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Analysis of the Effect of Bore Up Variation on Engine Performance

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Abstract*. The purpose of this study was to determine the power, torque and fuel consumption of a Kawasaki Athlete motorcycle engine with a standard engine comparison, bore up of 0.50 mm, bore up of 1.00 mm, and bore up of 1.50 mm. The testing process uses a dynotes engine. With Pertamax fuel type. From the results of research that has been done, the performance has increased compared to the performance on a standard engine. The highest power is found in the 1.50 mm bore up variation of 10,2 Hp, the lowest power is found in the standard engine of 3,5 Hp. The highest torque is found in the 1.50 mm bore up variation of 10,31 N.m, the lowest torque is found in the standard engine of 3,40 N.m. For fuel consumption in each variation of the bore up has increased.*
Keywords *- Bore up, Torque, Power, Fuel Consumption.*

INTRODUCTION

Motorcycles are vehicles that can facilitate mobility. This type of transportation is widely used by people for daily activities [1]. With the very importance of this vehicle, people choose a motorcycle that has good performance in all fields [2, 3].

Basically there are two types of motor work systems, namely 2 stroke and 4 stroke motors [4]. In general, nowadays motorcycle engines use a 4 stroke motor working system. The working system of a 4 stroke engine is the intake stroke, compression stroke, power stroke, exhaust stroke [5].

However, due to people's dissatisfaction with the performance of their vehicles, the idea arose to change the components of the motorcycle engine in order to get the desired performance [6]. In the world of the automotive industry, there are already many components that support better engine performance, such as modern piston carburetor and CDI racing [7]. These components function to boost engine performance [8].

One of the most popular options for people to boost engine performance is to enlarge the combustion cylinder (bore up) or often called oversize [9]. Bore up is the enlargement of the cylinder bore and replacing the piston size which is larger than the previous size [10]. To get even better performance, it is necessary to replace standard components with more sophisticated and supportive components [11]. But will enlarging the combustion cylinder without changing the components to be more sophisticated and supportive will still get better performance than performance with standard components? It is this condition that needs to be known, will result in better performance or even reduce the performance of the engine itself. Therefore, researchers are interested in knowing how much the increase in engine performance is based on the effect of bore up variations.

METHODS

A. Engine Performance Reference

Engine performance is generally expressed in the form of a graph that depicts between two references, for example between power and speed. Thus the performance of the machine can be made as an achievement graph. References discussed to determine engine performance are:

Engine Torque

The turning moment (torque) is the product of the force and the distance. During the business process, the pressures that occur in the motor cylinder cause an extraordinary force on the piston. The force is transferred to the crank pin through the piston rod and results in a turning moment or torque on the crankshaft [1]. The amount of engine torque can be calculated by the formula:

$$M = F.2.\pi.r$$

Description:

M = Torque (N.M)
F = Style on the piston (N)
R = Crankshaft radius (M)

Engine Power

Engine power is the engine's ability to do work expressed in units of Nm/s, Watts, or HP. To calculate the amount of power, it is necessary to know the average pressure in the cylinder during the working stroke. The average pressure of a four-stroke gasoline engine is 6-9 MPa.

The amount of engine power can be calculated by the formula:

$$Pi = \pi . A . s . n$$

In a four-stroke motor, every two rotation of the crankshaft there is one stroke of effort. Then the engine power formula for a four stroke motor is:

$$Pi = \pi . A . s . n/2$$

Description:

Pi = Power indicator (watt)
π = Average pressure indicator (N/m2)
A = Piston diameter (m2)
S = Piston stroke (m)
n = Rotation frequency (Hz).

Fuel Consumption

Fuel consumption is the amount of fuel per unit time used to produce 1 HP of power. For fuel consumption, only the volume of fuel per unit time (ml/hour).

$$Fc = V \times \frac{3600}{t} .$$

Description:

Fc = Fuel Consumption (l/h)
V = Volume of fuel used (ml)
t = Time spent on fuel consumption (s)

The method used in this research is the experimental method. The experimental method is the method used to test by comparing before and after treatment as a controller. In this testing process, dynotes are used to determine the power and torque produced for each variation of bore up size 0.50 mm, 1.00 mm, 1.50 mm. For testing fuel consumption, it is done by taking data at engine speed of 4000, 5000, 6000, 7000 rpm by calculating how long it takes to spend 15 ml of Pertamax fuel.

