STYLING

WHAT FEATURES MAKE THIS PRODUCT STAND OUT?

Designed with an overall grey and black colour scheme (as all Titan products are) with a black finish to the hex key, power cord and base plate.

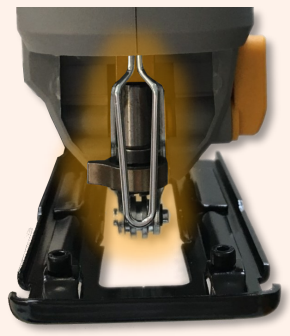
Black and orange indicate danger in the animal kingdom (visualise hornets) therefore evoking the primitive fear within humans of nature. This surges the power felt by the user; they are taming and wielding something wild and ferocious.

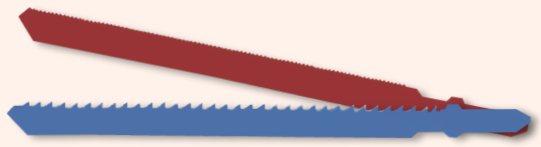
Brand label is large and printed in white on the product. Clarity surpasses general colour scheme in order to emphasise the brand name. This boosts brand loyalty by making users think of Titan every time this tool is merely observed.

The box design is one of the most important things to get right. This will dictate whether the jigsaw is flying off shelves or left alone to gather dust.

Titan use BOLD CAPITALISED LETTERS to show critical information with clear diagrams, usable for an international customer base.

Small metallic components such as the blade guide, parallel guide scale and blade guard are not painted black. This is likely due to a tight manufacturing budget, evidenced by the premium wireless model that addresses these inconsistencies with all said components painted black.

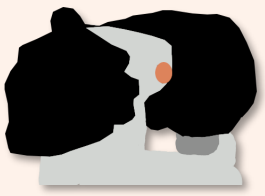




Both jigsaw blades provided did not come in black either, instead a red blade with finer teeth intended for metal cuts came with a rougher blue blade for wood.

Only 4 components are moulded in orange. Why?

The speed dial, the on/off switch, the trigger and the lock-on button are the only pieces with the privilege of being cast in orange plastic. These are also the only moving components that the user is encouraged to touch, likely being so vibrant in order to attract attention and be played with. Making the product feel fun like a toy causes users to intuitively discover the various jigsaw mechanisms for themselves.



But how does it feel?

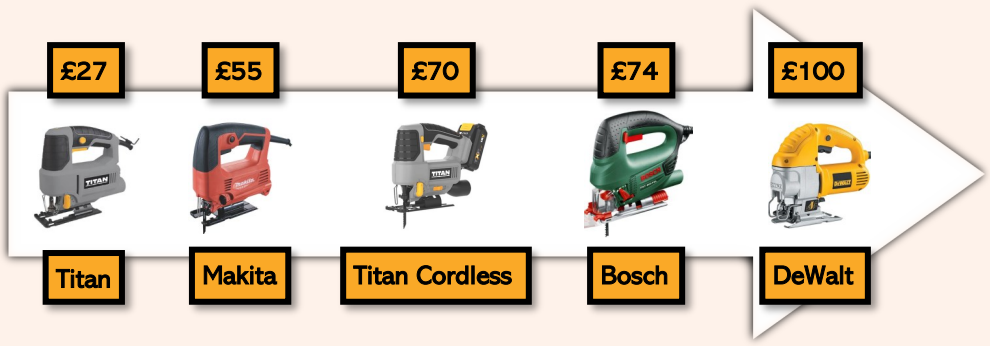
The ergonomics of this jigsaw are perfect for a right-handed male, having 2 thoughtfully placed rubber grips in clear black to be held while sawing. The lock-on button along with the speed dial are easily accessible for the main demographic of users.

COMPETITION

HOW DOES THIS JIGSAW HOLD UP AGAINST COMPETITORS AND OTHER MODELS?

Establishing a target audience

It appears that this product may be for hobbyists or professionals in small businesses. This conclusion can be reached by the very competitive price of this jigsaw. Price comparisons to Makita, Bosch and DeWalt prove that the Titan jigsaw outperforms all other models greatly on price.



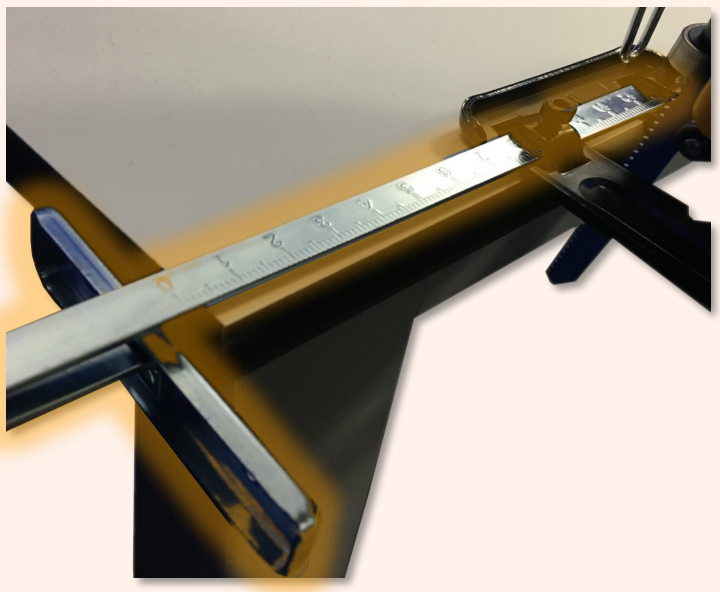
The Titan colour scheme is similar to DeWalt, their most esteemed competitor. One could argue this is to associate their product quality with that of DeWalt, however it is worth noting that Titan products are primarily black with only orange highlights.

The Titan cordless variant exists for a 260% price increase with a 2 Ah Li-Ion battery (would last for approximately 60 minutes). It has all metallic components painted black (including blades) unlike corded variant. This is clearly targeted to professionals.

There are many dissatisfied reviews on Screwfix.com, the owners of Titan, on how this model of jigsaw does not cut lines straight. Optimisations for a perfect mechanism may be detrimental to maintaining a competitive cost, explaining why this model has so much tactile and aesthetic considerations. The product does come with a blade guide to straighten lines, further evidence that the main buyers are likely amateurs.

Why are customers buying a jigsaw and not a bandsaw, scroll saw or circular saw?

Jigsaws are the most versatile cutting tool on the market. No other tool can as easily or as effectively cut large sheets of wood or metal into the shapes a jigsaw can bar laser equipment. Jigsaws allow users to slice through any material at any angle, anywhere.



What are the limitations of the Titan corded jigsaw?

The cord on this model is only 2.5 metres long. This makes the jigsaw ideal for usage within a workshop with plenty of outlets, however what happens when you want to go outside to do some carpentry? The corded variant forces the customer to bring an extension cable as well as clutter their workspace full of cables. The cordless variant is the ultimate tool for workspace flexibility, trumping the corded variant in utility.

