

(RESEARCH ARTICLE)



## Engineering excellence and racing dominance: The case study of the 1955 Mercedes W196 Grand Prix Car

Arpit Darbari \*

*M.Eng spec. In Mobility and Automotive Management, SRH University of Applied Sciences, Berlin, Germany – 10625.*

Global Journal of Engineering and Technology Advances, 2024, 20(03), 074–079

Publication history: Received on 25 July 2024; revised on 06 September 2024; accepted on 09 September 2024

Article DOI: <https://doi.org/10.30574/gjeta.2024.20.3.0166>

### Abstract

The 1955 Mercedes W196 Grand Prix car is a symbol of automotive innovation and racing excellence. This case study delves into the design, engineering, and racing achievements of the W196, emphasising its technological advancements and historical significance in the world of Formula One racing. By analysing its development, performance, and legacy, this study aims to provide a comprehensive understanding of how the W196 revolutionised motor racing and cemented Mercedes-Benz's position as a dominant force in the sport.

**Keywords:** 1955 Mercedes W196; Grand Prix; Formula One; Automotive engineering; Racing history; Mercedes-Benz; Juan Manuel Fangio; Stirling Moss; Technological innovation

### 1 Introduction

The 1955 Mercedes W196 Grand Prix car stands as a paragon of automotive and racing innovation, marking a pivotal era in the history of Formula One. Designed and introduced by Mercedes-Benz for the 1954 and 1955 Formula One seasons, the W196 was engineered with a singular vision: to reestablish Mercedes-Benz as a dominant force in the highly competitive world of motor racing. This ambition was fuelled by a rich heritage and a commitment to cutting-edge technology and engineering excellence.

At the heart of the W196's success was its groundbreaking design, which incorporated a myriad of technological innovations that were ahead of its time. [1] The car featured advanced aerodynamics, direct fuel injection, and a lightweight yet robust structure, all of which contributed to its superior performance on the track. The streamlined bodywork, often referred to as "streamliner" design, minimised drag and allowed for higher speeds, particularly on faster circuits. Additionally, the W196's 2.5 Liter straight-eight engine was a marvel of engineering, delivering unprecedented power and reliability.

The W196's racing pedigree is highlighted by its stellar performance in the hands of legendary drivers such as Juan Manuel Fangio and Stirling Moss. These drivers, with their exceptional skill and tenacity, propelled the W196 to numerous victories and podium finishes, underscoring the car's superior capabilities. Notable achievements include Fangio's victory in the 1954 French Grand Prix, which marked the W196's debut, and Moss's historic win at the 1955 British Grand Prix, where he became the first British driver to triumph in a British-built car at his home Grand Prix.

Beyond its immediate racing successes, the W196's influence extended far into the future, shaping the trajectory of Formula One car design and engineering. The innovations pioneered by Mercedes-Benz in the W196 laid the groundwork for subsequent advancements in aerodynamics, fuel efficiency, and materials science. [2] The car's legacy is evident in the continued success of Mercedes-Benz in modern Formula One, as the principles and technologies introduced with the W196 remain integral to the brand's racing philosophy.

\* Corresponding author: Arpit Darbari

This case study delves into the intricate details of the W196, examining its design, technological innovations, and racing achievements. By exploring the contributions of the W196 to automotive engineering and its lasting impact on Formula One, we gain a deeper appreciation for the legacy of this remarkable vehicle. Through this exploration, we uncover not only the story of a car but also the narrative of human ingenuity, relentless pursuit of excellence, and the unyielding spirit of competition that defines the world of motor racing.

---

## 2 Materials and Methods

### 2.1 History

Mercedes-Benz returned to Formula One racing in 1954 after a 15-year hiatus, aiming to re-establish its pre-war dominance. The W196 was unveiled with high expectations, featuring cutting-edge technology and innovative design elements that set it apart from its competitors. The car's debut at the French Grand Prix marked the beginning of a new era in motor racing.

The Mercedes-Benz W 196 R designed for the 1954 season met all the demands of the new Grand Prix formula decreed by the sport's governing body, the CSI (Commission Sportive Internationale): a capacity of 750 cc with or 2500 cc without supercharger, free choice of gas mixture, a racing distance of 300 kilometres or a minimum of three hours. The streamlined version was completed first because the Reims race kicking off the season permitted very high speeds. After that there was also a version with exposed wheels. [3]

Fritz Nallinger was in charge of the project as a whole, ably assisted by Rudolf Uhlenhaut, Chief Engineer of the racing department since 1 September 1936, and after the war also head of the Car Testing department, who influenced the development decisively. Uhlenhaut headed a team of engineers including Hans Scherenberg, Ludwig Kraus, Manfred Lorscheidt, Hans Gassmann, and Karl-Heinz Göschel, as well as further top-level staff of the company. And although, yet again, in the case of the W 196 R, the whole was much more than the sum of its parts, every component is worth mentioning: cutting-edge technology in terms of its era, in spite of the fact that, in some cases, there had been precedents in the history of motor sports.

