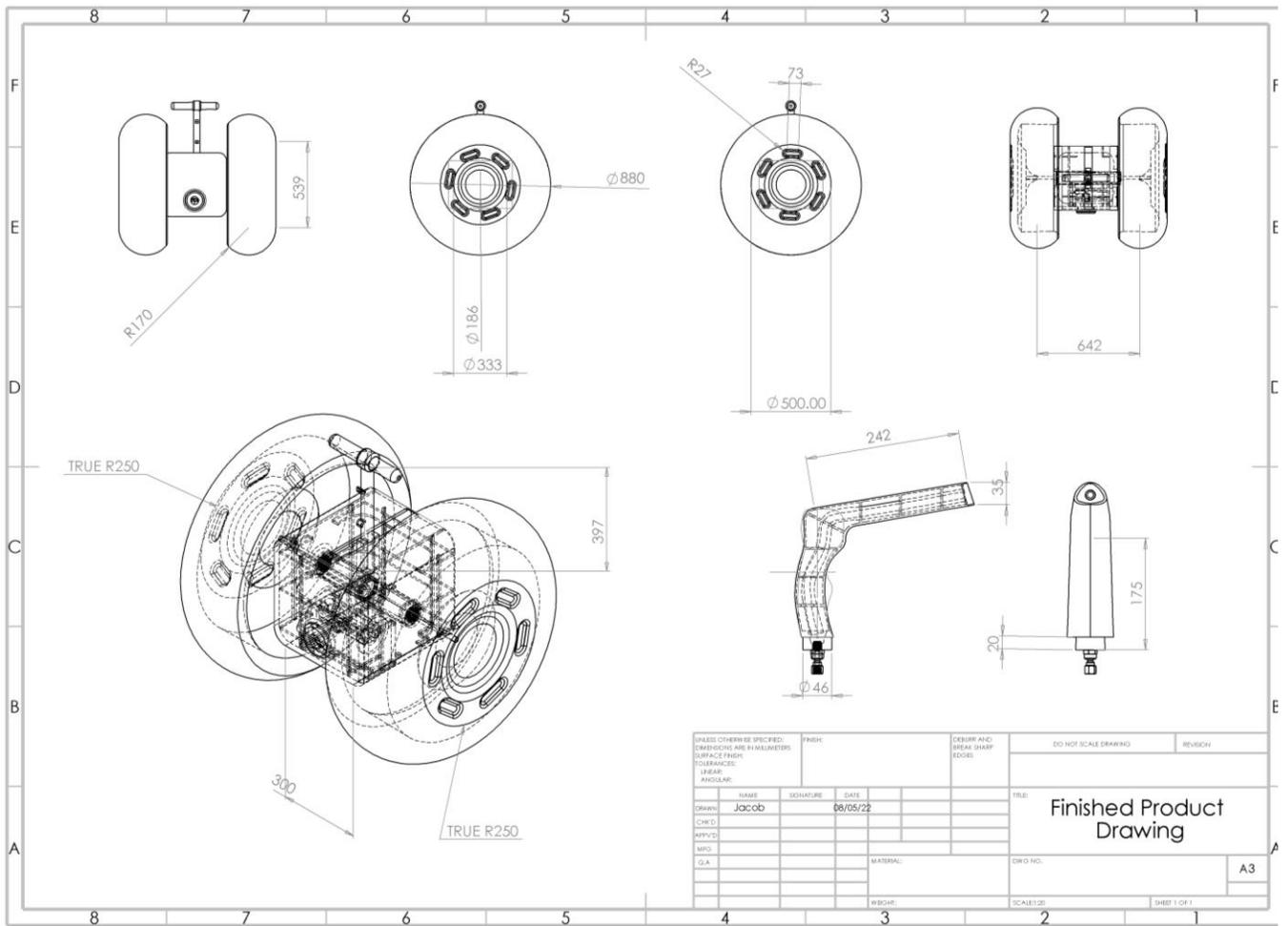
This will display the technical aspects of the various parts and display the different dimensions, parts, and views of the parts.





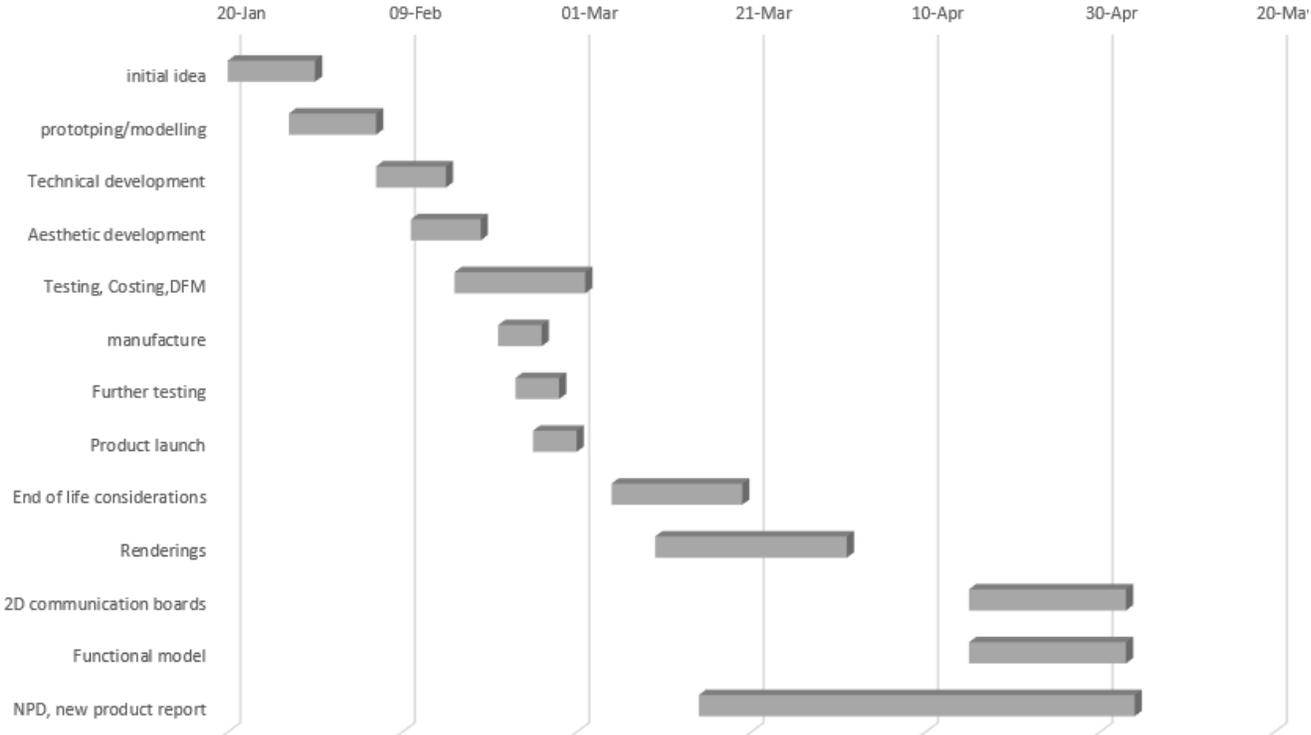




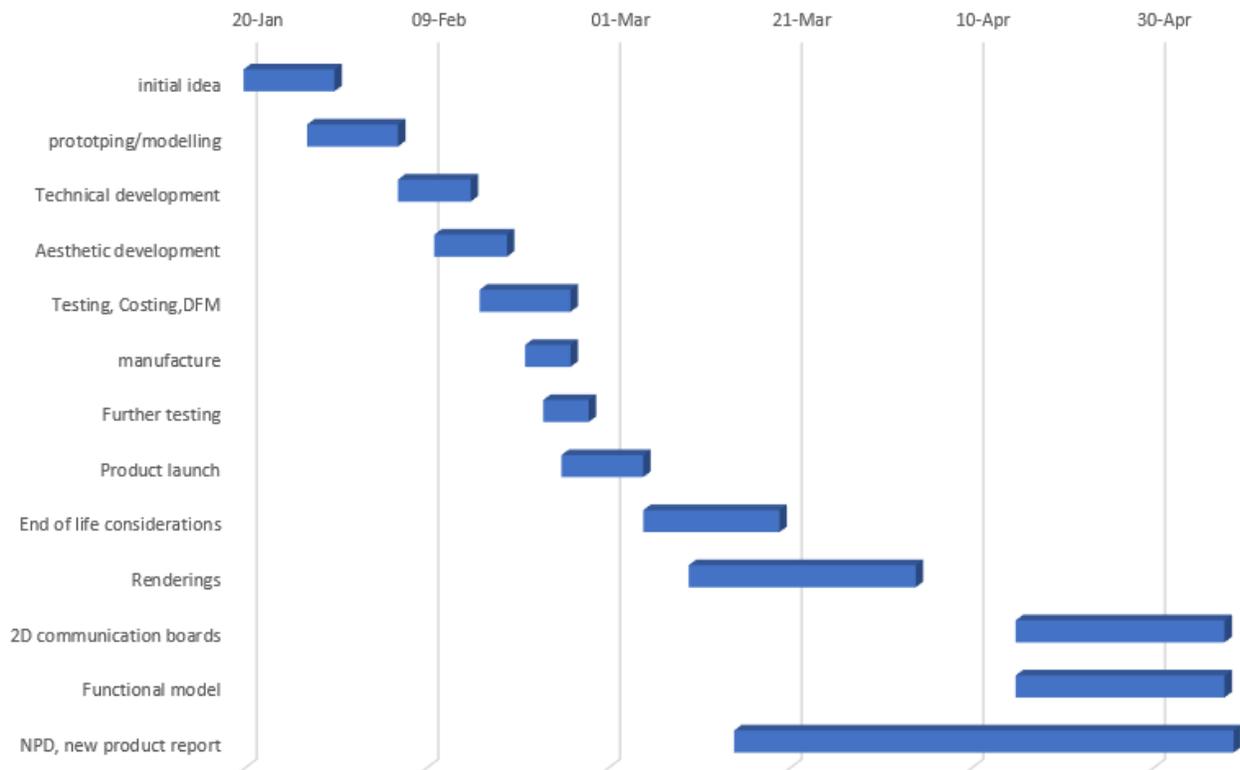


Gantt Charts

Expected Days Taken



Days Taken



1.3-Market Reassessment

The market is expected to grow at a 4.95 CAGR by 2026. The market is forever growing and increasing for the normal function and shape. The Zephyrus product is unique and has not really been seen on the market. This is a normal age group of middle age is what the current product on the market target with the elder consumers being left out. The elderly makes up around 40% of the market due to them enjoying gardening once, usually when they are retired.

1.4-Secondary Market

The secondary market will be vehicle detailing/cleaning. A recent trend is to use blowing tools with similar components to leaf blowers to blow off the standing water after washing a vehicle. It makes the process a lot easier and quicker and means the user can do a thorough job to get into all creases and joins.

- A car detailer can spend anywhere from 30mins to a full day fully detailing which means it is a low turnover.

- The car detailing business in the UK is worth around £1 billion a year on average with the highest recorded level being in 2016 with a turnover of £2.7 billion.
- There are currently 32.7 million passenger cars on the UK roads and at some point, they will need to be washed or detailed.

1.5-Introduction

The report investigates the new product development of the elderly-friendly leaf blower. It does identify the gap in the market and creates a product that allows the elderly to enjoy the tasks they want to do while being comfortable and independent.

1.6-Launch of Product

The product will be released in August 2023 which will be the following year. This allows time for the tooling such as the molds for the injection molded to be created. Other factors that it gives time for are the lead time for the product and the overall manufacturing process of the product to be completed. This will lead to the product to be released just before the autumn season begins, this is when trees start to shed their leaves and the ground becomes covered in dead leaves. This will be the time consumers will browse the current market for a leaf blower which will be the most popular time to release the product.

1.7-Advantages for Competitors

The competitors have a powerful reputation within the market with many products selling similar products for many years such as Bosch with their leaf blowers for example. Bosch have a powerful reputation within the market and many of their products are considered the best. The difference between the two products is that their range of garden products does not have a product range that aims at the elderly market who primarily take pleasure in gardening.

On average 80% of the elderly said they garden for pleasure and enjoy the activity, so most of the potential markets do not have a product that is ergonomic or based on their needs. The new product creates its own market due to the fact that many of the competitor products are in similar form to each other and don't specifically aim at the elderly person's needs.

1.8-Design Specification

1.8.1-Problem

The problem that is being faced is the lack of mobility and independence that elderly/65+ face daily. The elderly must have constant help whether that is from loved ones or a carer which is not confidence inspiring. My aim is to let the elderly do something they love independently or with loved ones if chosen. The main problem consists of three things. Number one is muscle dystrophy, and this is where the muscle fibers reduce in strength and weaken over time. The second problem is poor blood circulation. This can also reduce strength, especially in the legs, which can limit mobility through pain. The last problem is joint pain. This can occur with constant use of the joints within the user's lifetime which can deteriorate over time and become brittle and weak.

1.8.2-Solution

The solution is to enable the elderly to enjoy the tasks they desire to do while having the option to do it independently or with loved ones. The overall solution is to enable the elderly to perform gardening or activities such as leaf blowing within the garden while not being affected by any of the three problems mentioned above while maintaining their gardens. The product should eliminate these problems and ensure a pleasurable experience while doing something that on average the target consumer loves.