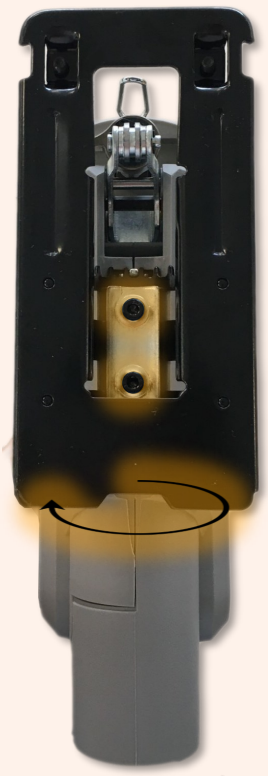
PERFORMANCE

A COMPREHENSIVE REVIEW OF PRODUCT PERFORMANCE

The Alan key

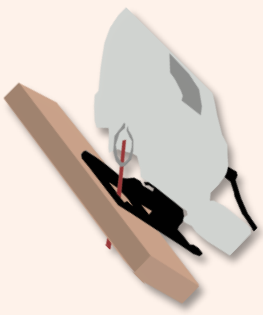
This product comes with an Alan key attached. This is the only piece of equipment needed for any user to be able to use the full functionality of the jigsaw.

As seen in the image on the left, the Alan key can be used to loosen 2 screws in the bottom plate in order for the blade guide to be fastened at any length between 0 and 15 centimetres from a straight edge.

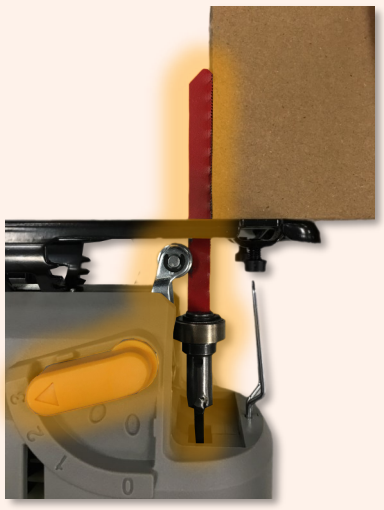


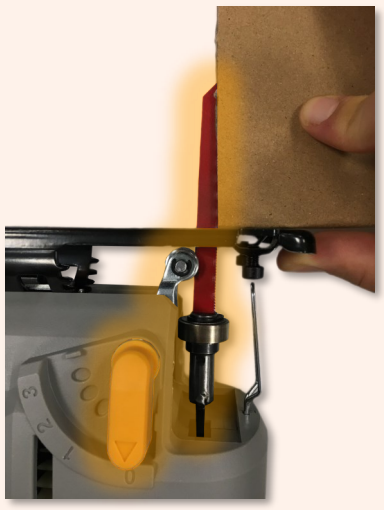
Changing angle

The base plate angle can also be easily adjusted with the provided Alan key to allow the blade to cut with a 90 degree range of lateral angles.



This feature makes the jigsaw the most versatile cutting tool.





Adjustable pendulum angle shown here is present in order to give the user control of the precision-to-speed ratio. On setting 3, the blade is purely perpendicular to the base plate, leading to a very accurate sawing experience around angles and minor wood splintering. On setting 0 however, the blade is allowed a greater range of motion in the horizontal axis. This allows the user to move the jigsaw faster through their material, lowering production time at the cost of greater splintering and accuracy.

Straight cut quality on setting 3

Quality on setting 0 (splintering)

Specifica-

- 220 - 240V
- @50Hz
- 600W
- 2.5-2.75 A
- 5A fuse
- 2kg weight
- 2.5m cord

WEAKNESSES

AND VARIOUS WAYS TO IMPROVE THE DESIGN

Spring loaded action

The blade locking mechanism requires a significant amount of pushing force to lock in any blade. Two hands are required to overpower the internal spring.

Not only does this make the product inaccessible to weaker or less-abled customers, but the spring causes the blade to aggressively shoot forwards up to 2 metres horizontally when opened.

This feature is a serious health and safety concern within a workplace with multiple moving parts and a flying hot blade.

A simple solution would be to change the internal spring to have much lower elastic potential energy.

Should the fuse be 5 Amps?

A short due to water damage or blunt impact would cause internal currents to rise up to 5 amps and cause tissue burning, heart paralysis and probable death if someone were exposed to the current for 1 second. A 3 amp fuse is much closer to the upper current limit used by the jigsaw and should be used instead. A 3 amp shock is very dangerous with ventricular fibrillation occurring, however this has a significantly higher survival rate than a 5 amp shock.

Blade appears to be secured but is not.

Blade now secured. No clicking noise indicated so and a strong "yank test" had to be applied to ensure the blade would not fly out in use. The avenues for failure here are limitless...

Blades serrated upwards, leading to wood splintering on the top side of any piece of wood that is being worked on. This can be a serious issue when the jigsaw is being used on a finished piece. In order to improve this, a jigsaw blade with teeth pointing downwards should arrive with the product.

Is this designed to accommodate for female hands? Is the weighting appropriate? What about handle circumference?

Frankly, this product is not designed with a female userbase in mind. The device weight of 2kg is appropriate for most users, however the handle circumference is optimised for men from the 25th to the 75th percentile in hand breadth. A large amount of women fall outside of this category, resulting in a challenging experience managing the power tool. There is an increased risk of dropping the jigsaw, which would have dire consequences for anyone not wearing protective gloves, trousers and boots.

A solution would be to provide a slightly modified variant for people with smaller hands that had a thinner handle section, or perhaps making the universal model have a modular handle that can have various sizes clipped on an off. This would be challenging to manage on a tight budget however, therefore the ideal jigsaw handle would be thin enough for users with small hands but be packaged with various cheap rubber grips of different thicknesses for users to feel comfortable.

What about lefties? They are only 10% of the population... right?

The lock-on button that keeps the jigsaw locked into its movement phase gets in the way for left handed users. It is only placed on one side and is quite large and obtrusive. The angle dial is also placed on the left side of the jigsaw, making it hard for left handed users to adjust. An ambidextrous design could be considered for more premium models with buttons on either side, however this would never be budget-friendly and unlikely to appear on the price-competitive models.

Source: ELCOSH, "ELECTRICAL SAFETY: SAFETY & HEALTH FOR ELECTRICAL TRADES", accessed on 20/10/2023, link: <elcosh.org/document/1624/888/d000543/section2.html>.

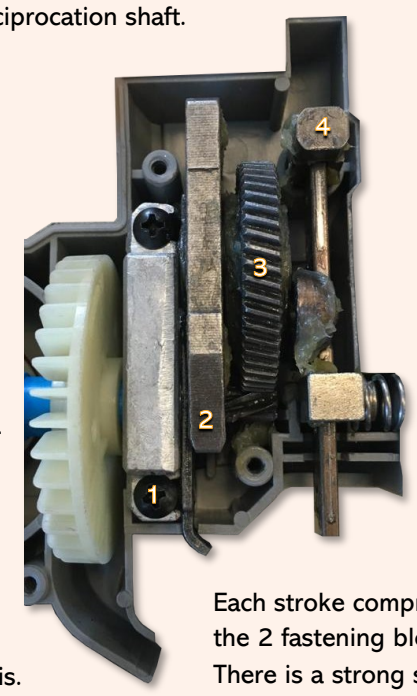
MECHANICS

ANALYSIS ON A MECHANICAL LEVEL

A motor turns a shaft, connected to a helical reduction gear which in turn moves a reciprocation motion shaft up and down with the serrated blade.

