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Introduction to automotive
Engineering

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Chapter 1

1.0 – Introduction:

In this technical report it will cover multiple topics based on automotive vehicle manufacturing, design and development. The vehicle that has been chosen to base and showcase these topics on is the 'McLaren P1' supercar. This technical report will explain the in depth process of the design and aerodynamics of the car and the manufacturing of the vehicle. It will also talk about the emissions of the vehicle and the hybrid system it has in the vehicle. The impacts of these topics has on the vehicle and the manufacturing of the vehicle will also be discussed. The technical report will also touch on how environmentally friendly this vehicle is and any environmental concerns this particular vehicle will raise, and if it is suitable to be used in the current environment. Appropriate referencing will also be used to back up information used in this technical report and there will be a conclusion that will summarise the topics discussed within the report.



Figure 1 :

Showcasing the McLaren P1

(*McLaren P1 Review 2023 (2021) Top Gear*. Available at: <https://www.topgear.com/car-reviews/mclaren/p1> (Accessed: March 28, 2023).

Chapter 2

2.1 – Design process:

The design process of the McLaren P1 is just like any other car. The process sourcing from the design team within the company. It all starts from sketches from highly skilled and dedicated designers. They will sketch a rough initial design of the vehicle based on the ideas that have been demanded. These initial sketches will consider the exterior design and the interior design of the car. Once an appropriate sketch has been completed, the sketch will then be used for the foundations to make a 3D model of the vehicle. This 3D model will be made by using CAD (computer aided design) software. This 3D model once produced initially, will then go through many revisions and improvisations to maybe compensate and take into consideration for other factors that the design will need to work around, such as weather, aerodynamics, safety and the fuel efficiency of the vehicle. Using the CAD model stress tests can also be undergone using the software. These revisions and improvisations will be done until the 3D model of the vehicle is absolutely perfect. After this process the vehicle will then start its fabrication process at the stamping plant followed by the body shop where the assembly will start. The McLaren P1 specifically has been designed in a sleek modernised way. A quote from McLaren design director gives some insight and perfectly describes what the design of the P1 is all about, *“My role as a designer was to make it look dramatic and beautiful. I wanted it to look like a purposeful racer”*.

2.2 – Aerodynamics:

Aerodynamics is a huge part when it comes to making a supercar. Aerodynamics, which in this instance, is the focus of how air reacts and flows around a vehicle. The McLaren P1 has been very aerodynamic driven as can be seen just by the look of the car alone. In order to understand the aerodynamics of the car there can be multiple steps taken. The first step works in unison with the CAD modelling of the vehicle. By taking the 3D CAD model and implementing it into CFD (computational fluid dynamics) software. The CFD software will give initial understandings of how air flows over the vehicle using simulations, this will also help influence the CAD design phase of the vehicle. On the McLaren P1 it features active aero. Active aero is when a set of mechanical motorised parts activate to provide the performance when necessary. Because of this active aero of front wings and rear wings, when in ‘race mode’ it can produce up to 600KG of downforce. The car also features ‘Formula 1’ style DRS (Drag Reduction System), it does this by moving the wing angle to zero degrees, because of this it can reduce drag by 23%.



Figure 2 – showcasing the aerodynamics of the McLaren P1

Car news - latest auto news, first looks and first drives (no date) Edmunds. Available at: <https://www.edmunds.com/car-news/> (Accessed: March 29, 2023).

2.3 – Hybrid systems:

As is the case with a lot of cars in the modern era, particularly with modern age supercars hybrid systems are more commonly used. The McLaren P1 features a 3.8L V8 twin turbo with a single electric motor. The hybrid system on the McLaren P1 works in tandem with the 3.8L turbocharged V8 to produce what is a combined 903BHP. The hybrid system is used mainly for the low end speed of the vehicle, this is to maximise the overall performance of the car as it means the battery will provide the initial power on acceleration, whilst the engine can reach its optimal performance window. This allows for peak overall performance of the vehicle. The hybrid system on the McLaren P1 itself provides 120kW of power output to partner the V8 engine. Hybrid systems also can allow for better emissions, which pushes the drive for less pollution and to minimise the carbon footprint in future. The hybrid system can be compared to its complete race version, the McLaren P1 GTR, where the hybrid system is used more as a KERS (kinetic energy recovery system) deployment system. This is used to act as boost to improve performance even more than its counterpart.

