

Performance of Using Spark Plugs and Fuels Variations on 4-Stroke Motorcycle Engines

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ABSTRACT

In the motorcycle ignition system, spark plugs play an important role in sparking the sparks needed to burn fuel with compressed air. The purpose of this research is to determine the ratio of torque, power, fuel consumption in 4-stroke gasoline engines produced from standard, two legged, platinum, and iridium spark plugs using pertalite, pertamax and pertamax turbo fuel. This test uses a 4 stroke 150 CC gasoline motorcycle. Motorcycle engine performance testing is done using a dynotest. The results obtained were the peak power in the Pertamina fuel test using iridium spark plugs of 14.3 Hp at 8000 RPM engine speed, 0.71% higher than Pertamina fuel using standard manufacturer spark plugs. Then the highest torque from all test data is on the Pertamina fuel test using iridium spark plugs of 13.43 Nm running the 7000 RPM engine which is 0.22% higher than Pertamina fuel using standard manufacturer spark plugs. Meanwhile, the lowest or most efficient fuel consumption was in testing the Pertamina turbo fuel using an iridium spark plug of 0.059 kg/kWh running a 6000 RPM engine, 1.69% more efficient compared to Pertamina turbo RON 95 fuel using a standard manufacturer's spark plug.

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1. Introduction

A motorcycle is a two-wheeled means of transportation that uses a gasoline engine as the prime mover. In Indonesia, motorcycle are popularly used by the public because they are easy to drive, economical and easier to maintain. Its relatively small dimensions are suitable for use in various road conditions in Indonesia with topographic characteristics which are generally lowlands, highlands, hills and mountains so that it can be used to remote areas [1].

Improving engine performance is one of the things that has always been the subject of research to get more perfect results. In general, there are several vehicle technology demands that must be met today, namely: high engine performance, fuel economy, low noise and vibration and low exhaust emissions. High-performance vehicles are currently required to have a smaller cylinder capacity (cc) and a large compression ratio, so that they still produce large power [2].

The use of three-mass spark plugs can increase engine performance compared to standard spark plugs. At 4000 rpm, the torque produced by the three-mass spark plug is 10.29 Nm, which is greater than the standard spark plug, which is 8.82 Nm. The resulting shaft power is also 4.3 kW greater than the standard 3.7 kW spark plug. Fuel consumption of 0.22

kg/hour is more efficient than standard spark plugs of 0.26 kg/hour. The use of specific fuel for a three-mass spark plug is 0.05 kg/kW.hour, which is more economical than a standard spark plug, which is 0.07 kg/kW.hour.[3]

The use of NGK Platinum C7HVX spark plugs can cause an increase in fuel consumption from the motor when compared to the use of standard NGK C7HSA spark plugs [4] and [5]

In Indonesia, in general, there are three fuels used in two-wheeled vehicles, namely premium, pertalite and Pertamina. As for one of the components of the ignition system, especially spark plugs, in Indonesia the ones that are often used by the public are standard spark plugs and platinum spark plugs.[6] Therefore researchers are interested in analyzing the relationship between variations in spark plugs and fuel on motorcycle performance, with the hope that it will be more precise in varying the use of fuel and spark plugs in motorcycle vehicles.

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2. Methods

2.1. Test Scheme



Figure 1. Combustion Motor Test Equipment Scheme

The test scheme is shown in Figure 1. which consists of components:

1. Torsimeter ,
2. Tachometer
3. Acquisition Data
4. Front wheel stop
5. Motorcycle engine
6. Roller dynamometers

2.2. Test Variables

Table 1. Test variable

	Fixed variable	Variable changes	Measured variable	control variable
Performance Using Variations Of Spark Plugs And Fuel In A 4-Stroke Motorcycle Engine	<ul style="list-style-type: none"> ● Cylinder 150 cc 4 stroke engine 	<ul style="list-style-type: none"> ● Iridium spark plugs ● Triple plug ● Recing brisk spark plugs ● Standard Spark Plug ● Fuel Variation ● Peralite ● Pertamina ● Pertamina turbo 	<ul style="list-style-type: none"> ● Power ● torque ● Fuel Consumtion 	<ul style="list-style-type: none"> ● Engine speed (Rpm)

2.3. Testing Process

The process of testing the performance of the combustion engine is carried out approximately 12 times using a dynamometer and will be carried out in different injection timing changes according to the variables carried out as shown in the following testing process table:

