STUDY OF THE EFFECT OF INSTALLATION OF TURBO CYCLONE AND AIR NOZZLE ON THE PERFORMANCE OF HONDA BRIO CARS

Compiled as one of the requirements for completing the Undergraduate Study Program at the Mechanical Engineering Department, Faculty of Engineering

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D 20A 163 003

MECHANICAL ENGINEERING STUDY PROGRAM
FACULTY OF ENGINEERING MUHAMMADIYAH UNIVERSITY SURAKARTA

2021

APPROVAL PAGE

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SCIENTIFIC PUBLICATION

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Study of the Effect of Installation of Turbo Cyclone and Air Nozzle on the Performance of Honda Brio Cars

Abstract

Air nozzle and turbo cyclone are an additional tool used in the combustion engine's induced airway to maximize airspeed and convert airflow into the swirl. Eco racing is an additive mixed into fuel to increase the octane value of the fuel. This research aims to find out the effect of combustion engine performance in the form of standard power and torque with engines that utilize turbo cyclone, air nozzle, and eco racing. This research uses experimental methods where research into turbo cyclone and air nozzle has been made previously in testing to compare the performance of standard condition combustion engine with turbo cyclone combustion engine, induction water and eco racing using dynamometers. The observed bound variables are torque and power. The results showed the highest torque of 96Nm at 4600rpm in turbo cyclone, air nozzle and eco racing. The highest power is 68hp at 4750rpm engine rotation with the same components. The use of turbo cyclones, air nozzle and eco racing can improve the combustion engine's performance.

Keyword: Turbo Cyclone, Power, Torque

Abstrak

Induksi udara dan turbo cyclone adalah alat tambahan yang digunakan pada saluran udara masuk motor bakar yang berfungsi untuk memaksimalkan laju udara dan mengubah aliran udara menjadi swirl. Eco racing adalah zat aditif yang dicampurkan ke bahan bakar untuk meningkatkan nilai oktan bahan bakar. Tujuan penelitian ini untuk mengetahui pengaruh unjuk kerja motor bakar berupa daya dan torsi standar dengan mesin yang memanfaatkan turbo cyclone, induksi udara dan eco racing. Penelitian ini menggunakan metode eksperimen dimana penelitian memeanfaatka turbo cyclone dan induksi udara yang telah dibuat sebelumnya dalam pengujian untuk membandingkan kinerja dari motor bakar kondisi standar dengan motor bakar menggukana turbo cyclone, air induksi dan eco racing menggunakan alat dynamometer. Variable terikat yang diamati yaitu torsi dan daya. Hasil penelitian menunjukan torsi tertinggi yaitu 96Nm pada 4600rpm pada penggunaan alat turbo cyclone, induksi udara dan eco racing. Daya tertinggi 68hp pada putaran mesin 4750rpm dengan komponen yang sama. Penggunaan turbo cyclone, induksi udara dan eco racing dapat meningkatkan unjuk kerja motor bakar.

Kata Kunci: Turbo Cyclone, Daya, Torsi

1. INTRODUCTION

1.1 Background

Indonesia is a country that has many companies engaged in the automotive sector so that the growth in the number of motorized vehicles in Indonesia is growing rapidly. Data from the Central Statistics Agency (BPS) per 2018 the number of motorized vehicles reached 146,858,769 units. And in 2019, according to data from the Association of Indonesian Automotive Industries (GAIKINDO), the number of cars that reached consumers was 1,043,017 units.

With so many vehicles, Pertamina said that fuel consumption in Indonesia reaches 134 million liters per day, while Indonesia's petroleum reserves refer to the Ministry of Energy and Mineral Resources data in 2019 reaching 3,775 billion barrels and only 9.22 years away.

The rapid development of motorized vehicles in Indonesia results in increased air pollution or exhaust gases resulting from the combustion process. The combustion process produces toxic and dangerous gases such as carbon monoxide (CO), hydrocarbons (HC), carbon dioxide (CO2), sulfur dioxide (SO2) and other types of pollutants, and also contributes to global warming

Of the various problems caused by the rapid development of motorized vehicles, everyone tries to create an innovation to reduce the negative effects of these problems while still providing comfort without neglecting the safety factor and the ability to generate large power. One of the simplest attempts to do is to choose a fuel that is of better quality, for example, has a higher octane value.