Reduction drive (3)

This set of gears acts to increase torque per shaft revolution by sacrificing rotational speed. The bottom gear is directly connected to the motor and the top gear is in contact with the reciprocation shaft.



Counterweight (2)

The counterweight moves down as the blade moves up and vice versa. It is moved by an embossed oval on the back of the large gear that slots into the counterweight.

This increases sawing efficiency by balancing the weight around the system's fulcrum, adding momentum.

Anchor piece (1)

The anchor keeps the entire system stable by fixing it to the jigsaw chassis.

Reciprocating motion shaft (4)

Each stroke compromises of this lubricated chaft going through the 2 fastening blocks that are embedded within the chassis. There is a strong spring located here to absorb vibrations.

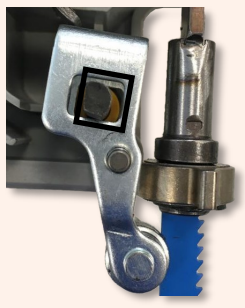
Lubrication prevents energy being lost via friction and mitigates resulting heating effects that may lead to the chassis melting.

Pendulum control

Setting 3

This central shaft is designed with 2 missing circular segments in order to create varying levels of support.

Setting 0 limits range of motion by effectively reducing the rectangle of potential movement in which the blade guide could oscillate.



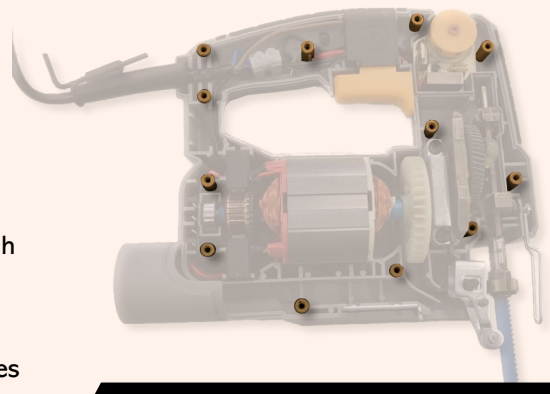
Setting 0

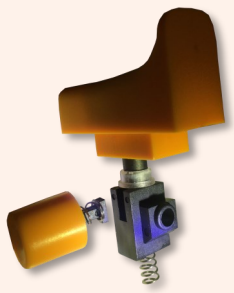
Chassis screw placement

The entire chassis contains 12 screw holes for general system dismounting. They are shown here in orange, with even placement peppered around the entire jigsaw. Evenly distributed screws offer the most structural rigidity and overall safety, especially important since the motor brushes are not screwed in and would spark if poor contact were to be made.

Due to the Phillip's head screws used for this, it can be inferred that the Alan key provided is intended for adjustments only and not repairs.

There is a circlip present where the blade attaches for extra security.





Trigger locking

The trigger is forced into a locked "on" state when a button on the side is pressed due to this T slot mechanism that locks into the trigger block. A spring prevents this button from falling into the slot, requiring an intentional press to lock into place.

ELECTRONICS

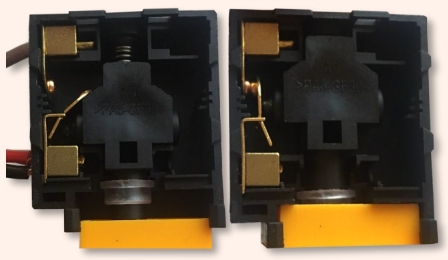
ANALYSIS ON AN ELECTRICAL LEVEL

Power cable

The plug follows traditional British conventions with a 5A fuse before the brown 240V power cable and a blue 0V ground cable to finish the circuit. No earth wire present.

Current flow shown, red arrows depicting 240V flow and blue being 0V GND.

Trigger power



This system is turned on by a simple switch located inside the spring-loaded trigger.

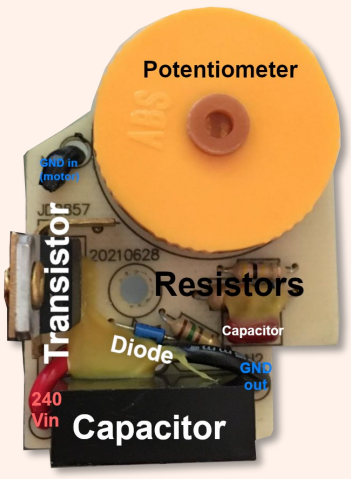
The switch is a JINDING FA-12 with a power rating 8A 250V rated for 50,000 operating cycles (5E4 rating).

Brown power cable from mains turns into a red cable for the electronics and black cable for motor power.

Safety mechanisms

Yellow glue has been applied to this PCB over the transistor and capacitor legs in order to prevent these legs snapping over time due to metal fatigue from vibrations.

A heatsink is present on the transistor in order to prevent overheating. The maximal operating temperature is 110 °C, exceeding this limit could result in combustion.



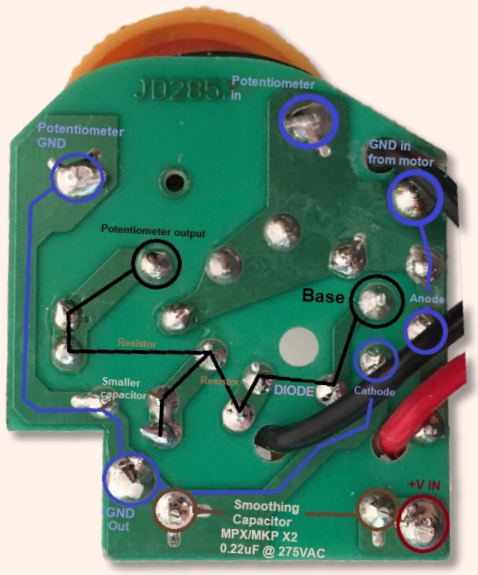
Speed control system

The yellow speed dial is the cover of a potentiometer beneath. This is an adjustable resistor which uses a wiper over a resistive track to determine how much current may be delivered to the motor. Higher resistance leads to lower current, therefore "speed 1" on the dial is the highest internal resistance this device can output. It can be seen connected to the base of the transistor through a series of smaller resistors, evidence that this is controlling the flow of current in the entire system.

A low-side bta08-600b TRIAC is controlling the load between the Voltage input (Vin) and the 0V ground (GND).

This transistor is rated for 600V and 84A which gives engineers ample room to make it a high-side system, however the TRIAC prevents overheating.

The transistor trigger current of 100mA shows that the minimum power setting on the potentiometer cannot be less than 24W on the jigsaw.