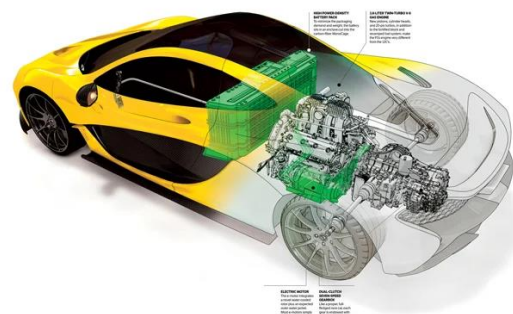


Figure 3 – showcasing the P1s battery

All McLaren road cars to be electrified within 10 years (no date). Available at: <https://www.autoguide.com/auto->

2.4 – Emissions:

When in the automotive industry., specifically that of the internal combustion engine (ICE) manufacturing, there is going to be emissions produced as a result of the combustion process in the engine. Emissions from cars include gases such as, Carbon dioxide (CO₂), Carbon Monoxide(CO), Nitrogen oxides (NO_x), Sulfur dioxide (Sox), hydrocarbons (HC), Benzene (C₆H₆) and particular matter. These emissions that are produced into the atmosphere all are harmful towards the earth's atmosphere. Therefore as a result of these emissions there has always been developments within the industry to lower them as the world has become more aware of climate change and its causes. With this there has been multiple regulations that have been introduced in an attempt to lower these, some successful such as the 'ultralow emission zone' (ULEZ) that is in place around select major UK cities, some not so successful, such as the diesel and petrol emissions cycle tests, that was supposedly supposed to simulate the average journey and gather the emissions results, but the issue with this was that it had been criticised for being too inaccurate as it did not perfectly simulate what was considered to be an average journey. An example of manufacturers trying to be more fuel efficient and better on emissions is 'stop start technology'. Because of the drive to push for lower or even zero emissions the government in the UK has decided to act upon that by pushing towards a more electric future by banning the sale of new internal combustion engine cars (ICE) in the year 2030, this is in the bid to fight against climate change. Due to this reason many car companies are heading towards the route of manufacturing hybrid and or electric cars. McLaren as previously mentioned, do this with the P1. McLarens hybrid system that has been previously referred to in section 2.3, doubles up for performance and for better emissions and efficiency. The battery in the McLarens hybrid system being inspired by the technology used in formula 1 definitely helps towards the fuel efficiency in terms of emissions. The McLaren P1 is an efficient and low in emissions in terms for a supercar. The P1 produces around 194g/km of carbon dioxide emissions, compare this to the direct competition of the Ferrari LaFerrari that produces around 340g/km CO₂ emissions, with what is essentially very similar engine philosophies. A feature on the McLaren P1 means it can run fully in electric mode that can see these emissions drop to complete zero.

2.5 – Materials and Manufacturing:

Within the motor vehicle industry the manufacturing process is one of the most important parts of car development and production. One of the most important parts within this manufacturing process is the materials that get used on the car. The materials that are used can make a serious impact on the performance of the car in, terms of weight and more vitally the structural integrity of the vehicle. In terms of the McLaren P1 for example, as it's a supercar, there should ideally be a balance of performance with the weight of the car, meaning light materials, whilst remaining as structurally sound as possible. On the McLaren P1 uses lightweight steel and a lot of carbon fibre. The use of the carbon fibre on the car is a perfect of example of a material that is both strong and incredibly lightweight. This means that the vehicle is as light as it possibly can be, further enhancing its performance. The carbon fibre runs throughout the entirety of the cars bodywork, including the interior. The reason why carbon fibre is so good and widely used on a range of high performance cars is due to its high stiffness and strength due to the multiple weaved layers of the material. It is also due to the fact it is so lightweight as well as strong, this is because of the fact it is mostly made up from carbon atoms.

2.6 – Vehicle sensors:

Around the vehicle itself there is 70+ sensors, each communicating with the computing system on the vehicle. Each sensor helps towards making mechanical or electrical parts function the way they should. These sensors include ones such as throttle position sensor (TPS) which senses the amount of input is put down on the throttle pedal, ABS sensor, located on each wheel which measures the rotational input of the wheels, lambda sensor which picks up the amount of oxygen, knock sensor which picks up if there is any knocking coming from the engine which if it picks up a reading of knocking it can prevent further damage to the engine by displaying a warning light on the drivers dashboard. There are many more sensors around the car. The sensors are around the vehicle to help with driver convenience and maintaining of the vehicle. Each of these sensors work by picking up their relative information by receiving a transmission of sound or input of movement, they then give readings of what the condition is, this can then be compared to what the reading should be. The McLaren however may have additional sensors due to having more functioning parts, such as a speed sensor that when the car reaches a certain speed it sends a transmission to the electronics system that functions the rear wing to come up as part of the active aerodynamics.

Chapter 3

3.0 – Current state of the industry

The current state of the industry is at one of the most advanced stages it has ever been. With the most technologically advanced systems the industry is able to produce some very advanced vehicles, much like the McLaren P1. The industry is currently also making the push to be more green to reduce the carbon footprint. However despite this there is still more to be done when it comes to distribution, sourcing and manufacturing of the vehicles themselves. In terms of design of McLaren the P1 has somewhat set the benchmark for McLarens beyond that, which can be seen with the McLaren Senna for example.

Chapter 4

4.0 – Conclusion

To conclude the McLaren proves that it is a marvel of vehicular engineering when each of the topics have been considered. With its high powered engine yet very low emissions especially when you consider its competition, it really shows how advanced the vehicle is. The information proves that the McLaren P1 sets a benchmark when it comes to vehicles of the modern era, whether its by performance or its high tech components the findings further prove its advancements of technology.

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