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The Effect of Gasket Thickness Variations (Packing Block) on Power, Torque & Engine Rotation of Yamaha F1ZR

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Abstract

This study analyzes the effect of gasket thickness on motorcycle engine performance, focusing on its role in maintaining pressure and temperature within the engine, which directly influences efficiency and power output. Employing a descriptive quantitative and qualitative approach, including in-depth interviews with mechanics, racers, and engine experts, the research explores the impact of gasket thickness on engine power, fuel efficiency, and durability under various conditions. Thematic analysis of the data reveals that thinner gaskets enhance power but compromise long-term durability, offering valuable insights for practitioners and manufacturers in optimizing gasket thickness for high-performance applications.

Keywords: *gasket thickness, engine performance, Yamaha F1ZR, power, torque, dyno test*

Abstract

Penelitian ini menganalisis pengaruh ketebalan gasket terhadap performa mesin sepeda motor, dengan fokus pada perannya dalam menjaga tekanan dan suhu di dalam mesin, yang secara langsung memengaruhi efisiensi dan daya output. Dengan menggunakan pendekatan kuantitatif deskriptif dan kualitatif, termasuk wawancara mendalam dengan mekanik, pembalap, dan ahli mesin, penelitian ini mengeksplorasi dampak ketebalan gasket terhadap daya mesin, efisiensi bahan bakar, dan daya tahan dalam berbagai kondisi. Analisis tematik data menunjukkan bahwa gasket yang lebih tipis meningkatkan daya tetapi mengurangi daya tahan jangka panjang, memberikan wawasan berharga bagi praktisi dan produsen dalam mengoptimalkan ketebalan gasket untuk aplikasi performa tinggi.

Kata-kata kunci: *gasket, ketebalan, kinerja mesin, penelitian kualitatif, wawancara mendalam, analisis tematik*

1. Introduction

The development of automotive technology continues to drive significant innovation in improving the performance and efficiency of motor vehicle engines [1], [2]. The main focus of this development is to achieve an optimal balance between engine power and torque without sacrificing durability and fuel efficiency [3], [4]. Among the various engine components, gaskets play a crucial role in maintaining compression pressure, preventing combustion gas leakage, and ensuring combustion efficiency in the combustion chamber. However, understanding the effect of variations in gasket thickness on engine performance, especially on the Yamaha F1ZR motorcycle which uses a two-stroke engine, is still limited and requires further exploration [5], [6].

Previous studies have shown that modifications to gasket design and materials have a significant impact on engine performance. Zhang et al. noted that changes in gasket design can affect compression pressure, combustion efficiency, and overall engine power output. Harris highlighted the advantages of aluminum gaskets in withstanding high pressures, although their use with inappropriate thickness can reduce engine durability [7], [8]. On the other hand, Johnson and Smith found that thinner gaskets can increase engine power output, but also have the potential to accelerate engine durability degradation. These findings highlight the importance of selecting the right gasket thickness to achieve a balance between performance and durability [9], [10].

Most studies on gaskets focus on four-stroke motor vehicles or four-wheeled vehicles in general. Two-stroke engines, such as those used in the Yamaha F1ZR motorcycle, have unique characteristics that make them an interesting subject for further study. These engines are often modified for racing and everyday use, offering an opportunity to explore how variations in gasket thickness can affect their performance, durability, and efficiency. However, studies on the effects of components such as aluminum gaskets on two-stroke engines are still very limited, leaving a gap in the literature that needs to be filled [9]–[11].

This study aims to comprehensively analyze the effect of gasket thickness variation on Yamaha F1ZR engine performance. Dyno tests are used to measure parameters such as power, torque, and maximum RPM, while interviews with mechanics and racers aim to explore practical perspectives on engine performance and durability [2]. This approach is expected to provide strong quantitative data as well as relevant qualitative insights. Thus, this study not only answers theoretical questions but also offers practical guidance for automotive practitioners, both for modification and product development purposes [12].