This silver masterpiece, of which 14 units including a prototype were built, drove its competitors to despair in the following two years. Its original streamlined body was both expedient and visually appealing. From the German Grand Prix on the Nürburgring in early August 1954 onward, however, an open-wheel (monoposto) version also formed part of the line-up. Its tubular space frame was light and sturdy, its suspension with torsion bars and a new single-joint swing axle at the rear as well as the giant, turbo-cooled, and at first centrally arranged Duplex drum brakes were unconventionally good. The eight-cylinder in-line engine with direct injection and desmodromic valve control (1954: 256 hp (188 kW) at 8260 rpm, 1955: 290 hp (213 kW) at 8500 rpm) was installed into the space frame at an angle of 53 degrees to the right to lower the centre of gravity and reduce the frontal area. What's more, meticulous preparations for each individual race harked back to the glorious 1930s while at the same time anticipating the modern Formula One approach.[4] But there was something else as well: so as to have the best cars in the world raced by the best drivers, racing manager Alfred Neubauer hired the – initially reluctant – superstar Juan Manuel Fangio, plus the up-and-coming Stirling Moss in 1955 – a virtually invincible pairing.



**Figure 1** 1955 Mercedes Benz W196

### 2.2 Two Versions of the W196:

The two versions of the W 196 R were interchangeable quite effortlessly. Chassis number ten, for instance, glittering with former glory in its brand-new aluminium body one day, was entered with open wheels in the 1955 Argentinean

Grand Prix (driven by Hans Hermann, Karl Kling and Moss to fourth place) and the Dutch Grand Prix (with Moss at the wheel, finishing as runner-up), and fully streamlined again performed tests in Monza.[5] Which of them was used depended upon the peculiarities of the circuit, the strategy chosen and the likes and dislikes of the respective driver.

The W 196 R featured a swing axle with low pivot point instead of the customary De Dion layout – a configuration explained by Uhlenhaut with its better behaviour under acceleration. An almost perfect balance was achieved by positioning heavy elements in the extremities of the W 196 R, the water and oil coolers right at the front, the tanks holding petrol and oil in the tail. In 1955 the front drum brakes were relocated into the wheels on some cars, while three wheelbase lengths were available: 2150 millimetres, 2210 millimetres, and 2350 millimetres. The shortest was ideally suited for the tight round-the-houses circuit in Monaco, at the same time it had an ambience of stocky purposefulness. [6] But it did not, of course, prevent the disaster that struck the silver cars on that 22nd day of May: Hans Hermann suffered a severe accident during a practice session, Fangio had to retire from the race with a broken propeller shaft, and both Moss and replacement driver André Simon in the third Silver Arrow with engine damage.



**Figure 2** Mercedes Benz W196 Streamliner



**Figure 3** Mercedes Benz W196 R

### 2.3 Design and Engineering

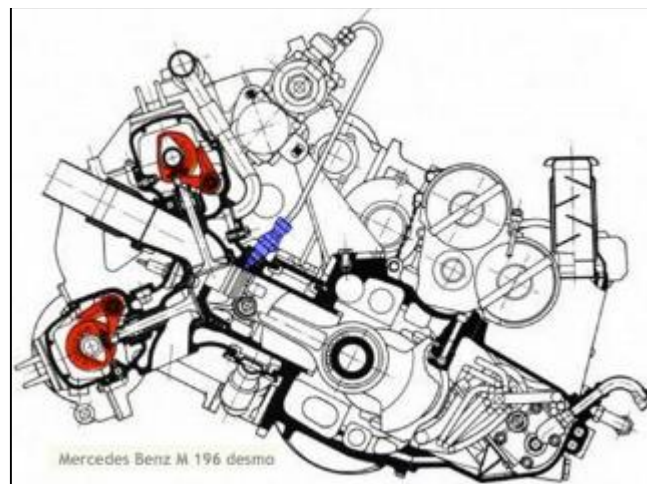
The W196 was a marvel of engineering, incorporating several advanced features that were groundbreaking at the time:

- Engine: As usual, before a fully-fledged eight-cylinder engine gave its first roar on the test rig, a single-cylinder test unit with 310 cc and four valves had to go through its paces. This solution uncovered a deficiency the Silver Arrows' racing engines had already struggled with in the 1930s, namely valve-gear problems when exceeding 8000 rpm and above all fragile springs.[7] Going home after work in a streetcar in the evening of 20 May 1952, suburban commuter Hans Gassmann came up with the answer, presenting it the next morning. Cam lobes and rocker arms would control both the opening and closing off the valves so that one could make do without springs. The advantages of that concept were obvious: higher revs, more safety, greater power. As it also permitted to employ larger and heavier valves, the engineers opted for two valves per cylinder.