1.8.3-The Market

The product must appeal more to men, around 70% and 30% to women. This is based on a recent study from the Telegraph. (The telegraph.co.Uk, Louise Grey)

This study shows men do more "grunt work" such as the more labour intensive jobs and the women will paint and decorate according to the study. The age group that the product will be aimed towards is (65-90. This is the age group that starts struggling when doing tasks independently. The average income varies due to many of the people in the age groups retiring or at the end of their working lives. The income scale for those who are still in work will vary from (20,000-100,000.

1.8.4-Retail

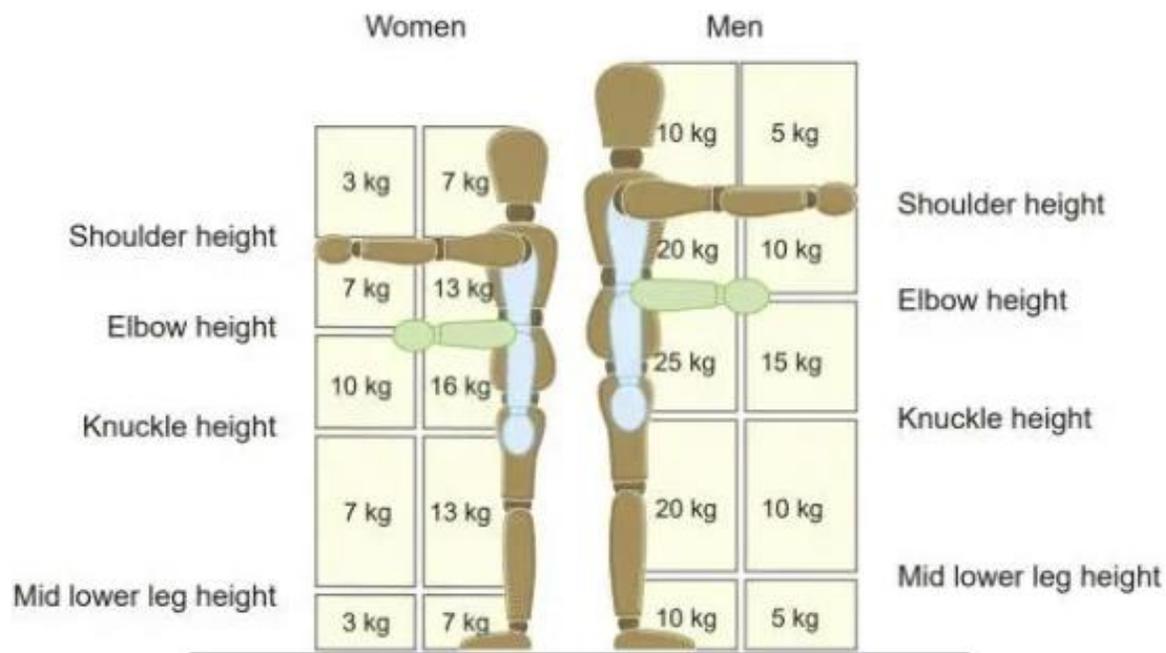
The product will be sold in many retail stores that sell outdoor equipment such as B&Q, Argos and through superstores such as Asda for example. It can also be advertised through their E-commerce websites.

1.8.5-Price

The price will be intended to be around the 120-150 pounds mark to stay in competition with the other brands in the market without the USP (Unique Selling Point) this product has. Many competitors' products range from 30-70 pounds for the plug-in ones whereas the petrol blowers are around 150-250 pounds due to the motors are more to manufacture so prices compete with similar internals

1.8.6-Ergonomics

The ergonomic considerations are the handle should be 4-5MM due to ergonomic studies that this dimension is the most comfortable and the best for a sturdy grip. The next dimension is the weight. The weight should be around 10-15KG. This is due to most of the weight not being lifted or required to move. The average a women can drag at waist height is around 13Kg and for men its 18Kg. (Liz Burton-Hughes, 29/10/21, manual handling)



<https://translyft.com/ie/case-studies/cases-insights/back-pain-lost-work-days-and-ergonomics/>
(translyft, 2019)

1.8.7-Aesthetic Considerations

The aesthetic considerations consist of not much contrast of the colours on various parts. This is due to it being harsh on elderly eyes and less bright colours should be used, hence the black, grey and royal blue colour scheme applied to the product.

The product must be visually appealing and instantly recognizable as the brand. It must be minimal and look rugged as if it is strong and durable.

The split line across the product creates a split between surfaces and makes the product look more minimal and more aesthetically pleasing while making the product more rugged and less likely to show up wear and tear marks in time.

1.8.8-End of Life Considerations

The product will be designed to be replaced with current standards in the future, the market is moving to repairing broken products and all components should be replicable if broken. Once at the end of life it should be recycled and remain sustainable. The majority of the of the parts that made the product should be recycled, an average of 80% of the parts should be recycled to ensure its environmentally sustainable.

1.8.9-Quality Control

The product and its material should be tested correctly and made sure that they can withstand many forces and wear and tear through its life cycle. These tests can consist of connection testing, material testing, heat testing and stress tests.

Many of the components such as the handles, wheels and main body should be tested due to the weights being forced onto its surfaces such as the floor pan with the weight of the components. The handle should be stress tested to see if it copes with the grip and the force from the movement of the pipe and connection.

1.8.10-Product Life Span

With the current trend as mentioned, the product should last between 10-20 years with parts being repaired and parts replaced if needed. This can extend the life span and it could extend longer than 20 years but must not drop below the minimum of 10 years.

1.8.11-Initial Material Considerations

The material must be strong, durable and hard wearing, this is to ensure a long-lasting life span. The materials also must have a good surface finish to enhance the aesthetics of the product. The materials must be recyclable so at the end of its life the parts can be recycled making the product sustainable and environmentally friendly. Overall, the material must ensure the product feels high quality and has all the traits a “high quality” product has.

1.8.12-Performance Considerations

In normal use, the leaf blower will be exposed to elements such as:

Liquids such as rain, standing water, tree sap and pond water if the consumer has ponds or water features. These elements can affect the product due to it staying on the product's surface for extended periods of time. This can leak into internals, so it is imperative that seals are placed in the joint point to stop water seeping into the main internals. The plastic used will be water resistant so water on the surfaces will not be a problem and it is corrosion resistant. Water will not affect the strength or durability of the materials; this will ensure the life span of the product.

Other elements such as mud and grass will be presented to the product, which means the product should be cleaned regularly to avoid any problems with the product that will be caused by this. Wipes or hosing it down is a sufficient way of cleaning if dried well after the last hose down to avoid any water ingress into the product. The product will mostly be used in the autumn =/ springs months after winter has passed so the product will encounter colder temperatures, this can range from 10 to -5° degrees in these months. Depending on storage conditions the product could encounter these conditions for 6 months of the year or be stored in a dry environment which will be the best conditions for the products. The product could encounter warm conditions also with temperatures rising to as high as 40° degrees in European countries, this can affect surface conditions. The product has been designed to accommodate the expanding materials and will avoid problems such as cracking, brittleness, warping or discoloration.

The product will encounter many stresses on its components when rolling over terrain. The wheels will have to have strong joins and the wall thickness which is 30mm (about 1.18 in) at its thickest will have to ensure they will not fail on terrains such as concrete, grass, flag stones and stones. This will vibrate the internals which may affect the performance, so to ensure this does not happen the ribs of the main body will hold the

components in place and connect them to the surface which will stop them from moving around and causing safety and performance problems.

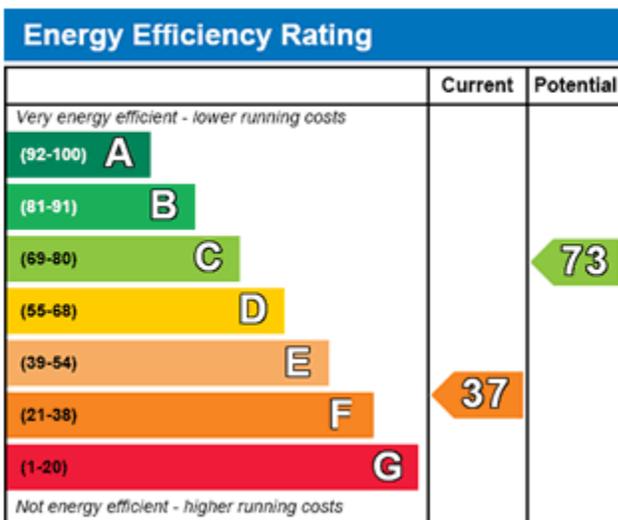
1.8.13-Size and Weight Considerations

The weight should be around 10-15KG. This is due to most of the weight not being lifted or required to move. The average a women can drag at waist height is around 13Kg and for men its 18Kg. (Liz Burton-Hughes, 29/10/21, manual handling) this was mentioned in a previous section, and this is due to the standards for lifting which is a standard for both professional and domestic use which ensure the safety and the health of the consumers using the product.

1.8.14-Environmental Considerations

Environmental considerations consist of material choices. The majority of the products will be made of ABS plastic with many of the internal parts being bought externally being made of a metal.

The power supply will be a 12 AMP powered motor for better performance. The energy efficiency rating should be A-C to ensure maximum efficiency with lower running costs which overall will have a positive impact on the environment using less energy within the household.



<https://www.electricityprices.org.uk/energy-efficiency-rating-guide/>

The end-of-life considerations also link to the environmental considerations. The end-of-life considerations contribute to environmental issues due to the waste of the products once finished with or broken. The product aims to be repaired if broken due to this being more environmentally friendly. To achieve this all components are not fixed and can be

replaced with simple tools by the user if components go wrong within ownership. The end-of-life consideration is for all parts to be recycled and potentially reused in the making of other leaf blowers or other plastic products to reuse the material. Many of the plastics can be recycled such as the main body and the wheels which are large pieces of plastic. The fixing can be recycled due to being made of steel. The motor is a standard part so can be reused in other leaf blowers or products that require this part, also with the wire and plug and chip board for the on/off switch and the power supply.

2.0-Market:



<https://www.diy.com/departments/outdoor-garden/garden-power-tools/leaf-blowers>

2.1-Competition:

- Bosch-Universal Garden tidy -£79.00
- Mac Allister-MBVP corded -£51.00
- FPBV-2500 corded blower -£32.00

These products all got a rating on the B&Q website of 2/5 stars with a lot of reviews. Many of the flaws are the wires with all the products being corded. Much of the current design trend is flawed with many of the negatives being of the form and how it is used.

2.2-Target market/user profile:

The target market will be aimed at the UK with later plans for release in Europe, in countries such as France, Germany and the Netherlands and many other of the countries besides.

The user profile will be aimed at 60–90-year-old users of any gender. The user will be retired in a retirement job where income will be up to £30,000. The user will have lots of spare time and regular likes to do gardening as pleasure and enjoyment.

The product allows the user to safely do gardening/leaf blowing without risking strain or injury which lets the elderly enjoy the activity and ensure if they do encounter strain, there is a valid resting point that reassures the health of the user.

2.3-Core Market Segmentation:

- Own garden use/domestic
- Landscaping

2.4-Second Market Segmentation:

- Professional use/landscaping
- Council use
- Vehicle detailing use
- Gardener by trade

2.5-Potential Buyers:

- The elderly (main buyer)
- Physically challenged
- Disabled persons
- Council
- Gardeners
- Landscapers
- Normal people
- Private parks

2.6-Expectations of the Product

There are many expectations and needs that the product will promise to the user which it has to meet. These consist of:

- Helping the user with muscle problems when in the garden
- Letting the user maintain their gardens without problems

- Maintains a good performance level
- Easy to use
- Allows for two people to use to create relationship

2.7-Market size:

Through the years from 2016-2021 the forecasted growth of the overall market which includes the corded, cordless and petrol blowers is set to grow by 4.9%. Petrol blowers are likely to see an increase through the years until 2024 due to them being more useful in heavy duty tasks while having lower energy costs compared to electric with the forecasted increase in electricity prices in houses.

Handheld leaf blowers were the largest segment of the market, covering over 51% of the whole market with the other 49% the other variants. The market is divided with different uses for the appliances. The segment for the market for domestic use is 73%, which is well over the majority of the market, which shows many of the blowers are being used within the household and the other 27% being purchased through commercial use. The overall market size is estimated to be 1444.73 million USD and is estimated to grow with GAGR an extra 4.15 until 2027.