B. Testing Installation

In this study, to determine power, torque, and fuel consumption on standard engines, bore up 0.50 mm, bore up 1.00 mm, and bore up 1.50 mm, a tool called dynotest was used. The following are the steps for data collection:

1. Prepare the motorcycle.
2. Prepare the dynotest test equipment.
3. Prepare a measuring tube to measure fuel consumption.
4. Raise the motorcycle on the dynotes engine, making sure the rear tires of the motorcycle fit on the dynotest roller.
5. After everything is ready, take power and torque data
6. Disconnect the fuel hose from the motorcycle gas tank leading to the carburetor.
7. Install the measuring tube hose on the carburetor
8. Once Installed do a fuel consumption test.

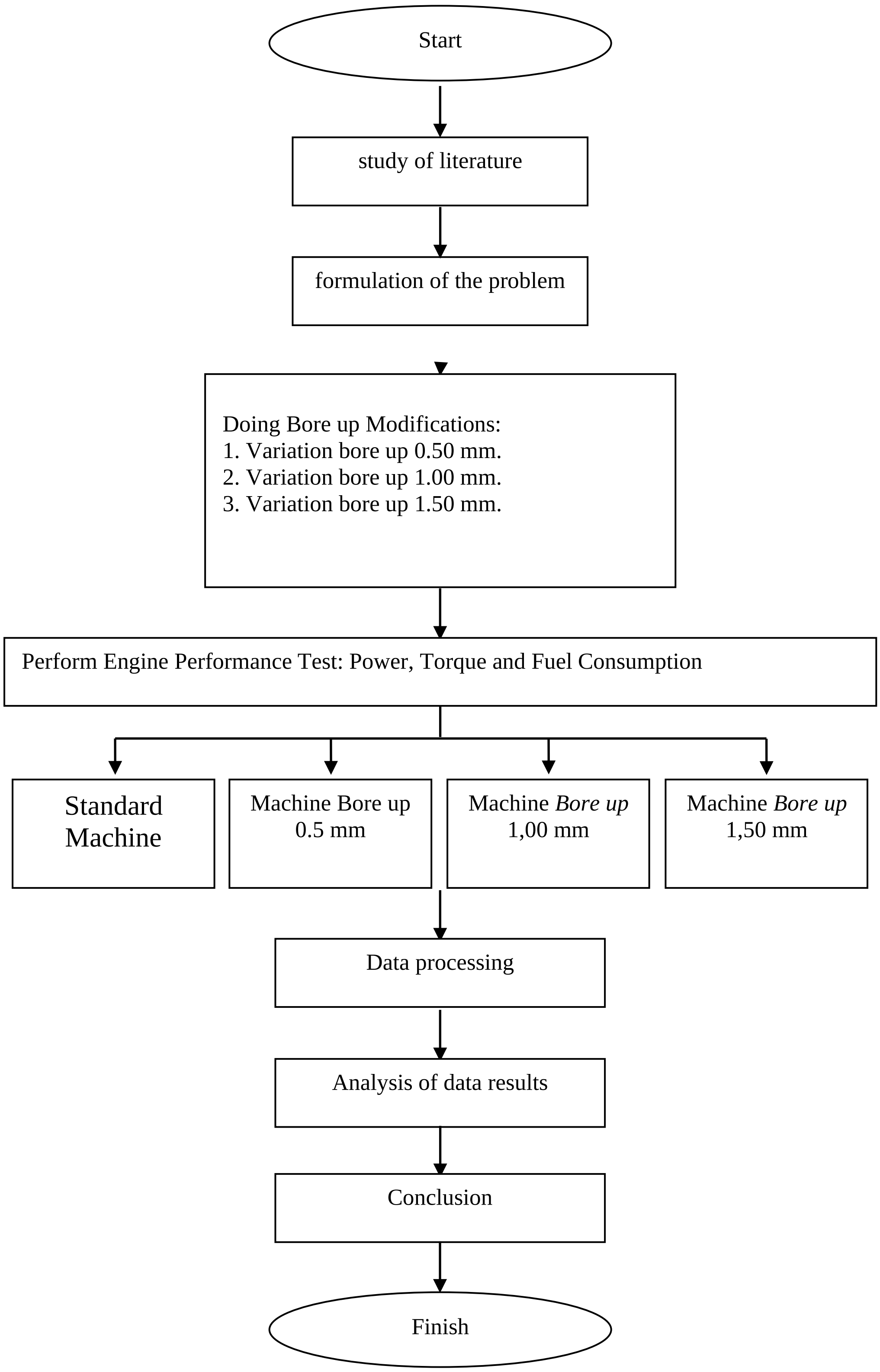

Figure 1. Research Flowchart

RESULTS AND DISCUSSION

A. Power Test results

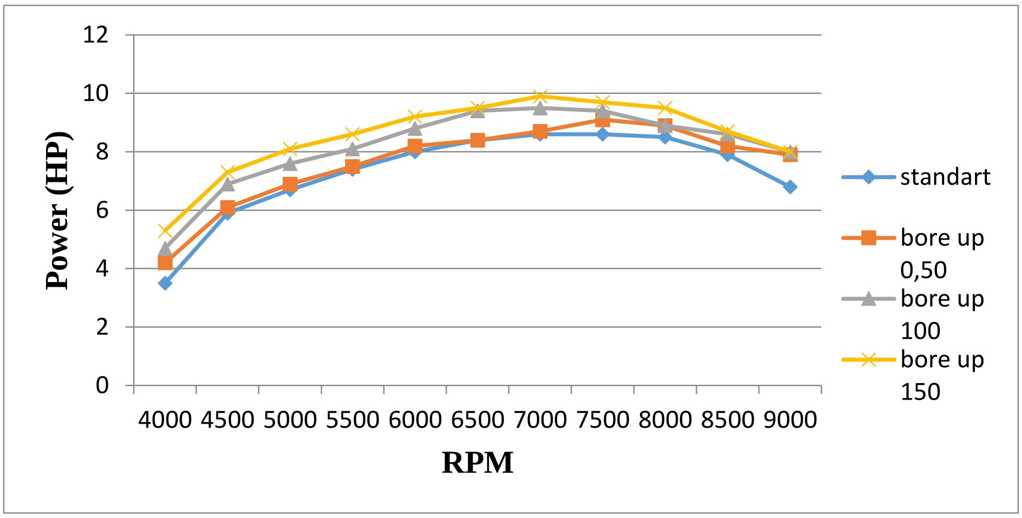

Figure 2. Power Graph

From the power test data on standard machines and bore up 0.50 mm, 1.00 mm, 1.50 mm, the highest and lowest power values were obtained. On the standard engine, the highest result is 8.7 HP at 7300 rpm engine speed and the lowest value is 3.5 HP at 4000 rpm