The main objective of this study is to find the gasket thickness that provides the optimal balance between engine performance and durability [13], [14]. The results of the study are expected to enrich knowledge in the field of automotive technology, especially related to two-stroke engines. In addition, this study also aims to offer technical parameters that can be used as a reference in decision making for automotive practitioners, from technicians to manufacturers, in designing or modifying engines for racing needs or daily use [15], [16].

Through this contribution, this research is expected to provide a significant impact on the development of automotive technology, both in academic and industrial contexts. Not only providing technical solutions, this study also opens up opportunities for further research to explore the influence of other variables in the design and configuration of two-stroke engines, expanding insights into efficient and sustainable technology in the future **[15], [17].**

2. Method

StudyThis study uses a qualitative approach to determine the effect of gasket thickness variations on Yamaha F1ZR engine performance. This study was conducted at the Dyno JETZ EXHAUST Workshop, Boyolali, Central Java, which is equipped with modern equipment for engine performance testing.

a. Types of research

This study uses an experimental method to test variations in gasket thickness (0.5 mm, 0.8 mm, 1 mm, 1.3 mm, and 1.5 mm) on engine power, torque, and RPM. In addition, a qualitative approach is applied with in-depth interviews to gain insights from mechanics and racers regarding the effect of gasket thickness on engine performance. This research test method uses an experimental approach to measure the effect of aluminium gasket thickness variations (0.5 mm, 0.8 mm, 1 mm, 1.3 mm, and 1.5 mm) on the power, torque, and RPM of the Yamaha F1ZR engine. Tests were conducted using a dynamometer (dyno) to record engine performance parameters, such as power (HP), torque (Nm), and maximum RPM. Each gasket thickness variation was tested in turn, and the results were recorded in the observation table.

In addition to the experiments, a qualitative approach was taken through in-depth interviews with two mechanics and two experienced racers. These interviews aimed to gain practical insights regarding the effect of gasket thickness on engine performance, durability, and comfort of use. Data from dyno testing was validated using triangulation with practical insights from respondents to ensure consistency of results.

Data analysis was conducted by comparing experimental results and interviews to find the relationship between gasket thickness and engine performance. Conclusions are drawn based on these findings, with recommendations for optimal gasket thicknesses suitable for both racing and daily use. The research design can be seen in Figure 1.

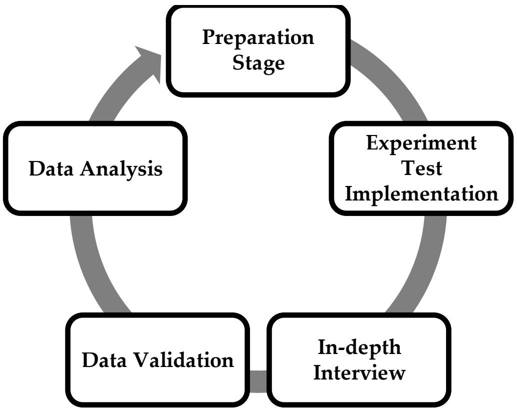


Figure 1. The Research Design

b. Materials and tools

1) Material: Aluminum gaskets with thicknesses of 0.5 mm, 0.8 mm, 1 mm, 1.3 mm and 1.5 mm; Yamaha F1ZR as a research object.

2) Tools: Dynamometer (Dyno), RPM measuring tool, computer with data analysis software, and documentation tools.

c. Data Collection Procedure

Data was collected through two main methods:

1) Dyno Test

a) Testing was carried out to measure power (HP), torque (Nm), and engine RPM at each variation of gasket thickness.

b) The test results are recorded in the form of graphs and tables for further analysis.

2) In-depth Interview

a) Respondents consisted of two mechanics and two riders who had extensive experience with the Yamaha F1ZR engine.

b) The interview focused on optimal gasket thickness recommendations, interpretation of dyno results, and the impact of modifications on engine performance.

d. Data Validity Techniques

Triangulation techniques were used to ensure the validity of the data, by comparing the results of the dyno test with insights from in-depth interviews. This triangulation ensures consistency between empirical data and the practical experiences of respondents.

e. Data Analysis Techniques

The data was analyzed through the following steps:

1) Data Reduction: Data from dyno results and interviews were filtered to focus on the effect of gasket thickness on engine performance.
2) Data Presentation: The results are presented in the form of tables and graphs to facilitate the analysis of the relationship between gasket thickness and engine performance.
3) Drawing Conclusions: Conclusions are drawn based on patterns and trends seen in the data, verifying the results through triangulation.

