



Aerodynamics in motorsport

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Introduction

Aerodynamics is explained as the way air moves around objects as they move forward. Everything that moves through air is affected by aerodynamics such as cars and planes. When looking at aerodynamics the main forces are Lift- The force that allows an object to move up through the air (NASA, 2017), Downforce- which is the way air pushes a car down towards the ground (Mercedes, 2024) And Drag- which is the force that acts on an object pushing back against it as it moves forward. (Dasilva, 2022)

Importance of aerodynamics in motorsport

In motorsport Aerodynamics play a crucial role in the performance of a car, ideally you would want a car with high downforce and little to no drag or lift. It is no doubt that F1 is the leading form of motorsport with a focus of aerodynamics and drag reduction, with the additions of front wings, rear wings and diffusers, all used to push the cars into the ground extracting the most amount of grip from their tires to improve lap times.

Drag

Drag is the force acting against an object as it moves forward, it can be calculated using the formula: $CD \times \frac{1}{2} \rho V^2 \times A$. Computers can be used to figure out how much drag and downforce a car produces using a system called CFD (computational fluid dynamics) this system allows the user to visually see how well the air flows around a vehicle before taking it to a wind tunnel to prove the results. (F1 Dictionary, 2024)

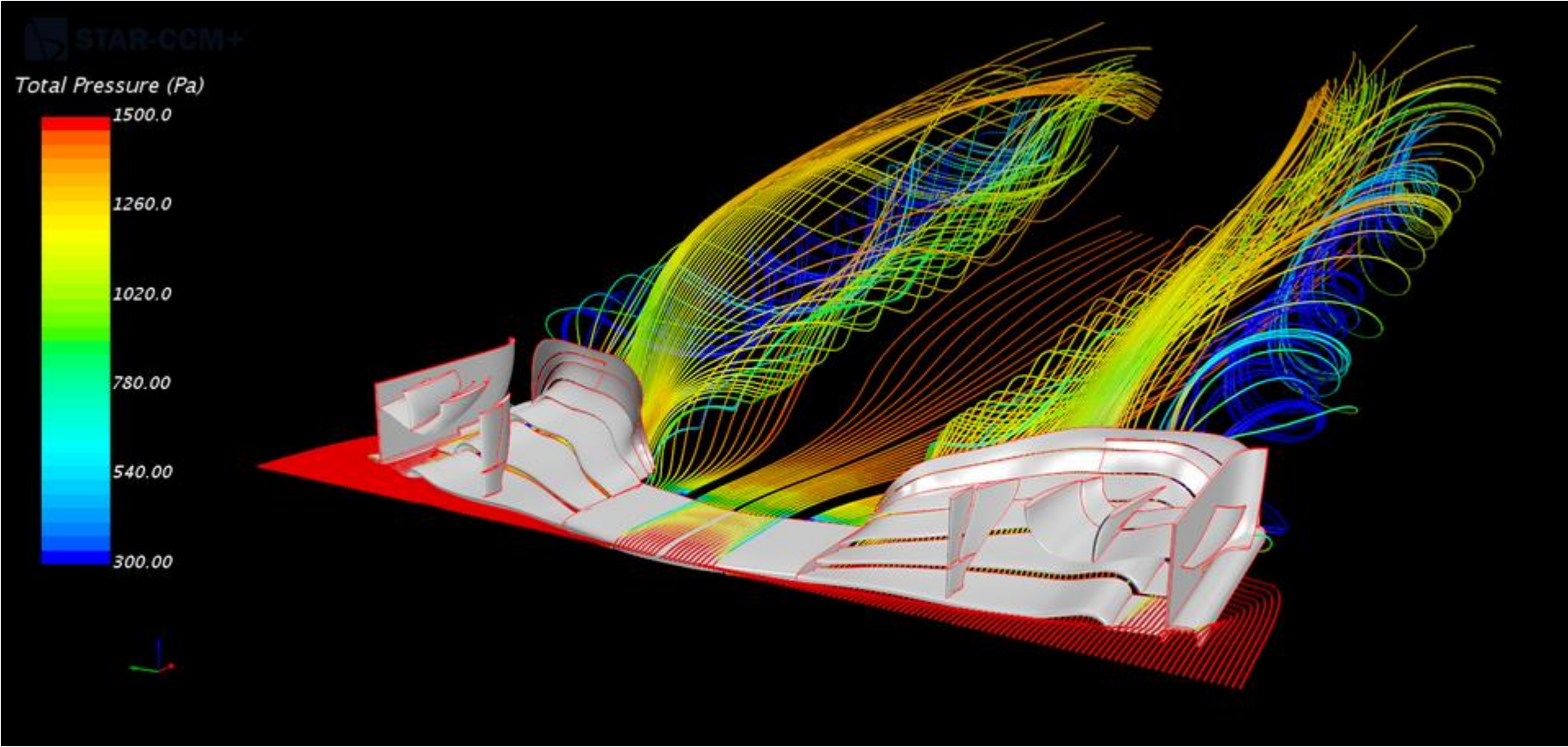


Image showing CFD of a F1 front wing and demonstrating vortex's generated (Pangerl, 2018)