Another innovation to improve fuel efficiency is by adding an air nozzle system. The air nozzle system here is by adding a funnel-shaped tool into the air filter box which will lead to the throttle body so that the air flow from the air filter box to the combustion chamber becomes more leverage.

Sei Y Kim (1988) through his invention called the Turbo Cyclone. Turbo Cyclone is a tool made of stainless steel which has several fins / blades with a certain tilt angle to its vertical axis. This additional tool is used on the

internal combustion engine which functions to make the air flow that will enter the carburetor and combustion chamber cylinder to rotate or rotate (twist). This occurs as a result of forced deflection of air by the inclined blades at a certain angle when passing through the turbo cyclone. The installation of a turbo cyclone causes a change in air flow characteristics, namely the emergence of a pressure drop in the combustion chamber and the air entering the intake manifold leading to the combustion chamber will form turbulently.

Therefore, the author wants to conduct further research on the effect of installing air nozzle and turbo cyclone on the performance of Honda brio cars. In this research, the engine performance will be tested on a car dyno test engine with the first variation using Pertamax fuel with the installation of air nozzle and turbo cyclone. Second, use Pertamax in standard car conditions. The third is using Pertamax fuel plus additives.

1.2 Research Purposes

The objectives to be achieved in this research are:

1. Knowing the performance of the combustion engine before adding air nozzle and turbo cyclone.
2. Knowing the performance of the combustion engine with the addition of eco racing which include torque and power.
3. Knowing the performance comparison of the combustion engine with the addition of a turbo cyclone, air nozzle and eco racing.

1.3 Problem Limitation

In order to make the research easier, the following restrictions are made:

1. Using a Jet Ranger Cyclone turbo cyclone with a diameter of 55mm.
2. Using air nozzle with an outer diameter of 106mm and an inner diameter of 56mm
3. Using a Honda Brio car in the 2016 production.

4. Increasing car performance in the form of torque and power as an object of research.
5. The tool used to determine the performance of a car engine is Dynotest.

