MODIFICATION EFFECT OF VOLUME CYLINDER FOUR STROKE ENGINE TO EFFECTIVE POWER

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Abstract: To improve the ability, power changes (performance) of a motor used for racing most mechanics do modifications to the cylinder volume. When the motor cylinder enlarged, the enlarged combustion volume, so that automatically will increase the compression ratio and compression pressure effect on the combustion pressure rise as well, in order to obtain great power. Bore up is a way to increase the volume of the contents of the cylinder, using a piston that has a larger diameter than the standard. So that the cylinder and piston are enlarged, the fuel and air for combustion in the engine can be more obtainable with high compression ratio that produces greater energy (torque) and a higher engine speed (rpm). In the discussion of this study the author discusses the influence of bore up the engine on the motorcycle supra x-cylinder 125 cc of cylinder diameter 52.4 mm to 54 mm, the things that need to be reviewed in this discussion include: Changes in power (performance), changes in torque before and after the engine in the bore up.

Keywords : Bore up, power, torque, an increase in the volume of the cylinder.

INTRODUCTION

Along with the rapid competition in the automotive and more people are thinking of adding to the engine it has, among others, by improving the performance and power bore up the motor by means of the moment of choice for modifying the motor, this way is considered more efficient and improve the ability praktis.Untuk a motor that is used for most racing mechanic make modifications to the cylinder volume. When the motor cylinder enlarged, the enlarged combustion volume, so that automatically will increase the compression ratio and compression pressure effect on the combustion pressure rise as well, in order to obtain great power. Bore up is a way to increase the volume of the contents of the cylinder, using a piston that has a larger diameter than the standard. So that the enlarged cylinder piston that will be used in order to fit in the cylinder, then the fuel and air for combustion in the engine can be obtained with much higher compression ratio that produces greater energy (torque) and engine rotation (rpm) higher.

The things to consider in doing bore up bore up is prior to the beginning of the machine see first volume, initial power, power end, effective pressure, thick liner and piston diameter would be used.

In the discussion of this study describes the influence of the author only bore up the engine on the motorcycle supra x-cylinder 125 cc of size 52.4 mm to 54 mm 4 stroke engine, the things that need to be limited in this discussion include:

1. Changes in power (performance) before and after the engine in the bore up.
2. Change the engine torque before and after in the bore up.

The purpose of this paper is to find out how much difference the effective power, torque, and how much fuel consumption generated by the engine on the motorcycle that bore up the experience.

BASIC THEORY

As is the combustion engine is an engine in which the mechanical energy obtained by burning fuel in the engine itself. Therefore, combustion engine sometimes classified in heat engines (Internal Combustion Engine).

One of the prime movers that are widely used heat engine, which is a machine that uses thermal energy to mechanical work, or change the thermal energy into mechanical energy. Energy itself can be obtained by the combustion process.

Parts of Internal Combustion Engine

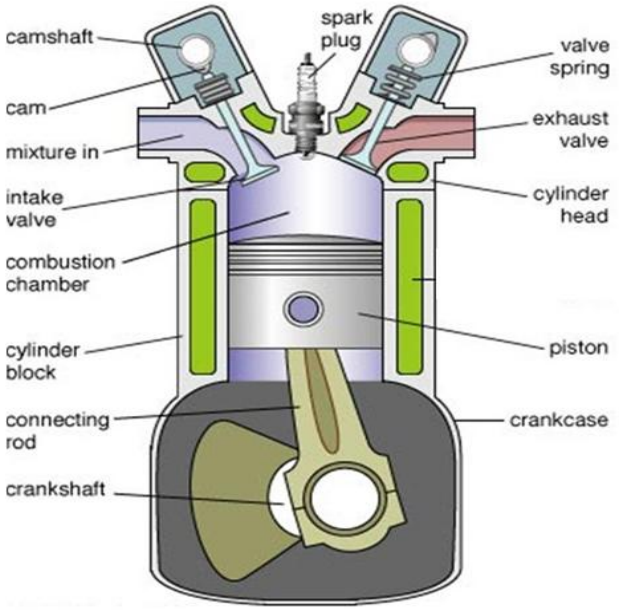
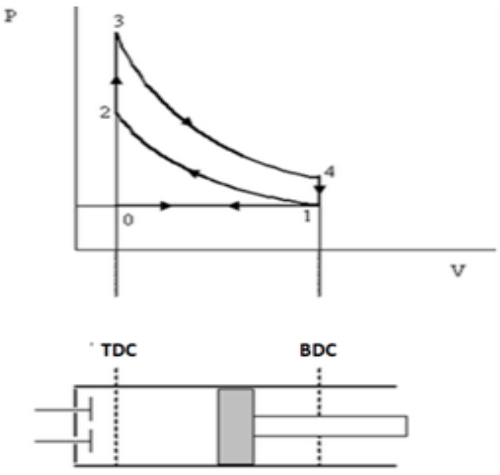