Capacitor

A large smoothing capacitor is placed in parallel in order to harvest voltage and current to be provided to the universal motor when the AC source is in the process of turning voltage negative or positive. This prevents motor stutter.

THE MOTOR

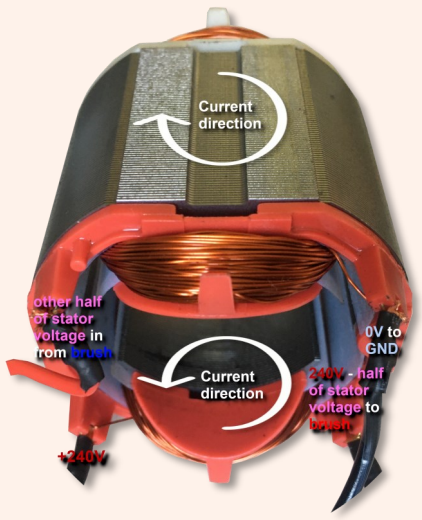
DEEP DIVE INTO THE CENTREPIECE OF THE JIGSAW

The universal motor works by generating a magnetic field in static electromagnetic coils which attract and repel an inner set of rotating EM coils around a shaft.

Wound stator

The voltage from the switch goes directly to the bottom electromagnetic coil. As current moves in the opposite direction, this creates a north or south pole depending on the supply.

Due to the 0V ground wire leaving on the opposite side of the top electromagnetic coil, the current will be moving in the opposite direction to the bottom coil, resulting in a alternating pole.



Rotor

When a wire carrying current is presented into a magnetic field around a **shaft**, it will move in a direction perpendicular to the current direction.

The **armature** consists of many tightly wound coils that carry current in the same direction.

The current is alternating within these **coils**, but the current is also alternating within the wound stator at the same rate, making this work effectively as a DC motor would.

These wires all have protective **enamel** to avoid short circuits and are connected to opposite sides of the **commutator**, allowing continual rotation.

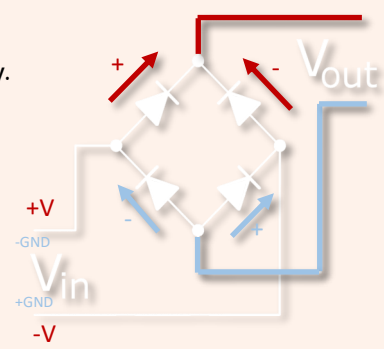
A simple **bearing** before the commutator keeps the shaft embedded into the chassis while allowing rotational movement.

Full-Bridge Rectifier for DC motor usage

A universal motor less power-efficient than a DC or AC only motor. Converting AC input to DC is done with a full bridge rectifier.

A full bridge rectifier should be implemented over any half wave rectifier for more efficiency. It also decreases ripple voltage, making the output current more reliable.

This would require less energy to be used by the jigsaw for the same output, making the jigsaw more environmentally friendly.



Colour coding wires for repairs

The wiring in this system is very poorly colour coded due to the lack of agreement on colours for the +240V and 0V wire. This makes the repair process challenging for anyone with electronics experience, especially since only 2/3 of red wires have been used for +240V and 1/2 of black wires have been used for the 0V connection.

An improved system would encase all power wires in brown casing and all ground wires in blue casing. This is because it would match the standard British plug colours.

Earth wire?

There is no earth wire in this electrical system which increases the risk of electrocution if a live wire escapes its enclosure. The casing, however, is made out of thick plastic, therefore there is zero chance of the chassis becoming live.

The wire may melt through the plastic though, so an earthed metallic casing may be worth considering if this could fit within the tight budget.

To brush or not to brush?

Brushless induction motors can use AC and DC. They require a complex control system in order to synchronise all 3 phases.

If implemented, the efficiency would save energy and continuous output would reduce vibrations, however it is more costly.

Brushed power

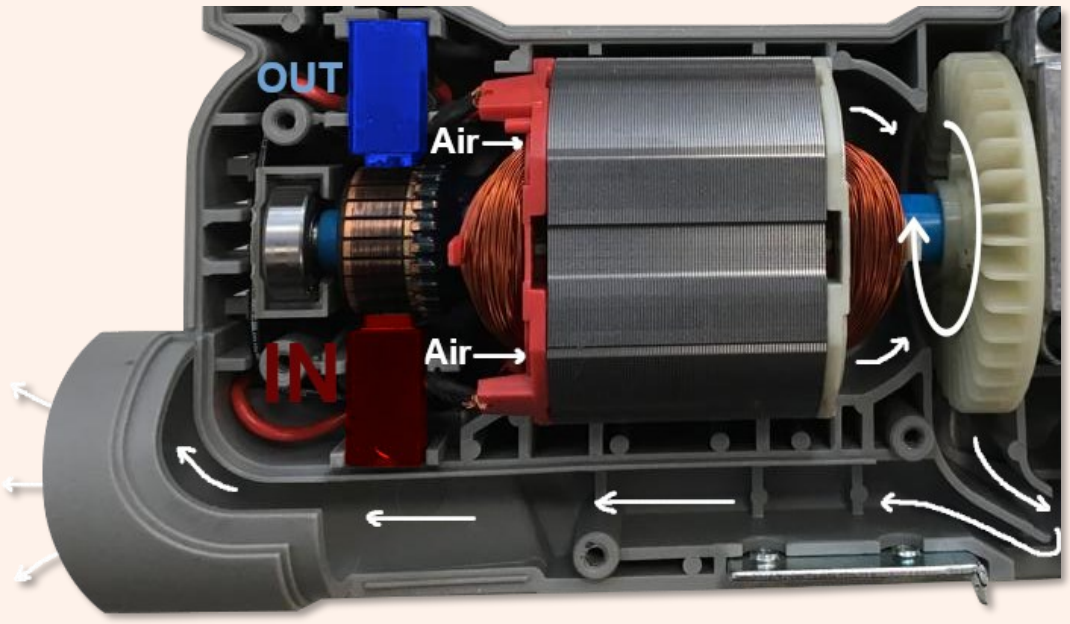
Carbon brushes are used to pass current through the commutator. The carbon is specially prepared to have high resistance in order to avoid sparking.

Each brush presses into the split-ring commutator due to a compressive spring mechanisms.

Active fan cooling

A simple motor fan clears dust particles from the internal mechanism while cooling the motor.

Air flows outside of chassis.



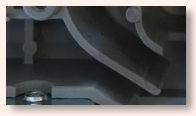
Passive thermal management

There are laminated aluminium layers throughout the stator to eliminate eddy currents. The motor casing is quite large in order to increase the surface area, a feature greatly increasing the rate of thermal radiation, which is aided by the active cooling system.

IMPROVEMENTS

WHAT FLAWS ARE PRESENT AND HOW TO FIX THEM

Increasing air flow



Air must travel between a channel only 4mm wide at points. Bernoulli's equation dictates that particle velocity will increase.

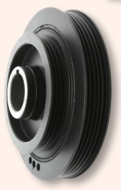
A particle greater than 4mm would block air flow, faster flow making this blockage heat up. To fix, change this width to 8mm.