2. RESEARCH METHOD

2.1 Research Flow Chart

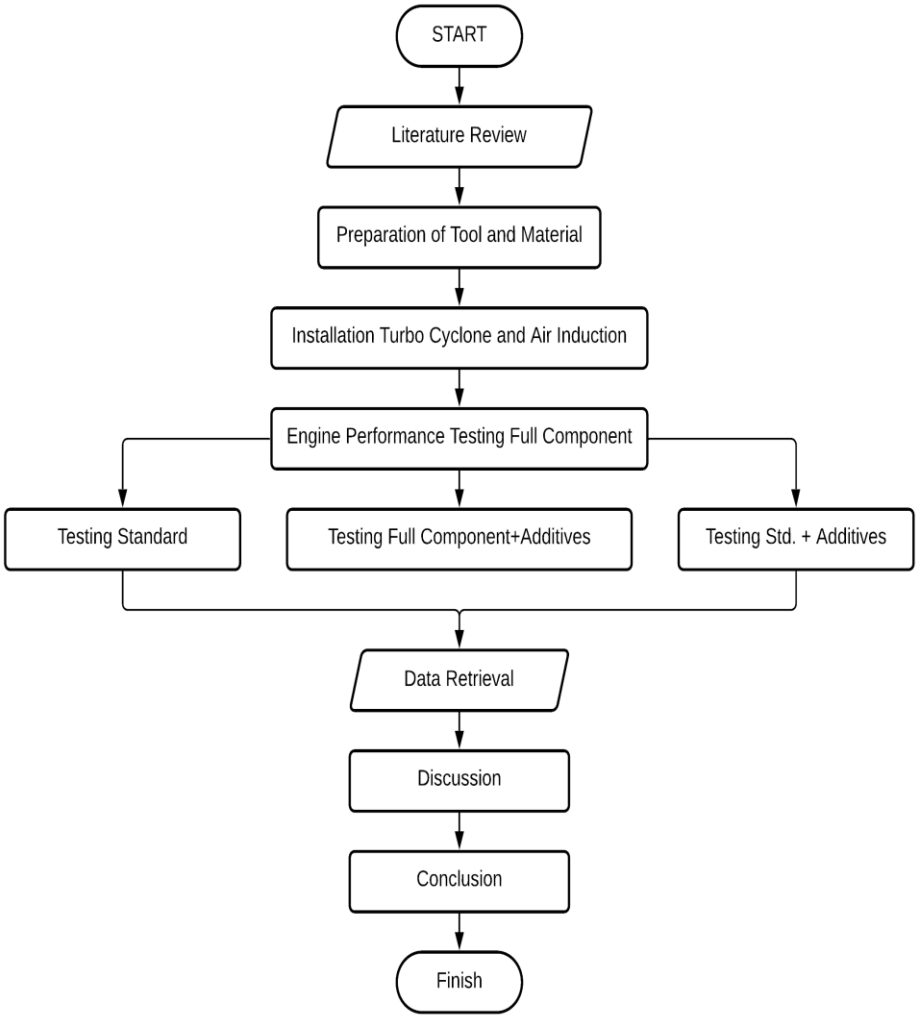


Figure 2.1 Research Flow Chart

2.2 Tool and Material

2.2.1 Research Materials

The materials used for research and data collection are as follows:

1. Turbo cyclone intake spacers
2. Turbo cyclone throttle body spacers
3. Air nozzle
4. Eco racing additives

2.2.2 Research Tools

In this experiment the test tools used are:

1. Honda brio 1.2L car

   The specifications are as follows:

   Engine type : 4 steps, SOHC, 16 valve

   Number of Cylinders : 4 Cylinders

   Bore x Stroke : 73.0 mm x 71.6 mm

   Cylinder volume : 1198 cc

   Compression Ratio : 10.2: 1

   Maximum Power : 90 PS / 6000rpm

   Maximum torque : 110 Nm / 4800rpm

   Fogging System : PGM FI

   Cooling System : Liquid cooling

2. Dynotest

   Brand: Mainline Dynolog

   Model Series : AWD1200

   Wheelbase : 2300 - 3250 mm

   Maximum Power : 850kW (1134Hp) 2-wheel and 1700kW (2280Hp) 4-wheel

Maximum torque : 1700Nm (1254Ftlb) 2-wheel and 3400Nm (2508Ftlb) 4-wheel

Maximum speed : 250 km / h

Maximum Load : 4.4 tons

Data that can be displayed / generated:

a. Power / power generated
b. Engine Torque
c. Wheel speed
d. Engine rotation speed
e. Fuel consumption

Figure 2.2 Dynotest

2.3 Time and Location of Research

The dynotest research to obtain data, power and fuel consumption was carried out at the Tiga Dara Dynolog Sukoharjo workshop on September 28, 2020 at 10.00 WIB until finished.

2.4 Data Collection Procedures and Use of Test Equipment

2.4.1 Car Installation Procedure on Test Equipment

In testing the performance of this engine using the dynotest which can display engine performance at various speed levels, the stages of installation are as follows:

a. Take the car to the top of the dynotest.
b. Position the front tire on the roller of the test tool.
c. Fastening or locking the back of the car by tightening the belt buckle.
d. The transmission condition of the car used is gear 3.
e. After all is safe, the car is ready to be tested

2.4.2 Data Retrieval Procedure on Dynotest

This test uses a mainline awd1200 dynamometer. Data collection is carried out on the test equipment which first raises the car above the test equipment by positioning it right above the roller of the test tool. The stages of data collection are as follows:

a. Testing a car with full components and pertmax fuel.
b. Testing standard cars with Pertamax fuel.
c. Testing standard cars with Pertamax fuel plus eco racing.
d. Testing of full-component cars with Pertamax fuel plus eco racing.

3. RESULT AND DISCUSSION

3.1 Test Result

The test was carried out on the combustion engine added by air nozzle and turbo cyclone components using the Pertamax fuel variations and the addition of eco racing and testing using a dynamometer to know the effect on the power and torque produced.

