arido

Body Drying Reimagined

A modern alternative to the towel that uses high speed, warm air to effectively sweep water from the body.

10 Page Summary

Fern Auld
MENG Product Design Engineering
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University of Glasgow
THE GLASGOW SCHOOL OF ART

The Problem

Towels were invented in the 17th century. Since then technology has greatly progressed, yet we are still using a piece of absorbent material to remove water from our bodies after washing.

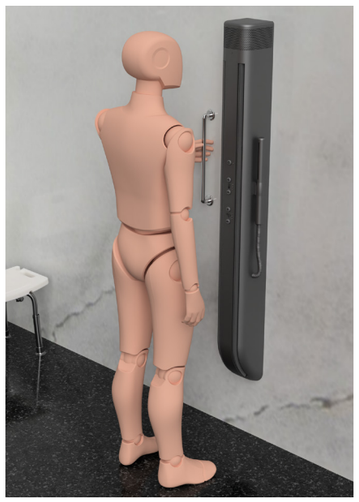
Towels are unhygienic

They consume significant water and energy through washing

The production process of cotton has an extreme environmental impact

Towels pose difficulty for users with mobility issues

The Solution



What

Arido is a body dryer that offers a more hygienic alternative to using a towel after washing.

Who

Most useful for individuals with mobility issues that struggle to use towels. However, eventually everyone could switch from using towels to using a body dryer.

Where

The product has been designed primarily for use within the home. Arido would be useful for many environments such as hotels, gyms, swimming pools, care homes and hospitals.

Why

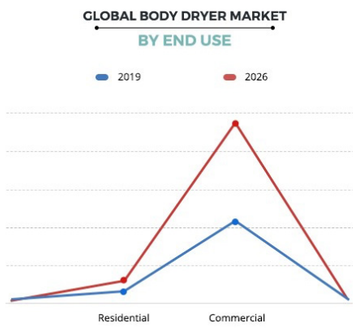
Towels are outdated, unhygienic and not environmentally friendly in terms of production and energy usage.

How

Warm streams of air from the vents evaporate and sweep air from the body. High speed air is produced using a centrifugal fan for more effective drying.

Research

Market Opportunity and Context



The humid bathroom environment creates the perfect breeding ground for bacteria on towels. 90% of bathroom towels are contaminated with coliform bacteria and 14% carry E-coli.

The body dryer market was valued at $2.6 million in 2018 and projected to reach $3.4 million by 2026.

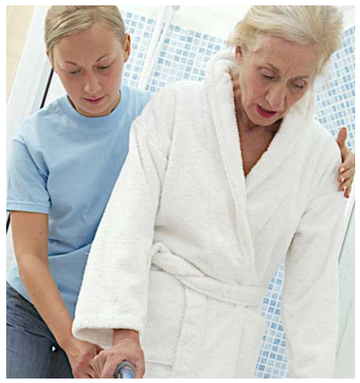
The commercial sector dominates the current market due to the initial cost of the product. However the increasing investment in smart homes could lead to growth in the residential sector.

User Group

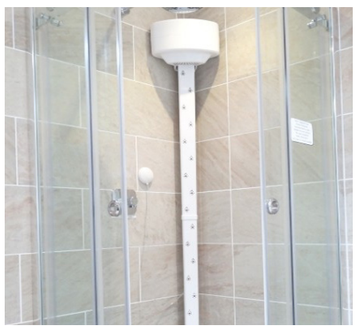
A wide range of users and environments were considered at the beginning of the project. Interviews were conducted with key individuals from the following sectors - care homes, hotels, leisure centres and healthcare.

This highlighted that the product could be useful to many user groups. However, the product could be most beneficial to users with mobility issues that struggle to use towels.

In addition, a product designed for those with mobility issues can also be utilised by able bodied individuals.



Existing Solutions



Existing body dryers on the market were not an effective drying solution with the air vents losing temperature and force just a few cm's away from the outlet. None of the existing products were very suitable for users that need to be seated. Any solutions designed for the user group are not very aesthetically pleasing.