Lengthening the jigsaw blade

The standard T-shank blade is 10cm long. By increasing the length of the blade, bending moments at the tip will linearly increase shear force.

A metal with a higher Young's modulus, such as titanium, could be used.

Vibration reduction

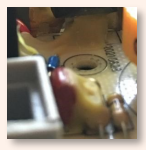


A cheap, simple solution would be to place rubber around the motor, however this doesn't solve the inherent issue of vibrations due to the twisting of the central shaft.

A small harmonic balancer would be perfect, absorbing tortional twist and vibrations by counteracting crank motions and changing the polar moment of inertia.

Yellow glue

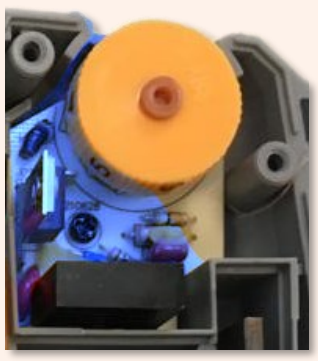
Yellow glue degrades over time with heat, becoming a brown colour, crumbling and becoming conductive and corrosive. Silicone adhesive is better at heat-resistance and insulation.



Water damage

Water due to usage of the jigsaw in the rain or in humid conditions could come into contact with the electronics. As impure water is conductive, it would likely cause a short circuit to form, potentially at the transistor gates.

Coating the entire jigsaw in epoxy resin or silicone would prevent this, however the most at-risk area is the speed control system due to there being a clear opening directly into the electronics to the left of the dial. Only this area must be insulated to avoid most cases of water damage.



Source: K1 Technologies, "What Does A Harmonic Balancer Do?", accessed on 10/11/2023, link: <https://k1technologies.com/k1-blog/what-does-a-harmonic-balancer-do/>.

Source: Tennessee Tech University, "CONTROL SCHEME AND CONTROLLER DESIGN FOR INDUCTION MOTOR DRIVES", accessed on 09/11/2023, link: <https://tntech.edu/engineering/pdf/cesr/ojo/asuri/Chapter5.pdf>.

Source: TELCO, "What Is An Electric Motor?", accessed on 11/11/2023, link: <https://telcointercon.com/blog/electric-motors-explained-ac-dc-and-universal/>.

Source: Elliot Sound Products, "Yellow Glue - The Enemy Of Electronics", accessed on 05/11/2023, link: <https://sound-au.com/articles/yellow-glue.htm>.

BILL OF MATERIALS

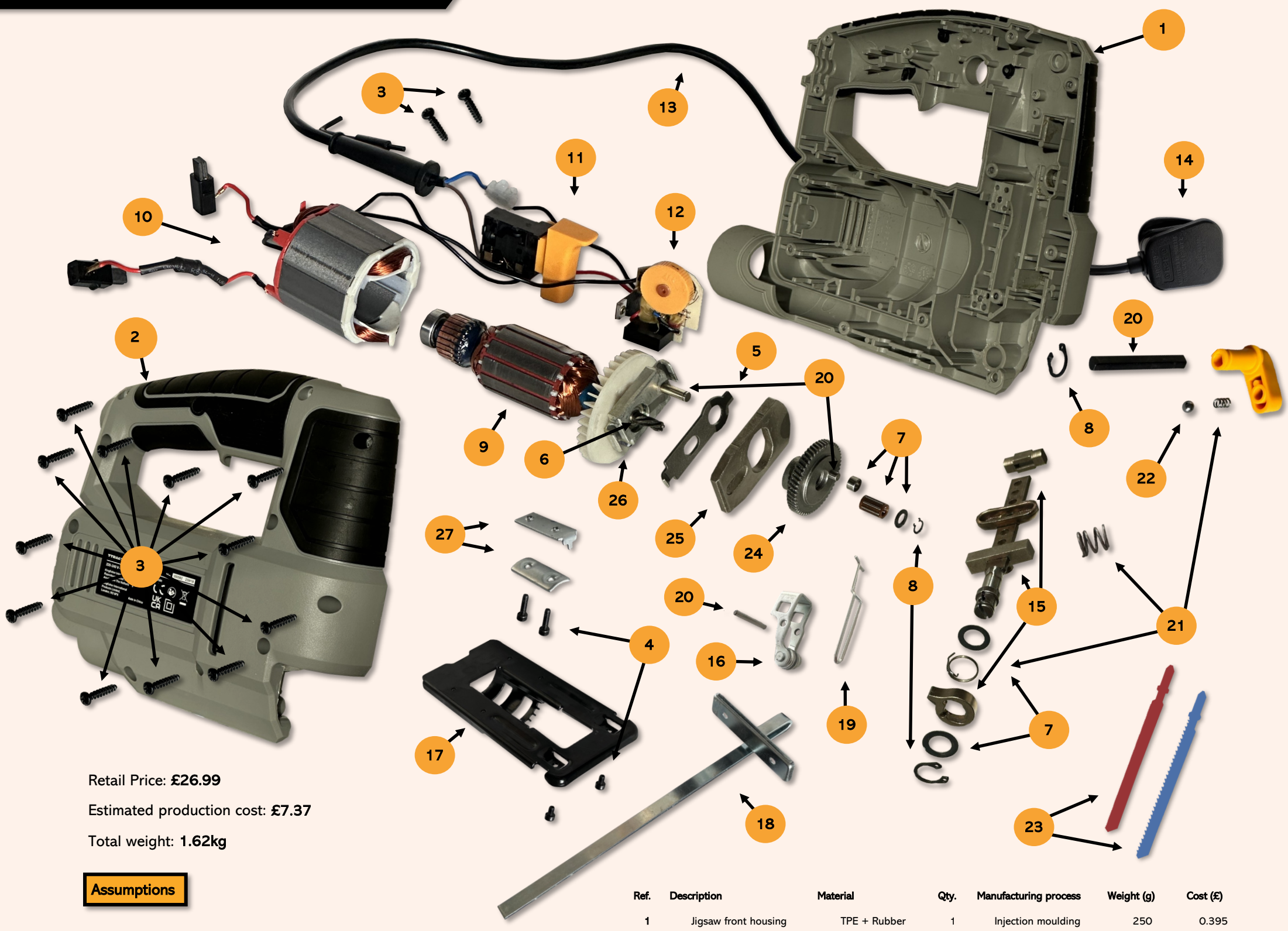
WITH COSTING ACCOUNTED FOR

Overview

This page consists of a BOM with full costing accounted for in order to estimate the production cost of this jigsaw.

~45 minutes to assemble by hand

Exploded view



Retail Price: **£26.99**

Estimated production cost: **£7.37**

Total weight: **1.62kg**

Assumptions

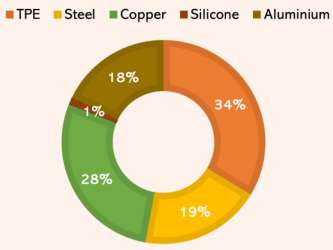
- Labels and online resources used to determine materials
- Analysis of density, surface colour and corrugations for some materials.
- Prices taken from Alibaba.com and made-in-china.com.
- Aluminium and steel differentiated through magnet test.
- Engineering and marketing costs are minimal.