3.2 Test Result of Torque and Power

3.2.1 Comparison between engine speed to torque and power on the standard engine

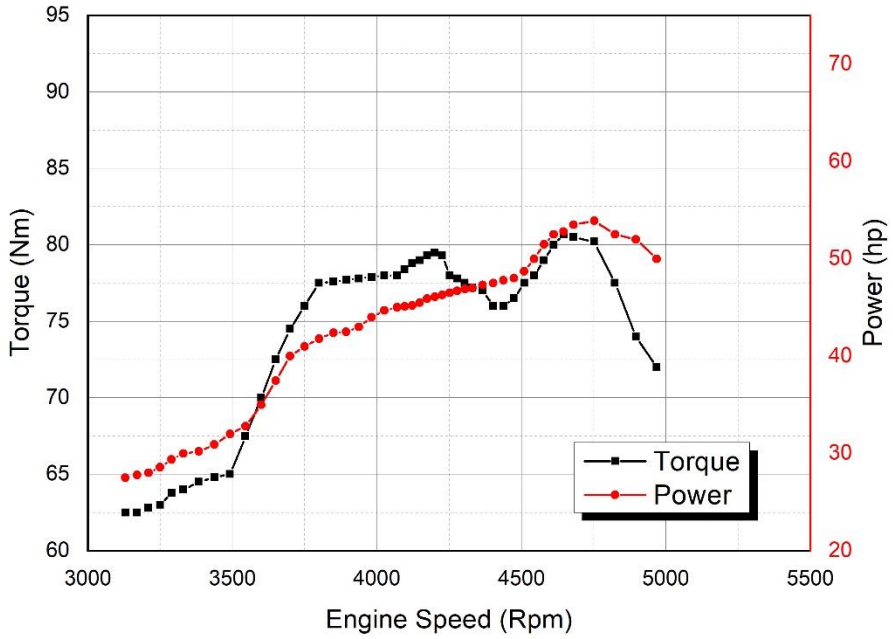


Figure 3.2.1 Graph comparison between engine speed to torque and power on the standard engine

From the graph above, where the test is carried out on a standard combustion engine, it can be seen that the maximum torque that can be achieved is 80.7 Nm at 4650 rpm engine speed. The increase in torque is also unstable, there is a decrease to 76 Nm at 4400 rpm engine speed. While the maximum power produced is 53.9 hp at 4750 rpm engine speed.

3.2.2 Comparison between engine speed to torque and power on the engine with air nozzle and turbo cyclone

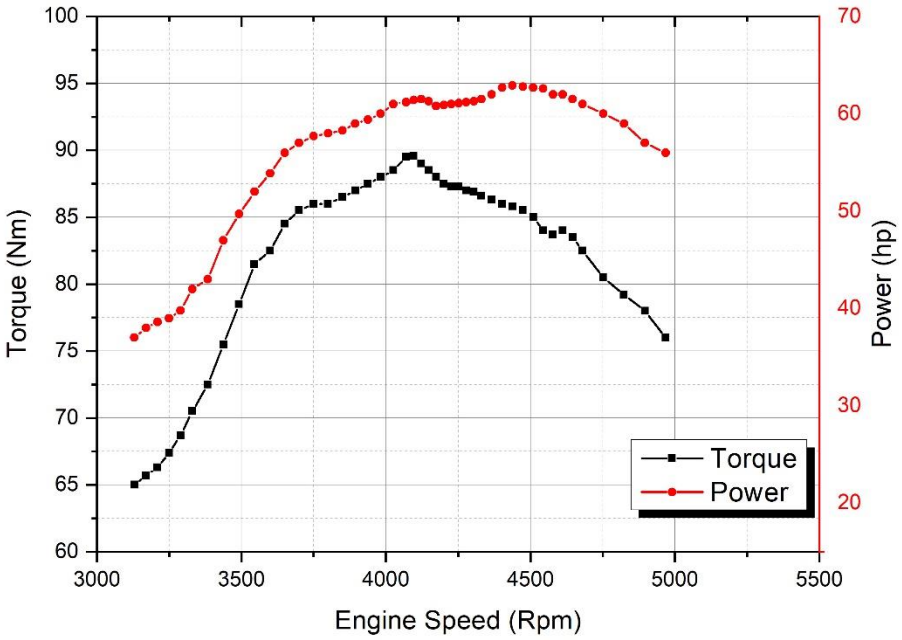


Figure 3.2.2 Graph comparison between engine speed to torque and power on the engine with air nozzle and turbo cyclone

In testing a combustion engine fitted with a turbo cyclone component and water induction with Pertamax fuel, the maximum torque results are 89.6 nm at 4100 rpm engine speed. In this test, the power produced is 62.9 hp at 4450 rpm engine speed.