3. Results and Discussion

This study focuses on the effect of gasket thickness variation on Yamaha F1ZR engine performance, including power, torque, and engine durability. Through dyno test and in-depth interview approaches, it was found that gasket thickness affects combustion efficiency and compression pressure in the combustion chamber, which in turn affects overall engine performance.

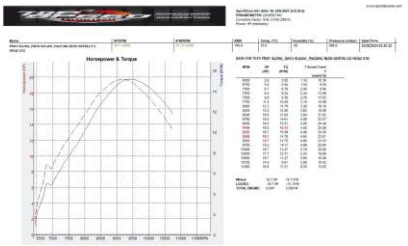
a. Dyno Test Results Analysis

Dyno test results show that a gasket with a thickness of 0.5 mm provides the highest power compared to other variations. This is due to the increase in optimal compression, resulting in more efficient combustion and high torque. However, too high compression poses a risk to engine durability, making it less suitable for daily use. In contrast, a gasket with a thickness of 0.8 mm shows a good balance between power, torque, and fuel efficiency. This choice is considered flexible because it can be used for daily needs and light racing.

The 1.0 mm gasket offers a stable compromise between performance and durability. Although its power and torque are lower than those of 0.5 mm or 0.8 mm thicknesses, its performance stability makes it ideal for users who prioritize engine durability. The 1.3 mm and 1.5 mm gaskets show a decrease in peak power, but increase engine durability. This thickness is more suitable for users who focus on fuel efficiency and long-term use. The results of the test can be seen in **Figure 2** and **Table 1.**

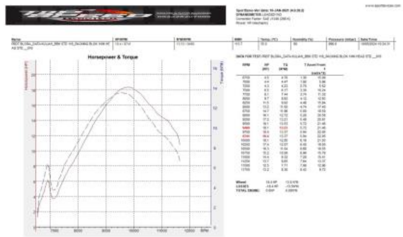
Table 1. Summary of Dyno Test Results

Gasket Thickness (mm)	Dyno Test Results	Excess	Lack
0.5	Delivers highest power with great torque	Improves engine performance, ideal for racing	Reduces engine durability, not ideal for daily use
0.8	Demonstrates the best balance between power, torque and fuel efficiency	Suitable for daily use and light racing, good durability	Slightly lower power compared to 0.5 mm gasket
1.0	Stable performance with moderate power and torque	A good compromise between durability and performance	Not optimal for racing due to power drops at high RPM
1.3	Produces good torque at low to medium RPM, lower maximum power	Increased engine durability, ideal for fuel efficiency	Does not provide significant increase in power
1.5	Provides lowest power but stable torque	Very good for increasing engine durability	Not suitable for improving performance, especially racing.

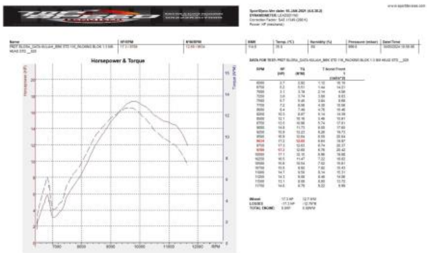


Test results of Packing Block with Thickness 0.5 mm

Test results of Packing Block with Thickness 0.8 mm



Test results of Packing Block with Thickness 1 mm



Test results of Packing Block with Thickness 1.3 mm

Test results of Packing Block with Thickness 1.5 mm

Figure 2. Test results of Packing Block with Thickness

b. Mechanic and Driver's View

The results of in-depth interviews with mechanics and racers support empirical data from dyno tests. Respondents agreed that parameters such as peak power, peak torque, and performance consistency across the RPM range are key indicators in determining optimal gasket thickness. Mechanics also emphasized that gasket modifications should be tailored to user needs, such as whether the engine is used for racing or daily use.