Kingfisher sell this exact same model in B&Q in white and blue TPE as a "Mac Allister" jigsaw. This hides the fact that identical production lines distribution networks make the same product as "Titan" in Screwfix, leveraging the compromise effect and the decoy effect. Jigsaws are likely not overproduced greatly.

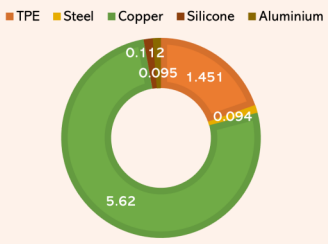
Jigsaws have a 0.6265% market share in the DIY market. As Kingfisher have a 2.1% market share of the global home improvement market, it can be assumed that a profit of USD 113.5 million is generated yearly via jigsaw sales.

With an estimated delivery fee of £0.13/unit, the profit margin per jigsaw can be estimated as £19.49 per unit. That would mean Kingfisher make 4.6 million units a year. This would be across all brands they own.

WEIGHT PER MATERIAL



COST PER MATERIAL (£)



Ref.	Description	Material	Qty.	Manufacturing process	Weight (g)	Cost (£)
1	Jigsaw front housing	TPE + Rubber	1	Injection moulding	250	0.395
2	Jigsaw back housing	TPE + Rubber	1	Injection moulding	225	0.356
3	Phillips head screws	Steel	12	Casting	12	0.012
4	Hex screws	Steel	4	Casting	2	0.002
5	Counterweight plate	Steel	1	Casting + Case-hardening	10	0.003
6	Ball bearing	Steel	1	Casting	1	0.020
7	Circular washers	Steel	5	Casting	2	0.002
8	Circlips	Carbon spring steel	3	Casting + Hardening	1	0.003
9	Universal motor rotor	Copper + Aluminium + TPE	1	Complex machining	270	2.820
10	Universal motor stator	Copper + Aluminium + TPE + Carbon	1	Complex machining	280	1.930
11	Switch with button	TPE + Brass	1	Injection moulding	20	0.240
12	PCB	Silicone + TPE + Solder + Brass	1	Printing and etching	20	0.112
13	3m power cord	Plastic + Copper	1	Injection moulding	100	0.870
14	Plug	Plastic + Copper	1	Injection moulding	50	0.460
15	Reciprocating motion shaft	Steel	1	Machining + Hardening	50	0.016
16	Blade guide	Aluminium	1	Casting	20	0.006
17	Base plate	Aluminium	1	Casting	190	0.063
18	Parallel guide scale	Aluminium	1	Casting	60	0.020
19	Blade guard	Aluminium	1	Casting	3	0.001
20	Prism shafts	Steel	2	Machining + Hardening	2	0.002
21	Springs	Carbon spring steel	3	Casting + Hardening	3	0.010
22	Ball	Steel	1	Casting	1	0.001
23	Saw blade	High-speed steel	2	Casting + Hardening	14	0.005
24	Reduction drive	Steel	1	Machining + Hardening	20	0.010
25	Counterweight	Steel	1	Casting + Hardening	20	0.006
26	Anchor piece	Aluminium	1	Casting	15	0.005
27	Rectangular washers	Steel	2	Casting	2	0.002

Source: B&Q, "Mac Allister 600W 220-240V Corded Jigsaw 2815", accessed on 09/12/2023, link: <https://www.diy.com/departments/mac-allister-600w-220-240v-corded-jigsaw-2815/5059340252148_BQ.prd>.

Source: Data Intelo, "Global Jig Saws Market", accessed on 09/12/2023, link: <https://dataintelo.com/report/jig-saws-market/>.

Source: Statista, "Leading home improvement retail companies worldwide in 2021, by sales ", accessed on 09/12/2023, link: <https://www.statista.com/statistics/257965/sales-of-the-leading-home-improvement-retail-companies-worldwide/>.

Source: Statista, "Home Improvement", accessed on 09/12/2023, link: <https://www.statista.com/markets/415/topic/462/home-improvement/#overview>.

DEEP DIVE - GEARS

HOW IS THE GEARING SYSTEM MANUFACTURED

Materials Used

The exact steel alloy used is not declared, however it is highly likely that a carbon-steel alloy was used.

This is because this steel variant is easy to machine, has good resistance against wear, is readily available worldwide at a low cost and has hardening capabilities due to having an above 0.06% carbon content.

Unlike the jigsaw blade, which is likely made from HSS with a Rockwell hardness rating of 60, these gears do not need to go above a rating of 55.

Machining Techniques

Fluting along a lathe would be incorporated for the smaller, drill-like gear.

The larger gear will have also been machined on a lathe, having smaller disks incrementally removed for the design and a drill passed through the middle.

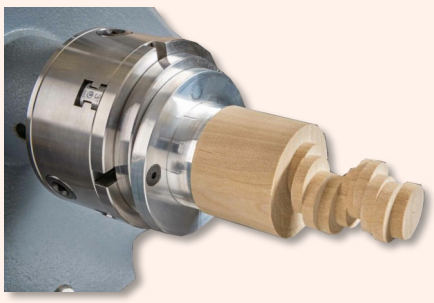
Each tooth will have been machined with lateral cuts on the lathe with precisely angled turns.

One disk on the back of the gear is offset from the centreline. An eccentric chuck was likely used to machine this.

This process was likely a mixture of automation with manual labour, depending on the cost of labour and scale of production.

Shown above is the gear directly connected to the motor.

Shown below is an eccentric chuck along with multiple off-centre discs.



Hardening Techniques

The through-hardening technique is a commonly used method to increase the hardness of carbon-steel alloys, wherein the gears would be heated to above 460°C (glowing red) and subsequently quenched in water or oil. This method requires higher grade carbon-steel alloys to be effective, therefore is unlikely to be used on a budget build

It is very likely that these gears underwent case-hardening instead, also known as carburisation, as a cheaper means to increase durability. This process requires encasing each gear in a carbon-rich surface layer and heated to above 700°C for up to 12 hours. This causes the outer layers of steel to have equivalent carbon concentrations to that of more expensive steels. After undergoing quenching in water, the final product may have a Rockwell hardness rating of over 60 on the surface and at the gear's teeth, while retaining a more malleable core.

Improvements

Choosing to manufacture these pieces with more expensive tool steels that can undergo through-hardening would make these gears stronger, therefore less likely to wear or break over times under highly intense loads.

This is what a dissection of a case-hardened gear looks like. The hardened metal is a lighter colour to the softer steel beneath. Ideally all would be hard.

Cost

This product is manufactured using the cheapest materials and manufacturing techniques that yield safe, reliable results. The product warranty lasts for 2 years, therefore technical improvements which increase costs are unlikely to be profitable.