3.2.3 Comparison between engine speed to torque and power on the standard combustion engine with eco racing

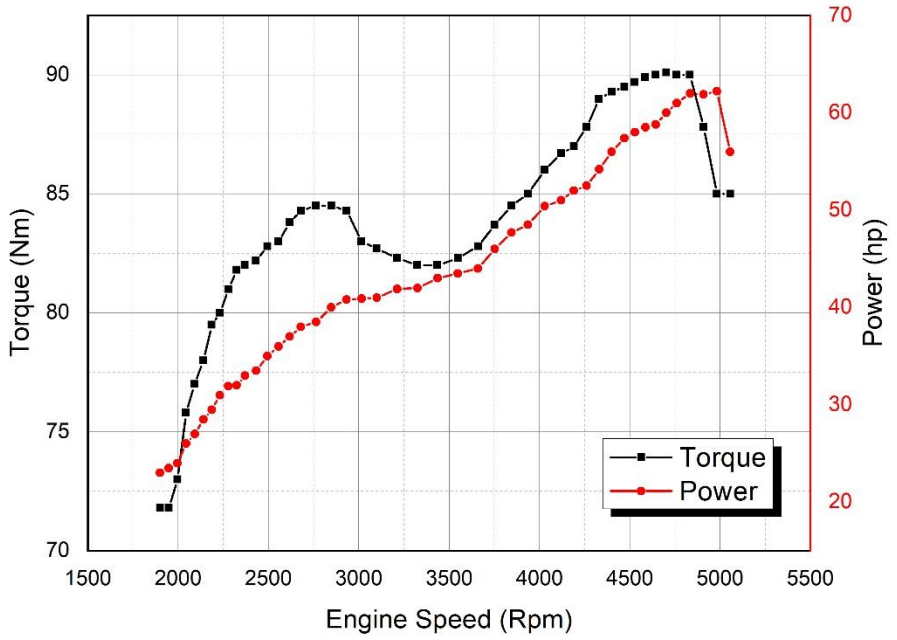


Figure 3.2.3 Graph comparison between engine speed to torque and power on the standard combustion engine with eco racing

When viewed from the graph above, torque the standard combustion engine test with Pertamax fuel mixed with eco racing shows a very significant increase in the graph at lower rotation, namely 84.5 nm at 2764 rpm engine speed after that it drops to 82 nm at 3324 rpm and returns up to the highest point of 90.1 nm at engine speed 4702 rpm. For power, this test shows a fairly constant increase in the graph up to the maximum point of 62.2 hp at 4982 rpm.

3.2.4 Comparison between engine speed to torque and power on the combustion engine with a turbo cyclone and air nozzle with eco racing

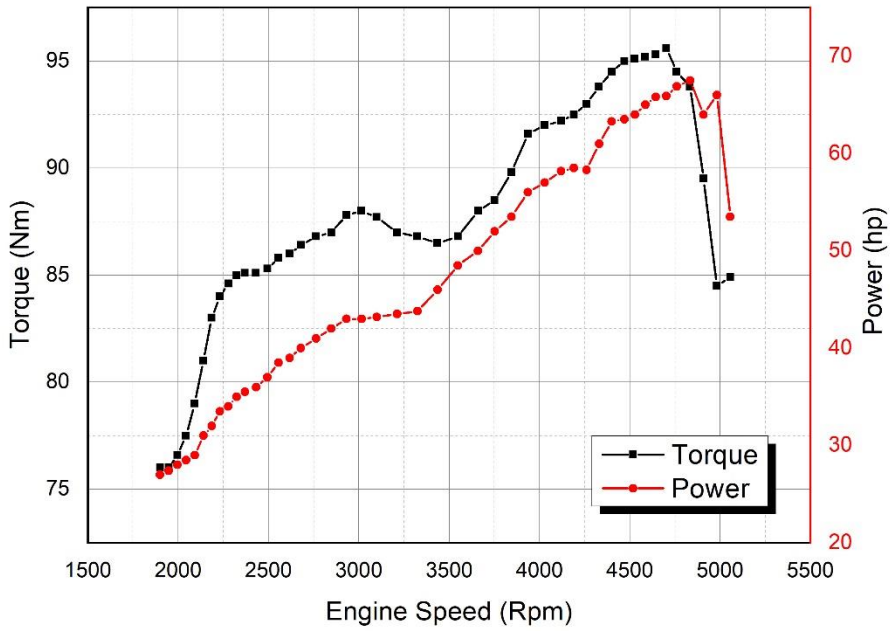


Figure 3.2.4 Graph comparison between engine speed to torque and power on the combustion engine with a turbo cyclone and air nozzle with eco racing

From this test, it can be seen that the torque at low speed shows a fairly fast increase, namely 88 nm at 3016 rpm engine rotation and has a slight decrease before moving to the maximum point, namely 95.6 nm at 4702 rpm engine speed. For the moving power of the graph increase is also quite stable and reaches a maximum point of 67.5 hp at 4834 rpm engine speed.

