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Re-design Component

I have chosen the Scooter X Sport Go-Kart frame as the part that I would like to change.



Fig 1. Scooter X Sport Go-Kart

The Go-Kart is in question (shown above in figure 1) is a popular choice aimed at children in America and sold on Amazon. It's built by the company Scooter X and it is described as their *"best and fastest go kart"* - (Scooterx.biz, n.d.). The frame used is built specifically for the use of the go-kart. The purpose of it is to be a solid base to mount other components on to, such as the wheels, seat and of course the engine. The frame of the go-kart is actually a large performance factor as the stiffness created from the construction can affect the responsiveness of the kart. This go-kart frame has been designed for on road or light off road purposes as unlike many go-karts this has mounting points for suspension which add comfort and greater performance over uneven ground.

I have now made some changes to the design of the go-kart frame to make it suitable to be used as the frame for a light mars exploration buggy. The frame will need to become more rigid and durable as that will be a critical to make sure it will last once it is over 30 million miles away and beyond more than minor repair. However, I have still had to keep in mind to keep the overall weight down to make it easier to transport to Mars. The frame will have a

windscreen and side bars to help enclose the user for safety and also be made with greater clearance under the frame to make it more ideal to use over rougher rocky terrain. I have also thought about how the vehicle will be powered once it's on Mars. I have designed the frame with plating to mount accessories to, such as solar panels which could be mounted to the roof to provide electrical power to the motors that power the wheels. Electrical motors will have to be used instead of the original combustion engine as there will not be enough oxygen to allow the fuel to burn.

Part	Material	Construction
Frame	Titanium	Titanium tubes pressure bent into shape. Saddle joined and TIG welded together.
Front Windscreen	Polycarbonate	Cut to size then fixed in place with the use of epoxy resin.

To make the new design of the go-kart frame suitable for being used as a light Mars exploration buggy the material will need to be changed from the light tubular steel that is currently being used to a more advanced material. Steel would not be a great choice to continue using for this purpose as it is heavy and to transport a large steel frame to Mars in a rocket will cause a lot more fuel to be consumed. I have decided to use Titanium for the frame of the buggy. Titanium has many diverse applications due to this elements properties.

“One of the most notable advantages of titanium is its strength. It’s among the strongest and most durable metals on the planet, which is why it’s used in so many industrial applications.”

- (Monroe, 2016)

The strength factor will help to make the frame much more sturdy and reliable in the rougher conditions on Mars. This paired with the fact that it is lighter than most other choices means that when the buggy is in use, it will prolong the fuel life.

“Another key advantage associated with titanium is its natural resistance to rust and corrosion. When metal is exposed to moisture, it triggers a chemical process known as oxidation, which can subsequently lead to corrosion” - (Monroe, 2016)

The corrosion resistance could also benefit the buggy as it will resist to wear from the elements on Mars as there is moisture in the atmosphere, there is also water on Mars, however it mostly exists as ice.

For the manufacturing of the frame, a common strategy is to use stainless steel pipework to make an original design. This design can then be tested beforehand and then used to create a jig to make sure that when the actual frame is made, it will follow an exact route that has already been created and tested prior to using the more expensive material, titanium. The titanium will be pressure bent using a hydraulic bending machine to fit to the jig. Once the pieces of the framework fit the jig individually, the ends can then be saddle cut to make a perfect fit.

“Any gap between the two parts to be welded can result in contamination of the weld by the air environment from the underside of the weld.” (Fulcer, 2009)

Once the ends of the titanium fit together perfectly, they can be TIG welded. TIG welding is an advanced manual skill. TIG welding stands for ‘Tungsten Inert Gas Welding. It relies on three things to work: Heat, Shielding and a filler to help join the two melting pieces together.

“The heat is produced by electricity passing through the tungsten electrode by creating an arc to the metal. The shielding comes from a compressed bottle of gas that flows to the weld area to protect it from air. The filler metal is just a wire that is dipped by hand into the arc and melted.” - (GoWelding.Org, n.d.)

Once the frame structure is complete, the windscreen can be added. The windscreen is a large singular piece of polycarbonate. The reason polycarbonate was chosen is because of its many advantages.

“Polycarbonate polymers are used to produce a variety of materials and are particularly useful when impact resistance and/or transparency are a product requirement (e.g. in bullet-proof glass).” - (Rogers, 2015)

Polycarbonate is a thermoplastic so it can be moulded to the right shape. They also have very good heat resistance and a natural UV filter. The only disadvantage of using polycarbonate is that it doesn't have very good scratch resistance. To prevent the screen from being scratched it will have a protective scratch resistant layer applied. Once the windscreen is made it can be glued to the frame with an epoxy resin adhesive.

Once the whole frame structure is complete it can then have the plating added around the frame to add to the safety of the buggy, preventing the user being directly exposed to the elements of Mars with its baron nature and dust storms. The plating can also be used to mount the other components and accessories onto, such as: Solar panels to power the electric motors, lights so the buggy can be operated in the dark and dusty conditions and the other onboard equipment needed.

Overall this product should now be much more capable for being used as a light Mars scout buggy. The frame has been improved drastically to be able to cope with the much harsher environment through the use of advanced materials such as titanium and polycarbonate to make sure it is much more durable. The materials chosen are also very light so even though the frame is significantly larger than the original, it should not be much heavier. This means that the rocket transportation to Mars will not need to use as much fuel to carry the extra load.

As this new product of a 'light Mars buggy' is not mass produced in any way this would make the manufacturing of the single frame expensive. The process of making a jig to TIG weld a one off titanium frame to be used for a Mars Buggy will never be cheap, but once the first has been made, many more will be able to be manufactured for much less as the jig will be able to be reused to manufacture every new frame needed. Polycarbonate also has a very high price, but it is a necessary material to use to protect the user of the buggy.

As the frame is manufactured to be used as a Mars buggy, it will only be used by a few companies or agencies. These companies will not have to worry much about justifying the

cost of the manufacturing and production of this one off buggy as it is performance driven and not cost driven. However, in the future if people move to other planets to inhabit them, a vehicle like this may be put into a larger scale of production, thus bringing the cost of manufacture down.

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Product Function Analysis

Component: Scooter X Sport Go-Kart Frame

This go kart is an expensive kids toy, it's purpose is for fun and travel over flat and minor off road terrain.



Bill of Materitals

Component: Go-Kart Frame

Materials: Thin Tubular Steel

Construction Method: Pressure bent steel, welded together.

Finish: Whole frame painted black.

Old

vs

New

Bellow is a list of points showing whats been changed.

- Frame structure is made out of titanium as it is lighter and more durable.
- A front windscreen made of polycarbonate and side bars for increased safety.
- Additional framework overhead for protection and to mount equipment.
- Frame now has plating to shelter user from under and above.
- More clearence under frame to benefit off-road ability.

Frame is now significantly wider at the rear for better stability.

- Frame is now large to accomodate user with their personal equipment.

