International Applied Science
**UMJember Proceeding Series** (2023) Vol. 2, No. 2 : 86-92

**SIGMA-1 EKSAKTA**

# 2007 110-CC 4 Stroke Motorcycle Performance Test Using Pertalite, Pertamax and Avgas fuel

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Published: July, 2023



**Abstract:** Motorcycle performance can be influenced by several factors, one of which is the type of fuel. To find out the performance of the motorbike, testing can be done using tools such as a dynamometer (dynotest). This research aims to determine the performance of a 110 cc 4 stroke motorbike using pertalite, Pertamax and Avgas fuel using a dynotest, which is connected to a computer. The computer will record a graph of the results of changes in power and torque from each fuel test. In this research, the use of pertalite fuel obtained the highest performance results, namely producing maximum power of 8.9 HP at 7036 RPM engine speed with a torque value of 10.40 N*M at 4322 RPM engine speed. Meanwhile, for the use of Pertamax fuel and the use of a mixture of Pertalite fuel with Avgas, the resulting performance tends to be smaller than the performance produced by Pertalite material. So it can be concluded that the use of fuel with an octane value higher than what is recommended by the manufacturer will cause a decrease in the performance of the motorbike engine itself.

**Keywords:** , power and torque, Pertalite, Pertamax, avgas

## INTRODUCTION

A combustion engine is a type of heat engine, namely a machine that works by converting thermal energy into mechanical energy or converting chemical energy from fuel into mechanical power. Energy is obtained from the combustion process in the vehicle's combustion chamber, where the fuel is reacted with oxygen and sufficient heat is added for combustion.

Determining the type of fuel oil (BBM) is important for motorized vehicles. By using a type of fuel whose octane value matches that recommended by the manufacturer, it will of course make combustion in the engine room more perfect . Each motor vehicle company usually provides recommendations regarding the type of fuel that is suitable for the vehicles it produces.

People's opinions differ regarding each type of fuel. Of course, each type of fuel has a different octane value. Some people say that the high octane value of fuel can increase motorbike engine performance. However, most people cannot determine that the fact that a high octane value can improve the performance of the motorbike engine itself.

Quoted in the forum seconds, AS Tedjosiswojo as *Senior General Manager Technical Service Division* PT. Astra Honda Motor (AHM) revealed that for motorbike engines with the need for Pertamax type fuel specifications, if you use the Premium type, it will have an impact on reducing the performance and service life of the engine. Meanwhile, if a motorbike engine requires Premium type fuel specifications, the Pertamax type does not tend to have a significant effect on the performance of the motorbike itself.

Based on research conducted by (Yasirul Khoiri, et al. 2019) entitled The Effect of Using Pertamax, Pertalite and Premium Fuel Variations on the Performance of 115 Cc Injection Motor Engines in 2013" concluded that the use of fuel variations (premium, Pertalite and Pertamax) means Pertamax is the best fuel because it produces the greatest power and torque, namely 9.4 Hp and 9.86 Nm of torque, with high compression pressure Petamax fuel and the characteristic of Pertamax which is difficult to burn at high pressure making combustion perfect. The result will be maximum efficient power and more economical fuel consumption.

So based on the background above, the author wants to conduct research on testing the performance of a 110cc 4-stroke motorbike in 2007 using a variety of Pertalite, Pertamax, and a mixture of Pertalite and Avgas

fuel with volume ratios of 30%, 40%, and 50%. This research only focuses on testing motor performance, namely testing power and torque. The aim of this research is to find out the comparison of motor performance results produced from several variations of fuel.

## RESEARCH METHODS

This research was carried out at the YAMAHA Anugrah Sejahtera Motor Arjasa workshop located at Jl. Supriadi, Arjasa, Kab. Jember in September 2022.

The motorized vehicle used in this research is a 2007 110 cc 4-stroke motorbike with the following specifications:

| | |
|---|---|
| Machine type | 2P2, 4 Stroke, SOHC, 2 Valves (Air Cooled) |
| Diameter x stroke | 51.0 x 54.0mm |
| Cylinder volume | 110.3 CC |
| Compression comparison | 9.3 : 1 |
| Max power | 9.0 PS/8000 rpm |
| Max torque | 9.2Nm/ 5000 rpm |
| Lubrication system | Wet Lubrication |
| Engine oil capacity | 800cc Periodic Replacement |
| | Total Replacement 1000cc |
| Carburetor | Mikuni VM 17 x 1, Pilot Screw Setting 1-3.8 turns out |
| Engine idle rotation | 1,500 rpm |
| Engine air filter | Dry type |
| Starting system | Starter Motor and Crank Starter |
| Transmission type | 4 Speed ROTARY Type (N-1-2-3-4-N) |

The research method used in this research is an experimental method. The experimental method is a method used to test the effect of a new treatment or design by comparing the design with a design without treatment as a control or comparison. The experimental method can also mean comparing tests of several treatment variations with tests without variations as a comparison.