Table 2. Testing process

Spark Plug Variations	Fuel Variation		
	Pertalite	Pertamax	Pertamax Turbo
Standard spark plug	✓	✓	✓
Iridium spark plugs	✓	✓	✓
Triple spark plug	✓	✓	✓
Brisk spark plug	✓	✓	✓

From this data will be processed to obtain a graph of the performance of a 4-stroke engine in accordance with the test data as follows:

1. Graph of power comparison from changes in spark plug variations with fuel variations
2. Torque comparison graph from changes in spark plug variations with fuel variations
3. Graph of comparison of fuel consumption from changes in variations of spark plugs with variations in fuel.

3. Results

The following is a discussion and analysis of the results of engine performance testing on a 4-stroke motorcycle which includes a comparison of power, torque and specific fuel consumption.

3.1. Power Comparison Test Results on Spark Plug and Fuel Variations.

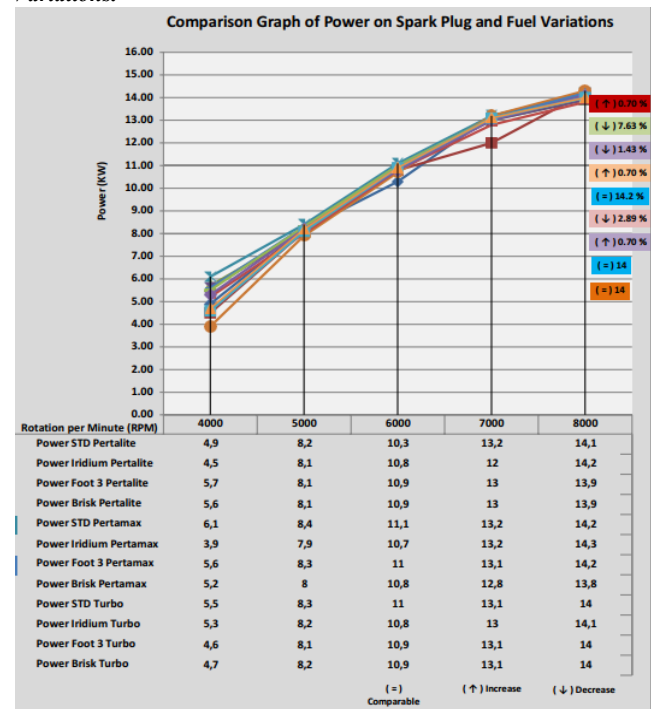


Figure 2. Power comparison graph with spark plug and fuel variations.

From the graphical image of the power comparison with variations of spark plugs and variations of fuel, the highest power is obtained at 8000 RPM engine speed, namely the use of iridium spark plugs of 14.3 HP with Pertamina fuel, while the pertalite fuel using iridium spark plugs obtains the highest power of 14.2 HP. Then on Pertamina turbo fuel using iridium spark plugs, the highest power is 14.1 HP.

On pertalite fuel using iridium or variable 1 spark plugs the peak power increases by 0.70% compared to using standard manufacturer spark plugs, then on pertalite fuel using triple spark plug or variable 2 spark plugs peak power decreases by 7.63% compared to standard manufacturer spark plugs, then on pertalite fuel using brisk spark plugs or variable 3 the peak power decreased by 1.43% compared to using standard manufacturer spark plugs.

On Pertamina fuel using iridium or variable 4 spark plugs, the peak power increases by 0.70% compared to the manufacturer's standard spark plugs, then on Pertamina fuel using triple spark plug or variable 5 spark plugs, a peak power of 14.2 HP is obtained when the engine runs at 8000 RPM comparable to the peak power using the manufacturer's standard spark plugs, then on Pertamina fuel using brisk or variable 6 spark plugs the peak power decreased by 2.89% compared to using the manufacturer's standard spark plugs.

On Pertamina turbo fuel using iridium or variable 7 spark plugs, the peak power increases by 0.70% compared to using standard factory spark plugs, then on Pertamina turbo fuel using triple spark plug or variable 8 spark plugs, a peak power of 14.0 HP is obtained . the 8000 RPM engine is comparable to the peak power using the manufacturer's standard spark plugs, then on Pertamina turbo fuel using brisk or variable 9 spark plugs a peak power of 14.0 HP is obtained at 8000 RPM engine comparable to the peak power using the manufacturer's standard spark plugs.