Proposed Environment

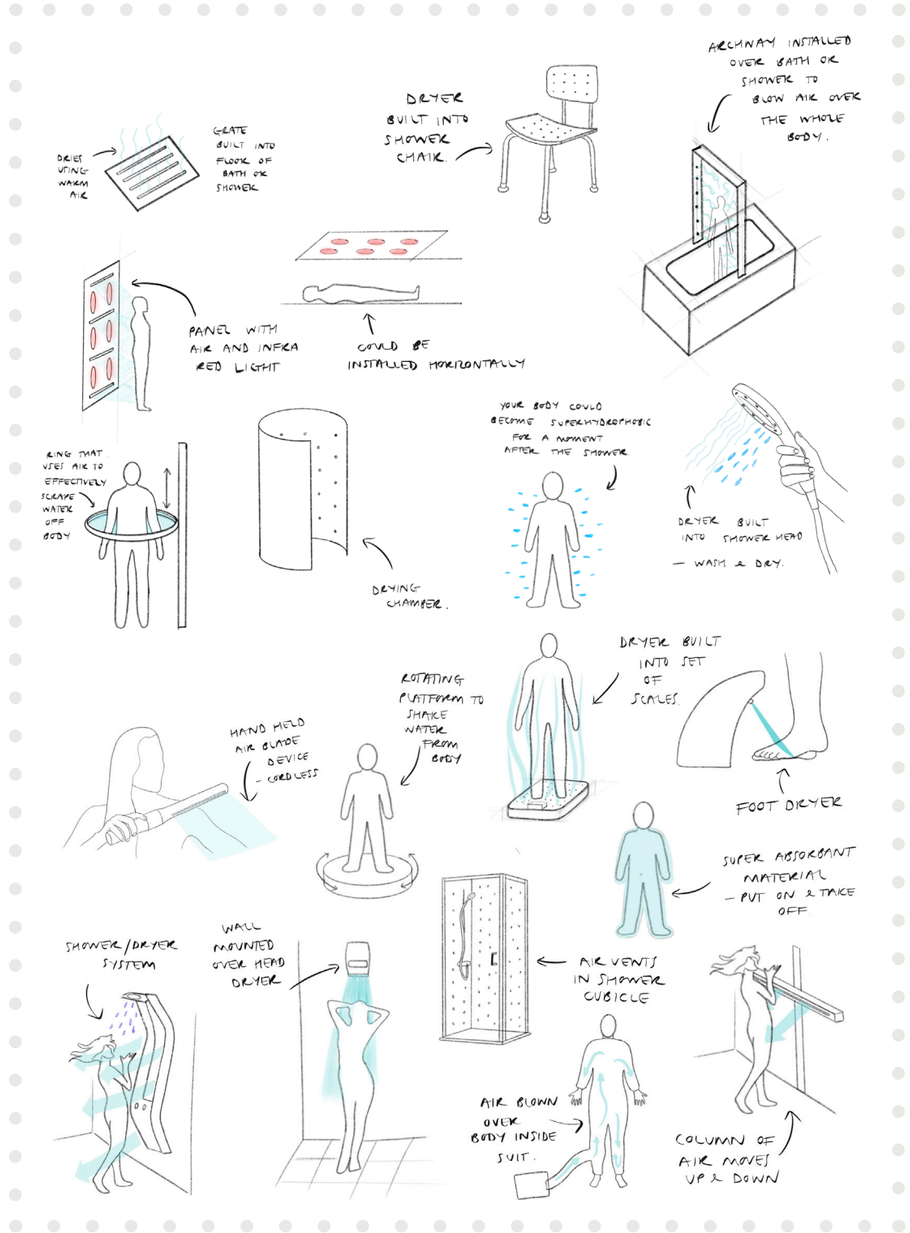
Due to the high price of care in the UK, the product was designed for use in the home with the aim of allowing users to remain independent.

Project Brief:

Design a product to replace the use of towels that is convenient, hygienic and inclusive for users with mobility issues.

Concept Generation

2D Ideation



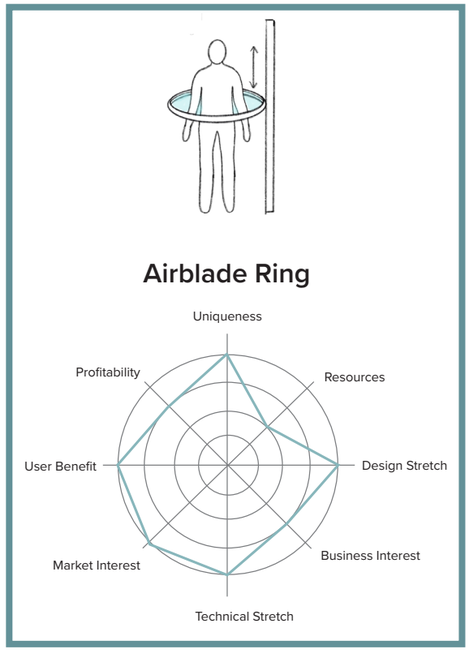
A vast range of initial concepts were generated based on different methods of drying. These included using air, infra red light, making the skin hydrophobic or shaking the water from the body.