engine speed. On the 0.50 mm bore up engine, the highest power is 9.2 HP at 7589 rpm engine speed, the lowest value is 4.2 HP at 4000 rpm engine speed. The 1.00 mm bore up engine has the highest power of 9.6 HP at 7410 rpm while the lowest value is 4.7 HP at 4000 rpm. On the 1.50 mm bore up engine, the highest value is 10.2 HP at 7340 rpm engine speed and the lowest value is 5.3 HP at 4000 rpm engine speed.

B. Torque Test Results

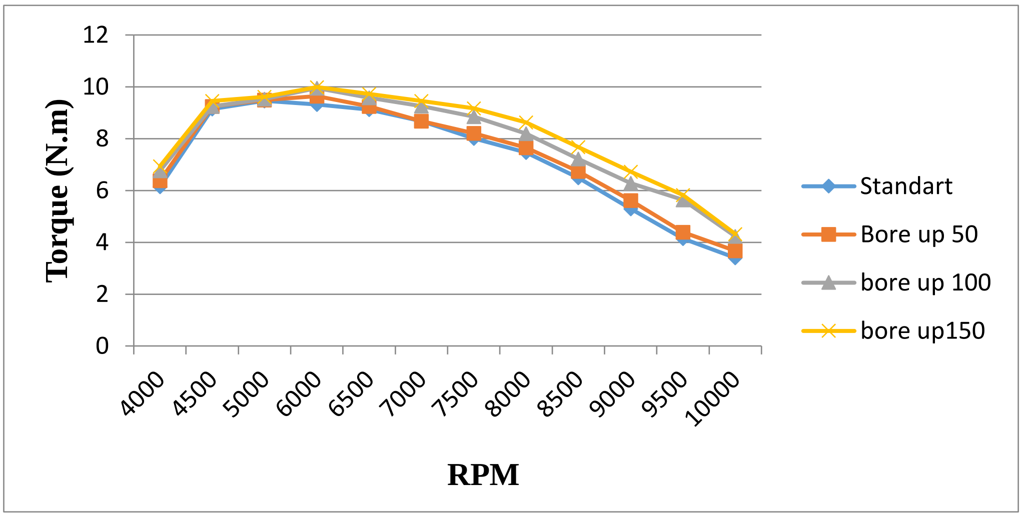

Figure 3. Torque Graph

From the torque test data on standard machines, bore up 0.50 mm, 1.00 mm, 1.50 mm, the highest and lowest torques are obtained. On the standard engine, the highest result is 9.59 N.m at 5251 rpm and the lowest value is 3.40 N.m at 10000 rpm. On the 0.50 mm bore up engine, the highest result is 9.89 N.m at 5651 rpm engine speed, the lowest value is 3.67 N.m at 10000 rpm engine speed. In the 1.00 mm bore up engine the highest result is 10.26 N.m at 6110 rpm engine speed, the lowest value is 4.23 N.m at 10000 rpm engine speed. In the 1.50 mm bore up engine, the highest result is 10.31 at 6062 rpm engine speed while the lowest value is 4.32 N.m at 10000 rpm engine speed.