<https://www.gminsights.com/industry-analysis/north-america-and-europe-leaf-blowers>,
(gminsights 2018)

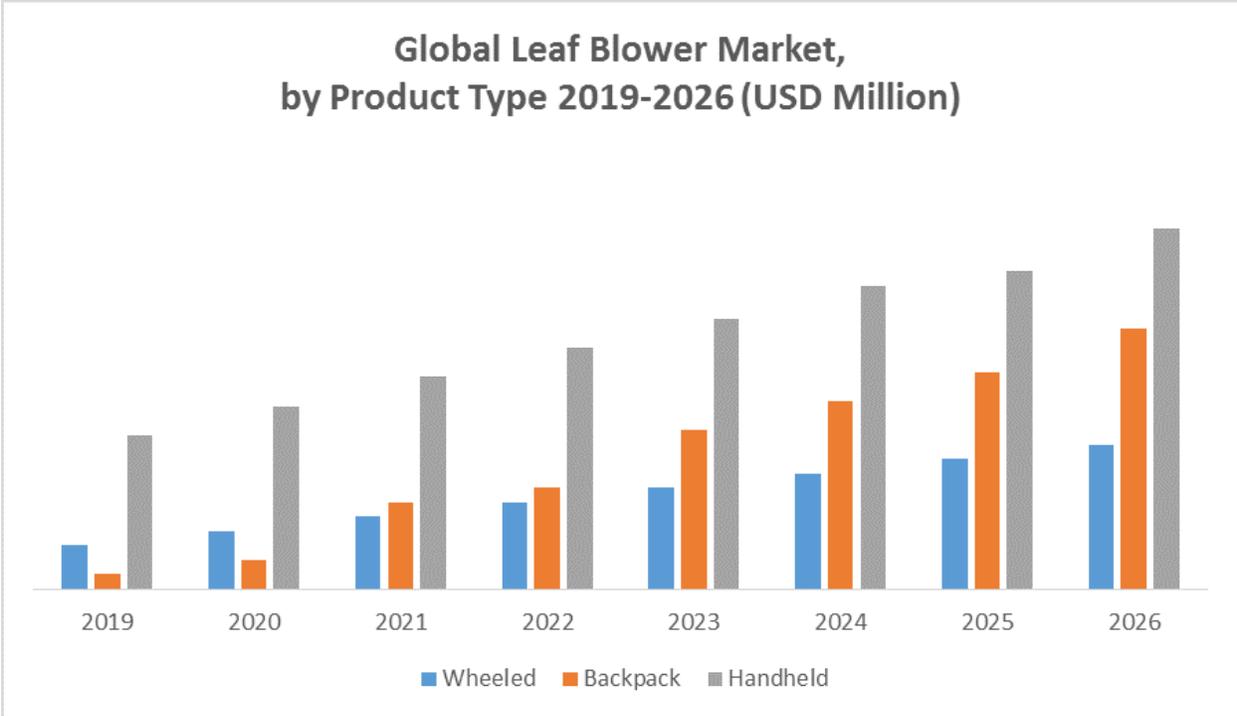
2.8-Market Strategy

The product should go onto the market with the early adopters and start to sell quickly due to the product being unique and having the USP of being targeted at the elderly, but which can benefit everyone who uses it as stated in the primary market. The product will be introduced into the market in August due to the product being seasonal. This will be the time the season will begin to change, and the gardens will need to be maintained. The product is a new product and is not a new addition to the market so it should get attention fast within the market, which makes it gain popularity.

The product will be launched in the UK to begin with. This is where the demand is for the product with many of the elderly market enjoying gardening and having a market just specific need. When the product gains popularity, it can be sold within the U.S market because of them having a large demographic of elderly people and having a lot of urbanization and space for greenery.

Once the product is established within the market, the product can be offered to councils or organizations such as groundkeepers or park keepers to further enhance the reputation and open to alternative markets such as the landscaping or even car detailing which was mentioned in (secondary market).

Overall, the product should be a success due to its unique selling point and how it differs from the competitors on the market. It offers so many benefits and can open potential options for consumers who are unable such as the elderly and disabled.



<https://teachin.id/blogs/56087/Leaf-Blower-Market-Industry-Analysis-and-Forecast-2020-2026-Makita> (Ashuuahirio, 2021)

The graph shows the different variations of the leaf blowers and their trends. For this purpose, the blue bar is the wheeled and through the majority of the years up till 2022, it has been low. The trend, however, for the predicted years is positive and there is an increase, but this is for wheels examples with the normal function. Zephyrus is a mix of wheeled and handheld which is the most popular, which shows that this product is already popular and still gives a USP to the market and the user. This was analyzed when the product was being designed, hence why the product links to the graph.

2.8-Swot Analysis

2.8.1-Strengths:

- Foldable
- Wheels slide inwards to cover the main body of the product
- Blows/gathers leaves
- Easy to use for the elderly
- 12FT pipe for maximum coverage
- Handle to easily pull the product
- Handle for the user to rest on
- Handle/ stand to help the user stand from knelt position
- Simple on/off switch.
- Push or pull
- Large wheels for easy maneuverability
- Allows for independent use or multi person use

2.8.2-Weaknesses:

- Requires user to sweep up leaves later/has no vacuum option
- Will be loud when travelling across concrete surfaces
- Regular cleaning required
- Added weight to keep product stable
- Wire may get tangled due to its length
- Basic corded design

2.8.3-Opportunities:

- Develop a cordless option to make it more mobile
- Develop inflatable wheels for a more compact design.
- Develop inflatable wheels to ensure versatility on all surfaces
- Make the mechanism self-stabilizing
- Ba/change the environmental laws to limit the use of petrol blowers
- Adjustable handle

2.8.4-Threats:

- If the product needed repairing, it could be hard for the user to do it themselves

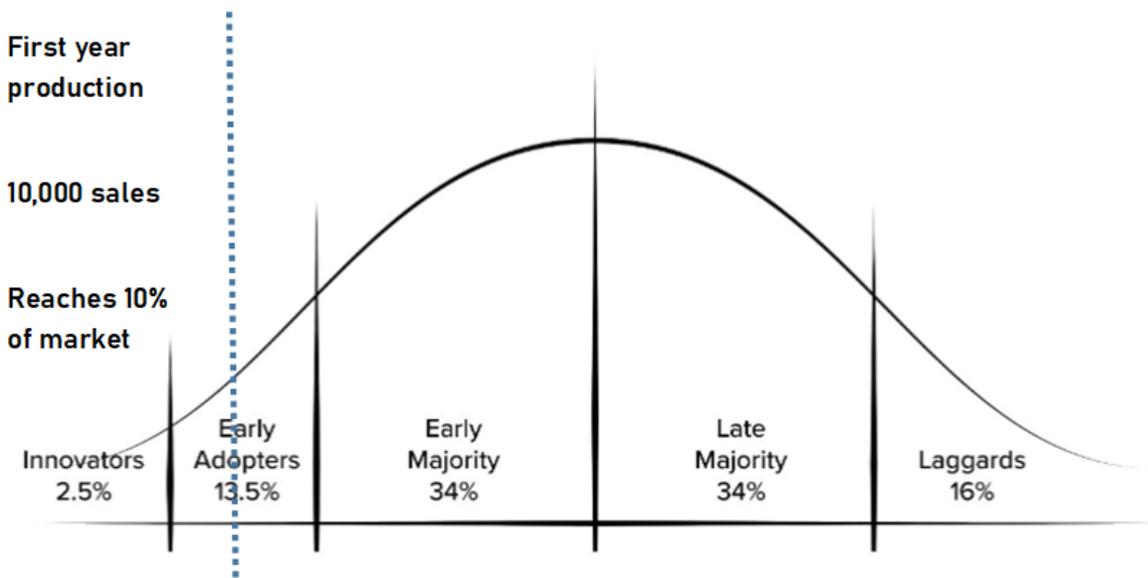
2.9-Pricing Strategy:

2.9.1-Sales predictions:

The total market size on average for the past full year of 2021 was estimated at 1611.3 million USD and is estimated to grow a further 4.9% through till 2024.

- Rapid urbanization along with increasing availability for outdoor space or gardens increases the demand and need for leaf blowers across all segments.
- Ever growing sizes for gardens requires more leaf blower's sales. On average all UK gardens take up around 433,000 hectares.
- 69% of the potential buyers in the leaf blower market prefer to purchase a cordless leaf blower.
- The commercial usage of the leaf blower market is estimated to be worth over 597 million USD with the other side of the market being domestic/household use. This is estimated to be worth around 1014 million USD.
- There are two main competitors on the market who are Bosch and Makita
- The product is seasonal so will be bought only when needed from around August to March in the autumn and wintertime when the leaves start to fall and garden maintenance is required.

For both segments of the market, the predicted units sold within the year is 10,000 units in the seasonal period.



(Authors own, sourced P.T.T.Norris, lectures)

The current market for corded leaf blowers is the strongest and most saturated segment of the market. The pricing ranges from around £30 for the lowest quality products up to around £100 for the best quality with the best-known names such as Bosch and de walt. Cordless products are a growing product within the market and are becoming an increasingly popular choice for domestic use. The price of these products ranges from £80 for a basic example, through to around £200 for the best product on the market in that segment. Lastly the decreasing segment of the market is petrol blowers which are becoming less popular due to the new BSI standards for noise and the increasing environmental problems that fossil fuel powered products face. These products range from £150 for a standard example to £1000 for products which can be used professionally in landscaping for example.

This product is a cord blower so to keep it within the market and attract potential consumers the price should range from £50-£150 due to its USP. The product will be priced at £150 due to its USP and the fact that it is first within the blower market. The product will not be at the top of the price bracket due to it only having a blowing function and not a vacuum function, which would make the product more useable. This considered all the costs involved in manufacturing and tooling to make Moulds to Mould the various parts of the product.

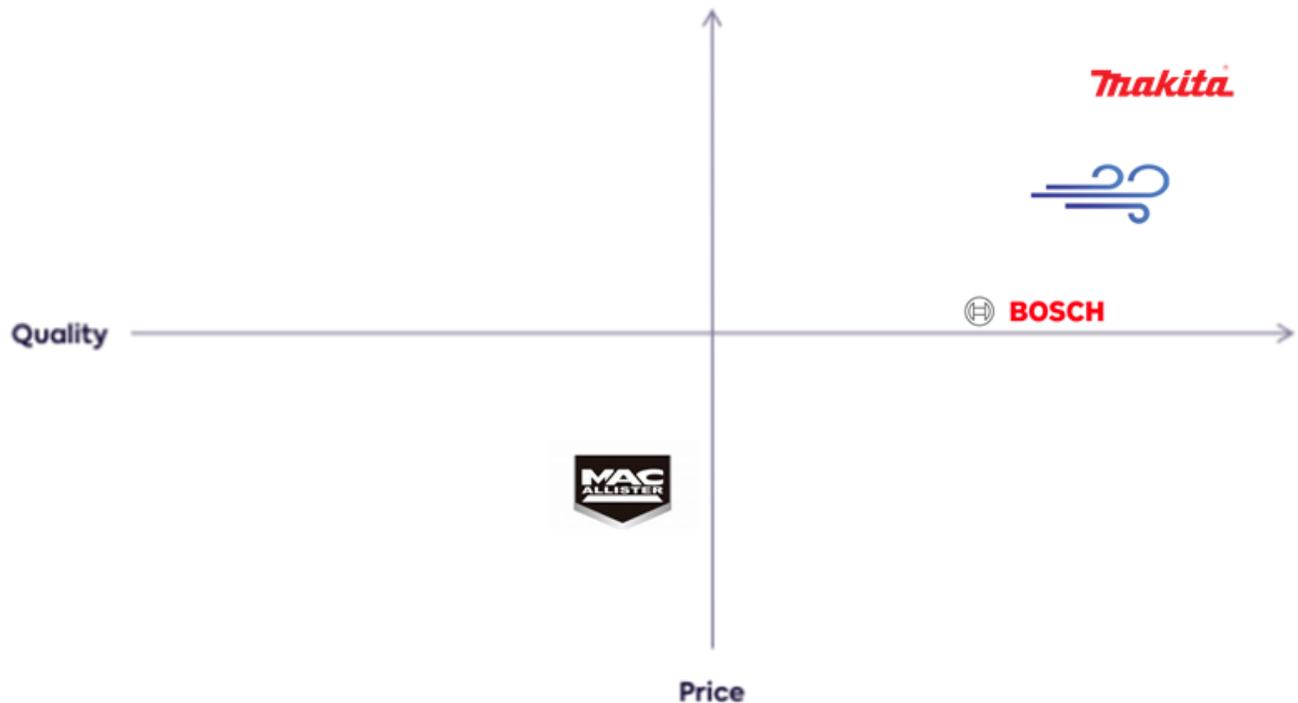
The unit costs will be kept as low as possible so then the product can have a 20%-35% profit margin on each unit sold which will be around £26-£45.50 for each product on

average to begin with. The unit cost will slowly drop with supplier relations improving and initial costs at the start levelling out due to the income from sales.

2.9.2-Pest Analysis

Pest	Now	5 Years	10 Years
Political	✓	✓	✓
Economical	✓	✓	✓
Social	✓	✓	✓
Technological	✓	✓	✓

Product Positioning Scale



(Authors own, sourced P.T.T. Norris, lectures)

The chart consists of three of the brands with market. The other three brands range from low cost and low quality to high cost and quality. An advantageous position for the Zephyrus product is at a lower cost than Makita but matching them for quality to spark a good reputation within the market and increasing prices to the same level as Makita and Bosch, once gained a good reputation and repeat business with the consumers.

Linking back to the pricing strategy, the price of around £120-£150 will be directly between the two competitors mentioned above. This will put the product in the price range but will stand out with its USP and quality will be on par with the competitors, which will be another selling point.

2.9.3-standard Parts List and Sizes Required

- Centrifugal fan/motor X1
- 30MM, M2 nuts X10
- 90MM, M2 bolts X10
- 30MM washers X10
- Rubber Grommets, 30,50,80 MM X5
- 12ft silicone rubber pipe X1

2.9.4-Standards/Upcoming Legislation

- Noise regulation for outdoor equipment has been regulated at 55DB
- During daytime hours, the sound level should be 45DB
- Ban noisy and polluting gas- and petrol-powered leaf blowing machines from being used anywhere in the UK.
- Ban the use of any type of leaf blower from March to August during bird nesting season
- Ban any type of leaf blower within 1 mile of any nature reserve
- The sound level should be 45DB-55DB within 50 feet of another person/Neighbours.

2.9.5-BSI Standards

- BS IEC IEC 60335-2-107:2017/AMD2:2021
- BS EN IEC 62841-4-3:2021+A11:2021 BS EN IEC 62841-4-3:2018/AA
- BS ISO 21628:2020

(<https://standardsdevelopment.bsigroup.com/search/Standards>)

Overall, the focus for the standards is noise pollution to protect the user and other around when in use. The sound level should be below 45DB when 50 feet away from a standing by person and below 55DB for the user.