3.2.5 Power Comparison of All Tests

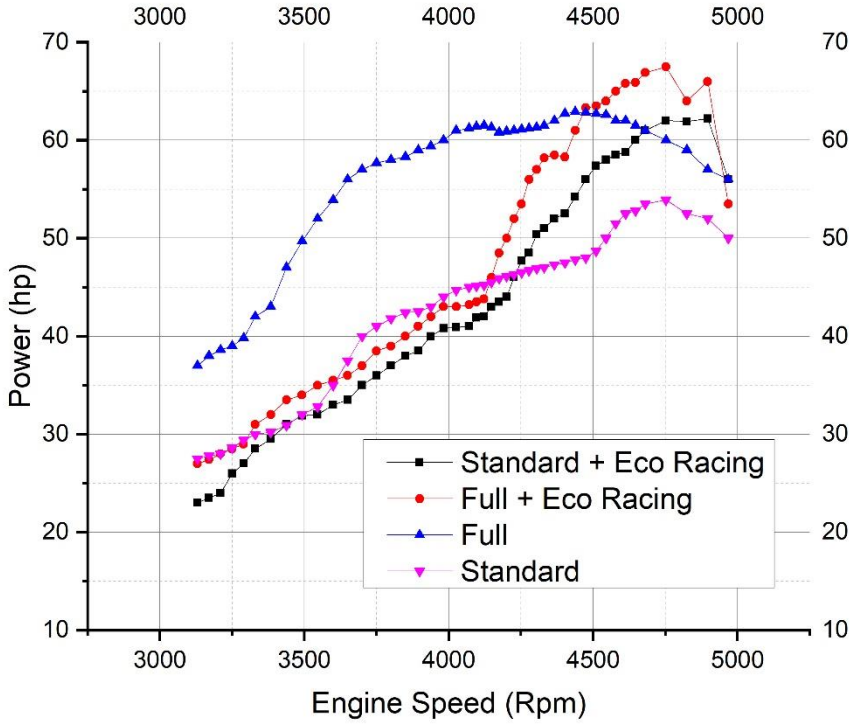


Figure 3.2.5 Power comparison graph

From the results of the test data on engine power to engine speed, it is obtained the results of the comparison of the power of the combustion engine from the condition standard with combustion engine using a turbo cyclone, air iduction and eco racing with Pertamax fuel in the form of graphics.

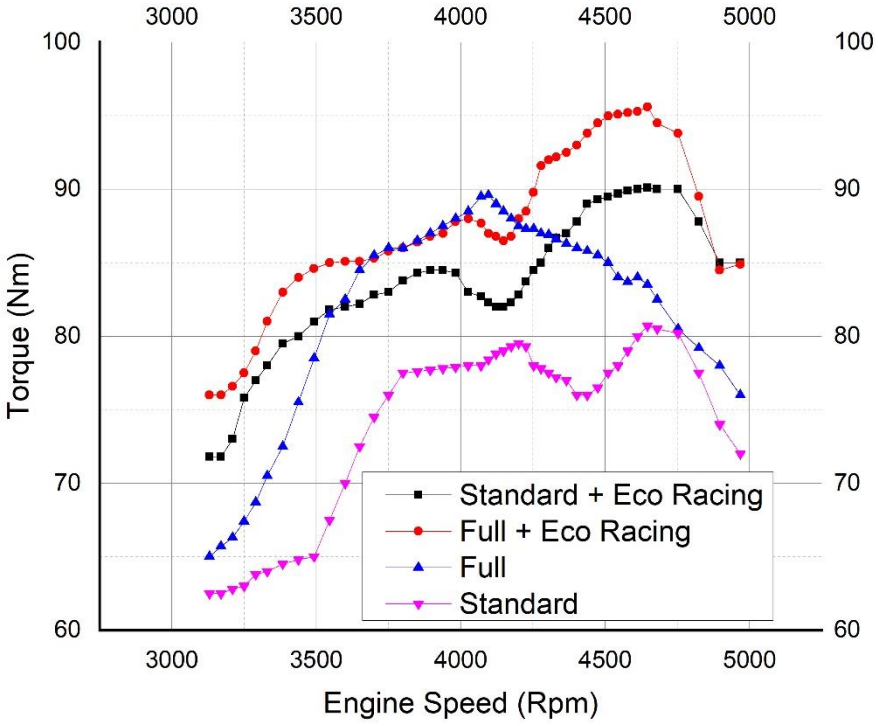
The power generated from the addition of the use of a turbo cyclone and air nozzle gives the effect of increasing power at 3250 - 5000 rpm engine speed. This is evidenced by the data on the highest power results of the standard combustion engine, namely 53.9 hp at 4750 rpm. The power of the combustion engine using a turbo cyclone and air nozzle increases from the start and produces a maximum power of 62.9 hp at 4450 rpm engine