Figure 1. Parts of The Internal Combustion Engine



Remarks:
P = pressure of the working fluid (kg / cm2)
V = Volume (cm3)
TDC = Top Dead Point
BDC = Bottom Dead Point

0-1 intake stroke
1-2 compression stroke
2-3 combustion process (Process inclusion heat at constant volume)
3-4 working stroke
4-1 heat release process
1-0 exhaust stroke

Figure 2. Otto Cycle (Four Stroke Internal Combustion Engine)

The plunger (piston)

Piston which functions as a tool to suck the fuel, compress the fuel (compression), to accommodate the high-pressure power with higher temperatures. When the piston is replaced with a larger size, automatically measure the cylinder bore must be enlarged also in accordance with the relevant piston diameter and cylinder bore enlarging the term referred to the crankcase. See: RS. Northop. Motorcycle Repair Technique (1987, p: 36).

Figure 4. Cylinder and plunger (piston)

Volume of Cylinder

The total volume (Vt) obtained from the total volume of the piston stroke (V1) and clearence volume (VC). The volume of the piston stroke (V1) obtained from stroke piston is at TDC and BDC. Where large volumes of steps depending on the cylinder diameter (D) and the piston stroke length (L) usually has a unit cubic centimeters (cc).

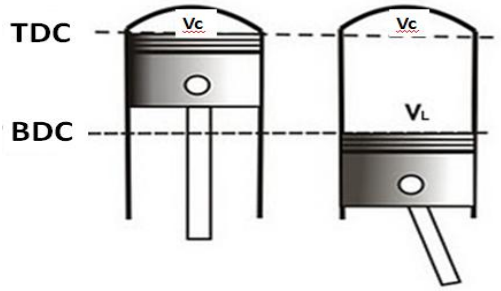


Figure 5. The volume of a cylinder

$V_t = V_L + V_c$

V_L = Area circle x length stroke

$$VL = \frac{\pi \; x \; D^2 \; x \; L}{4}$$

where:

V_L = Stroke volume (cm3)
D = Cylinder diameter (cm)
L = Stroke length (cm)

Clearence volume

Clearence volume (Vc) obtained from stroke piston is at TDC and the combustion chamber.

$V_c = V_t - V_L$

Thus, the amount and size of cylinder combustion engine by volume depending on the number of cylinders used and the size of the cylinder.

The compression ratio

The compression ratio is the number of comparisons between the total volume and the volume of clearance.

$$\varepsilon r = \frac{VL + Vc}{Vc}$$

where:

r = The compression ratio
V_L = Stroke volume (cm3)
Vc = Clearence volume (cm^3)

Effective power in the Internal Combustion Engine

Motor power is the amount of motor work for a certain time to address all engine load, engine four stroke effective power (4 stroke) uses one cylinder is:

$$Ne = \frac{Pe\ x\ Vl\ x\ n\ x\ z\ x\ a}{100\ x\ 60\ x\ 75}$$

Where :

Ne = Effective Power (PS)
Pe = Mean pressure effective (kg/cm^2)
D = Cylinder diameter (cm)
n = Engine Speed (rpm)
V_L = Stroke volume (cm3)

Torque moment

Torque is a measure of the ability of a machine to do the work, the amount of torque is the amount of a derivative that is used to calculate the energy produced from the object rotates on its axis, torque values can be calculated :

$$T = \frac{VL\ x\ z\ x\ a\ x\ Pe}{2\ x\ \pi\ x\ 100}$$

Lihat : Wiranto Arismunandar. *Internal Combustion Engine*. (2002, p: 33)