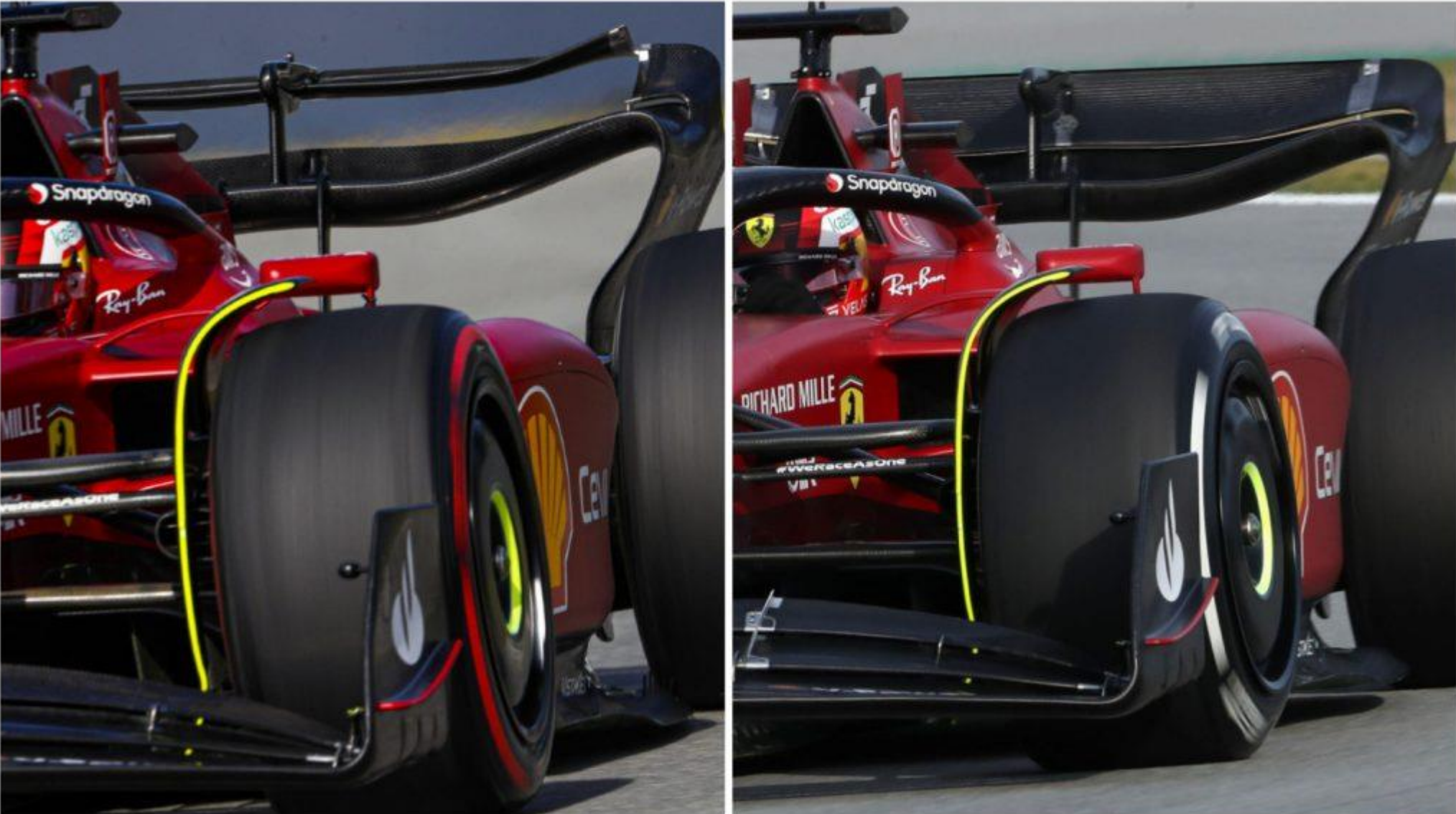


Image showing an F1 cars DRS being open (left) and closed (right). (PlanetF1, 2022)