In this research, it was carried out by comparing the power and torque results produced by 110cc motorbikes using Pertalite, Pertamax, and Pertalite mixed with avgas fuel. The test is carried out using a power and torque testing process. From these results, comparative data is obtained.

In carrying out this research, the first step that must be prepared is to prepare fuel such as pure pertalite fuel, pure Pertamax and also a mixture of pertalite and avgas fuel with a volume ratio of 70% pertalite + 30% avgas, 60% pertalite + 40% avgas and 50% pertalite. % + avgas 50%. After completing the fuel preparation, the next stage is to lift the motorbike or test material to the dynotest tool and install all the dynotest hardware on the vehicle. After everything is installed, then fill the fuel into the burette which is connected to the carburetor. The next stage is collecting data using a dynotest according to the specified fuel variations. After data collection for all fuel variations has been completed, the final step is to remove all dynotest hardware installed on the vehicle and also turn off the dynotest software.

Figure 1. Dynotest

After the test results are complete, the next step is analyzing the test result data. Analysis of test result data can also be done by calculating using predetermined power and torque formulas. The purpose of calculating power and torque is to obtain more accurate power and torque results. The following is the power and torque calculation formula:
To calculate the amount of power, the following rumors can be used:

$$P = \frac{2\pi(n.T)}{60000}(kw) \quad \text{..... (1)}$$

Where :

P: Motor power (HP)

n: Engine speed (RPM)

T: Torque (Nm)

(Heywood, 1988; 46)

The rotating compressive force on the rotating part is called torque, the motor engine is driven by force through the drive rod. Torque or moment of force is the force to rotate an object around its axis. So torque can be thought of as a rotating force on an object. The units used are Nm ( *Newton meters* ) or *lbs ft* ( *pound feet* ). From this definition, the torque formula is:

$$\mathrm{T} = \frac{\mathrm{Pm.A.L.i}}{\mathrm{a}};\ \text{atau}\ \ \mathrm{T} = \mathrm{W.b} \quad \text{..... (2)}$$

Where

T : Torque (Nm)

Pm : Average effective pressure (kgf/cm2)

F : Force (Newton)

A : Cylinder cross-sectional area (cm2)

b : Distance (meters)

L : Piston stroke length (m)

i : Number of cylinders

a : Number of rotation cycles , 4 stroke

(Jalius Jama & Wagino, 2008 :23)

## RESULTS AND DISCUSSION

### 1. Engine Performance Results Data

1. Power and torque results using 100% pertalite fuel.

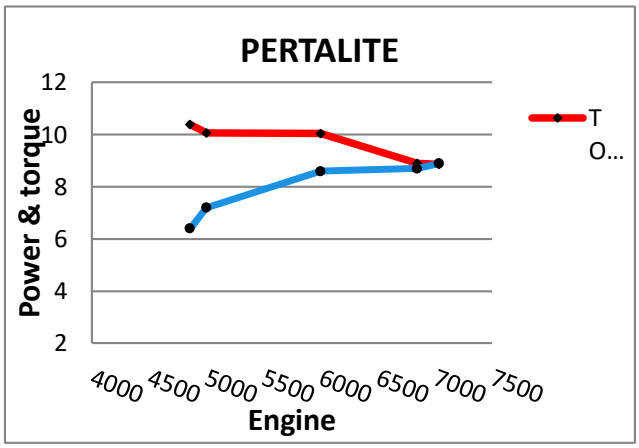


Figure 2. Power and torque graph using pertalite fuel

It can be seen from the graph above that the power produced using pure pertalite fuel is 6.4 HP at an engine speed of 4322 RPM, and the power continues to increase until the last rotation, namely 7036 RPM with a maximum power of 8.9 HP. Meanwhile, the torque results at rotation between 4322 RPM show the highest torque results, namely 10.40 N*m. As the engine speed increases, the torque produced between 5000 RPM engine speed to 7500 engine speed decreases, namely getting a torque of 8.86 N*m at 7036 RPM.