Where :

T = Torque moment (kg.m)
Pe = Mean effective pressure (kg / cm2)
V_L = Stroke volume (cm3)
Z = Number of cylinders
a = The number of cycles per revolution

METHODS

Implementation Research

The study was performed using motorbike engines Supra X-125 cc and a standard that has been in the bore up (modified). This test focused on the comparison of the performance of the machines, which are obtained from the comparison between the standard engine with a cylinder diameter of 52.4 mm and engine that already bore up (modified) with a 54 mm diameter cylinder.

This research is data taken power (power), the torque produced by the engine are not experienced and bore up the change and and a machine that already bore up (modified) with a 54 mm diameter cylinder at engine speed 1500, 2500, 4000, 5500 and 7000 rpm.

Tools and Materials

Tools and materials used in this experiment as follows:

1. One unit of Honda Supra X-125 cc in 2006.
2. The standard engine block units and one unit engine block that already bore up (modified) Honda Supra X-125cc.
3. Dynojet, a tool used to calculate engine torque and maximum power is obtained at engine speed (rpm) specific.
4. The fuel, in this case, or premium gasoline.
5. Stop watch, to measure time in the experiment.
6. Tachometer, to measure the rotation speed of the engine
7. Feeler gauge, used to measure the valve gap and spark plug gap.
8. Compression tester, used to measure the compression pressure in the cylinder.

Figure 6. The cylinders and pistons are used in testing

Research Procedure

Preparation experiments

a. Prepare and check the support equipment used in the study.
b. Prepare and check the vehicle motorbike Supra X-125d.
c. Prepare a standard engine block unit and one unit block has bore up (modified) motorbike supra x 125d that will be used in this study.
d. Measuring the compression of the engine and the engine is standard bore up.

Implementation of the experiment

1. Experiment to standard machine conditions :

a. Measure the compression pressure on a standard machine conditions using Compression Tester, by installing a compression tester in the spark plug hole, then the machine at the kick starter a few times.
b. Open a faucet in the fuel line so that the carburetor filled.
c. Pressing the channel igniton switch to "on".
d. Turning the engine by means of a kick starter machine.
e. After the engine, adjust the throttle rev the engine to set up a stationary condition and then left to stand for 3-5 minutes to warm up.
f. After warming the engine for about 3-5 minutes, adjust / rotate the throttle so the initial rotation of 1500 rpm the engine and left for some time so that the rotation is stable.

g. Once the machine has been incited, new vehicles increased to Dynojet or dynotest.
h. At the same time, the data are read. Reading the magnitude of the torque, power or power at engine speed 2500 rpm.
i. Repeating steps i to round (n) = 4000 rpm.
j. The next step is the same as i. Every up 1 stroke, setting the addition of 1500 rpm engine rev up at 7000 rpm rotation and is also accompanied by the reading of the data.
k. When finished, operate the throttle control to the idle position, then turn off the engine.

2. Experiment for the condition of the engine that has been modified (bore up) :

a. Install the cylinder block dibore up on the vehicle.
b. After silnder block installed, then do the same test as the standard engine testing above.
c. When finished, operate the throttle control to the idle position round, then turn off the engine.

Analysis

This research uses the method of observing the direct observation of experimental results then make conclusions and research results.

Analysis Calculation Before The Bore Up

1. Determine the Stroke Volume (VL)

Piston diameter (D) = 52.4 mm = 5.24 cm
Stroke Length (L) = 57.9 mm = 5.79 cm

$$VL = \frac{\pi \text{ x } D^2 \text{x } L}{4}$$

$$VL = \frac{3{,}14 \text{ x } (5{,}24 \text{ cm})^2 \text{x } 5{,}79 \text{ cm}}{4}$$

