

University of Wales Trinity Saint David

Wales Institute of Art and Science

The Evolution of Aerodynamics In Motorcycle Racing (Moto GP)

Konah Hughes

Student Number: 2415258

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1. Introduction

In this Technical report I am going to investigate the evolution of aerodynamics in motorcycle racing, predominantly Moto GP. The aim is to highlight past technology and the importance of development within this subject area.

I will be looking at the impact these developments have made on the performance of racing motorcycles, race craft, race regulations and other areas of racing that have been affected by this.

I will highlight key research areas from sources within this field and demonstrate my findings using imagery and text data. I will also be analyzing the data found and the similarities and differences between them if possible.

Using the data I have collected; I will then be giving my take on what I believe is to come within regards to aerodynamics on racing motorcycles in MotoGP.

Firstly, I will investigate the 1950's MotoGP bike and how the evolution of this shaped the way for future developments. I will then look into modern technology and compare the differences between the 1950's aerodynamic packages to the 2024 packages.

I will also investigate the development methods used in the 1950's compared to the modern-day race team.

2. Background

2.1 History of Aerodynamics in MotoGP

In the early 1950's motorcycle aerodynamics were not a thing. The bikes were simply unassisted by any form of aerodynamic technology. This was the case right up until the mid 1950's when the introduction of the 'dustbin' fairing was brought to life. As seen in figure 1, the fairing was incredibly streamline friendly with a generous portion of the front wheel and suspension covered. The design was groundbreaking at the time with straight line speed capability being increased massively. Moto Guzzi was responsible for the development of this due to wind tunnel testing (Figure 2). This design was used within MotoGP from 1954 until 1957 were the International Motorcycling Federation (FIM) introduced regulation against it.



Figure 1 – Moto Guzzi V8 Grand Prix Bike (Moto Guzzi,ND)



Figure 2 - Moto Guzzi Wind Tunnel (Moto Guzzi,ND)

2.2 Regulation Changes

The FIM carried out an investigation in 1957 against the use of the dustbin fairing. (N.Spalding ,2017) states “They were condemned for being too sensitive to cross winds, as well as being poorly mounted”. The bikes inability to still be stable forced the FIM to enforce regulation changes for rider safety from the 1958 season. These changes were “full exposure of the front wheel, complete visibility of the rider from both sides and above, and no streamlining forward of a defined vertical plane or to the rear of the rider.” stated by cycle world, (2023)

These changes have shaped the design and evolution of the technology and design of MotoGP bikes as far as today.

As seen in figure 3, this forced race teams to adopt a new style of fairing and new research to be conducted to ensure a balance was met between straight line speed, stability and cornering capabilities.

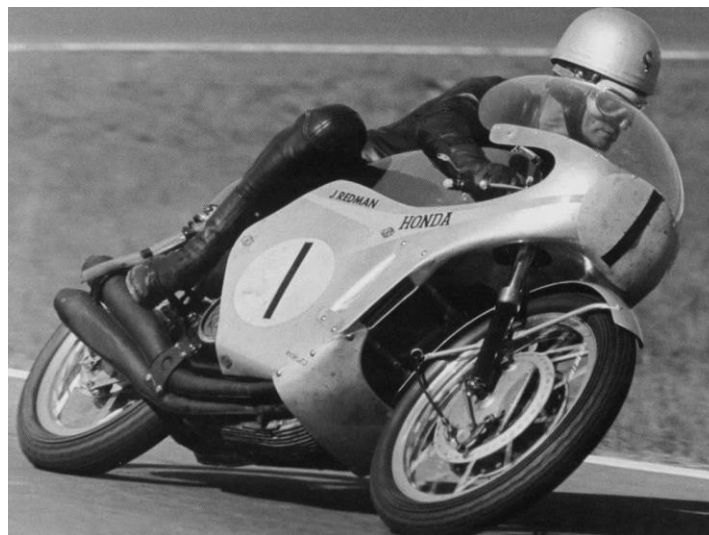


Figure 3 - 1963 Jim Redman (Ridefast,ND)

3. Discussion

3.1 Modern Technology

For 50 years, the design and advancement of Moto GP aerodynamic technology has remained rather similar. Throughout the 2000's teams experimented with different ideas and designs to enhance their aerodynamic performance in different ways.

This came in the form of redesigned fairings and riding styles as well as the addition of aerodynamic winglets as seen in Figure 4. Winglets were increasingly popular by the 2017 season and are still used on today's race machines.

Regulations were put in place by the FIM to restrict teams exceeding a fairing width for safety. *"The MotoGP regulations have remained stable since 2011 – it's been a long time. Aerodynamics is one of the few things, along with the bike height adjustment system, that started to be developed recently."* stated by (Motorcycle Sport, 2024).

As seen in Figure 6 Modern teams are required to fit their bike within a regulation box upon scrutineering in order to comply with regulations and be signed off to race. Modern technology sees MotoGP aerodynamics at the highest level its ever been with assistance to performance.

The increased understanding of aerodynamic flows and how they affect the ride of the bike has also had an impact on fairing design and winglet placement. As seen in Figure 5 the ability to 3d scan a race machine has further developed the knowledge of aerodynamic packages on race bikes.

This means race teams have the ability to test and visually analyze results without needing to physically manufacture parts. Wind tunnel tests such as the test Moto Guzzi carried out in the 1950's are now carried out via computer simulation technology.



Figure 4 - Red Bull Moto GP Winglets (IntentsGP, (2024).