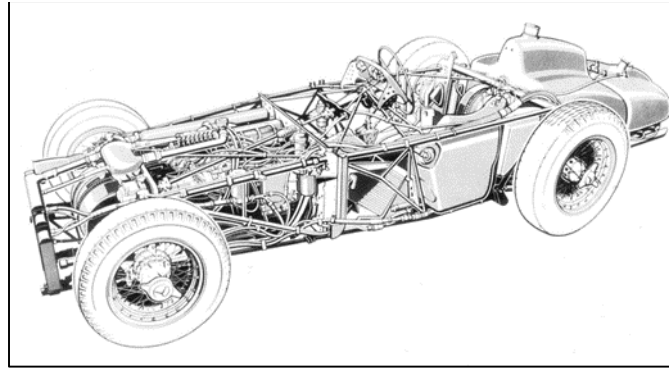
**Figure 4** Mercedes Benz W196 Engine

- **Fuel Injection:** The W196 was one of the first Formula One cars to use direct fuel injection, a technology borrowed from Mercedes-Benz's experience in aircraft engines during World War II. This system provided better throttle response and fuel efficiency. [8] The injection pump, developed together with Bosch and not unlike the ones used in diesel engines, consisted of a casing with eight cylinders which fed the gas straight into the combustion chambers at a pressure of 100 kilograms per cubic centimetre. The eight-cylinder in-line configuration was inspired by the famous 18/100 hp Grand Prix car of 1914 in that the cylinders (two groups of four, with central power take-off) were firmly connected to a base plate, though bolted to an aluminium casing separate from the valve gear housing and surrounded by a welded-on cooling-water jacket. The fuel used was a highly reactive Essa mixture with code RD 1, concocted from 45 percent benzene, 25 percent methanol, 25 percent 110/130 octane petrol, three percent acetone and two percent nitro-benzene.[9] This blend would have eaten away a tank made of unprotected steel overnight, as Hans Herrmann remembers.



**Figure 5** W196 Fuel Injector (Direct Injection)

- **Chassis and Aerodynamics:** The W196 featured a lightweight tubular space frame chassis, which offered rigidity and reduced weight. The car's streamlined bodywork, designed in both open-wheel and streamlined versions, minimised aerodynamic drag and increased top speed.



**Figure 6** W196 Chassis

- **Suspension and Brakes:** The car utilised independent suspension with torsion bars and hydraulic dampers, providing superior handling and ride comfort. The inboard drum brakes, mounted next to the differential, reduced unsprung weight and improved braking performance.

## 2.4 Racing Achievements

The 1955 Mercedes W196 Grand Prix car made a sensational racing debut, with Mercedes-Benz drivers Juan Manuel Fangio and Stirling Moss leading an era of dominance in the 1954 and 1955 seasons. [10] The W196's potential was immediately evident at the 1954 French Grand Prix, where Fangio's victory set a high standard for the future. This trend continued into the 1955 British Grand Prix at Aintree, where Moss made history as the first British driver to win the British Grand Prix in a British-built car. The season culminated in Fangio's outstanding performance, securing multiple victories with the W196 and earning his second consecutive World Championship title, solidifying the car's legendary status in motorsport history.

## 2.5 Technological Impact and Legacy

The Mercedes W196 Grand Prix car revolutionised Formula One racing with its groundbreaking design and engineering innovations. Introduced in the 1954 season, the W196 incorporated advanced features that set new benchmarks in the sport. Among its notable innovations were the streamlined bodywork optimised for aerodynamics, mechanical direct fuel injection derived from the company's aviation technology, and the use of lightweight, high-strength materials such as aluminium alloys and magnesium. The aerodynamics of the W196 were a significant leap forward. Mercedes-Benz developed two versions of the car: one with a streamlined body for high-speed tracks and a more traditional open-wheel design for tighter circuits. This dual approach allowed the W196 to perform optimally across different types of racecourses. The streamlined version, with its sleek, enclosed wheels, reduced drag and allowed higher top speeds, demonstrating the critical role of aerodynamics in racing performance.

Another pivotal innovation was the W196's fuel injection system, a first in Formula One. This technology provided more precise fuel delivery compared to carburetors, resulting in improved power output and fuel efficiency. The fuel injection system contributed to the car's superior performance, giving it an edge over competitors. [11] The W196 also featured advanced materials that enhanced its durability and performance. The use of aluminium alloys and magnesium not only reduced the car's weight but also improved its strength and heat dissipation capabilities. These materials allowed for a lighter, more agile car that could withstand the rigors of high-speed racing.