Most mechanics recommend a 0.8 mm gasket for daily use, as it provides the ideal balance between performance and durability. However, for racing needs, a 0.5mm gasket is considered superior in increasing power and torque, although it risks reducing the durability of other engine components.

c. Discussion

Dyno test data shows a significant relationship between gasket thickness and engine performance, including power, torque, RPM, and top speed. Gasket thickness affects the compression pressure in the combustion chamber, which in turn determines combustion efficiency and engine power output **[18]–[20].** Thinner gasket thickness, for example, increases compression pressure. This results in more efficient fuel combustion and higher power output, especially in two-stroke engines such as the Yamaha F1ZR that rely on high performance at certain RPM ranges. However, this increased pressure also has side effects, such as higher combustion chamber temperatures and increased internal pressures that can accelerate wear on components such as pistons, cylinders, and other seals.

On the other hand, the use of thicker gaskets offers different characteristics. Lower compression pressures due to the thickness of the gasket create cooler and more stable operating conditions, which reduce the risk of component damage due to wear or overheating. This makes the engine more durable, especially for daily use or under constant workload conditions. However, the side effect of higher thickness is a decrease in power and torque due to reduced combustion efficiency. This can reduce engine response, especially at high acceleration or in competitive use such as racing **[21], [22].**

This study confirms the findings of Zhang et al., who highlighted the importance of gasket design and material in improving combustion efficiency [23], [24]. Zhang et al. emphasized that gaskets play a role not only in maintaining the integrity of the combustion chamber but also in ensuring optimal pressure and temperature distribution. However, this study provides a new contribution by focusing on two-stroke engines, specifically the Yamaha F1ZR. Two-stroke engines have faster combustion characteristics than four-stroke engines, so variations in gasket thickness have a more pronounced impact on overall performance **[25], [26].**

This experiment is also relevant to the automotive industry, especially in the context of racing engine setup and vehicle modification. Yamaha F1ZR users often modify their vehicles to improve racing performance or fuel efficiency. The results of this study provide practical guidance for mechanics and users on the optimal gasket thickness limit to achieve a balance between power, fuel efficiency, and durability **[27], [28].** Thus, the implications of this study not only contribute to academic literature but also to real-world applications in the automotive world.

In addition, this study highlights the importance of understanding the trade-off between engine performance and durability. The optimal gasket thickness must be adjusted to the intended use of the engine, whether for racing, daily use, or other needs. Therefore, these results can be used to design better maintenance and modification strategies, including selecting gasket materials that can withstand high pressure and temperature without compromising their structural integrity [27], [29].

4. Conclusion

This study concluded that variations in gasket thickness have a significant effect on the performance of the Yamaha F1ZR engine. The optimum gasket thickness was found to be 0.8 mm, which provides the best balance between power, torque, and durability. This finding supports the study's objective of determining the most appropriate gasket thickness for daily use and light racing applications. A thickness of 0.5 mm provides maximum power but sacrifices durability, while thicknesses of 1.3 mm and 1.5 mm increase durability but decrease overall power performance. The main point of this study is that gasket thickness affects the compression pressure of the combustion chamber, which in turn affects combustion efficiency and engine performance. These results provide practical insights for mechanics and automotive enthusiasts to choose gasket thickness based on specific needs, both to improve racing performance and to maintain engine durability in long-term use.

This research contributes to the development of knowledge in the automotive field, especially in understanding how technical parameters such as gasket thickness can be utilized to modify the engine optimally. With the empirical data provided, this research can be a reference for further development in the design of gaskets and other engine components. Future research could explore the effects of gasket thickness on other engine types or different gasket materials, such as composite materials or alloys. In addition, research into the interaction between gasket thickness and other engine components, such as pistons or cylinders, could provide more insight. Testing under more extreme operating conditions, such as professional racing, is also recommended to more thoroughly test the durability of components.

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