3.0-Design

3.1-Design influences and styles

The design was influenced by Dyson products with the hollow wheel design and the colours. The shapes and forms of the product were also influenced by Dyson and appeal to the elderly due to the soft edges and lack of contrasts between the shapes.

The colour choices of navy, grey, black and white colours were influenced by a study () where it states that these colours are easy on elderly eyes and have a low contrast which makes it easier for the elderly user to use/look at the product. Another factor which influenced the colour choice was that these colours don't show dirt easily and will still look aesthetically pleasing with harsh use or years of wear and tear.

The tactile elements of the product exist on the handle with 2 rubber sections front and back on the handle. This rubber element is extruded with indents and will give a soft feel but will feel different to the plastic which tells the user about the correct hand position without looking at the handle. The other tactile feature is the handle that is used to transport the product. This has the same effect as the rubber due to it having the same rubber texture and again allows the user to feel their way into an ergonomic grip on the handle. The texture on the wheels were influenced by skin textures of various animals. It gives an aesthetically pleasing look with the pattern but also serves a purpose and has 5MM indentations through the lines. This helps with the grip on various surfaces such as grass and or wet leaves by providing grooves to grip onto the surface. It can also make the wheel lighter which makes it easier to rotate and requires less force to push or pull the product in transportation.

The material choices for aesthetic purposes were chosen due to the surface finish. The majority of the product will be manufactured out of ABS plastic, and this can be sourced in many different colours and when the process is complete, it can have a high-quality surface finish with the correct procedure. Black pigmented rubber was also chosen for the tactile parts due to them being hard-wearing and will maintain their aesthetic appeal for prolonged periods and can be easily maintained with regular cleaning to keep optimum condition.

3.2-Relation to the market

The other products on the market usually looking at the products have one standout colour that will match with other products in the range. The less important parts of the product will be grey scale, with many parts being black. Also, to add contrast, the

product will have contrasting logos or writing describing the products or accents of contrasting colour on additional components such as switches or styling parts.

This is similar to the Zephyrus product with one main colour on the forefront parts, with the less prominent parts being black or grey, the only difference is the contrasting colour is not present on the product. Alternatively, the blue theme is continued but used on the logo and handle which contrasts to the main body which is grey. This makes the blue components stand out.

4.0- commercial arguments- Manufacture

For the following section, the commercial arguments will focus on the wheel assembly and the heel axle mechanism.

4.1-Parts Issues

4.1.1-The Mechanism

There are three parts that make up the assembly of the mechanism. These consist of:

- The bearing
- The injection moulded mechanism piece (1)
- The injection moulded mechanism piece (2)

One issue with the axle mechanism is that it will need to withstand the weight of the whole product and all its accessories. This will put constant pressure on it throughout its life and will have to ensure it can withstand the weight of the whole product.

The mechanism should withstand the weight alone but also with other factors such as, the user leaning on the product or using excessive force to push or pull the blower when moving the product.

The rough surface that it will have to withstand will also exert pressure and shocks through the mechanism. It will have to be used on all surfaces and not break or expose any health hazards to the user.

The mechanism must also be able to withstand excessive wheel RPM. The wheel will spin at various speeds, and it must withstand these speeds to avoid safety hazards and potentially leaving the product unusable and useless for the user. The bolts and

connections should also be checked for this to ensure the wheel is secure. The bearing will also impact this and should also be secure and should be able to withstand the RPM.

All the components should also be able to withstand and resist the wear from harsh conditions. In the lifetime of the product, it can be exposed to outside conditions due to its use. This means it can be left outside when not in use or even when being used. Elements such as rain, wind, dirt and even sun can cause cracks and wear on the rubber surrounding the bearing and the grommets within the mechanism which can expose parts to moisture and water. The parts should be able to withstand this and still work to its maximum efficiency and performance.

The mechanism allows the use of large wheels to cover the main body for storage purposes to create more space when stored. The mechanism is a simple sliding tube with a male and female parts. This part must work continuously over the lifetime of the product and last longer than the product itself to reduce the chance of injury or inconvenience for the user. The mechanism should not break if the user closes the wheel cover with excessive force several times. It should withstand the constant knocks and other circumstances such as the user closing it in a rush or being exposed to the harsh elements. To avoid this, regular cleaning can prolong the life expectancy of the product and will make it look appealing and in good condition for long periods. A cloth and cleaner or water should be used with around 100ml of water. (See instruction manual for further information.)

To ensure this the main body of the mechanism (1) and (2) will be manufactured out of stainless steel to firstly stop oxidization and rusting which can stop the mechanism working correctly. It also ensures the strength and durability of the mechanism and ensures the product withstands the majority of normal conditions in the less likely circumstances such as the user leaning on the product.

The breakpoint for the axle would be the mechanism part (2) due to its cheaper cost and it can be replaced easily without tampering with the structure of the product. It also stops the user using the product if this section breaks which is safe and will stop the user potentially exposing many health concerns if they carry on using but fortunately this part will failsafe first and ensure the user's safety. The user cannot physically check the condition of the mechanism without taking a wheel off the product, which may be impossible for some users. A simple check of all its features can give a gage to the user of the condition of the mechanism which can be carried out by the majority of consumers.

The product will come prebuilt so these parts will be protected and packed as efficiently as possible for such a large product.

4.1.2-The Wheel

There are two parts for the wheel, they consist of:

- The wheel surrounds
- The nut cap

One issue the wheel must withstand has to be lightweight to enable the user to push or pull the product easily, which means having the lighter wheel. This will lead to a less quality feel to the wheel and will make the wheel make a lot of noise over stones. It must not cause damage such as flat spots, indents, cracks, or holes in the wheels while maintaining a nice aesthetic look with the paint finish

The wheel must be able to withstand all surfaces without failing or causing damage to the wheel. This is for safety reasons and the life of the product which needs to last for over 10 years. While dealing with the various surfaces, it must also be durable enough to withstand the weight of the product and any other forces that may be exerted onto the product such as the user leaning or using it as an aid to lift themselves up from lower positions. The maximum load that should be on the wheels should be around 100KG due to the chance of the user using the product to help themselves to stand which may see the force get close to this figure.

The wheel structure and wheel finish should be able to withstand being left out in various conditions such as rain and snow. This will ensure the longevity of the product but also the safety of the user due to the wheels withstanding this and not reduce internal strength on the wheels. It should also be protected if the internal material is visible. The products wheel will be manufactured in ABS plastic and is durable and will not oxidize or rust due to it being plastic and the internal strength again will not be affected by this.

The wheels will get fairly dirty due to being in constant contact with the floor in many conditions so will get dirty quickly which requires the users to clean regularly. This will keep the appearance of the product to a high standard but could cause a problem for the user with potential water ingress into the mechanism or internal inside the body. (See instruction manual for further advice)

When transported the product is large and will not be efficient when transported. The mechanism for the wheels can help this by being in the products' storage mode. This is where the wheels will cover the main body and create a smaller packaged product by around 10-20CM on each side which will reduce the packaging size and reduce space within transportation and lower costs.

The nut cover should be able to stay on and connected to cover the nut inside. This should be able to stay connected when the wheel is rotating at all speeds. It should stay on when bouncing over different surfaces. This is due to if it becomes disconnected then it can rust the nut and bolts causing it to seize, resist or even break. The cap should also stop this when in place and stop water ingress or dirt or Debris entering this part and can cause the problems mentioned before. The cap should also be strong and durable because it can face stress from the warm weather and the heat but other factors such as rough terrain or being hit while being stored.

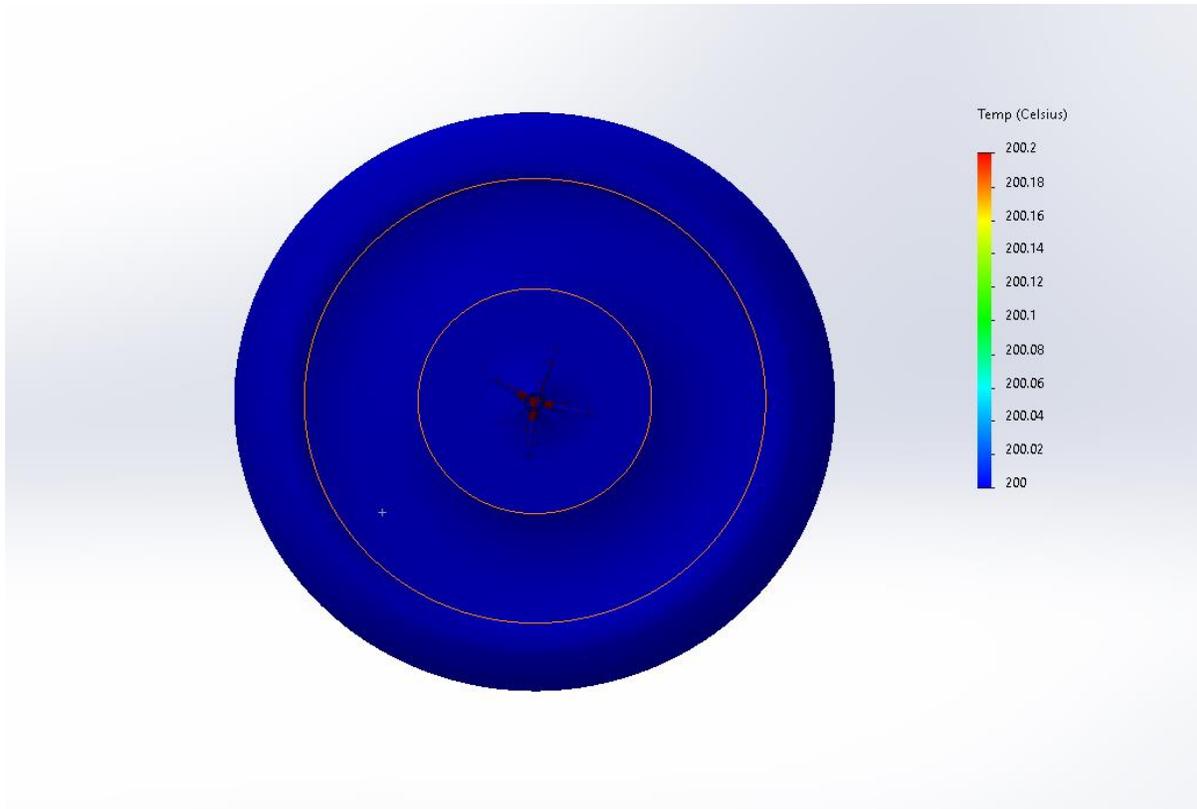
The breaking point for safety reasons on the wheel will be the neck of the connection on the inside of the wheel. The connection to the axle can be replaced if needed but a full wheel replacement is advised for safety reasons. The connection is where the mechanism part (2) meets the wheel, and this part should failsafe before the wheel due to it being easier to replace and is not as strong as the wheel.

4.2-Appropriate Analysis and Compromise

4.2.1-Heat Testing

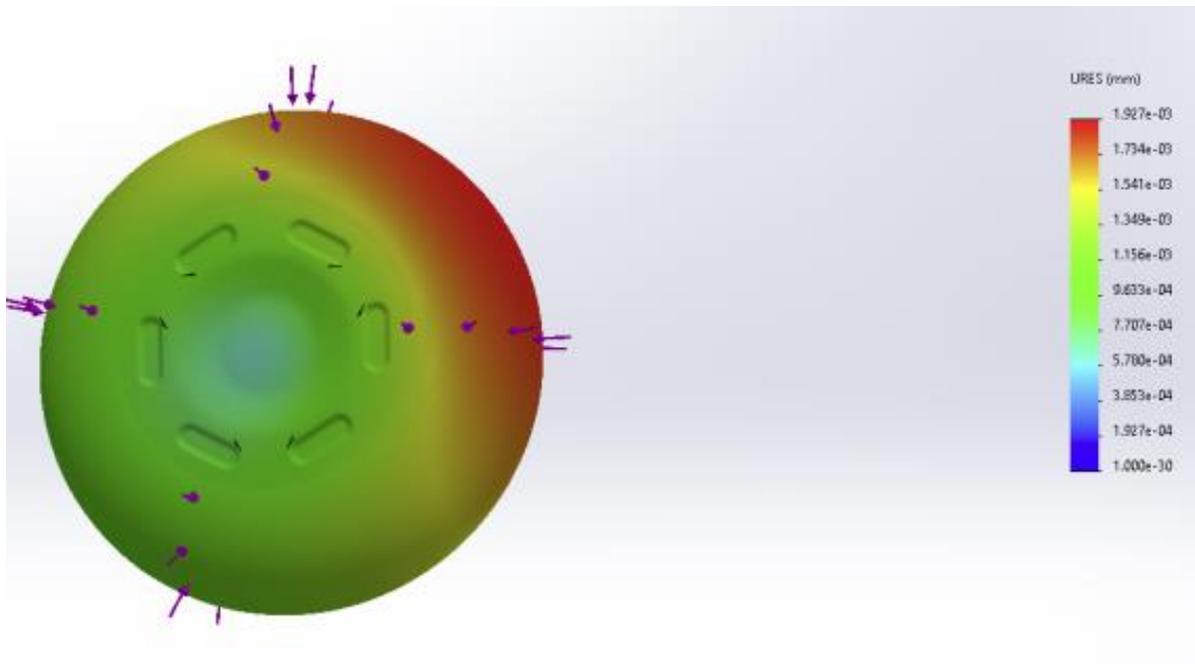
Thermal heat testing was carried out on the inside of the wheel, the connecting neck piece that will have the most contact with the mechanism to test the heat from the wheel rotating.