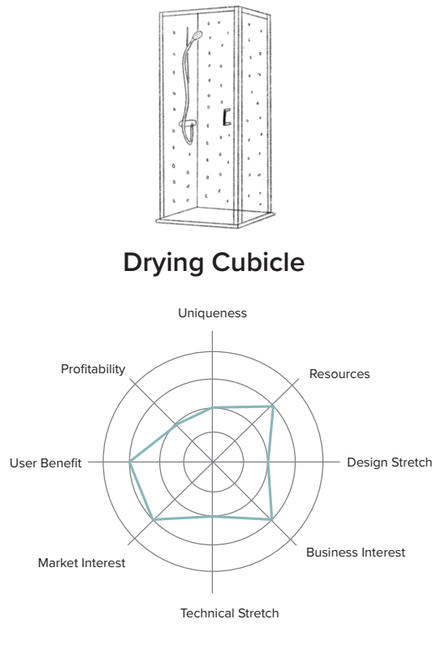
Evaluation

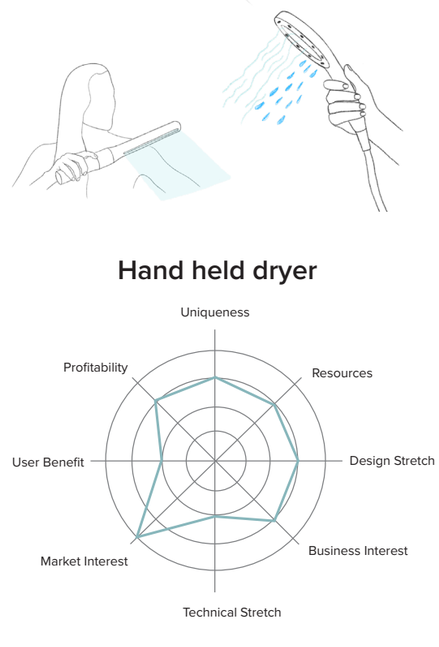
The most promising options were air or infra red light. After further research into far infra red, it was decided that it would not be suitable. It has multiple therapeutic benefits, however it would cause the body to sweat, which is not desirable after showering.

	CONCEPT								
CRITERIA	1	2	3	4	5	6	7	8	9
Ease of use	DATUM	-	=	+	-	=	-	=	+
Hygiene		-	=	=	=	=	-	+	-
Efficiency		=	+	=	-	=	-	=	-
Environmental impact		+	+	=	+	=	=	+	=
Maintenance		+	+	=	+	+	-	+	-
Cost		+	-	=	=	+	+	=	+
Size		+	+	+	+	=	+	+	+
TOTAL	0	2	3	2	1	2	-2	3	0

The concepts were evaluated using matrix of product requirements, these were set following conversations with members of the user group.

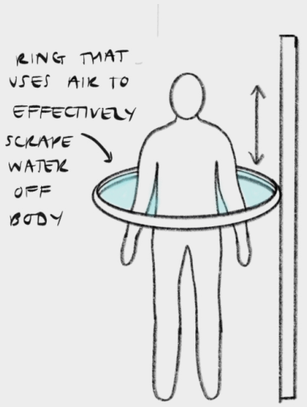




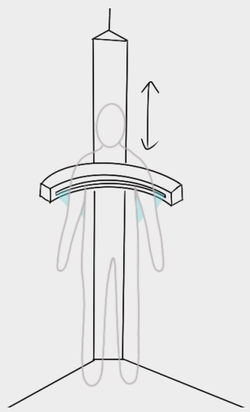


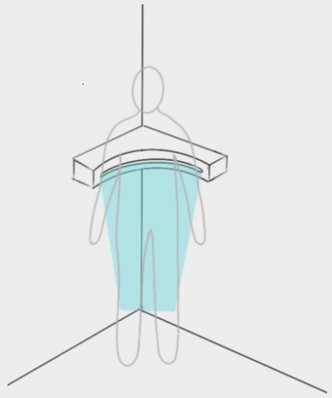
Radar charts were then used to evaluate the three best designs, with the airblade ring being chosen as the concept to develop. This concept is unique compared with existing products for body drying and has plenty of scope for design and technical stretch.

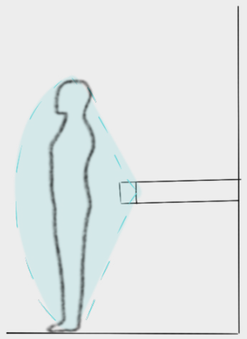
Design Development



Initial concept was too restrictive for the intended user group, could not be placed within the shower cubicle because it would take up too much space.



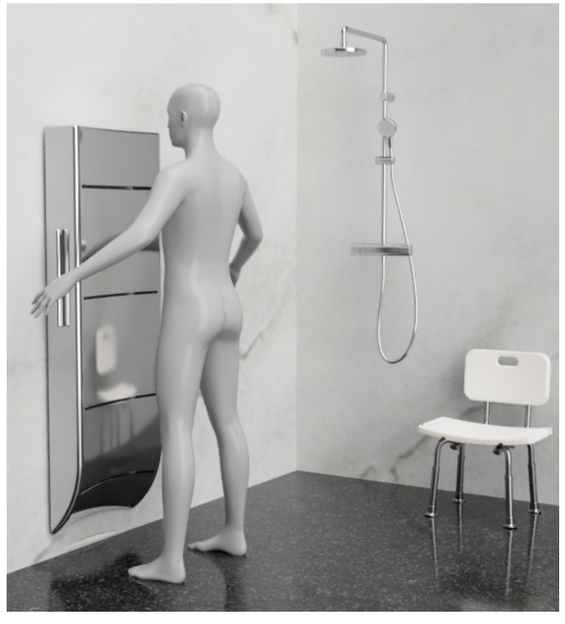




The design was developed into a curved design which fits into the corner of the shower cubicle or wet room and a horizontal blade of air rotates to remove water from the body.

