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Deconstruction and Material/Process Analysis of Existing Product

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Tamiya TT-01 Deconstruction and Analysis

Introduction & History

The unique hobbyist sector of the remote control car market first emerged in the 1960's, specifically 1966. The first R/C cars were 'Nitros', powered by small one or two-cylinder engines that ran on nitromethane, methanol and castor oil. Tamiya were among the first manufacturers that employed the use of brushed electric motors in place of 'Nitro' engines. This allowed a much wider audience to enjoy the hobby due to the relative simplicity of the electric cars compared to 'Nitro' kits (RC Roundup). The Tamiya TT-01 is a 1:10 scale hobbyist remote controlled car, powered by an electric motor, first released in 2003. It is available with a multitude of body shells and wheels however; the chassis of the base kits remains unchanged (Ultimate Tamiya). It uses the same ABS (Acrylonitrile Butadiene Styrene) plastic injection moulded construction that the classic 'The Hornet' buggy kit (1984) laid down as the new standard (Tamiya). The TT-01 is highly popular, striking the balance between cost, simplicity and accessibility that allows consumers to purchase it as an entry into the hobby.

Product Type

This product is an enthusiast grade remote controlled touring car chassis. It is available in both kit and pre-assembled forms ('XB' or 'Expert Built'), each using the same parts and materials. The TT-01 was one of the earliest affordable, mass produced options in the sector that was widely adopted and became the standard chassis for R/C touring car racing and is still widely used to this day (Ultimate Tamiya). Whilst an affordable option for its portion of the sector, it is very expensive in comparison to more basic children's R/C cars (around £170 for a kit complete with motor and shell, compared to around £20-30 for a basic toy R/C car) (Hill, 2018).

Materials & Production Methods

- Body shell – Polycarbonate (Vacuum formed, hand painted)
- Wheels & gears – Nylon (injection moulded)
- Tyres – Rubber (Injected moulded)
- Chassis & running gear – ABS (Injection moulded)
- Suspension springs – Steel (CNC & Heat Treated)
- Axle rods, fixings & motor housing – Aluminium (CNC)
- Motor coils – Copper (Machine Spun)
- Motor Brushes – Iron (Cast)

The outer body is a vacuum formed polycarbonate shell. It is created by heating a thin sheet of polycarbonate and pushing it over a positive of the model that is going to be created. A vacuum is then applied to the area between the sheet and the mould and allows for the creation of smaller details as the polycarbonate is pulled on to the mould (Klein, 2009). The shell is then hand painted on the inside face and finished with pre-cut vinyl decals. These last two steps are either completed before sale by the manufacturer or after sale by the customer depending on the version of the kit (XB or standard) (Ultimate Tamiya).

The wheels and drive gears are produced using nylon. They are mass (or batch) produced using injection mould tools. The injection moulding process is used to mass and batch manufacture complex plastic products; it requires a large, expensive metal (usually steel) mould tool. The tool has a cavity that is the negative image of the product that is going to be produced. This negative is

split over the two halves of the tool so that the product can be extracted once the process is complete. The result is that the product will have a split line on its surface. However, intelligent design and engineering can allow this to be on a section of the part that will not be visible on the final product if the fit and finish is required to be of a very high standard. The cavity is injected with hot plastic at a high pressure, filling the cavity in the mould tool and creating the desired product/part. The tool and part cool for a few seconds, then the metal tool separates and ejects the final product (Goodship, 2004).

The method by which the suspension springs are made is significantly more complex. The machinery employed uses a CNC lathe as the basis of its operation. It comprises of several parts: a set of wire guides, feed rollers, a cutter, a pitch tool and coiling points. The wire guides and feed rollers force the material toward the coiling points. These interrupt the straight path of the material and as a result shape and form the coil of the spring, creating a constant curve. Whilst the coiling points curve the material, the pitch tool controls the frequency and spacing of the coils by disrupting the movement of the material. Finally, once the spring is the correct length, the cutter slices the material and the spring is dropped into a hopper from where it is sent to be heat treated. This process ensures a functional compression spring with shape memory so that it does not compress without elastic force returning it to its original state. The stiffness of the spring is controlled by the temperature of the heat treatment (Acxes Spring).