DEEP DIVE - CASING

LOOKING INTO ALL THE ASPECTS OF CASING MANUFACTURE

The casing has been manufactured via thermoplastic elastomer injection moulding. This process consists of TPE pellets mixed with grey colorants being dropped into a hot barrel. A screw churns, compresses and pushes the TPE into a custom mould. After a few minutes of water cooling, the mould opens and ejects the finished piece with ejector pins.

Gussets and ribs

4 areas (in red) have gussets introduced for greater structural rigidity, and 3 areas (in blue) employ parallel ribs instead due to components such as screws, cords and shafts vertically passing through, limiting thickness.

Bosses

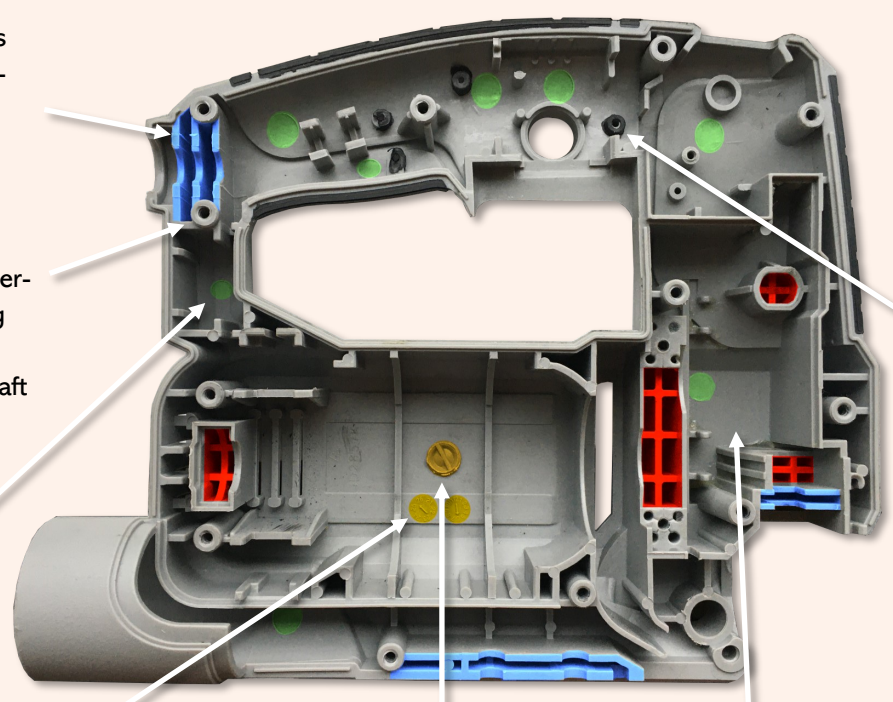
Present in the front housing with an internal thread for screws. The back housing has wider pillars to accommodate the screw head. All bosses have a minor draft angle.

Ejector pin witness marks

Highlighted in green are all the marks that evidence the locations where the ejector pins used in the mould pushed the finished casing out of the system.

Information inside

The date wheels can be seen, indicating the month and year of production. Interestingly, both pieces are dated as having been created in 2024 and 2025 respectively. This is likely an error.



Custom individual mould

No visible gate witness marks and no clear sprue mark indicates that each piece is likely manufactured with a hot runner gate, as they have reduced material waste, greater control over the injection process and faster cycle times.

Smooth surface

The internal plastic is smooth to the touch. This indicates that a high quality mould was used with an appropriate draft angle that has been adequately maintained,

Miniscule crenulations are evidence of the machining process used to create the mould, likely using a CNC mill.

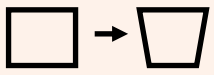
Parting lines

The parting line is hidden well by being at the edge border between the outside and the inside of the casing.

It is only clearly revealed at the cylindrical exhaust pipe on the front housing. The smooth inside reveals that a horizontally moving ejecting system using a pipe has been used for this section.

Attachment points

Shown are areas where rubber was inserted into the TPE piece in order to prevent the over mould from slipping off.



Area for improvement

The casing has no right angles on the exterior side, using draft angles and soft corners.

A flaw in this system is the lack of draft angles inside the casing. When the TPE is ejected from the bottom of the mould, if the piece has not cooled enough, the various parallel walls would collapse inwards due to a vacuum forming.

By making the mould slightly trapezoidal inside rather than rectangular, the TPE could be ejected at a higher temperature.

This would result in more casing produced per minute.

Source: Kuraray Elastomer, "What is TPE?", accessed on 11/12/2023, link: <https://www.elastomer.kuraray.com/blog/what-is-tpe/>.

Source: Axminster Tools, "ECCENTRIC WOODTURNING | OFFSET COASTERS PROJECT", accessed on 10/12/2023, link: <https://www.axminstertools.com/ideas-advice/eccentric-woodturning-offset-coasters-project/>.

Source: Star Rapid, "Design for Manufacturing Optimization Best Practices", accessed on 11/12/2023, link: <https://www.starrapid.com/services/design-for-manufacturing/>.

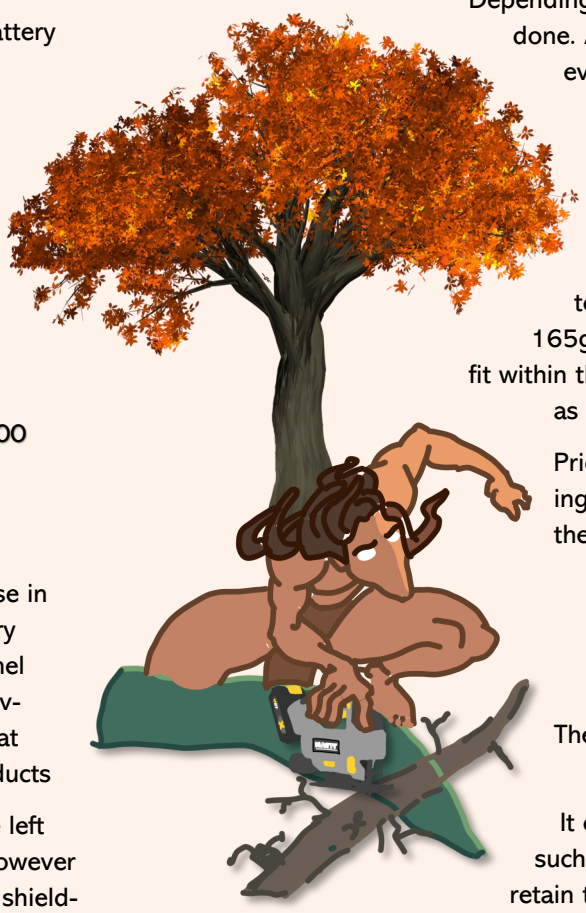
Source: Gear Solutions, "Finding the ideal materials for gears", accessed on 10/12/2023, link: <https://gearsolutions.com/features/finding-the-ideal-materials-for-gears/>.

SOLAR POWERED BATTERY

AVOIDING THE MAINS ENTIRELY

This idea consists of allowing the jigsaw to have battery charging, enabling the use of the jigsaw outdoors and away from a power supply, along with a large solar panel that is able to charge the battery.