The thermal heat value was increased to a point that will not be experienced while using the product to emphasize safety and to see if it withstands the extreme heat.



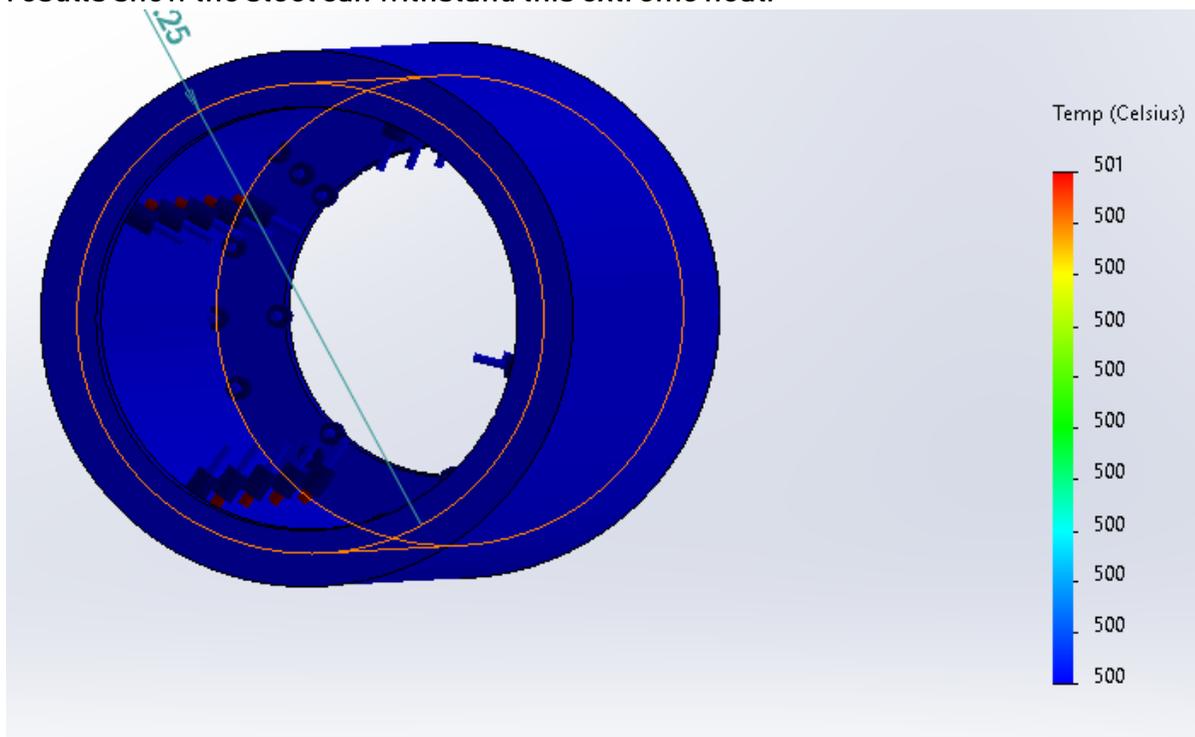
4.2.2-Force Test

This test shows the force on the outer wheel part which the value was 150KG. The results show the wheel will withstand the force from many factors which ensures no changes are needed to the structure.



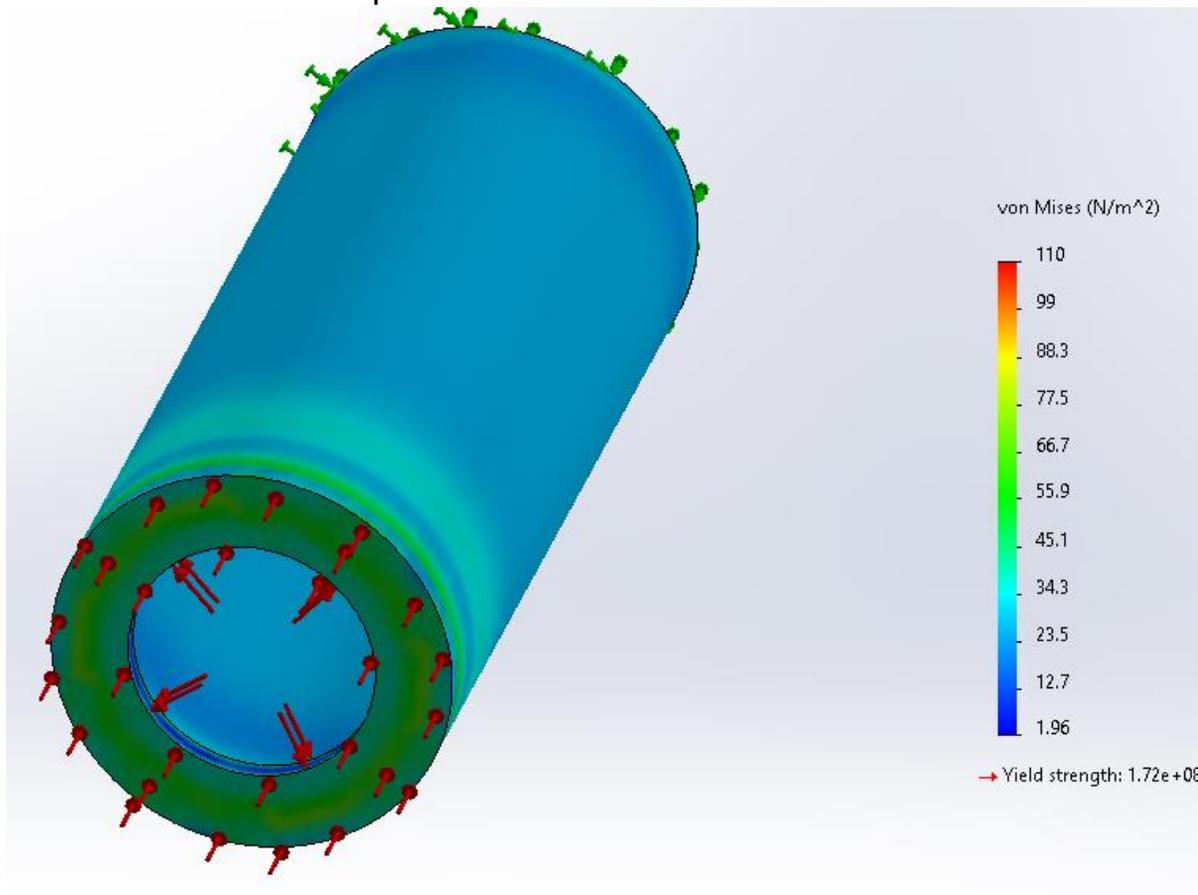
4.2.3-Thermal Test

The results of this test show that when the axle spins inside this part, the axle will provide friction which will heat up this part. The thermal test value was 500 degrees, and the results show the steel can withstand this extreme heat.



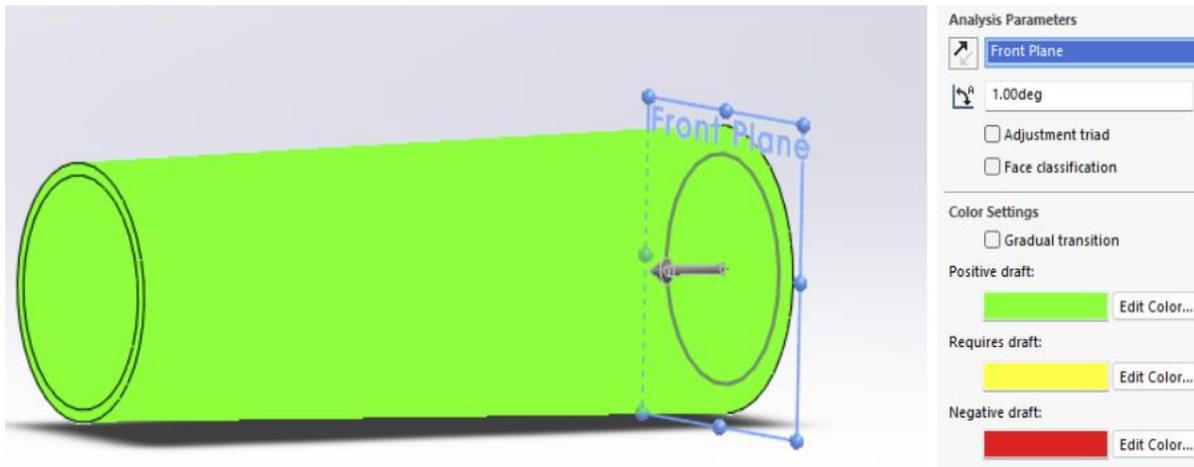
4.2.4-Pressure Test

The result of the pressure test was positive. The value of the pressure was around 20NM forced on the front and edge of the front. The results of the test were positive, and no alterations needed for the part.



4.2.5-Draft Analysis

The draft test shows the analysis of the draft to see which draft is needed to be able to work. The results also show what draft angle is needed for it to work again and all 1-2 percent which shows up green.



4.3-Costs/Unit Costs

The product's overall price will be £150, and the costs will be broken down as follows:

- 20% for the profit = £30
- 40% for the overhead costs =£60
- 40% for the manufacturing =£60

Many of the parts are standard parts and the main bodies are the unique parts that will require manufacturing by Zephyrus. Joint manufacture could be achieved for the internals and Zephyrus could work with others to produce the internals, which will bring the costs down and prevent additional development costs or the risk of stopping production.

Month	Parts Needed	Total Cost of Mechanism (1)	Total Cost of Mechanism (2)	Total Cost of Bearing (£7.96)	Total Cost of Tooling (1)	Total Cost of Tooling (2)
January	900	£1584	£3204	£7164	£320.41	£814.58
February	900	£1584	£3204	£7164	£320.41	£814.58
March	900	£1584	£3204	£7164	£320.41	£814.58
April	900	£1584	£3204	£7164	£320.41	£814.58
May	900	£1584	£3204	£7164	£320.41	£814.58
June	900	£1584	£3204	£7164	£320.41	£814.58
July	900	£1584	£3204	£7164	£320.41	£814.58
August	900	£1584	£3204	£7164	£320.41	£814.58

September	900	£1584	£3204	£7164	£320.41	£814.58
October	900	£1584	£3204	£7164	£320.41	£814.58
November	900	£1584	£3204	£7164	£320.41	£814.58
December	900	£1584	£3204	£7164	£320.49	£814.62
Total	10,800	£19008	£38448	£85,968	£3845	£9775

(<https://www.protolabs.co.uk/>)

The prices that are stated above could be altered or changed in the current period. This is due to economies of scale and other factors that could reduce or increase the prices. The reason behind the prices is to manufacture slightly more than projected sales for the first year of sales due to preparing for over sales prediction. 800 more products will be produced with a 20% profit margin on the products amounting to around £30 on each unit sold.

The overheads will take up around 40% of the total price of the product, which will amount to approximately £60. The overhead consists of:

- Transport costs
- Packaging costs
- Storage of products
- Labour costs
- Setup costs
- Protection costs
- Salary/wages
- Electricity bills

4.3.1-Parts Breakdown

Part Number	Name	Material	Finish	Tooling cost	Unit cost
1	Wheel	ABS PC	SP2-A1	*RCFM	*RCFM
2	Wheel (2)	ABS PC	SP2-A1	*RCFM	*RCFM

3	Mechanism (1)	STAINLESS STEEL	1G-2G	£3845 x1	£1.76
4	Mechanism (1)	STAINLESS STEEL	1G-2G	£3845 x1	£1.76
5	Mechanism (2)	STAINLESS STEEL	1G-2G	£9775 x1	£3.56
6	Mechanism (2)	STAINLESS STEEL	1G-2G	£9775 x1	£3.56
7	Handle	ABS	SP2-A1	*RCFM	*RCFM
8	Main body	ABS	SP2-A1	*RCFM	*RCFM
9	Bearing	STEEL	1G-2G	*RCFM	*RCFM
10	bearing	STEEL	1G-2G	*RCFM	*RCFM
11	Top of body	ABS	SP2-A1	*RCFM	*RCFM
12	Reel	ABS	PM-F1	*RCFM	*RCFM
13	Pipe	SILLICON	N/A	*RCFM	*RCFM
14	Gun	ABS	SP2-A1	*RCFM	*RCFM
15	Blower	STEEL	N/A	*RCFM	*RCFM
16	Wheel cap (1)	STEEL	1G-2G	*RCFM	*RCFM
17	Wheel cap (2)	STEEL	1G-2G	*RCFM	*RCFM
18	Handle grip	RUBBER	N/A	*RCFM	*RCFM
19	Handle grip	RUBBER	N/A	*RCFM	*RCFM

(RCFM- Requires confirmation from manufacturer)

The ABS granules used for the injection Moulding, the prices would vary due to these products being bought in bulk for the ABS parts and will be bought in bulk so the prices may decrease with the repeat business.

Other materials such as the bearings will vary due to the quality of these parts and the amounts needed. The one price is £7.96 but if bought in bulk the price may vary again.

The overall price cannot be displayed but an estimation can be produced by using the £150 starting price and using 40% for the manufacturing costs.

- 40% of £150= £60
- 11,000 estimated sales in the first year.
- 60×11,000= £660,000

For the first year of production, the overall costs of manufacturing are estimated to be approximately £660,000. The correct figure should not exceed this figure due to that affecting the profit margin and overhead costs budget. This figure will drop over the next

manufacturing years due to relationships and economies of scale affecting the price of products and services.