3D Exploration

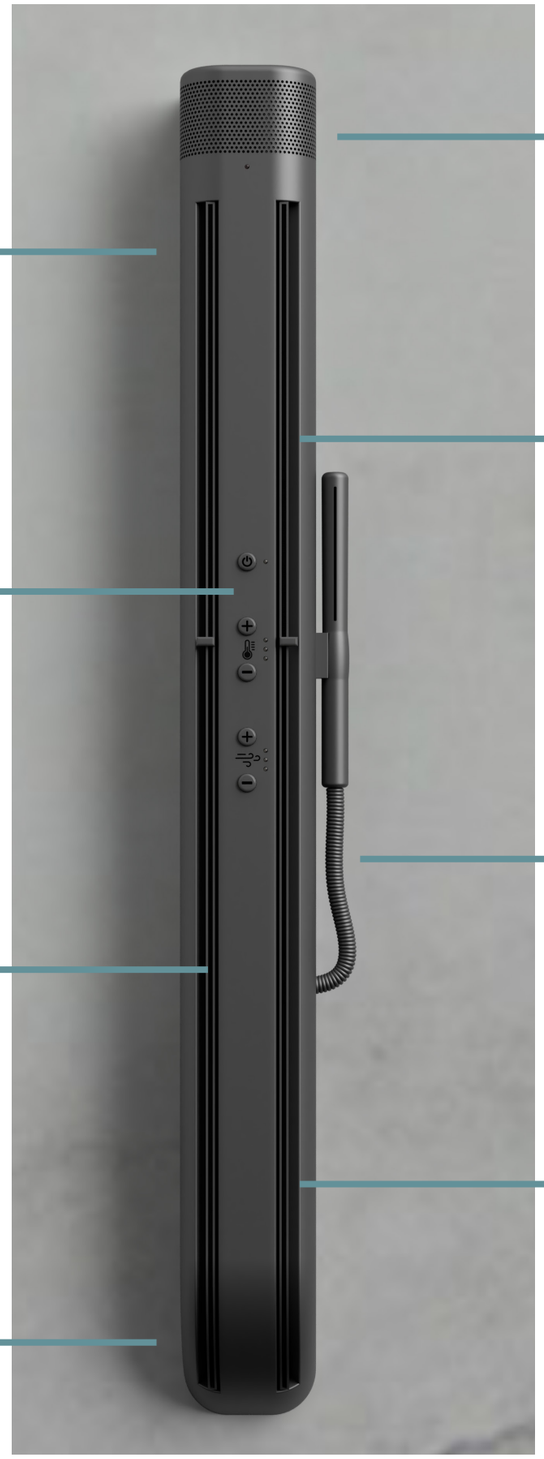
The majority of user feedback highlighted the fact that this concept would not provide even drying over the full body.



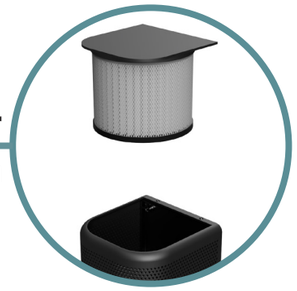
This led to an iteration with multiple horizontal blades of air. This design is bulky and would not fit within the limited space of most bathrooms.

In an attempt to reduce the overall profile of the product, a design including two vertical air vents and a hand held attachment was developed. This was greatly received by users and was therefore the design chosen to develop further.

Product Overview & USP's



HEPA filter
To ensure the air is clean



Aesthetically pleasing design

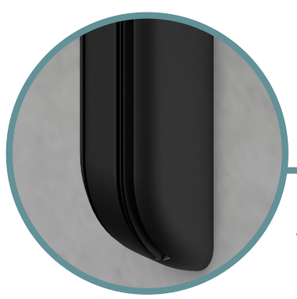
Adjustable air vents
For standing or sitting

Simple, intuitive user interface

Hand held attachment
For hair and hard to reach areas

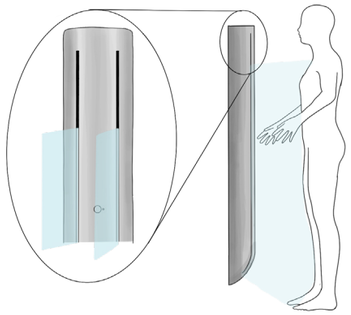
Blades of air
All existing products have circular air vents