2. Power and torque results using Pertamax fuel

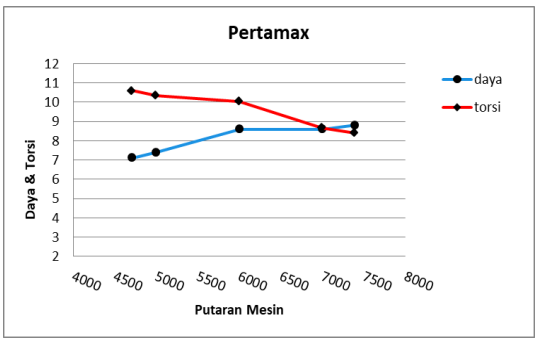


Figure 3. Graph of engine power and torque using Pertamax fuel

We can see from the graph above that the engine power produced by pure Pertamax fuel is 7.1 HP at 4713 RPM engine speed, 7.4 HP at 5000 RPM, 8.6 HP at 6000 to 7000 RPM, and 8.8 HP at 7395 RPM. Meanwhile, the torque produced is aimed at 4713 RPM, namely 10.59 N*m, then from 5000 RPM engine speed to 7500 RPM the torque results continue to decrease as the engine speed increases.

3. Power and torque results using a fuel mixture of 70% pertalite + 30% avgas

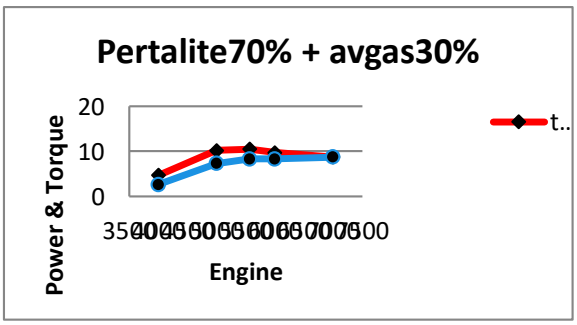


Figure 4. Engine power and torque results using a fuel mixture of 70% pertalite + 30% avgas

For the power produced from using a mixture of pertalite and avgas fuel, we can see that at an engine speed of 4000 RPM, a power output of 2.6 HP appears. and as the engine speed increases, the power output continues to increase until at 7000 RPM, which produces power of 8.7 HP. And the torque output at 4000 rpm is 4.65 N*M and continues to increase until the engine speed is 5571 RPM, namely 10.47 N*M, but the torque results decreased at 6000 RPM engine speed up to 7000 RPM engine speed, namely 8.72 at 7003 RPM engine speed.

4. Engine power and torque results using a fuel mixture of 60% pertalite + 40% avgas

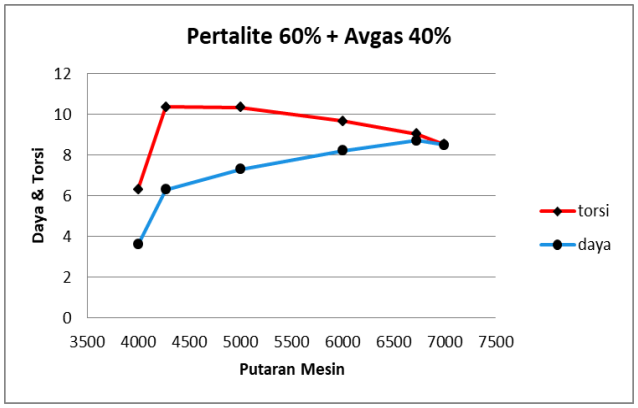


Figure 5. Engine power and torque graph using a 60% + 40% pertalite fuel mixture

For the power produced from using a fuel mixture of 60% pertalite and 40% avgas, we can see that at an engine speed of 4000 RPM, a power output of 3.6 HP appears. and as the engine speed increases, the power output continues to increase until the engine speed is 6728 RPM, which is 8.7 HP. at 7000 RPM the power produced decreases to 8.5 hp and the torque produced with a mixture of pertalite and avgas fuel at 4000 RPM to 4273 RPM is 10.35 N*M. and then at 5000 RPM to 7000 RPM the torque produced continues to decrease to 8.51 N*M at 7000 RPM.