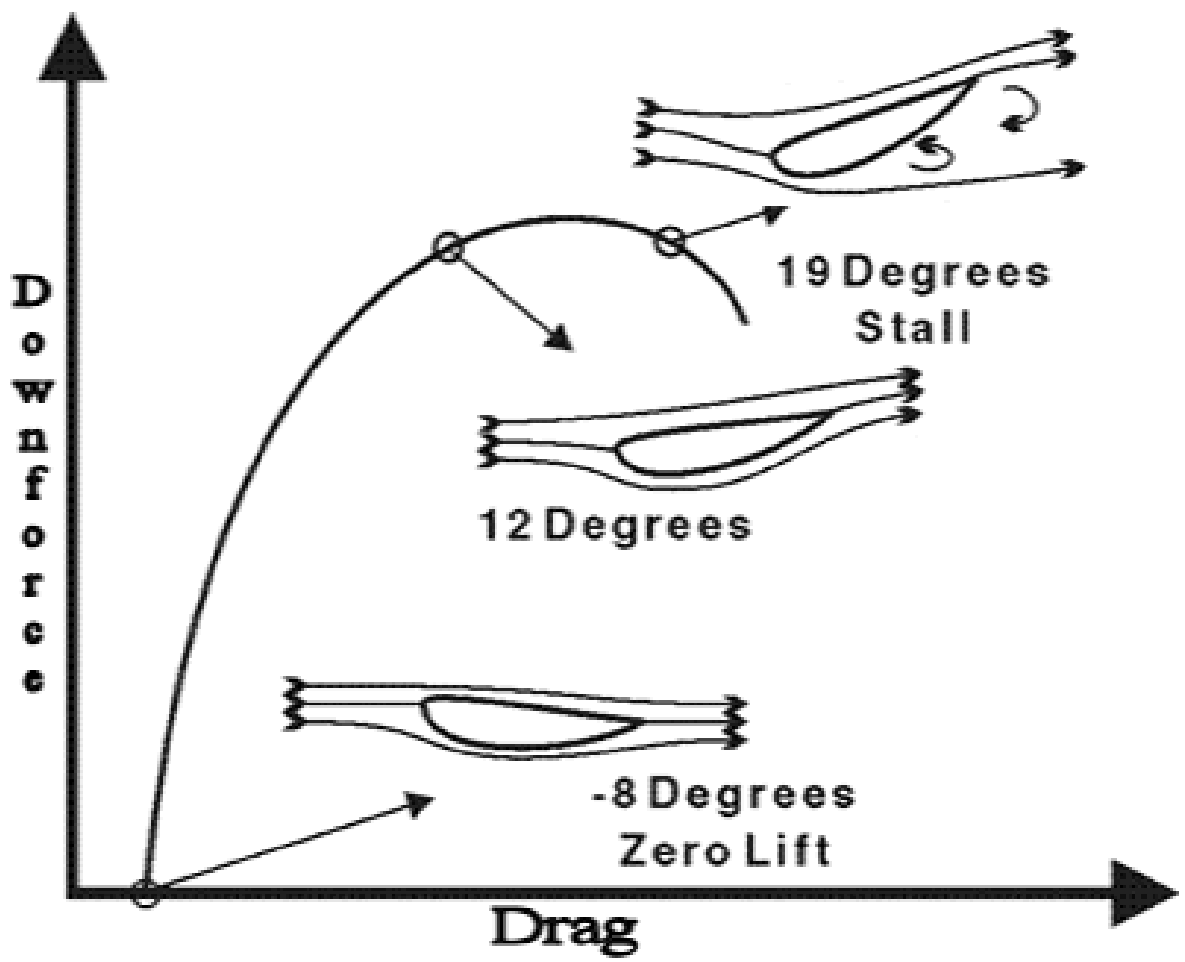


Image showing angle of attack and its effect on downforce and drag (F1 Dictionary, 2024)

Front wing

The front wing of a Formula One car is the first contact with airflow when out on track, it is essential for it to be perfectly designed, otherwise the rest of the car's aerodynamics will suffer, as the floor and diffusers will not be fed clean air from the vortex's created by the end plates efficiently enough to be effective. (Autosport, 2020) The Front wing is responsible for up to 40% of a car's total downforce. (F1 Chronicle, 2021)

Rear Wing

The rear wing of a Formula one car is crucial for the rear grip and stability of a F1 car. The rear wing design is taken from the design of an aeroplane wing, which is called an aerofoil, it's a teardrop shape with a bent-up tail at the end, this provides an aeroplane with lift to take off from a runway using the surrounding air pressure, but when inverted it can be used to produce downforce. Teams can adjust the angle of the rear wing as well as the front to produce more front or rear downforce according to the driver's needs, high speed straight tracks require less downforce and reduced drag while technical circuits would need more downforce to improve grip while turning. (F1 Chronicle, 2021) DRS (drag reduction system) was introduced in 2011, it is a piece of the rear wing that can be opened while drivers are travelling down a straight section of the circuit to reduce downforce and drag to gain a small amount of speed to aid with over taking. (Autosport, 2020)

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