Rotating air vents
Allowing for full body coverage

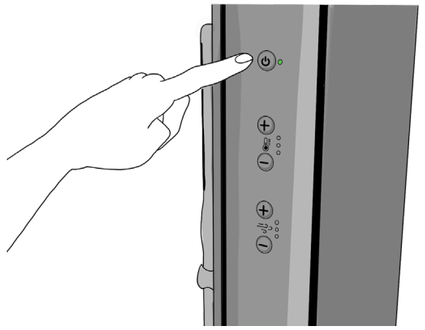


Curved profile
To direct air towards the feet

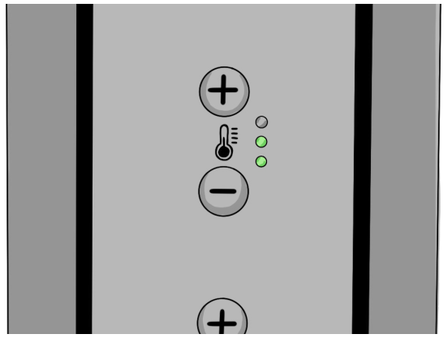
User Interaction



1 Use sliders on the vents to set the height of airflow

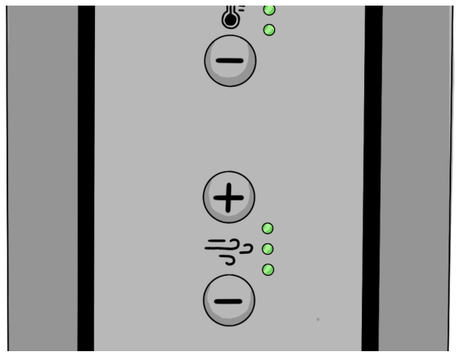


2 Switch on the body dryer

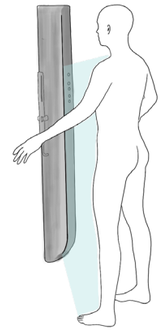


3 Select temperature, once heated dryer stays on standby

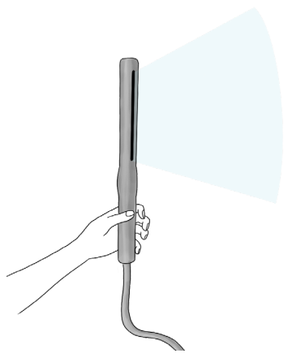
4 Have a shower



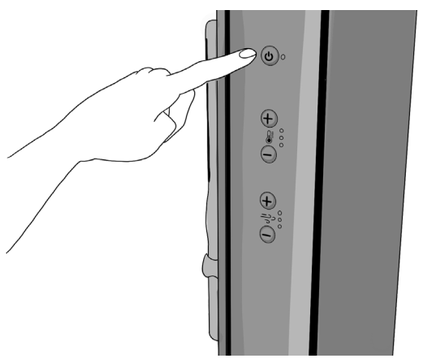
5 When out of shower, select speed to start the body dryer



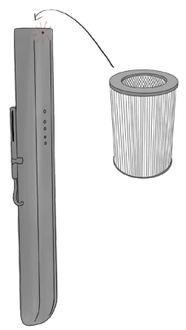
6 Stand in front of the product allowing it to dry the body



7 Use hand held attachment to dry hair or hard to reach areas



8 Once dry, turn off the product

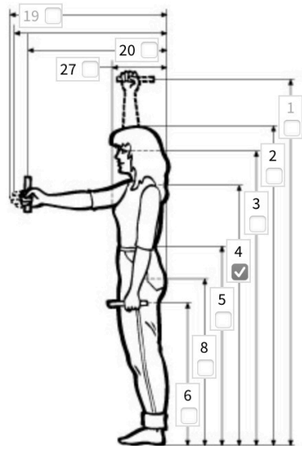


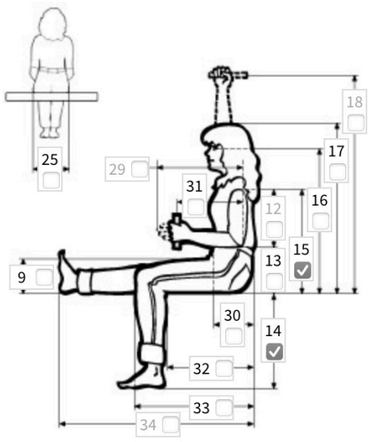
9 When light shows remove cover and replace the HEPA filter

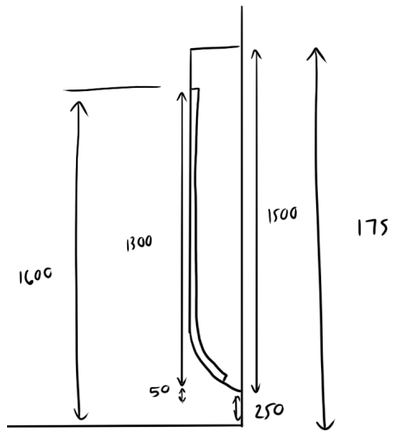
Develop

Anthropometrics

The height of the user interface, hand held attachment and air vents were all determined using anthropometric data. The 95th percentile male and 5th percentile female figures were used to create a range suitable for the majority of users.

