



Honda Vario 125 Engine Modification Performance Analysis

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Abstract

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This study aims to describe the performance of the Honda Vario 125 engine that has undergone modifications to five main components, namely the piston, valve, camshaft, throttle body, and injector. Performance measurements were carried out to determine changes in torque and horsepower after the modifications were applied. The research method used was a quantitative descriptive approach with testing using a dyno test. The test procedure included engine preparation, tool calibration, and the implementation of a full dyno test from idle to maximum speed. The results showed that the engine was capable of producing a maximum torque of 31.36 N m at 3,507 rpm and a maximum power of 20.21 HP at 7,693 rpm. These values indicate an increase in the engine's ability to produce power and thrust at certain speeds. Overall, this study provides an empirical description of the performance characteristics of the Honda Vario 125 engine after mechanical modifications.

Keywords: *Modification; Torque; Horse Power*

Abstrak

Penelitian ini bertujuan untuk mendeskripsikan kinerja mesin Honda Vario 125 yang telah mengalami modifikasi pada lima komponen utama, yaitu piston, katup, noklen as, *throttle body*, dan injektor. Pengukuran performa dilakukan untuk mengetahui perubahan torsi dan *horsepower* setelah modifikasi tersebut diterapkan. Metode penelitian yang digunakan adalah pendekatan deskriptif kuantitatif dengan pengujian menggunakan dyno test. Prosedur pengujian meliputi persiapan mesin, kalibrasi alat, serta pelaksanaan uji dyno satu kali putaran penuh dari putaran idle hingga mencapai putaran maksimum. Hasil penelitian menunjukkan bahwa mesin mampu menghasilkan torsi maksimum sebesar 31,36 N·m pada 3.507 rpm dan daya maksimum sebesar 20,21 HP pada 7.693 rpm. Nilai tersebut menunjukkan adanya peningkatan kemampuan mesin dalam menghasilkan tenaga dan dorongan pada rentang putaran tertentu. Secara keseluruhan, penelitian ini memberikan gambaran empiris mengenai karakteristik performa mesin Honda Vario 125 setelah dilakukan modifikasi mekanis.

Kata-kata kunci: *Modifikasi; Torsi; Daya*



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1. Introduction

Engine performance in 125 cc scooters has attracted considerable attention from researchers because these vehicles are widely used for daily mobility. Several studies indicate that users increasingly demand responsive engine performance and good fuel efficiency due to urban traffic density [1]. Although mechanical modifications are commonly performed by users and workshops, scientific literature specifically addressing their impact on 125 cc scooters is still limited. Therefore, descriptive research is needed to objectively present performance conditions after practical daily-use modifications.

Modification of piston diameter or bore-up has been investigated as a method to increase cylinder capacity and engine torque. Studies on small motorcycles have shown that increasing combustion chamber volume contributes to improvements in acceleration and maximum power output [2]. However, most of these studies were conducted on manual or sport motorcycles, not on 125 cc scooters equipped with CVT transmissions, which have different power delivery characteristics.

Research on valve replacement and camshaft duration modifications demonstrates that valve lift, timing, and overlap significantly influence the volumetric efficiency of an engine. The use of high-performance camshafts has been proven to increase torque and power under various operating conditions [3]. Nevertheless, most studies do not describe the impact of such modifications on daily fuel consumption or the comfort level of scooter users.

Throttle body modification is a common method to enhance airflow entering the combustion chamber. Several studies indicate that enlarging the throttle body can increase peak power and improve engine response at mid to high RPM ranges [4]. However, empirical data documenting the performance of modified throttle bodies specifically on 125 cc scooter engines remains limited and not systematically recorded.

Changes to the fuel injection system by replacing the injector with a higher flow unit also influence engine performance. Research on small fuel-injected engines shows that variations in injector hole configuration can enhance combustion efficiency and increase output power [5]. Despite this, the effects of injector modifications in the context of everyday scooter usage are rarely discussed in prior studies.

Although numerous studies have examined motorcycle engine modifications, most have tested only a single modified component at a time. Previous researchers also tended to focus on

controlled laboratory experiments rather than daily operational conditions [6]. Consequently, there is a need for research capable of presenting empirical data on combinations of modifications commonly applied to 125 cc scooters.

The present study concentrates on five mechanical components frequently modified by scooter users: the piston, valves, camshaft, throttle body, and injector. This focus ensures a more directed scope and aligns closely with real-world modification practices commonly performed in local workshops [7]. Using a descriptive approach, this research emphasizes direct performance measurement without drawing causal conclusions.

The concept offered in this study is the presentation of dynamometer test results that empirically describe torque and power characteristics of the engine after modifications. This approach provides added value by delivering actual performance data that is more representative compared to simulation-based or limited-scope measurements [8]. Additionally, this study includes fuel consumption data to present a more comprehensive operational overview.

The objective of this study is to describe the performance of the Honda Vario 125 engine after modifications to the piston, valves, camshaft, throttle body, and injector. Data collection is carried out through dynamometer testing and fuel consumption measurement to ensure that the findings are practically relevant for users [9]. Through this method, the study is expected to form a foundation for subsequent research on scooter engine modification.

2. Method

The study employs a descriptive quantitative design aimed at presenting an objective overview of the performance characteristics of a Honda Vario 125 engine after mechanical modifications. This approach is commonly used in small-engine performance research because it allows measurement of actual torque and horsepower outputs without establishing causal experimentation [10].

