ORACLE
Red Bull
RACING

Introduction

Oracle Red Bull Racing is the F1 team, based in the United Kingdom. Red Bull debuted in 2005 and their recent domination sees that they are the best F1 team winning the constructors championship in the last 2 years.

Physics is an extremely important part of Formula 1 and the stunts pulled by Red Bull. From the aerodynamics to the trackside experiment, we will be explaining the role of physics in the Oracle Red Bull Racing team.

Aerodynamics Mastery

Aerodynamics is crucial in Formula 1 as it directly impacts the vehicles speed, stability and handling.

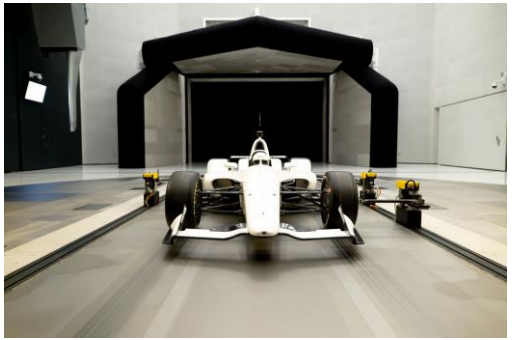
Red Bull Racing’s mastery of aerodynamics in Formula 1 is attributed to their advanced research, innovation, and attention to detail. The team, led by renowned aerodynamicist Adrian Newey, has consistently pushed the boundaries of aerodynamic design. Their cars are known for innovative solutions, such as intricate front wing designs, efficient airflow management, and clever packaging.

Red Bull focuses on creating high level of downforce without sacrificing Straight-line speed. Additionally, red bulls investment in multiple experiments such as the Wind tunnel testing and Computational Fluid Dynamics(CFD) simulations has played a huge role in maintaining their aerodynamic superiority over other Formula 1 teams in the competitive world of F1.

Wind tunnel testing

A wind tunnel test, is a test performed by inventors and manufacturers which helps provide information about how air flows around an object. determining the aerodynamic nature of the object is an important factor when considering its design.

Wind tunnels are useful in confirming engineers' calculations, whilst helping reduce drag and lift, being optimal features of an F1 car. Whilst confirming calculations, wind tunnels help highlight any defects with the object, indicating areas of stress or low performance, being another crucial way of ensuring the performance of the car is optimum.



CFD Simulation

Computational Fluid Dynamics (CFD) simulation is a computer-based technique used to analyse and simulate the behaviour of fluid flow, including air, around objects. In the context of Formula 1 and aerodynamics, CFD plays a crucial role in testing and optimizing designs without the need for physical prototypes

Red Bull Racing harnesses Computational Fluid Dynamics (CFD) to refine their Formula 1 car designs. Using sophisticated software, they create a digital model of the car and simulate airflow to analyse aerodynamic performance. This virtual environment allows engineers to swiftly do design changes, optimizing factors like downforce and drag without physical testing. CFD enables Red Bull to fine-tune their car for specific tracks, saving time and costs compared to traditional methods. This adaptable nature of CFD contributes to continuous development throughout the racing season, giving Red Bull a competitive edge in the dynamic world of Formula 1.

High-Speed Dynamics

High-speed dynamics are crucial in F1, determining how well the car performs at high speeds.

There are several factors that affect the high-speed performance of the vehicle, some being:

- The shape of the car
- Weight
- Engine
- Airflow around the car

The shape of the car - The car being streamlined, allows air to flow around the car, instead of into the car, creating drag.

Weight - The weight of the car determines how much force the engine needs to exert in order to get the vehicle to high speeds. As F = ma, the higher the mass of the object, the higher the amount of force required to accelerate the object.

Airflow - The presence of ‘clean’ or ‘dirty’ air affects the performance of the car. This is due to clean air flowing around the car increasing the amount of downforce exerted upon it, keeping it to the track which allows it to better turn corners.

Engine - The power of the engine determines the amount of force and rpm that the car is able to produce, ensuring that the car is able to have a high acceleration. Alongside the production of horsepower, the engine also determines the efficiency of the car, and how quickly it runs out of fuel

Tire Dynamics

In formula 1, the different types of tyres used on the car, is a crucial part of every racing team's strategy. Different types of tyres are used in different conditions, such as wet or dry, which ensures the car is still able to perform to an optimal standard. There are three main types of tyre compounds, which form the soft, medium and hard tyre.

Alongside the three main types of tyre compound, F1 tyres can also be treaded, which ensures a higher performance during wet conditions, preventing aquaplaning from occurring, lifting the car off of the track.

Tyre compound 	Advantages	Disadvantages
C1 compound (Hard tyre)	• High durability • Low degradation • Able to withstand high energy loading circuits.	• Long time to warm up (Gives opposing drivers a head start)
C2 compound (Medium tyre)	• Can be used for a large variety of circuits • Durable • Faster than C1 compounds.	• Provide the least grip on the circuit (Causing slipping/lack of friction)
C3 compound (Soft tyre)	• High amounts of grip • Warm up quickly • Able to withstand sharp turns	• Low durability (Driver has to pit more) • Deteriorate within minutes

Energy Recovery System (ERS)

ERS or Energy Recovery System is a secondary power source consisting of ‘wasted’ energy.

ERS operates by converting kinetic energy from the brakes and the heat from the turbochargers exhaust and storing it in a battery to be used by the electrical motor when accelerating. ERS is useful as the torque provided by the electrical motor allows for better traction, more speed around corners, better fuel management and provides faster lap times.

ERS was introduced as a clean energy and is apart of Formula One’s movement to being environmental friendly.

Conclusion

Oracle Red Bull Racing have pushed the limits of physics with both their stunts and their cars. Red Bull will continue to push these limits and reach further heights, faster laps and more championships. Their continuous experimentation and technological advancement will prove useful to the motorsport industry.