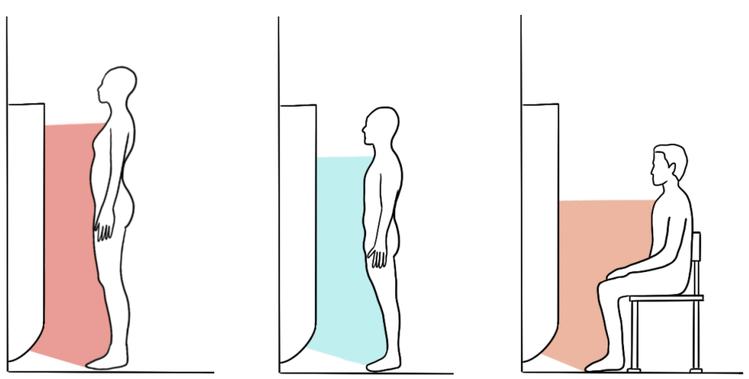






The 95th percentile male shoulder height is approximately 1600mm which was set as the maximum height of the air vents. The overall height of the product is 1500mm with the air vents spanning 1300mm of the height. This meant the body dryer should be placed 250mm from the ground. The hand held attachment and buttons were placed 800mm from the bottom of the product to allow them to be easily accessible when seated or standing.

The air vents can be closed off using a sliding mechanism, (to a height of 900mm), which is the 5th percentile female shoulder height when seated.



User Interface

With my chosen user group it was extremely important to take into account both physical and cognitive abilities when designing the product. Push buttons were chosen because they are the easiest to use for individuals with limited dexterity.

LED lights are used to show the current setting.

Buttons with clearly marked symbols were chosen over an LCD screen to ensure the controls were simple and intuitive.

Grab Rails

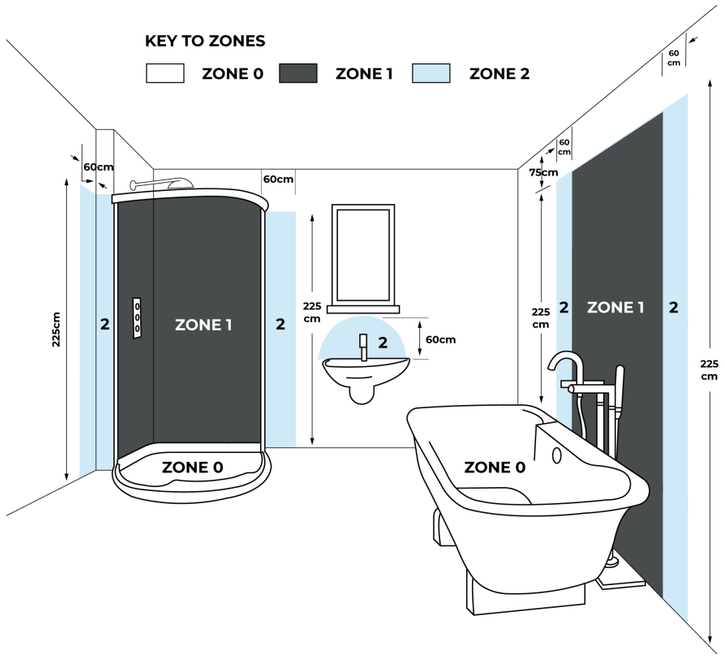
Grab rails were considered as an addition to the design to allow individuals with balance issues to hold onto something. After conversations with an occupational therapist, it was advised that they should be installed separately because different users require them at different heights and angles. There are also regulations for grab rails to be secured to the wall and it could pose a safety risk if the product was to be pulled from the wall.

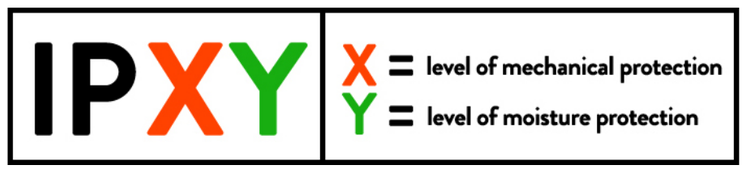

Doc M Pack
Shower Scenario

Technical Development

Standards

Complying with standards was especially important in this case because an electrical product in the bathroom can be a major safety concern. The British Standard most appropriate for this product is BS7671 which outlines the requirements for electrical installations.





Section 601 contains information relating to locations containing a bath or shower and outlines the 3 bathroom zones. In order to be placed in zone 0, 1 or 2 the product must be a maximum of 12V and have a minimum IP rating of IPX4 to ensure sufficient protection from water.

It was decided that the product will be installed outside zone 2 because the fan itself requires more than 12V. The IP rating was chosen as IP56 which means the product will be protected against dust and strong jets of water. This is a superior level of protection in comparison to most products however protection from water is especially important in this case.