This would enable customers to leave their battery outside, underneath the solar panel to charge for hours, making the jigsaw powered entirely from free renewable energy.

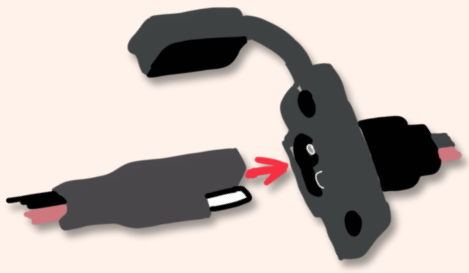


Challenges

×4,600,000

Primary issue would be a large proportional increase in cost. Not only does the jigsaw now require a battery and standard battery charging port, but a solar panel in the package too. This cost can be reduced by having a standardised design of battery/solar panel that can be used across Kingfisher's large range of products

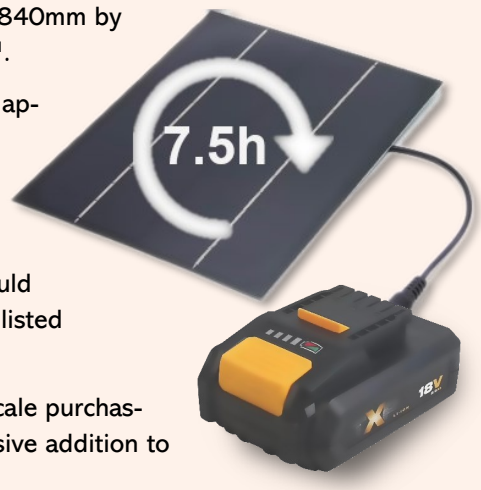
Another issue is water damage to the battery while left outdoors to charge. Solar panels are waterproof, however the cables connecting them to the battery must be shielded to avoid damage.



Technical Requirements

The battery from the TITAN TTI866JSW cordless jigsaw is an 18V 2Ah Li-Ion battery, therefore 36Wh must be generated to recharge it.

Depending on the time frame, different size solar panels could get the job done. A 36W rated panel would only take an hour, however these are almost a metre long (840mm by 420mm) and costly (around £40)[1].



An 18V 5W solar panel is more appropriate, size-wise and cost-wise. It would take under 7.5hrs to charge the battery to completion, weighing only 165g. Being 170mm by 220mm, it would fit within the jigsaw packaging (the jigsaw is listed as 285mm in length).

Priced at £11.84 on eBay for large scale purchasing, it would not be an unduly expensive addition to the product[2].

Additional benefits

The tool could be used in survival situations or camping, where individuals may have no access to electricity at all. This makes the tool more versatile.

It could also be now used to cut down invasive brambles and tree species, such as was required in the Ruxley Gravel Pits Nature Reserve team in order to retain the area as a biological Site of Special Scientific Interest[3].

Simple devices such as saws require a lots of time and energy from volunteers, a sustainable rechargeable jigsaw would vastly speed up conservation efforts.

BIODEGRADABLE PLASTICS

AND USING RECYCLED CARDBOARD AND PAPER

This idea consists of using PLA HR-870 (polylactic acid) instead of TPE (thermoplastic elastomers) to manufacture the jigsaw casing due to its production from renewable sources like sugar cane and its degradation in a few days to a few months. TPE is not sustainable or biodegradable, only recycled[4].

Reasons to use PLA HR-870

Originally, the idea was going to be using PLA 4043D due to the low cost but it is not reliable for engineering tools[7]. It is unsafe to use at 130°C, however PLA HR-870 has a heat deflection temperature of 144°C, above the jigsaw internal operating temperatures[8]. This imitates TPE more closely, which can have HDTs of up to 150°C.

HR-870 is also less brittle than 4043D, giving the plastic room to bend if the jigsaw is under high torsion or tension. This is pivotal, preventing a dangerous snap.

Recycled cardboard

The packaging already makes a big deal about the fact that the cardboard, evidenced by the 20 PAP symbol, can be recycled, evidenced by the "Widely Recycled" symbol too.

Kingfisher have pledged to have 100% sustainably sourced paper and cardboard, preventing habitat loss for ecosystems[5].

Nothing evidences that the box is made from recycled cardboard, which would actually lower amount of trees felled. Kingfisher would use the mobius loop with a percentage, ideally as close to 100% as possible, to signify this.

Manual inside

The manual could be made from recycled paper as well. This would also reduce the quantity of trees felled, increasing the global rate of CO2 reduction due to the photosynthesis process.

Unfortunately, recycled paper does not retain ink well, warps more easily under humid conditions and has a 100 to 1000x higher concentration of bacteria[6].

Advantages

Advantages of using PLA over TPE:

1. Reduced CO2 emissions during production of raw material.
2. Less energy consumed in the manufacturing process.
3. Less landfill area needed due to ability to decompose.
4. Sourced from renewable resources.
5. Low toxicity, less damage to wildlife.
6. Cheaper per kg than TPE.
7. Takes to new shapes easily.

Disadvantages

Disadvantages of using PLA over TPE:

1. Brittleness, even in HR-870, will reduce durability in cold temperatures.
2. Lower resistance to high temperatures than TPE. In extreme cases, it can melt inside of hot cars.
3. Sensitivity to moisture would make the jigsaw less reliable outdoors.
4. May require more research and development to implement, increasing costs and reducing recyclability.
5. Expensive equipment is required to make PLA decompose rapidly. It cannot be left in nature as it takes 80 years to decompose at 20 °C.

1: Amazon, "36W Solar Panel System Set", accessed on 03/01/2024, link: <https://www.amazon.co.uk/Inverter-Battery-Cigarette-Controller-Alligator/dp/B0BW88ZNZN>.

2: eBay, "18V 5W Epoxy Solar Panel", accessed on 03/01/2024, link: <https://www.ebay.co.uk/itm/116002074879>.

3: Bexley Wildlife, "Ruxley Gravel Pits Nature Reserve Team", accessed on 04/01/2024, link: <https://www.bexleywildlife.org/ruxley-gravel-pits-nature-reserve-team/>.

4: Arabella Ruiz, "Is TPE Eco-Friendly?", accessed on 09/01/2024, link: <https://theroundup.org/is-tpe-eco-friendly/>.

5: Kingfisher, "Sustainable Packaging Policy Guidelines", accessed on 07/01/2024, link: <http://www.kingfisher.com/PackagingGuidelines>.

6: Papernet, "VIRGIN VS RECYCLED PAPER", accessed on 07/01/2024, link: <https://www.papernet.com/americas/en/virgin-vs-recycled-paper>.

7: NatureWorks LLC, "Ingeo™ 4043D", accessed on 10/01/2024, link: <https://www.eumakers.com/pub/media/technical_sheets/EUMAKERS_TDS_PLA_Polymer_DataSheet.pdf>.

8: Sakata 3D, "PLA HR-870 Technical Data Sheet", accessed on 10/01/2024, link: <https://www.sakata3d.com/descargables/TDS-HR-870.pdf>.