The success of the W196 was not solely due to its technological advancements but also the result of a well-coordinated team effort. Mercedes-Benz's engineers, mechanics, and drivers worked in harmony, ensuring that every aspect of the car's performance was optimised. The meticulous preparation and execution by the team were crucial in maintaining the car's reliability and competitiveness throughout the racing seasons. The impact of the W196 extended far beyond its immediate racing achievements. Its innovative design and engineering set a precedent for future Formula One cars. The emphasis on aerodynamics, advanced fuel systems, and lightweight materials became standard considerations in race car development. [12] The W196 influenced a generation of engineers and designers, inspiring continuous advancements in automotive technology and engineering.

In summary, the Mercedes W196 Grand Prix car was a masterpiece of engineering and design that not only dominated its era but also left an enduring legacy on the sport of Formula One. Its innovative features and the seamless collaboration of the Mercedes-Benz team set new standards that have influenced the evolution of racing cars for

decades. The W196's success story is a testament to the importance of technological advancement, strategic teamwork, and a relentless pursuit of excellence in motorsport.

---

### 3 Conclusion

The 1955 Mercedes W196 Grand Prix car stands as a landmark in the history of Formula One, exemplifying the pinnacle of engineering, design, and racing excellence of its time. Through innovative features such as advanced aerodynamics, direct fuel injection, and the use of lightweight materials, the W196 set new standards that have profoundly influenced the development of racing cars. Its unparalleled success on the track, highlighted by the victories of legendary drivers Juan Manuel Fangio and Stirling Moss, demonstrated the effectiveness of Mercedes-Benz's holistic approach to engineering and teamwork.

The W196's legacy extends far beyond its immediate racing triumphs. The technological advancements and design philosophies pioneered by this remarkable vehicle laid the groundwork for future innovations in automotive engineering and motorsport. The principles established by the W196 continue to resonate within Mercedes-Benz's ongoing contributions to Formula One, showcasing a sustained commitment to excellence and innovation.

By studying the W196, we gain invaluable insights into the evolution of motor racing and the enduring impact of engineering ingenuity. The car's achievements underscore the importance of integrating cutting-edge technology with meticulous design and cohesive team effort. As a symbol of automotive and racing heritage, the Mercedes W196 remains a beacon of inspiration, exemplifying the relentless pursuit of perfection that defines the spirit of Formula One.

In conclusion, the 1955 Mercedes W196 Grand Prix car is more than just a vehicle; it is a testament to the transformative power of innovative engineering and a lasting legacy in the world of motorsport. Its story enriches our understanding of the sport's history and inspires future generations of engineers, designers, and racers to push the boundaries of what is possible.

---

### References

- [1] Higham, P. (2000). *The Guinness Guide to International Motor Racing*. Guinness Publishing.
- [2] Nye, D. (1986). *The Grand Prix Car 1954-1966*. Motor Racing Publications.
- [3] Ludvigsen, K. (2009). *Mercedes-Benz Grand Prix Race Cars: 1934-1955*. Motorbooks.
- [4] Mercedes-Benz Classic Center. (2024). *The W196: A Legacy of Innovation*. Daimler AG.
- [5] <https://www.jstor.org/stable/44554164>
- [6] <https://www.combustion-engines.eu/pdf-116163-60382?filename=Powertrain%20technology.pdf>
- [7] [https://books.google.com/books?hl=en&lr=&id=UzVEAgAAQBAJ&oi=fnd&pg=PP1&dq=mercedes+benz+w196+1955&ots=DdQE8EYGs8&sig=EvCRPqDLpjQtpfF\\_7r0TneZ0jHU](https://books.google.com/books?hl=en&lr=&id=UzVEAgAAQBAJ&oi=fnd&pg=PP1&dq=mercedes+benz+w196+1955&ots=DdQE8EYGs8&sig=EvCRPqDLpjQtpfF_7r0TneZ0jHU)
- [8] <https://www.theseus.fi/bitstream/handle/10024/337022/Samer-Hammami.pdf?sequence=2>
- [9] <https://books.google.com/books?hl=en&lr=&id=REdhBQAAQBAJ&oi=fnd&pg=PT8&dq=mercedes+benz+w196+1955&ots=z9GNsUW0DM&sig=v5gGVbaxQjalzmxkpYh9h0iqzu0>
- [10] <https://journals.co.za/doi/abs/10.10520/EJC-4ea505a1a>
- [11] [https://link.springer.com/chapter/10.1007/978-3-658-38470-8\\_2](https://link.springer.com/chapter/10.1007/978-3-658-38470-8_2)
- [12] <https://search.proquest.com/openview/e9c12d6b02f5fb55b617bfad886234b8/1?pq-origsite=gscholar&cbl=18750&diss=y>