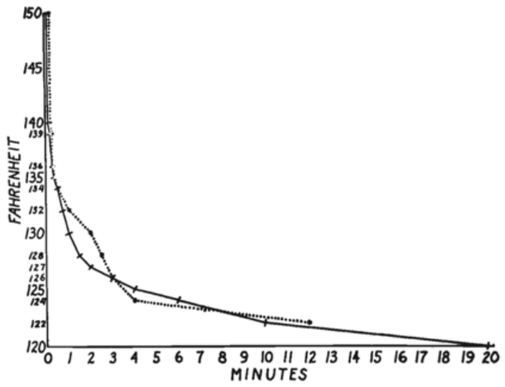
Air Temperature

Safety was of critical concern when setting the air temperature. Based on tests performed using a hair dryer and digital thermometer, (as well as research into the time-temperature relationship that causes burns on human skin), the following 3 temperature settings were decided on.

28°C **38°C** **48°C**

Direct exposure to 48°C for more than 5 minutes can cause 3rd degree burns to the skin.

As a safety feature the body dryer will automatically switch off after 5 minutes of inactivity.



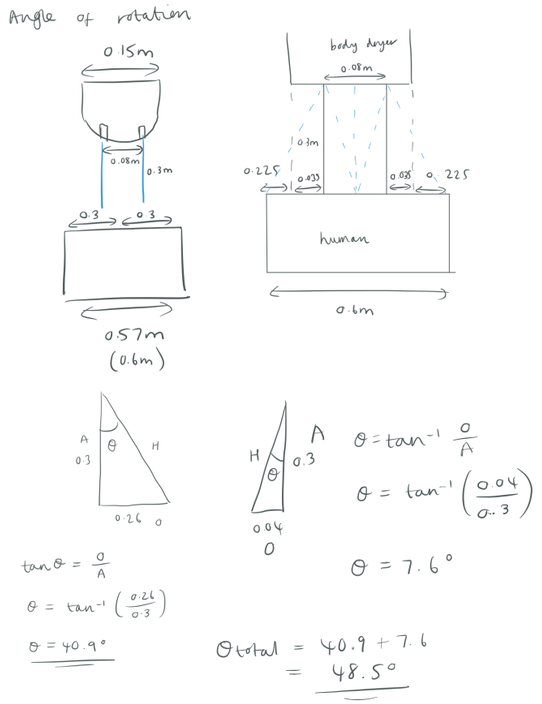
Air speed

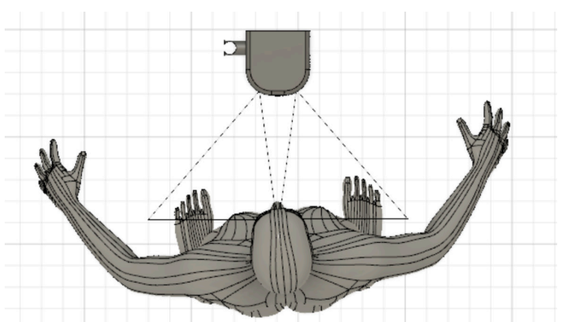
The air speed was decided based upon other products that use air to dry, such as hand dryers. To be considered high efficiency a hand dryer must operate at speeds of 50-80m/s. The target user group might suffer from fragile skin so therefore 50m/s was selected as the highest speed.

Design Details

Rotating Air Vents

The 95th percentile male shoulder width was used to determine an appropriate angle for the air vents to rotate for full body coverage. The total angle each vent has to rotate is approximately 50 degrees.





Height adjustment

Concertina slider mechanism can be physically adjusted to change the maximum height of the vents.

Maintenance

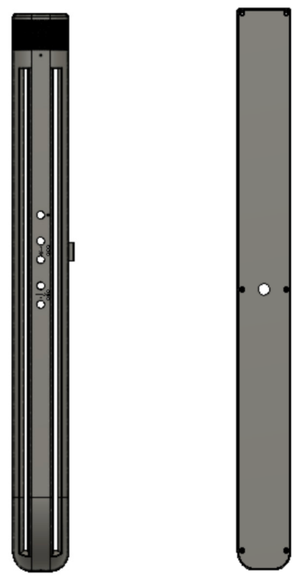
The red led light at the top of the product alerts the user when its time to replace the HEPA filter. A differential pressure sensor can detect the change in pressure caused by the build up on the filter.

Pressing down on the lid of the product gives access to the filter. The filter can then be removed from the snap fit on the inside of the lid, discarded of appropriately and replaced.