4.4-Material Choices

4.4.1-Mechanism

The material which was chosen for the mechanism was stainless steel. This does not include the rubber seals and the ball bearing and was chosen due to the following: the strength of the material makes the part strong and long lasting. It is stainless and will not oxidize and rust when it is exposed to moisture or water when stored/used outside. It's a vital part of the product and should last if the other parts on the product and with stainless steel this is ensured. The material has changed since the development pack, but this was due to adding a second function to the product by stating that the elderly user could use the handle on the top as a rest throughout use when they needed it. It can be also used for holding themselves up when leaning over or to help stand from kneeling positions when gardening.

4.4.2-Wheel and cap

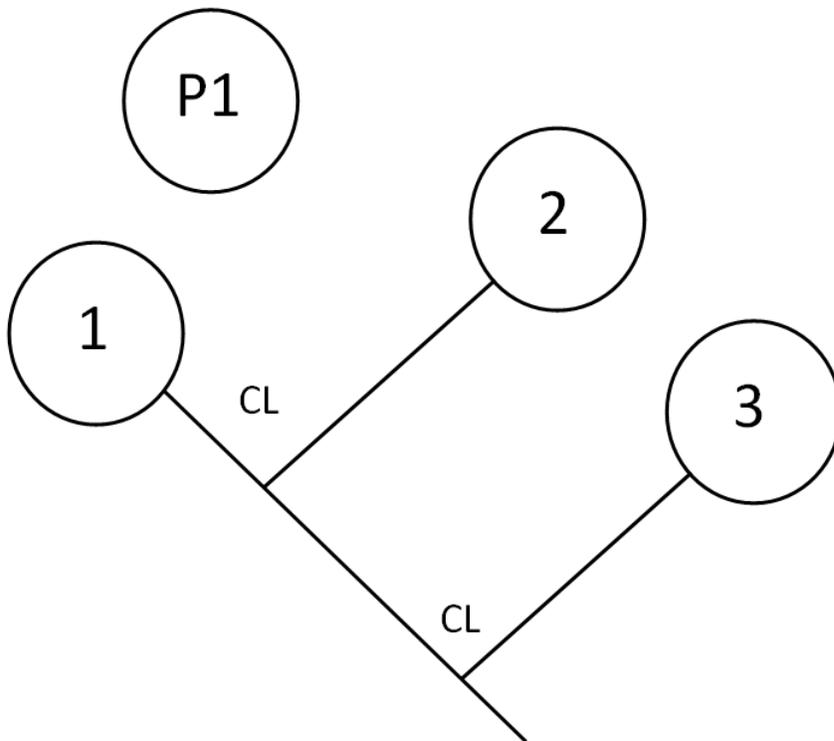
The wheel and cap combination will be made from ABS PC and steel for the cap. The wheel is being produced by using ABS, this is due to the wheel needing to be strong put lightweight. This is due to reducing unsprung mass on the wheels which makes it easier for the wheel to rotate, which requires less effort from the user. The tensile strength of the ABS is 5900 PSI and can be easily injection moulded which makes the Manufacturing costs low. The cap is steel to protect the nut and bolt which holds the wheel onto the axle which is important for safety reasons. So having a strong cap covering the nut ensures safety and the cover will be finished and painted which protects it from rust so costs can be saved by not using stainless steel.

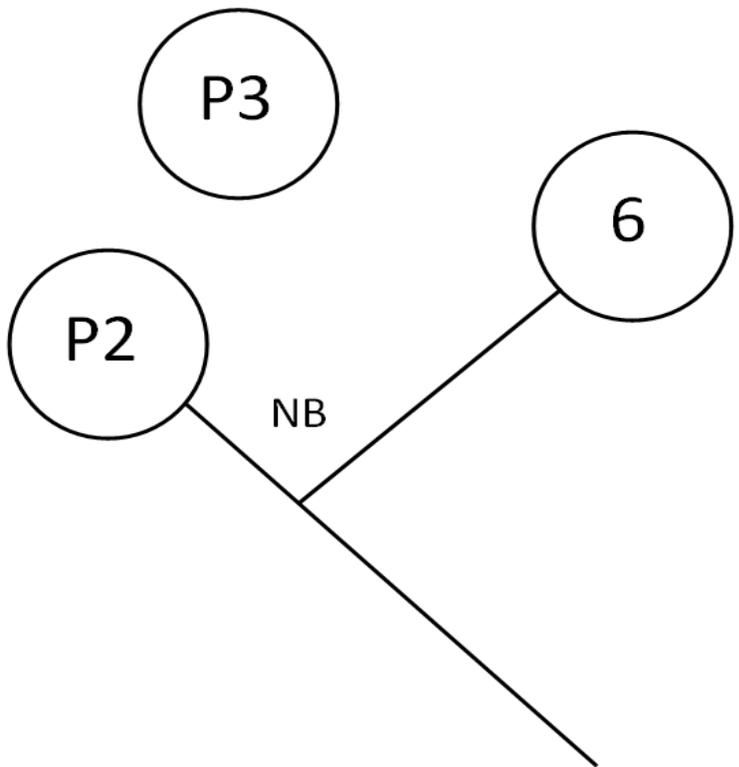
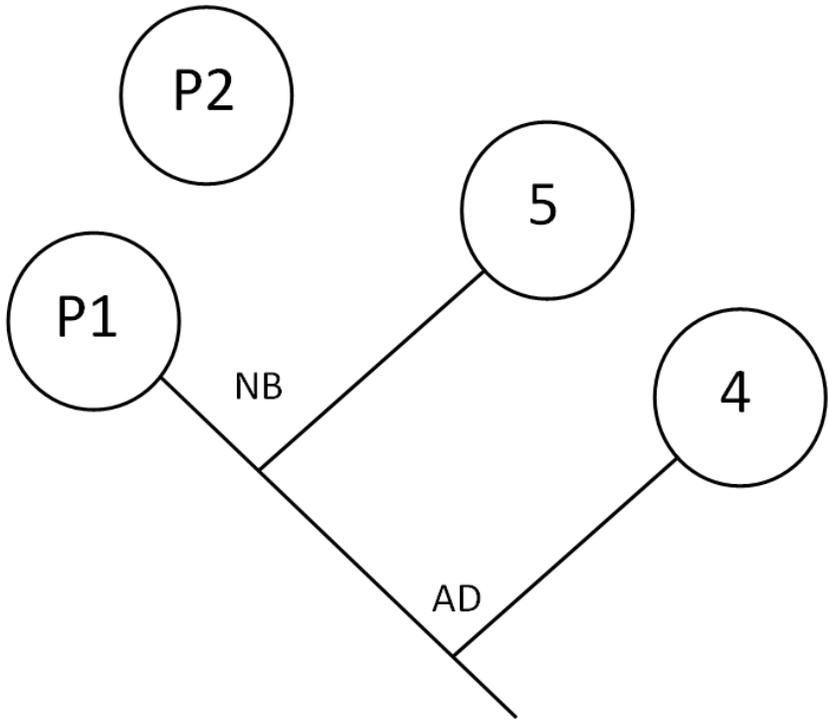
4.5-Assembly trees

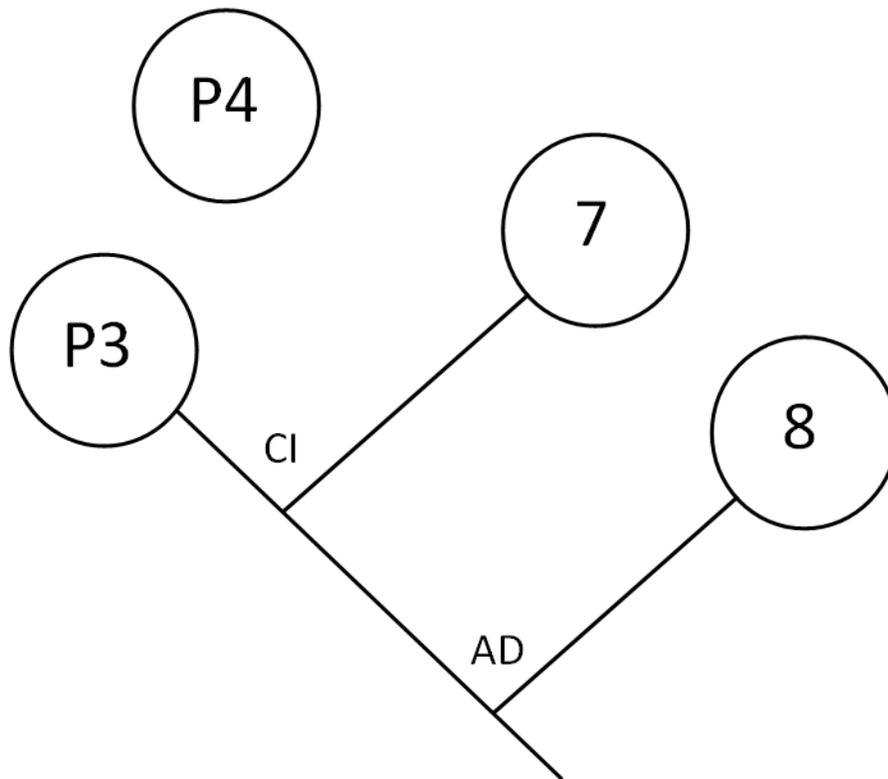
Part Number	Part
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1	Mechanism (1)
2	Mechanism (2)
3	Bearing
4	Axle surround
5	Mid-point on axle
6	wheel
7	Wheel cover
8	Rubber seal

Code	Method
NB	Nut and Bolt
AD	Adhesive
CI	Clip in







5.0-Manufacturing Specification

The wheel finish will be SP2-A1 which is a polish clear finish to the wheels ABS material which it will be manufactured from. The stainless steel that will make up the mechanism will be a rough 1G-2G due to it not being seen and covered inside the axle so will not be seen but is stainless steel due to it being exposed to moisture or water regularly due to it being stored and used outside.

The wheel and wheel cap will be injection moulded due to them being manufactured from ABS this can be efficient, but checks will be carried out once the first batch of products are produced to check for any potential problems such as sink marks or lines on the parts. The mechanism parts will be made from stainless steel and will be casted and CNC

machined for maximum efficiency. Much like the wheels, the mechanism will be checked at random to check for imperfections or breaks within the parts.

The first step of manufacturing is to buy in the resources. Bags of ABS granules can be purchased to be used for the injection moulding process. These can be bought in various colours so no paint needs applying and saves costs. The next step is to purchase the sheets/ blocks to heat and turn them into molten metal ready for the casting process.

Once all set and the processes are complete, these parts will be connected to the other parts that make up the product. The mechanism will fix to the axle which then the wheel will fix to the moving part of the mechanism/axle piece that allows the wheel to turn but also push in and out for its storage modes. This will be assembled by members of staff due to there being fixings, which make the assembly simple and straight forward hence why the user can repair or replace if parts go wrong.

6.0-Material Design Compromise Issues

One of the main compromises is todo with the mechanism/axle. Due to increased weight and additional function of a resting weight from the user, the product must be able to withstand the weight of a human to ensure safety. The mechanism was being produced along with the wheels which will be made from ABS, but this was too weak for the weight application. Changes to the material to stainless steel was required which makes the axle much stronger but more expensive. It can still use a similar process of injection moulding/stamping as the metal process is called. The extra costs come from the material cost which for steel sheets cost around £20 compared to the price of ABS which is around £10 so 50% increase on the overall price but ensures the quality of the product.

One other compromise with this is if the user needs to replace this part due to it being the breaking point in case excessive force or pressure is applied. The overall cost will be more expensive than the ABBS part would have been but on the other hand the steel part will be less likely to break and withstand more pressure than the plastic variant.

7.0-Quality aspects

The life span of the product should be 10-20 years. The user will on average use the product around 10 times per year and the quality should be ensured that it starts every time and remains at an optimum performance for those years.

The user should expect the product to last this length of time and have no problems for the first ten years regardless of the well keeping of the product such as:

- Where it is stored

- Is it cleaned regularly
- Is it used properly
- Is it regularly exposed to water

The product will come with a one-year warranty to ensure the user is able to use the product for the first year and is happy with the product.

Quality checks will be carried out before it leaves manufacturing. The first batch of manufactured parts such as mechanism part one and two will be injection moulded and checked for weak points such as:

- Split lines
- Burn marks
- Warping
- Short shots
- Vacuum voids
- Sink marks
- Weld lines

If these aspects pass the quality checks, all continuous processes such as painting and sanding/preparing the surface will be assessed to ensure a high-quality standard.

Once all is checked, if up to a high standard the products' components and finished product will be chosen for random inspections to ensure quality is of a high standard while not interfering with the turnaround of the products.

8.0-Testing and Failure Considerations

Tests will be carried out to ensure the safety of the user while using the product.

Firstly, the handle should be tested by dropping the handle from waist height, chest height and between the chest and waist while being loaded with air to ensure the durability of the handle as well as the finish on the handle. The most significant factor is the safety of the user while the product is in use. There should be no chance of the handle becoming disconnected while in use which could result in injury to the user.

The other tests should consist of dropping the product on its wheels with two times its weight (15KG), to ensure that the factor of safety is high enough to ensure the safety of the user. The wheels should be tested at different RPM such as 20,40,60,80 and 100 revs per minute to ensure the wheel connections and axle can withstand the majority of situations that the wheel will experience but also situations where the circumstances are unlikely to happen such as the 100RPM test.