5. Engine power and torque results using a fuel mixture of 50% pertalite and 50% avgas

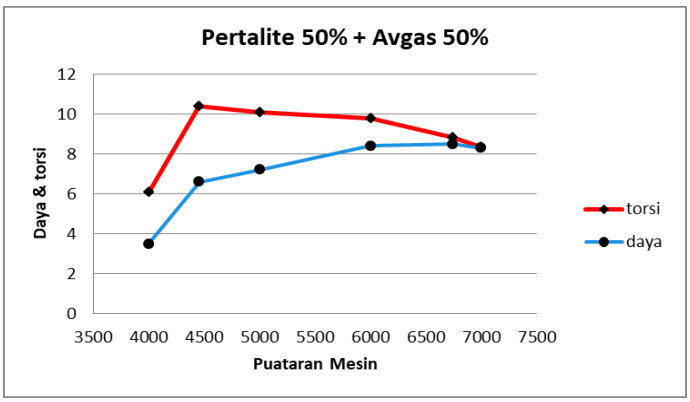


Figure 6. Engine power and torque using a fuel mixture of 50% pertalite and 50% avgas

From the table above we can see that the effective power produced by the engine continues to increase as the engine speed increases, namely 3.5 HP at 4000 RPM, 6.6 HP at 4456 RPM, 7. HP at 5000 RP, 8.4 HP at 6000 RPM, 8.5 at 6745 RPM. However, at 7000 RPM the effective power produced starts to fall again, so that at 7000 RPM the power produced is 8.3 HP. and Meanwhile, as seen at 4000 RPM to 4456 RPM, it produces an effective torque of 10.39 N*M, then slowly the torque produced continues to decrease even though the engine speed is getting higher. at 5000 RPM to 7000 RPM the torque produced continues to decrease to 8.51 N*M at 7000 RPM.

## 2. Power Analysis

Based on figures 2 to 6, the maximum power of each fuel is obtained. The maximum power of the five fuels can be seen from the graph as follows:

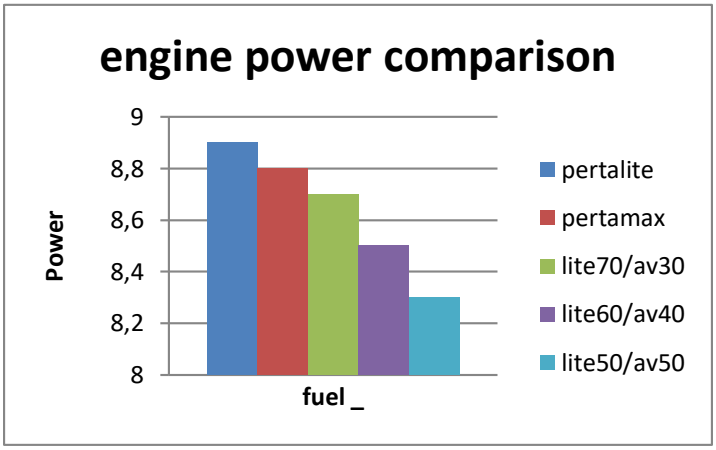


Figure 7. Comparison of engine power results

Based on the table above, we can see the effective power results for each fuel used using a 110 cc 4 stroke motorbike. The graph above shows the power results for each fuel, namely, the use of Pertalite fuel produces an effective power of 8.9 HP at an engine speed of 7036 RPM, the use of Pertamax material produces an effective power of 8.8 HP at an engine speed of 7395 RPM, the use of a Pertalite fuel mixture of 70% + 30% avgas produces an effective power of 8.7 HP at an engine speed of 7000 RPM, the use of a fuel mixture of 60% pertalite + 40% avgas produces an effective power of 8.7 HP at an engine speed of 6728 RPM. And finally, the use of a 50% pertalilte fuel mixture + 50% avgas produces a power of 8.5 HP at an engine speed of 6745 RPM.

So, based on the discussion above, Pertalite fuel is the most suitable fuel for 110 cc 4 stroke motorbikes, because from this discussion, Pertalite material shows the highest power value among the other test fuels. Apart from that, if you look at it from an economic perspective, Pertalite fuel is also superior because the price is cheaper than Pertamax fuel.