$$VL = 124{,}8 \text{ cm}^3$$

2. Determining the Clearence Volume (Vc)

Compression ratio = 9.3: 1
Stroke Volume = 124.8 cm3

Jadi, $r = \frac{Vl + Vc}{Vc}$

$$9{,}3 = \frac{124{,}8 \text{ cm}^3 + Vc}{Vc}$$

$$9{,}3\ Vc = 124{,}8 \text{ cm}^3 + Vc$$

$$9{,}3\ Vc - Vc = 124{,}8 \text{ cm}^3$$

$$8{,}3\ Vc = 124{,}8 \text{ cm}^3$$

$$Vc = 15{,}03 \text{ cm}^3$$

Analysis Calculation Bore Up After The (modified)
Determining Stroke Volume (VL)

$$VL = \frac{\pi \text{ x } D^2 \text{x } L}{4}$$

Given: Piston Diameter (D) = 54 mm = 5,4 cm
Length stroke (L) = 57,9 mm = 5,79 cm

$$VL = \frac{3{,}14 \text{ x } (5{,}4 \text{ cm})^2 \text{x } 5{,}79 \text{ cm}}{4}$$

$$VL = 132{,}54 \text{ cm}^3$$

Compression ratio after modified (r)

$$r = \frac{Vl + Vc}{Vc}$$

Where :
Clearence Volume = 15,04 cm^3
Stroke Volume = 132,54 cm^3

Then, $r = \frac{Vl + Vc}{Vc}$

$$r = \frac{132{,}54 \text{ cm}^3 + 15{,}04 \text{ cm}^3}{15{,}04 \text{ cm}^3}$$

$$r = 9{,}8$$

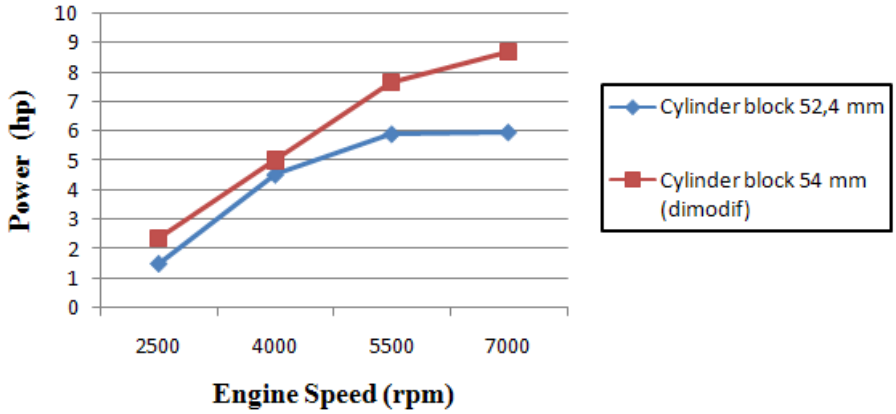
RESULTS AND DISCUSSION
Research Results
Specifications Motor Honda Supra X-125d
Engine type: 4 stroke
Diameter x Stroke: 52.4 mm x 57.9 mm
Volume stroke : 124.8 cc
The compression ratio: 9.3: 1
Diameter x Stroke: 54 mm x 57.9 mm (modified)
Volume Stroke: 132.54 cc (modified)
The compression ratio: 9.8: 1

The results of the data collection engine condition at Bore Up (modified)
Collecting data in a test using a 54 mm cylinder block as follows:
From the test results with the use of a 54 mm diameter cylinder block, from stage 1 to stage 4, power and maximum torque changes or significant increases of approximately 2 hp from the use of 52.4-mm diameter cylinder block.