Finally, the method by which the motor housing and driveshaft pins are made is CNC (computer numerical control). This technology uses a router or a lathe, depending on the end product, which is controlled by a computer. The computer uses CAD (computer aided design) data in order to operate the equipment to produce the desired product. (Hess, 2009) The motor housing for the TT-01 would be CNC routed and then bent to shape around the completed motor internal assembly, protecting the user from injury and the motor from damage.

Technology Development

Since the TT-01s release in 2003, there have been a number of developments made to the platform. The first of these was the option to add aluminium parts in order to add strength and rigidity to improve handling and durability, followed by a simplified version of the chassis completely constructed from aluminium Whilst being vastly more expensive, the weight was similar, and the structural integrity was improved dramatically. More recently, a carbon fibre version of the chassis has been offered with the running gear parts being constructed from aluminium (3 Racing Parts). This is considered the ultimate version of the product as it uses materials from real super cars and motorsport vehicles to create a product far superior to the original (albeit more expensive).

Summary

The Tamiya TT-01 components use a variety of materials and mass production processes in its construction, from CNC aluminium to injection moulded ABS. Combined, these ensure that it is affordably priced within its specific category, produced economically and quickly and is sturdy and reliable. However, there are more advanced versions with higher performance available, catering for all budgets.

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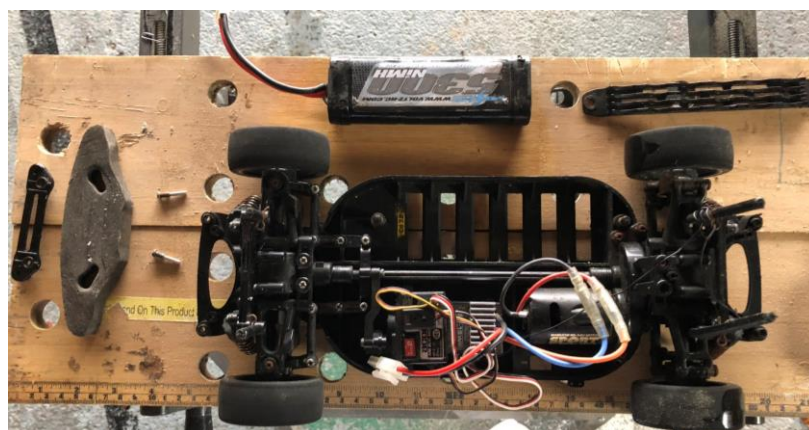
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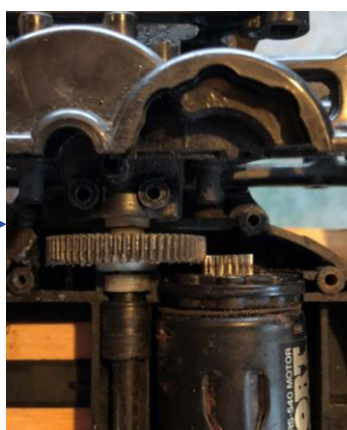
Tamiya TT-01



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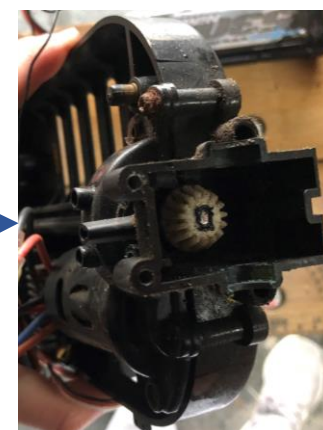
The main construction of the body is ABS. Almost all parts are made completely or partially from injection moulded ABS. The front bash bar is one of the few parts that is not solid plastic or metal; it is polystyrene. The battery is covered with a durable plastic wrapping and is held in place by steel pins and an ABS support strut.



The ABS chassis has a moulded protected cover for the nylon driveshaft cogs. The upper half of the ABS cover is fastened to the chassis with steel screws in four points.



The brushed motor has a aluminium casing containing the iron brushes and copper coils. It is fixed with screws to an ABS plastic mount that secures it to the chassis. A steel cog is fixed to the end of the motors output shaft that turns the nylon cog that splits the power to the front and rear differentials.



On the chassis half of the differential, there is another nylon cog that turns the larger cog which is attached to the rubber and aluminium driveshafts.



The nylon differentials output the drive from the motor to plastic and aluminium hubs, between which are rubberised plastic driveshafts with aluminium rods to secure them within the hubs. The front outer hubs are made of several components – ABS hub, ABS wheel securing nut, ABS and aluminium drive hub, two nylon washers and an aluminium pin.