In the engine rotation range of 4000 to 8000 RPM the graph tends to increase, this is influenced by volumetric efficiency which tends to be high, this means that there is enough time for the air and fuel mixture to enter the cylinder during the suction stroke. A cylinder that is fully filled with a mixture of fuel and air will produce a high combustion pressure on the effort stroke. This high combustion pressure will push the piston firmly so that the power produced by the engine is higher. [7]

3.2. Torque Comparison Test Results on Spark Plug and Fuel Variations.

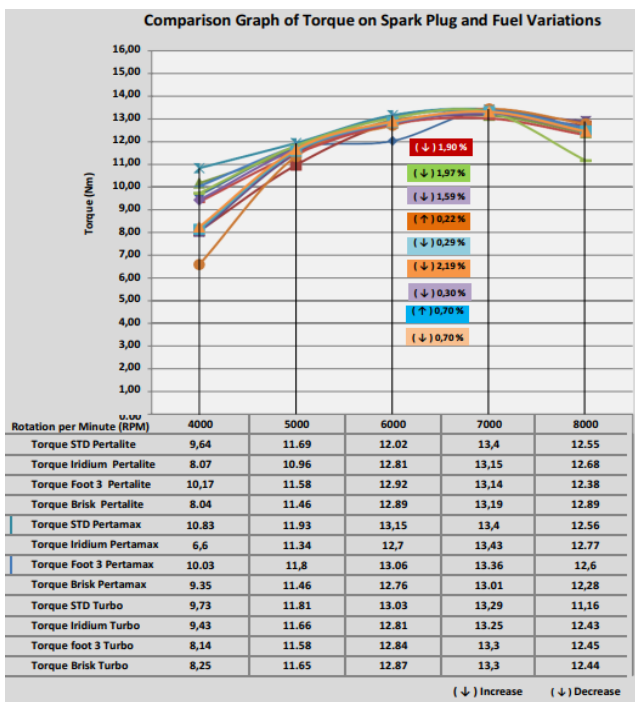


Figure 3. Comparison graph of Torque with spark plug and fuel variations.

From the graphical image of the comparison of torque with variations of spark plugs and variations of fuel, the highest torque is obtained at

engine speed of 7000 RPM, that is, on Pertamina fuel using iridium spark plugs of 13.43 Nm, while on peralite fuel using standard manufacturer spark plugs the highest torque value is 13.40 Nm. Then on the Pertamina fuel using the manufacturer's standard spark plugs the torque value is 13.43 Nm, then on the Pertamina turbo material the highest torque is obtained at 13.29 Nm.

On peralite fuel using iridium or variable 1 spark plugs the peak torque decreases by 1.90% compared to using standard factory spark plugs, then on peralite fuel using triple spark plug or variable 2 spark plugs the peak torque decreases by 1.97% compared to using standard manufacturer spark plugs , then on peralite fuel using brisk spark plugs or variable 3 the peak torque decreased by 1.59% compared to using the manufacturer's standard spark plugs.

On Pertamina fuel using iridium or variable 4 spark plugs, the peak torque increases by 0.22% compared to using factory standard spark plugs, then on Pertamina fuel using triple spark plug or variable 5 spark plugs, the peak torque decreases by 0.29% compared to using standard manufacturer spark plugs. , then on Pertamina fuel using brisk spark plugs or variable 6 the peak torque decreased by 2.19% compared to using the manufacturer's standard spark plugs.

On Pertamina turbo fuel using iridium or variable 7 spark plugs the peak torque decreases by 0.30% compared to using standard factory spark plugs, then on Pertamina turbo fuel using triple spark plug or variable 8 spark plugs the peak torque increases by 0.70% compared to using standard spark plugs manufacturer, then on Pertamina turbo fuel using brisk spark plugs or variable 9 the peak torque decreases by 0.70% compared to using standard factory spark plugs.