Table 1. Average power and torque on cylinder 52.4 mm and cylinder 54 mm

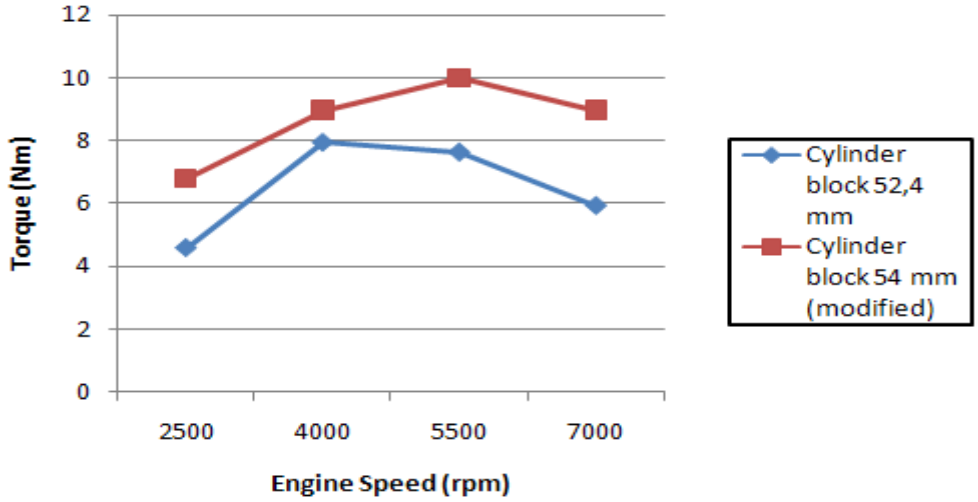
Type Cylinder	Speed rotation (Rpm)	Power (Hp)					Torque (Nm)				
		1	2	3	4	Average	1	2	3	4	Average
Cylinder block standar 52,4 mm	2500	2.00	2.10	1.01	0.87	**1.50**	5.23	5.75	4.02	3.38	**4.60**
	4000	4.38	4.49	4.70	4.52	**4.52**	7.75	8.00	8.20	7.93	**7.97**
	5500	5.93	5.87	6.02	6.15	**5.90**	7.50	7.53	7.83	7.76	**7.66**
	7000	5.92	5.92	6.00	6.00	**5.96**	5.86	5.90	6.01	6.02	**5.95**
Cylinder blok 54 mm (*modification*)	2500	2.49	2.25	2.61	2.25	**2.40**	7.20	6.00	7.11	6.94	**6.81**
	4000	5.00	4.90	5.25	5.00	**5.04**	9.02	8.62	9.21	9.00	**8.96**
	5500	7.75	7.50	7.75	7.75	**7.69**	10.01	9.90	10.01	9.97	**9.97**
	7000	8.81	8.32	8.84	8.83	**8.70**	9.00	8.83	9.00	8.99	**8.96**

Graphics Power (hp) vs Engine Speed (rpm)



From the chart above, it is seen that the power cylinder combustion engine that uses a block of diameter 54 mm higher, because it is basically an enlarged cylindrical major effect of increasing the power generated.

Graphics torque (Nm) vs engine rotation (rpm)



From the graph above, the value generated torque of the motor under test increases with increasing engine rev up to 4000 rpm and then decreased, both for the use of state of the cylinder block 54 mm increased to 5500 rpm and then decreased.

CONCLUSIONS AND RECOMMENDATIONS

Conclusion

Based on the results of research and analysis of data and discussion of the theory of the field is done, it can be concluded as follows:

1. In testing the power and torque of the engine to the standard conditions of cylinders 52.4 mm, 6.15 hp gain maximum power and maximum torque of 8.20 Nm using test equipment Dynojet.
2. Then in a test using a 54 mm cylinder power gain (power) 8.84 maximum hp and maximum torque of 10.01 Nm.
3. Specifications Engine before modified (bore up) :
   Stroke Volume (VL) = 124.8 cm3
   Clearence volume (Vc) = 15, 03 cm3
   Compression ratio (r) = 9.3: 1
   Maximum Effective Power = 6.15 Hp
   Torque (T) = 8.20 Nm
4. Specifications Engine after modified (bore up) :
   Stroke Volume (VL) = 132.54 cm3
   Clearence volume (Vc) = 15, 03 cm3
   Compression ratio (r) = 9.8: 1
   Maximum Effective Power = 8.84 Hp
   Torque (T) = 10.01 Nm
5. Judging from the analysis calculation upgrade the engine by means of a bore up stroke affect the volume, cylinder volume, power and greater torque than a standard machine conditions.

Suggestion

1. For motorcycle users who want to increase the power and speed of the bike can bore up the engine.
2. For the motorist who has experienced bore up the engine, you should change it ignition system and the fuel system in order to get a big power anyway.
3. It is recommended if you want to bore up, need to pay attention to the thickness of the cylinder wall, if it is too thin and followed the suggested enlarging the cylinder to replace the cylinder block as desired.

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