9.0-End of Life Considerations

At the end of the product's life, the product will be recycled by individual parts and reused where possible due to many parts being standardized parts. Parts such as the fan can be reused in other appliances but many of the large pieces of plastic can be recycled. The product has a repair scheme and will be promoted to be repaired instead of recycled to extend the life of the product.

10.0-Packaging considerations/aspects

The new law within the UK states that all new packaging must be recyclable or used recycled material.

The packaging is a once used item and should be recycled after use or reused as a storage box for the product or to keep other items in the garden or in the household.

The packaging will have basic instructions printed on for users who have the knowledge and want to start using straight away.

As mentioned above the packaging is a one-use item and should have a symbol displayed on the packaging.



11.0-Product Manual

The product should come with a manual. This will help the user understand how to use the product and understand the features. These features will consist of:

- How to turn on/off
- How to extend the wheels

- How to push in the wheels
- How to pull out the pipe
- How to connect the handle
- How to clean the product
- How to maintain
- Testing

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<https://www.fastradius.com/resources/know-your-materials-polycarbonate-acrylonitrile-butadiene-styrene-pc-abs/>

https://www.accu.co.uk/hexagon-nuts/412418-HPN-M30-A25?uk_google_shopping=1&c=3&gclid=CjoKCQjwg_iTBhDrARIsAD3Ib5hgUGVGV_H_oykcSW1JGPpbjNa2EkccmlGK4HMHANzSKWtCO_J5k5UAaArQREALw_wcB

THD1382- Jacob Merson

Appendix Product Design (Bsc)hons

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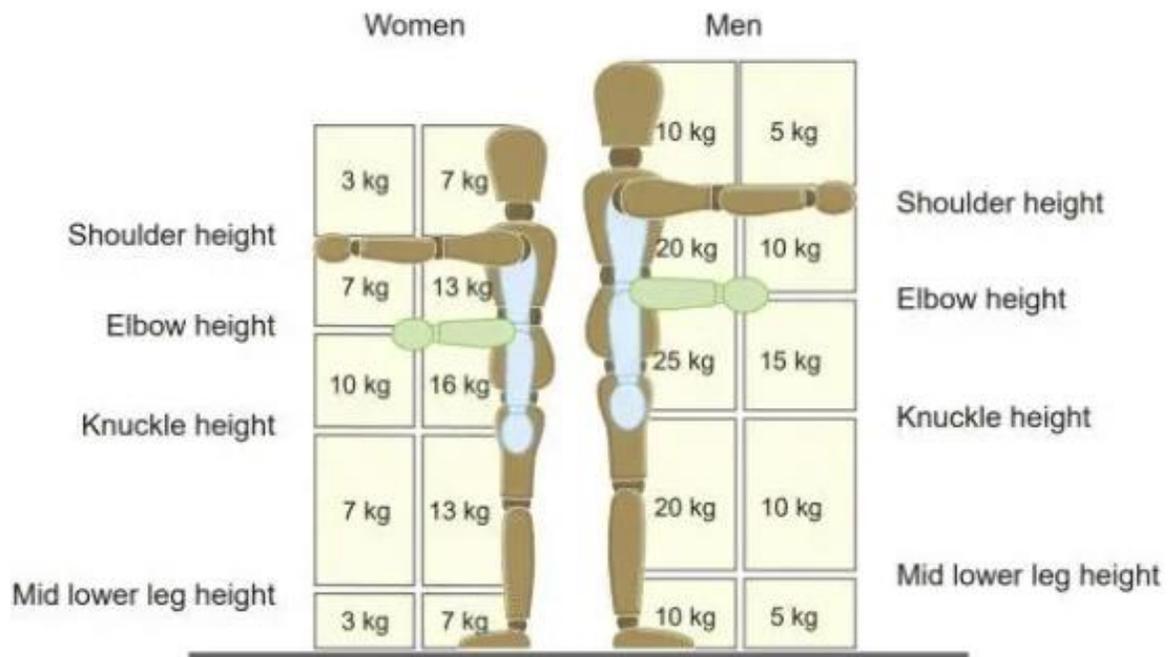
Appendix One- Market Reassessment

Press Release

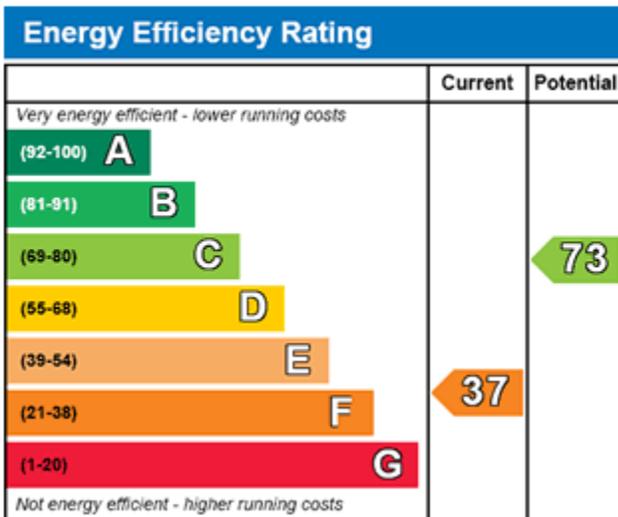
Global Leaf Blowers Market | Growing at CAGR 4.4%, Business Statistics, Development Data, Forecast Period 2022-2028

The Leaf Blowers market size is USD million in 2022 from USD 1611.3 million in 2021, with a change of between 2021 and 2022. The Leaf Blowers market size will reach USD 2171.8 million in 2028, growing at a CAGR of 4.4% over the analysis period.

Appendix two-ergonomics



Appendix 3-environmental Considerations



Appendix 4- Market

List of competitors



Bosch-Universal Garden tidy -£79.00

Mac Allister-MBVP corded -£51.00

FPBV-2500 corded blower -£32.00

Stihl

Husqvarna

Makita

Toro

MTD

Stanley Black&Decker

Robert Bosch

Koki

Milwaukee

Emak

Positec Tool Corporation (Worx)

Globe Tools Group (Greenworks)

Zhongjian Technology

Zomax Garden Machinery

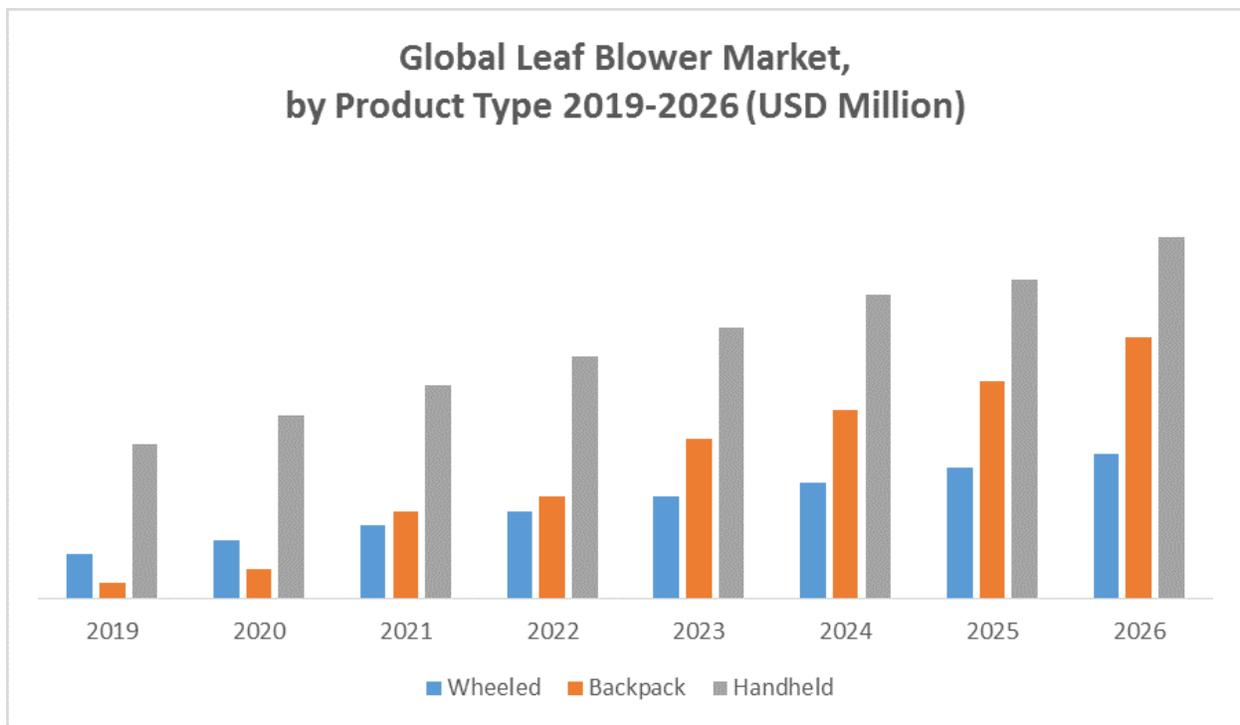
Potential buyers

The elderly (main buyer)

THD1382

Physically challenged
 Disabled persons
 Council
 Gardeners
 Landscapers
 Normal people
 Private parks

Market product segmentation



Appendix 5- Pricing strategy

Rapid urbanization along with increasing availability for outdoor space or gardens increases the demand and need for leaf blowers across all segments.

Ever growing sizes for gardens requires more leaf blower's sales. On average all UK gardens take up around 433,000 hectares.

69% of the potential buyers in the leaf blower market prefer to purchase a cordless leaf blower.

The commercial usage of the leaf blower market is estimated to be worth over 597 million USD with the other side of the market being domestic/household use. This is estimated to be worth around 1014 million USD.

There are two main competitors on the market who are Bosch and Makita

The product is seasonal so will be bought only when needed from around august to march in the autumn and wintertime when the leaves start to fall and garden maintenance is required.

(<https://www.imarcgroup.com/leaf-blower-market>)

Appendix 6- Standard Parts

Fan

[Home](#) < [HVAC, Fans & Thermal Management](#) < [Air Conditioning & Fans](#) < [Centrifugal Fans](#)

ebm-papst Centrifugal Fan 248 x 237 x 100mm, 370m³/h, 230 V ac AC (G2E140 Series) ebmpapst

RS Stock No.: 498-8617 | Mfr. Part No.: G2E140-NS38-01 | Brand: ebm-papst



[View all Centrifugal Fans](#)

6 In stock - FREE next working day delivery available

1 available from Europe for delivery within 1 working day(s).

-
1
+
Units
Add to basket

[Check stock levels](#)

Price Each

£201.81 **£242.17**

(exc. VAT) (inc. VAT)

Units	Per unit
1 - 4	£201.81
5 - 9	£176.58
10 - 19	£161.45
20 +	£146.51

You may also like

Nuts

Nuts & Hexag Nuts

★★★★★ 1

M30 Hexagon Nuts (DIN 934) - A2-50 Stainless Steel

Accu Product Code (APC): HPN-M30-A25



Key Features

- ✓ M30 metric thread size (30mm)
- ✓ Hexagon Nuts
- ✓ A2-50 annealed Stainless Steel, also known as 18-8 or 304 Stainless Steel
- ✓ Manufactured to DIN 934 specification
- ✓ Thread Size: M30 (30mm)

3D CAD Model Downloads [Details](#)

Simple 90 Day Returns [Details](#)

3 Year Warranty [Details](#)

Accu

Official AccuScrew Product

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£6.42 /each including tax

Buy 5 Save 7%	Buy 10 Save 10%	Buy 20 Save 20%
Buy 50 Save 30%	Buy 100 Save 42%	Buy 200 Save 44%
Buy 400 Save 47%	Buy 800 Save 48%	Buy 1000 Save 51%
Buy 2000 Save 52%		

Quantity: 1

Add to Cart

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Express Stock

Get it by: **24** Order in 5 hours & 34 minutes for same day dispatch.

Up to: **334** 1 Day

Bolts

Precision Screws & Hexag Full Thread Hexagon Bolts

★★★★★ 6

M5 x 90mm Full Thread Hexagon Bolts (DIN 933) - Stainless Steel (A2)

Accu Product Code (APC): SEBF-M5-90-A2



Key Features

- ✓ M5 Metric Thread Size (5mm)
- ✓ 3 Year Extended Warranty
- ✓ Free Technical Support From Our Engineers
- ✓ A2 Stainless Steel, also known as 18-8 or 304 Stainless Steel
- ✓ Thread Size (T): M5 (5mm)

Available in Other Materials & Finishes

Matte Black Thread Locking

3D CAD Model Downloads [Details](#)

Simple 90 Day Returns [Details](#)

3 Year Warranty [Details](#)

Accu

Official AccuScrew Product

Buy More & Save Show Break Prices

£1.99 /each including tax

Buy 4 Save 12%	Buy 8 Save 19%	Buy 12 Save 26%
Buy 25 Save 27%	Buy 50 Save 42%	Buy 100 Save 48%
Buy 250 Save 55%	Buy 500 Save 60%	Buy 1000 Save 63%
Buy 2000 Save 65%	Buy 4000 Save 67%	Buy 8000 Save 68%
Buy 10000 Save 70%		

Quantity: 1

Add to Cart

[Get A Quote](#)

Express Stock

Get it by: **10** Order in 5 hours & 25 minutes for same day dispatch.