In the engine rotation range of 4000 to 7000 rpm the torque graph tends to increase, this is due to the higher engine speed, the volumetric efficiency results in more fuel being compressed, so that the explosion that occurs during combustion is greater. the explosion generates a large thrust on the piston head. It is this thrust that causes the torque to increase.[5]

3.3. Test Results Comparison of Fuel Consumption on Spark Plug and Fuel Variations.

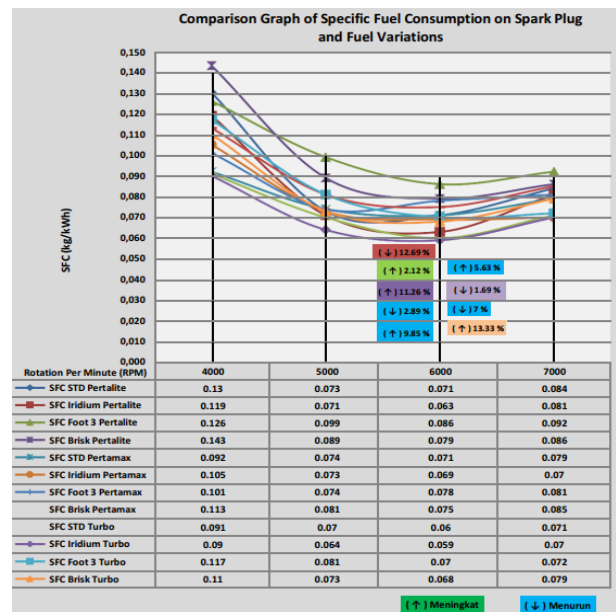


Figure 4. Comparison graph of specific fuel consumption with spark plugs and fuel variations.

From the graphical comparison of specific fuel consumption (SFC) with spark plug variations and fuel variations, it is found that the lowest specific fuel consumption is on Pertamina turbo fuel of 0.059 kg/kWh running a 6000 RPM engine using iridium spark plugs and the highest fuel consumption is on pentalite fuel of 0.143 kg/kWh the engine runs at 4000 RPM using brisk spark plugs. The lowest specific fuel consumption was on pentalite fuel using the manufacturer's standard spark plug of 0.071 kg/kWh, then on Pertamina fuel the lowest specific fuel consumption was using the manufacturer's standard spark plug of 0.071 kg/kWh, then on fuel Pertamina turbo has the lowest specific fuel consumption using the manufacturer's standard spark plug of 0.059 kg/kWh.

On pentalite fuel the lowest specific fuel consumption using iridium spark plugs decreased by 12.69% compared to using standard manufacturer spark plugs, then the lowest specific fuel consumption on pentalite fuel using triple spark plugs experienced an increase of 21.12% compared to using standard spark plugs the manufacturer then the lowest specific fuel consumption on pentalite fuel by using brisk spark plugs increased by 11.26% compared to using standard manufacturer spark plugs.

In the fuel Pertamina, the lowest specific fuel consumption using iridium spark plugs has decreased by 2.89% compared to using the standard manufacturer's spark plugs, then the lowest specific fuel consumption on the first fuel using triple spark plugs has increased by 9.85% compared to using standard manufacturer's spark plugs, then the lowest specific fuel consumption was on Pertamina fuel using brisk spark plugs which increased by 5.63% compared to using standard manufacturer spark plugs [8] and [9].

In Pertamina turbo fuel, the lowest specific fuel consumption using iridium spark plugs has decreased by 1.69% compared to using standard manufacturer spark plugs, then the lowest specific fuel consumption is on Pertamina turbo fuel using triple spark plugs, which has increased by 7% compared to using factory standard spark plugs, and the lowest specific fuel consumption on Pertamina turbo fuel using brisk spark plugs increased by 13.33% compared to using standard manufacturer spark plugs.

On the initial high specific fuel consumption (SFC) graph, this is due to the initial start of the motor, power and fuel it takes more to do the work. After the motor rotation is increased at 4000 RPM to 7000 RPM the required power increases so that the specific fuel consumption increases. (SFC) decreased. However, along with the increase in engine speed, fuel consumption also continues to increase, so that the specific fuel consumption also tends to increase. The increase in SFC will be even greater due to a decrease in power at high rotation. [10]

4. Conclusion

Based on the results of tests that have been carried out through the performance of the use of various spark plugs and fuel variations, it can be

concluded that the use of iridium spark plugs is better than standard spark plugs, tripod plugs and brisk spark plugs, namely with a value of:

1. The highest power is 14.3 HP at 8000 RPM engine speed with Pertamina fuel,
2. The highest torque is 13.43 Nm at 7000 RPM engine speed with Pertamina fuel.
3. The lowest fuel consumption is 0.059 Kg/kWh at 6000 RPM engine speed with Pertamina turbo fuel.

So that it is obtained for spark plug variations and fuel variations the best is to use iridium spark plugs with fuel using Pertamina Turbo.

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