C. Fuel Consumption Test Results

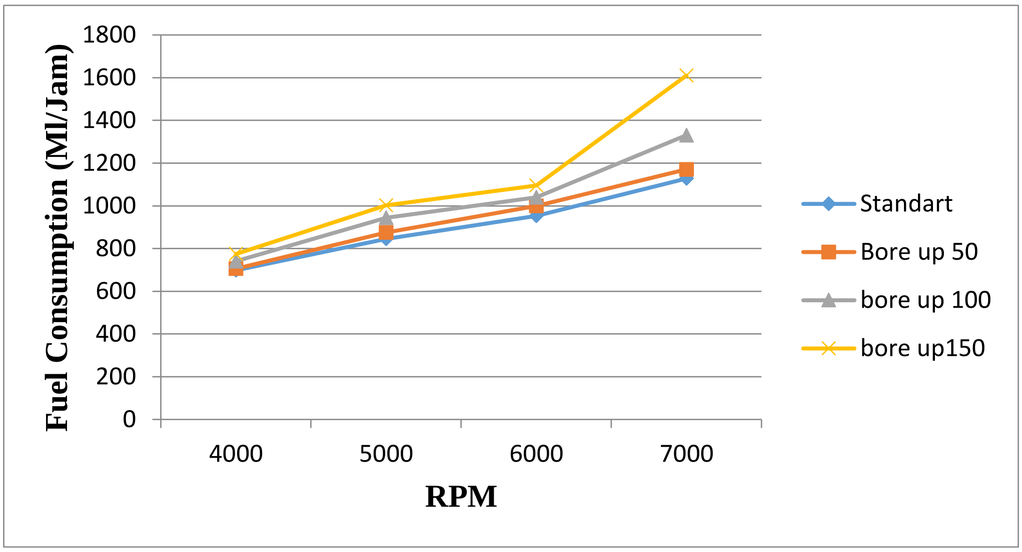

Figure 4. Graph of Fuel Consumption

From the test data on fuel consumption on standard engines, bore up 0.50 mm, 1.00 mm, 1.50 mm, the lowest and highest fuel consumption were obtained for each cylinder size variation. On a standard engine, the lowest yield is 698.3 ml/hour at 4000 engine speed and the highest is 1127.8 ml/hour at 7000 engine speed. Variation of bore up 0.50 mm, the lowest is 705.6 ml/hour at 4000 engine speed, the highest is 1170.8 ml. /hour at 7000 engine speed. The lowest variation of bore up 1.00 mm is 740.8 ml/hour at 4000 engine speed, the highest is 1330.7 ml/hour at 7000 engine speed. At 1.50 mm bore up engine the lowest result is 774.4 ml/hour at 4000 rpm engine speed and the highest yield is 1095.1 ml/hour at 7000 rpm.

D. Data Analysis

In this test using a 3rd gear transmission because if you use the lowest or largest gear the data generated will be less than optimal. For example, if you use gear 1 or 2, torque and power will still be generated, but for power the results will be less than optimal and vice versa if you use gear 4, the torque and power are also read but the torque is less than optimal and it takes longer to get maximum results. Data collection starts at 4000 rpm because if the data collection starts from 0 rpm, the results will be less than optimal considering that data collection is carried out using a 3rd gear transmission.

The results of the data obtained show that after the bore up the engine performance and fuel consumption increase due to denser compression and the combustion process is getting bigger, so more fuel intake is needed. Because if there is less fuel intake, the combustion process will be dry.

CONCLUSION

From the results of this research, it can be concluded that the engine performance on a motorcycle engine that has made changes to the cylinder block with bore up variations of 0.50 mm, 1.00 mm, 1.50 mm results in increased performance, the highest power generated is 10.2 HP at bore up variation 1.50 mm. The highest torque is 10.31 N.m at 6062 rpm engine speed at a variation of 1.50 mm. The standard piston diameter has a more efficient fuel consumption compared to engines with bore up variations of 0.50 mm, 1.00 mm, and 1.50 mm. The bore up variation, the greater the fuel consumption, the more wasteful the fuel consumption will be because the increasing compression in the engine requires more fuel.

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