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1 Introduction

The aims and objective of this technical report is to investigate the main purpose of Aerodynamics in regard to motorsports and to indulge into its significance throughout the history of vehicle manufacturing.

2 Background/Research

Formula 1 has come a long way since it was first established in 1946 by the Commission Sportive Internationale (CSI), they are an autonomous committee that would oversee international motorsport matters they form very strict regulations that the manufacturers must abide by. Teams only had one objective which is to have the fastest vehicle on track, Aerodynamics, one of the most significant key factors that played a massive role relating to motor racing with its ability to decrease drag and increase downforce. There are various ways for a Formula 1 car to generate grip to stay on the track at incredible speeds. Firstly, through mechanical grips created through the suspension and tires. The alternative method is creating downforce generated by wings (Racing Sports Cars, 2024).

2.1 Pre WWII



Figure 1 *Le jamais contente* (Historics, 2019)

Around 1900s where the journey of aerodynamics initially began, with the vehicle manufactured named 'Le jamais contente' made by Camille Jenatzy. This was famously known for the first ever land vehicle to be recorded that exceeded the velocity of

62mph-100km/h (Hurst, 2023). At the time this was a very impressive design considering they did not have technology such as wind tunnel testing, shaped like a bullet the streamlining was impeccable but a factor that became a major setback was the driver engulfing all the drag (Donut, 2020). Back in the 1900s people did not really consider the term aerodynamics, they cared

more for what looked fast, vehicles had minimal bodywork keeping the features of the cars simplistic. Unfortunately, after 4 years the record was broken in 1902 by Leon Serpollet's with his steam powered vehicle.

As they go further up the timeline, car manufacturing became more and more popular and streamlining piqued the interests of car makers. A particular vehicle in history that was mass produced and mainly revolved around the idea of streamlining was the Rumpler Tropfenwagen, with its unique body, shaped like a teardrop crossed between a submarine which had the drag coefficient of .28 (Nash, 2019). This vehicle at the time was famous for being the 'first streamliner' with its feature of curved windows that enhanced its aerodynamic (Smith, 2022).



Figure 2 Rumpler Tropfenwagen (Smith, 2022)

2.2 Early ages of Introducing aerodynamics features. (1950-1970s)

With the production of vehicles with the design of a cigar the 'classic cigar shaped cars' designed to cut through air, an object in comparison to a sharp object flowing through liquid (Francks, 2024), allowed a huge



Figure 3 Lotus 49B (Lotus, 2024)

advantage amongst other competitors. In 1968, Formula 1 witnessed its pivotal evolution with the exposure of high winged vehicles. Colin Chapman brought his designed Lotus 49B which portrayed aerodynamic features such as the front wing and rear wing, this enabled the vehicle to have an increased downforce and provided the vehicle with stability as air resistance/drag pushes down on those components (Francks, 2024). These aerodynamic features soon became a revolutionary idea in the F1 industry, permanently altering the blueprint of Formula one racing. Another vehicle that made a significant impact to history was a vehicle that went by Chaparral 2J, it was developed and designed by Jim Hall in the 1970s. It was one of the early examples of a ground effect racing car reiterated to be a vehicle ahead of its time.

2.3 Late 1960s early 1970s innovation of the wind tunnel technology

In the earlier ages of Formula 1, the primary way of testing aerodynamics is heavily relied on track testing, which was very time consuming and inefficient. Engineers were severely limited as they could only collect data at the race weekends, which meant that their ability to come up with new configurations and geometry to further improve stability and aerodynamics of the vehicles were inadequate (Thakur, 2023). So, teams have come to realized that there is a need for aerodynamic testing to be more efficient and have a controlled environment. Introducing, the Wind tunnel testing, significantly altering motorsports. Wind tunnel is a laboratory facility where aerodynamicists can investigate the airflow simulated by a propelling powerful fan. With its ability to simulate what occurs in reality, individuals can investigate the aerodynamic properties of the object which portrays a definitive insight into whether an idea is working or not. There are two different types of wind tunnel testing. There is the open tunnel and closed return tunnel, the differences between these two is the open tunnel has a section where both ends are open and utilizes the air from the environment where it is located, this particular test is not used for motorsports as the air is not guided back into the test section which will not create a laminar flow but more of a disturbed flow. The closed loop tunnel portrays a much more beneficial and accurate results of how the air flows surrounds the vehicle, this is due to the fact that it uses a self-contained circuit which recirculates back to the test section through the use of vanes, the use of vanes allows the air to not be disturbed and cause vortices within the airflow the vanes allow a smooth change in direction. The closed loop tunnel is not vented therefore it circulates and recycles the same air (Nagel, 2023).

The stated features of the closed loop tunnel allow the airflow to be more predictable which gives a better overall analysis of aerodynamics in terms of how the air particles surrounds the vehicle (Blackstock, 2020). Wind tunnel testing is a significant key factor of how a vehicle is manufactured specially for motorsports vehicles, when chasing the lowest drag coefficient. As engineers can determine and quickly find the solutions of the problem.

3 Main discussion

The study of aerodynamics dates back way before motorsports, it initially began with aeronautics, objects such as planes and rocket ships. The curiosity of how their investigation began is how they could make a lump of metal be at its most fuel efficient also with the study of how air/gasses surrounding the object interacts with one another. One of an early examples of a vehicle that uses the same principle of an airplane is the Chaparral 2J with the use of ground effect aero. The way that the vehicle was designed was ahead of its time, with the limited use of wind tunnel. The skirts slightly above the track partially formed a seal to enable the two fans in the back to produce an area of extremely low-pressure zone underneath the vehicle, thus causing a vacuum producing tremendous amount of downforce. When a vehicle manoeuvres around a corner it experiences body roll which compromises the skirts to lift away from the track threatening to disturb the vacuum seal but with the innovation of the chaparral 2J the skirt rail was designed mounted to the suspension setup in such a way that they were effectively unsprung, meaning the car effectively moved around them the same way it moved around the wheels. (Donut, 2020)

Wind tunnel testing was revolutionary in motorsports, it allowed various things to occur in history that significantly altered the sports of racing today. From the ability to study how airflows interact with vehicles, it allowed engineers to chase the idea of lowest drag coefficient possible. Now in modern days aerodynamicists/engineers can introduce aero techs such as

active inlet louvers, air curtains, rear spoilers. These aero techs are completely the same to how it was in the pass but in just a more efficient and evolved idea.

4 Conclusion

The purpose of this technical report is to provide an overview of how aerodynamics has evolved through out time, and its significance to how its altered everything in modern society in relations to motorsport.

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