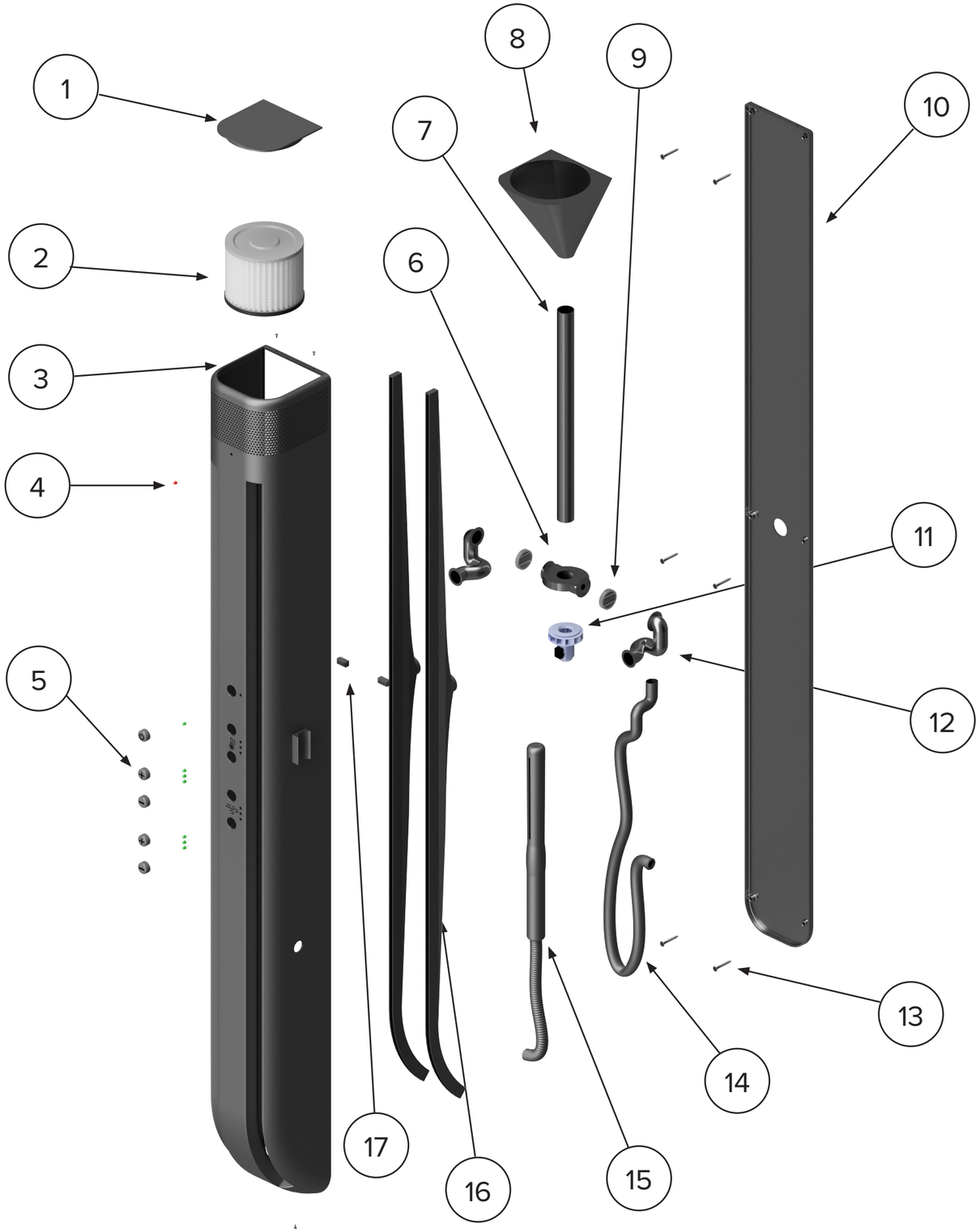
Materials & Manufacturing

Initially, stainless steel was chosen as the material for the casing due to high corrosion resistance. However, after incorporating the hand held attachment into the design, the high density and conductive properties of stainless steel were not desirable. PC/ABS was selected due to the combination of high impact strength, heat resistance and processability.

Injection moulding was selected as the most appropriate manufacturing method due to the complexity of the part. The current target market would be considered niche, this is not appropriate for the high initial tooling costs of injection moulding. However, the product could be adapted for use in multiple environments, by those with mobility issues as well as able bodied. The adaptability of the product justifies mass market production.



Assembly



Parts List			
Item	Qty	Part Description	Material
1	1	Lid	PC/ABS
2	1	HEPA filter	Glass fibre
3	3	M3 Tamper proof screw	Stainless Steel
4	8	LED	N/A
5	5	Push button	PC/ABS
6	1	Fan casing	PP
7	1	Cylindrical vent	PVC
8	1	Funnel vent	PVC
9	2	Heating element	Ceramic
10	1	Backplate	PC/ABS
11	1	Centrifugal fan	PP
12	2	Flexible air vent	Silicone
13	6	Screw	Stainless Steel
14	1	Hand held vent	Polyethylene
15	1	Hand held attachment	PC/ABS
16	2	Rotating air vents	PC/ABS
17	2	Vent adjustment handle	PC/ABS

Tamper proof torx screws were chosen to secure the front casing to the backplate. This is a safety measure to stop easy access to the electrical components.