Washers

WESTFIELD FASTENERS +44 (0) 1844 201133
enquiries@westfieldfasteners.co.uk

Home / Hexag Washers / Penny Washer 30mm OD M5 in A4 Stainless

Penny Washer 30mm OD M5 in A4 Stainless

Also known as a flange or spacer washer, this very popular type offers a large external diameter. Often employed to prevent, amongst others:




Technical Summary

Material:	A4 Stainless Steel
Finish:	Standard

Description	Unit Qty	Qty	Price	Specification	Request Estimate
Penny Washer 30mm OD M5 in A4 Stainless (APC:W530)	1000	4	£4.04 (inc. VAT)	M5 in stainless steel (18% Cr, 8% Ni)	Request

Prices are subject to quantity discounts based on a pricing scale. Enter the desired quantity in the relevant box in the table above. This will automatically calculate a unit price including the applicable rate for the quantity entered. All prices shown exclude VAT.

Grommets

RS Parcel Tracking Login £5.00

Browse

[Cables & Wires](#) < [Cable Management](#) < [Cable Grommets](#)

RS PRO Black PVC 31.7mm Cable Grommet for Maximum of 25mm Cable Dia.

RS Stock No.: 666-4619 Brand: RS PRO




1458 in stock - FREE next working day delivery available

1 Bag(s)

Check stock levels

Price 1 Bag of 100

£6.54 (exc. VAT) **£7.85** (inc. VAT)

Bag(s)	Per Bag	Per unit*
1 - 14	£5.54	£0.065
15 - 24	£5.14	£0.061
25 - 49	£5.76	£0.058
50 +	£5.47	£0.055

*price indicative

[View all Cable Grommets](#)

Hose



Description

- We offer a comprehensive range of platinum cured silicone tubing suitable for use with food and beverage applications.
- With sizes ranging from inner diameter 2mm - 15mm, wall thickness 1mm - 2mm and outer diameter 3mm - 14mm.
- Supplied as 625HA as standard, this tubing is non-yellowing with a high gloss finish, excellent clarity and high tear strength.
- Fully compliant with FDA, BPA and WRAS approvals, this tubing is an excellent choice for pumps and transfer operations.

Additional information:

Colour: Black

FDA Grade Silicone Tubing - Black

Size: Internal Dia. 4.00mm x Tube Wall: 1.50mm x Outer Dia. 7mm

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Appendix 7- Standards

Noise regulation for outdoor equipment has been regulated at 55DB

During daytime hours, the sound level should be 45DB

Ban noisy and polluting gas- and petrol-powered leaf blowing machines from being used anywhere in the UK.

Ban the use of any type of leaf blower from March to August during bird nesting season

Ban any type of leaf blower within 1 mile of any nature reserve

The sound level should be 45DB-55DB within 50 feet of another person/Neighbours.

Search for "Equipment. Horticulture" returned 70 standards result(s)

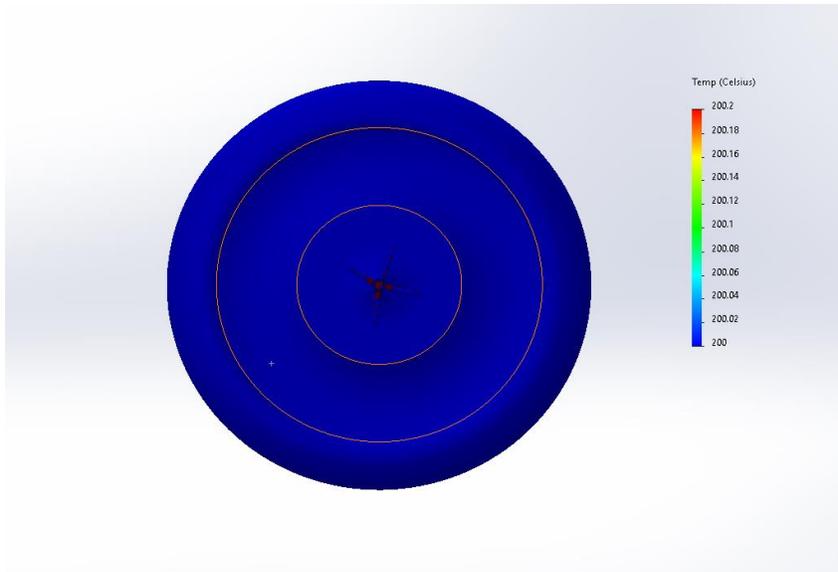
Download List

Show 10 results

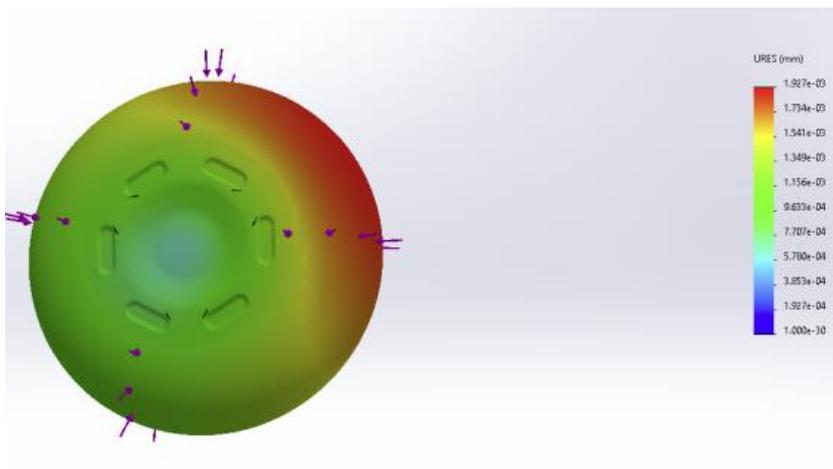
Reference	Standards description	Committee	Status
BS EN 13684:2018/A1	Garden equipment - Pedestrian controlled lawn aerators and scarifiers - Safety Categories: Equipment. Horticulture	AGE/20 Powered lawn and garden equipment	Public comment
BS IEC IEC 60335-2-107:2017/AMD2:2021	Amendment 2 - Household and similar electrical appliances - Safety. - Part 2-107: Particular requirements for robotic battery powered electrical lawnmowers Categories: Equipment. Horticulture	CPL/116 Safety of motor-operated electric tools	Public comment
BS ISO 8893:2021	Forestry machinery. Portable brushcutters and grass-trimmers. Engine performance and fuel consumption Categories: Equipment. Horticulture Equipment. Forestry	AGE/29 Forestry machinery	Published standard
BS EN IEC 62841-4-3:2021+A11:2021	Electric motor-operated hand-held tools, transportable tools and lawn and garden machinery. Safety. Particular requirements for pedestrian controlled walk-behind lawnmowers Categories: Equipment. Horticulture Domestic electrical appliances	CPL/116 Safety of motor-operated electric tools	Published standard
BS EN IEC 62841-4-3:2021+A11:2021	BS EN IEC 62841-4-3:2018/AA Electric motor-operated hand-held tools, transportable tools and lawn and garden machinery - Safety - Part 4-3: Particular requirements for pedestrian controlled walk-behind lawnmowers Categories: Electric tools Equipment. Horticulture	CPL/116 Safety of motor-operated electric tools	Approval
BS EN 50636-2-107:2015+A3:2021	Safety of household and similar appliances. Particular requirements for robotic battery powered electrical lawnmowers Categories: Equipment. Horticulture	CPL/116 Safety of motor-operated electric tools	Published standard
BS ISO 21628:2020	Gardening machinery. Powered material-collecting systems. Safety Categories: Equipment. Horticulture	AGE/20 Powered lawn and garden equipment	Published standard
BS EN 50636-2-107:2015+A3:2021	Safety of household and similar appliances. Particular requirements for robotic battery powered electrical lawnmowers Categories: Equipment. Horticulture	CPL/116 Safety of motor-operated electric tools	Published standard

Appendix 8- Analysis/Testing

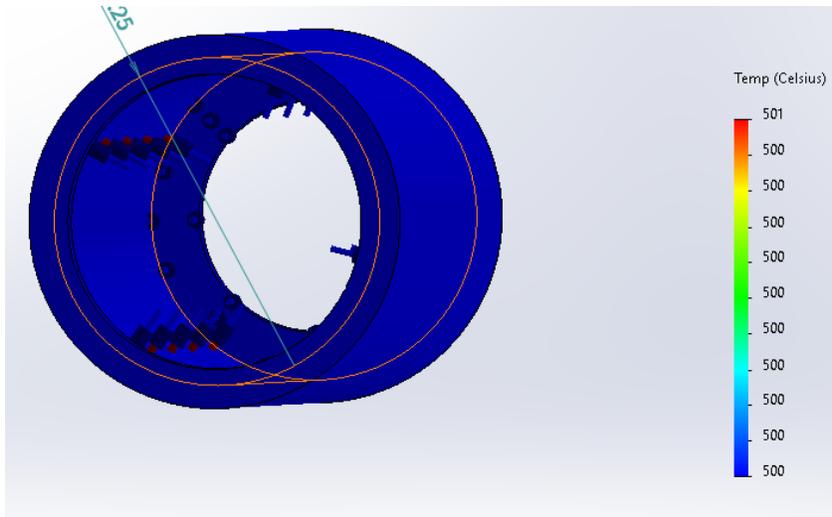
Heat Testing



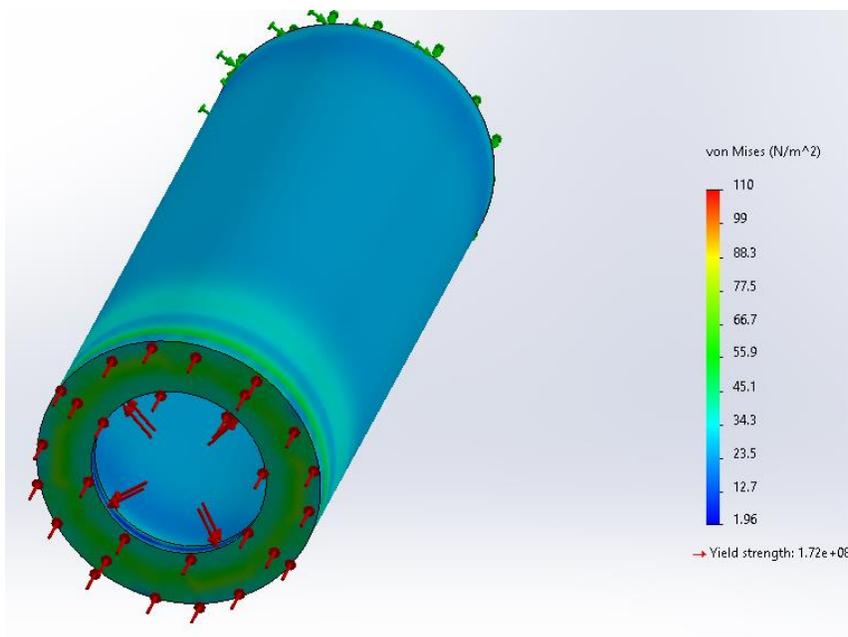
Force Test



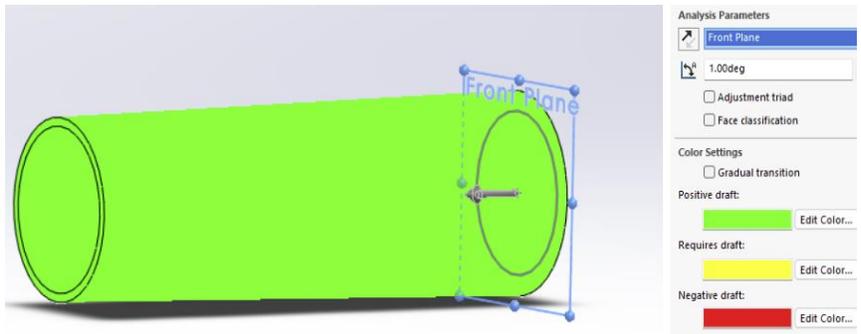
Thermal Test



Pressure Test



Draft Analysis



Appendix-9- Costs

Total Cost of Mechanism (1)	Total Cost of Mechanism (2)	Total Cost of Bearing (£7.96)	Total Cost of Tooling (1)	Total Cost of Tooling (2)
£1584	£3204	£7164	£320.41	£814.58
£1584	£3204	£7164	£320.41	£814.58
£1584	£3204	£7164	£320.41	£814.58
£1584	£3204	£7164	£320.41	£814.58
£1584	£3204	£7164	£320.41	£814.58
£1584	£3204	£7164	£320.41	£814.58
£1584	£3204	£7164	£320.41	£814.58
£1584	£3204	£7164	£320.41	£814.58
£1584	£3204	£7164	£320.41	£814.58
£1584	£3204	£7164	£320.41	£814.58
£1584	£3204	£7164	£320.41	£814.58
£1584	£3204	£7164	£320.41	£814.58
£1584	£3204	£7164	£320.49	£814.62
£19008	£38448	£85,968	£3845	£9775

mechanism part 2.SLDPRT



(<https://buildit.protolabs.com/quotes/f8324eef-b00a-4ebe-7198-08da2e0948b1/review/>)

mechanism (1).SLDPRT



(<https://buildit.protolabs.com/quotes/abf93b88-4296-4626-4d34-08da2e09532b/review/>)

Unit Cost

3	Mechanism (1)	STAINLESS STEEL	1G-2G	£3845 x1	£1.76
4	Mechanism (1)	STAINLESS STEEL	1G-2G	£3845 x1	£1.76
5	Mechanism (2)	STAINLESS STEEL	1G-2G	£9775 x1	£3.56
6	Mechanism (2)	STAINLESS STEEL	1G-2G	£9775 x1	£3.56

Appendix 10- manufacturing specification

Problems With Injection Moulding

Split lines

Burn marks

Warping

Short shots

Vacuum voids

Sink marks

Weld lines

Appendix 11- Packaging