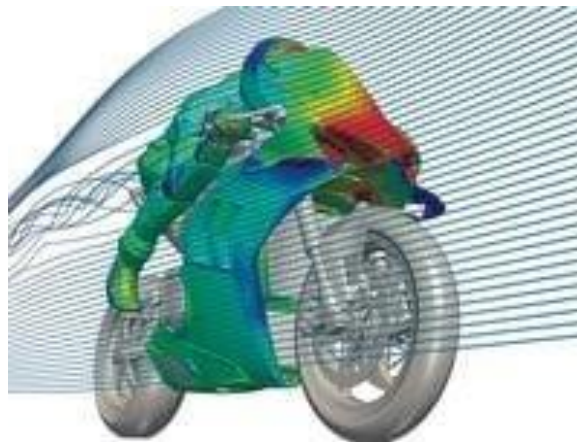


Figure 5 - Aerodynamic Flow (Cycle World, (2023).



Figure 6 - MotoGP Regulation Check (MotoGP,2022)

3.2 The Benefits of Evolution

As a result of natural progression and advancement of technology over the years there has been a huge improvement in the practicality and performance of a racing motorcycle. Many aspects of racing have evolved which has led to things like lean angle and straight-line speed being pushed to the limit.

Aerodynamic evolution has increased competition as well as technology and innovative ideology.

The 1950's Moto Guzzi race bikes aero development came as a result of wanting to find more straight line speed. This was achieved as a result of the dustbin fairing and the aerodynamic flow.

In modern aerodynamic packages, there is a wider benefit to a well thought out package. As well as cornering and straight line speed, it has also been found that the ability to control drag on the bike has increased the use of aerodynamic forces to prevent unwanted wheelies under power. In a recent interview MotoGP rider Jack Miller states "I saw a quote from somebody at Aprilia saying it's cheaper for them to develop the aero than it is the engine" (Autosport, 2024).

In Figure 7 you can see that the aerodynamic package has been designed in a way that allows air to flow upwards. This means that greater downforce is applied to the bike meaning the front tyre has greater contact with the floor. The manipulation of airflow around the motorcycle has allowed professional teams to advance development in aerodynamics over engine performance as a cost effective way to make gains.



Figure 7 - Creating Downforce (MotoGP,2024)

3.3 The Data

It is clear to see that years of evolution has led to modern day bikes being the fastest and best performing machines the championship has ever seen. This is evident when reviewing the lap data from today compared to the 1950's.

As seen in Figure 8 and Figure 9 the lap times between the GP of Assen 1955 and the GP of Assen 2024 are considerably quicker. This is a combination of multiple developments throughout the years however in terms of straight line speed and cornering ability, the evolution of aerodynamics has most definitely played a huge part.

As you can see not only are the lap times of the modern bikes around 6 and half seconds quicker but they have also broken the all time lap , best race lap and best pole records.

TT Circuit Assen

Motul TT Assen

Records	Season	Rider	Motorcycle	Time / Speed
All Time Lap Record	2024	Francesco BAGNAIA (ITA)	Ducati	1'30.540
Best Race Lap	2024	Francesco BAGNAIA (ITA)	Ducati	1'31.866
Best Pole	2024	Francesco BAGNAIA (ITA)	Ducati	1'30.540

Figure 8 - GP of Assen 2024 Lap Data (MotoGP,2024)

POS	Nº	DRIVER	TEAM	LAPS	TIME	GAP	INTERVAL	KP/H
1	?	 Geoff Duke	 Gilera	27	1:37:03.200			128.594
2	?	 Reg Armstrong	 Gilera	27	1:37:19.200	+ 16.000	+ 16.000	128.241
3	?	 Umberto Masetti	 MV Agusta	27	1:39:09.200	+ 2:06.000	+ 1:50.000	125.87
4	?	 Dreikus Veer	 Gilera	27	1:39:14.200	+ 2:11.000	+ 5.000	125.764
5	?	 Robert Brown	 Matchless	26		1 Lap	1 Lap	

Figure 9 - GP of Assen 1955 Lap Data (Motorsport Stats,ND)

4. Conclusion

4.1 The Future of MotoGP Aerodynamics

The constant research and testing by race teams on complex aerodynamic science has driven the championship to become extremely competitive. At the start of each season, the teams race to gain a competitive advantage by testing the winter development projects. This has been the case for many years, however in 2027 the FIM has announced new regulation changes to the championship within regards to aerodynamic packages on a race machine.

The changes are deemed to make racing even more competitive, exciting for the fans and safer for the riders.

MotoGP released official comments on the matter that stated “Aerodynamics will be reduced and more tightly controlled from 2027, with the aim of minimising their negative effects. The width of the top of the front fairing will be 50mm narrower and the nose will be pushed back 50mm, reducing the effect of aero where it matters, on the straights and the braking areas. This will create even closer racing, with even more overtaking.

At the back, the aero behind the rider will be part of the homologation from 2027, and teams will only be allowed to update that once per season to control costs.”

(MotoGP,2024)

4.2 My Predictions

With technology on the forefront of research methods I believe that race team simulation will take the evolution of aerodynamics further than ever. The new regulation changes mean teams will need to rethink many of the designs that have previously been developed. This may take some time, but I believe when the formula is cracked there will be remarkable outcomes.

Although some may at first think this is a step backwards, I do not believe this to be the case. In a recent interview KTM rider Jack Miller stated, “I don't think it'd be putting anybody at a clear disadvantage nowadays, because everybody's aero is pretty bloody good, they're all spending millions of dollars to develop their fairing.” MotoGP,(2024). With the new regulations on the horizon, I believe this will bring fresh and creative ways to work with aerodynamics.

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