speed, the combustion engine using a turbo cyclone, air nozzle and eco racing produces a maximum power of 67.5 hp at 4834 rpm engine speed, combustion engine using eco racing produces a maximum power 62.2 hp at 4982 rpm engine speed.

From the overall results of the combustion engine power test, the addition of a turbo cyclone and air nozzle can increase the power at 3250 - 4400 rpm because the addition of a turbo cyclone and air nozzle can accelerate and change the straight flow into a vortex so that the mixture of fuel and air is better resulting in an increase power than the standard combustion engine. However, at 4500 rpm to the top of the combustion engine with the addition of a turbo cyclone and air nozzle, the power decreases. This is because the air supply in the combustion chamber at high rpm cannot meet the needs of the combustion chamber and the addition of a turbo cyclone causes an increase in the amount of air flow resistance so that the air supply to the combustion chamber decreases.

When coupled with eco racing both in standard conditions and using a turbo cyclone and air nozzle power when the engine speed is up to 4300rpm it is almost the same in standard conditions, but at 4300 rotation and above it has a clear increase because there is a difference in the quality of the fuel produced from the Pertamax mixture and eco racing.

3.2.6 Torque Comparison of All Tests



Graph 3.2.6 Torque comparison graph

From the results of the engine torque test data on engine speed, it is obtained the results of the comparison of the torque of the combustion engine from the condition standard with combustion engine using a turbo cyclone, air iduction and eco racing with Pertamax fuel in the form of graphs.

The torque resulting from the addition of a turbo cyclone and air nozzle gives the effect of increasing torque at low engine speed and immediately reaches the maximum torque, namely 89.6 Nm at 4100 rpm but after that it drops. This is evidenced by the data on the highest torque yield of standard combustion engine, namely 80.7 Nm at 4650 rpm. The combustion engine using a turbo cyclone, air nozzle and eco racing

produces a maximum torque of 95.6 nm at 4702 rpm and this is a high value. The combustion engine using eco racing produces a maximum torque of 90.1 nm at engine speed 4702 rpm.

4. CLOSING

4.1 Conclusion

Based on the results of the research that has been done, the following conclusions can be obtained:

1. The performance engine before using the turbo cyclone and air nozzle component get the maximum torque that can be achieved is 80.7 Nm at 4650 rpm engine speed. While the maximum power produced is 53.9 hp at 4750 rpm engine speed.
2. With adding the eco racing the performance of combustion engine get significant torque increase at lower rotation, namely 84.5 nm at 2764 rpm engine speed and the highest point of 90.1 nm at engine speed 4702 rpm. For power, this test shows a fairly constant increase in up to the maximum point of 62.2 hp at 4982 rpm.
3. The use of turbo cyclone components, air nozzle and eco racing can increase torque and power compared to standard engines. The resulting torque is 95.6 nm at 4702 rpm and a power of 67.5 hp at 4834 rpm. In standard conditions the resulting torque is 80.7 nm at 4650 rpm and a power of 53.9 hp at 4750 rpm.

4.2 Suggestion

The author realizes that there are still unsolved problems related to the turbo cyclone and air nozzle made. Therefore, to be able to develop it further, the researcher gives the following suggestions:

1. In testing, data collection should be carried out several times so that the data taken is more accurate.

2. The turbo cyclone blade and the air nozzle surface should be made as smooth as possible without any surface arising so that the flowing air does not experience much friction.
3. In this research, only the performance of the combustion engine is analyzed in the form of torque and power. So it is hoped that in future studies it can analyze discussing fuel consumption, air fuel ratio (AFR), and more specific forms of airflow. So that it can be analyzed the fuel efficiency, the ratio of the fuel and the shape of the flow

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