## 3. Engine torque analysis

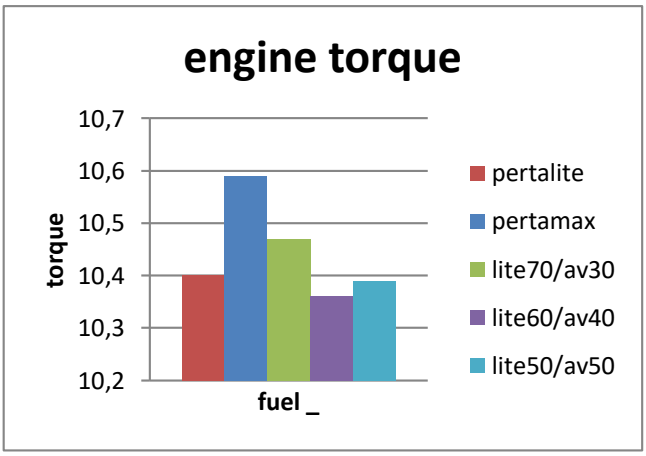


Figure 8. Comparison of engine torque results

Based on the graph above, we can see the effective torque results for each fuel, namely the use of Pertalite fuel produces the highest torque of 10.40 N*m at 4322 RPM engine speed, Pertamax fuel produces the highest torque of 10.59 N*M at 4714 RPM, Pertalite fuel 70% + 30% avgas produces the highest torque of 10.47 engine rotation 5571 RPM, 60% + 40% pertalite fuel produces the highest torque of 10.35 engine rotation 4273 RPM, and for 50% pertalite + 50% avgas fuel produces the highest torque of 10.39 engine rotation 4456 RPM . So from this explanation, the highest torque is shown when using Pertamax fuel, namely

10.59 engine revolutions 4714. The resulting torque graph is in accordance with the statement according to (Ganesan, 2006), that the torque value of all types of fuel variations tested has the same tendency, namely increasing. and also decreases as the engine speed increases.

## 4. Calculation of each effective power using various fuels.

To obtain valid data results, the researchers also carried out manual calculations of the power that had been generated. The following is a calculation of the power produced by the Pertamax material, Pertalite. And also a mixture of pertalite fuel with avgas:

a. Calculation of pertalite fuel at 7036 RPM engine speed

$$p = \frac{2\pi(n.t)}{60.000} = \frac{2\ x\ 3{,}14(7036\ x\ 8{,}86)}{60.000}$$
$$= \frac{6{,}28\ x\ 62338{,}96}{60.000} = \frac{391.488{,}66}{60000} = 6.5248 \text{ kw} = 8.9 \text{ HP}$$

b. Pertamax fuel calculation at 7395 RPM engine speed

$$p = \frac{2\pi(n.t)}{60.000} = \frac{2\ x\ 3{,}14(7395\ x\ 8{,}40)}{60.000}$$
$$= \frac{6{,}28\ x\ 62118}{60.000} = \frac{390101{,}04}{60.000} = 6.5016 \text{ kw} = 8.8 \text{ HP}$$

c. Calculation of 70% pertalite fuel + 30% avgas at 7003 RPM engine speed

$$p = \frac{2\pi(n.t)}{60.000} = \frac{2.3{,}14(7003\ x\ 8{,}72)}{60.000}$$
$$= \frac{6{,}28\ x\ 61066{,}16}{60.000} = \frac{383494{,}48}{60.000} = 6.4 \text{ kw} = 8.7 \text{ HP}$$

d. Pertalite fuel calculation 60% + 40% avgas at engine speed 6728 RPM.

$$p = \frac{2\pi(n.t)}{60.000} = \frac{2.3{,}14(6728\ x\ 9{,}04)}{60.000}$$
$$= \frac{6{,}28\ x\ 60.821}{60.000} = \frac{381.955}{60.000} = 6.4 \text{ kw} = 8.7 \text{ HP}$$

e. Calculation of 50% pertalite fuel + 50% avgas at 6745 RPM engine speed

$$p = \frac{2\pi(n.t)}{60.000} = \frac{2.3{,}14(6745\ x\ 8{,}84)}{60.000}$$
$$= \frac{6{,}28\ x\ 59.625}{60.000} = \frac{374.450}{60.000} = 6.24 \text{ kw} = 8.5 \text{ HP}$$

## CONCLUSION

Based on the results of research carried out on a 110 cc 4 stroke motorbike using a variety of fuels, it can be concluded that the highest performance is obtained when using pertalite fuel, namely producing 8.9 HP of power. Pertalite fuel is slightly superior to Pertamax fuel even though the octane value of Pertamax material is higher and the use of a mixture of Pertalite and Avgas fuel produces the lowest performance, this is because the octane value contained in Avgas is too high which results in excessive heat in the space. burn so that some of the fuel experiences self-ignition which is usually not caused by sparks from the spark plug. To get maximum results when using a fuel mixture, it is necessary to adjust the compression ratio on the test motorbike, and it is also necessary to test specific fuel consumption and exhaust emissions.

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