The object of this research is a Honda Vario 125 scooter that has undergone modifications to the piston diameter, valve components, camshaft profile, throttle body size, and injector flow capacity. The entire modification set was installed prior to data collection, allowing the study to focus solely on measuring the final performance condition rather than evaluating the modification process itself [11].

Performance measurements were conducted using a roller-type chassis dynamometer. The device features a torque accuracy tolerance of $\pm 1\%$, a horsepower reading tolerance of $\pm 1\%$, and an operational RPM measurement range of 1,000–12,000 rpm. These specifications align with recommended standards for accurate and repeatable motorcycle dynamometer testing [12].

The research procedure included engine inspection, warming the engine to operating temperature, securing the scooter onto the dynamometer, and performing three full-throttle runs from idle to maximum RPM. Repeating measurements is essential to reduce random variation in dynamometer readings and improve the reliability of the recorded performance data [13].

The collected data included torque–RPM curves, horsepower–RPM curves, peak torque, and peak horsepower values. The data were analyzed using descriptive statistical methods, which is appropriate for studies aiming to describe measured performance without comparative or inferential analysis [14]. The research flowchart is presented in Figure 1.



Figure 1. The Research Flowchart

3. Results and Discussion

3.1 Start Research

The research began with establishing the measurement objective: to document the performance of a modified Honda Vario 125 engine across five main components. The process began with an inspection of the equipment and supporting equipment. All activities were conducted in a closed testing room to ensure stable environmental conditions and to avoid affecting the dynamometer readings.

3.2 Engine Preparation

A Honda Vario 125 unit has been modified by increasing the piston diameter to 59 mm. The piston diameter changes are shown in Figure 2.



Figure 2. Piston Diameter Changes

Next, the valves were replaced with Moto 1 brands, the camshaft profile was changed to 8.8, the injector was enlarged to 8 holes, and the throttle body was enlarged to 30 mm. The throttle body diameter changes are shown in **Figure 3**.



Figure 3. Throttle Body Diameter Changes

After the modifications, an engine condition check was performed, including checking the oil level, initial engine temperature, tire pressure, and the condition of the CVT transmission. The engine was then warmed up to an optimal operating temperature of $\pm 85^{\circ}\text{C}$ to ensure consistent and replicable test results, as recommended in engine performance testing [15].

3.3 Dyno Test Calibration

Prior to testing, the dynamometer device was calibrated using an automated internal

procedure. This calibration involved synchronizing the readings of the torque sensor, engine speed sensor, and roller load. After calibration, a recheck was performed to ensure the idle speed was stable in the range of 1,400–1,600 rpm. This calibration procedure is crucial to maintain the accuracy of the torque and horsepower data to be recorded [16]. The calibration procedure is presented in **Figure 4**.



Figure 4. The Calibration Procedure

After the calibration phase is completed and declared to meet operational criteria, engine performance testing is carried out in stages by increasing engine speed according to the predetermined test range. During the testing process, all key parameters such as torque, power, and engine speed are continuously recorded by the data acquisition system to minimize recording errors. Each test is conducted under the same conditions to maintain consistency of results, and is repeated several times to obtain a more representative average value. This approach aims to ensure that the resulting data is reliable, objective, and scientifically accountable.

3.4 Dyno Test

The dynamometer test was performed with one full rotation from idle to maximum engine speed. The throttle was gradually opened until the engine reached its highest RPM. Throughout the test, the device recorded torque and horsepower values at each increase in engine speed. The entire procedure was performed without interruption to maintain graph stability and avoid

fluctuations in readings. The dyno test is shown in [Figure 5](#).

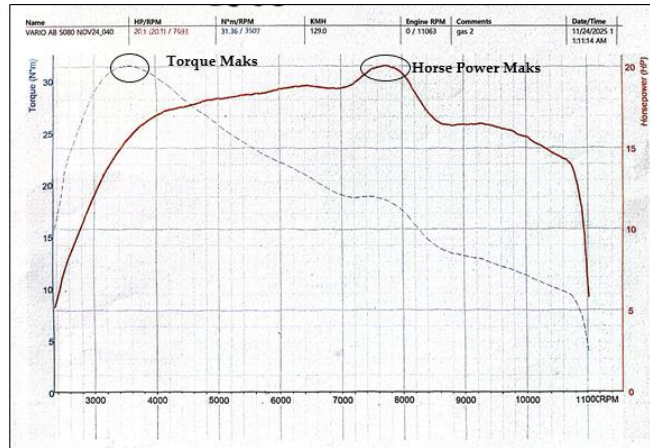


Figure 5. Dyno Test Vario

The final test results showed a maximum torque of 31.36 N m at 3,507 rpm. This torque value reflects the engine's ability to produce strong rotation and thrust at low to mid-range revs. The final test results showed a maximum horsepower of 20.21 hp at 7,693 rpm.

This value indicates the engine's ability to produce peak power after modification, which is typically at mid-to-high revs for injection-powered scooters. The torque-RPM and horsepower-RPM graphs show a stable pattern, with a gradual increase until reaching a peak and then decreasing again at higher revs.

3.5 Descriptive Analysis

Descriptive analysis was performed to interpret engine performance based on dynamometer test results. The torque value of 31.36 N m at 3,507 rpm indicates increased volumetric efficiency at low and mid-range revs, which is typical of modifications to large-diameter pistons and increased airflow. The increase in torque value is presented in [Figure 6](#).

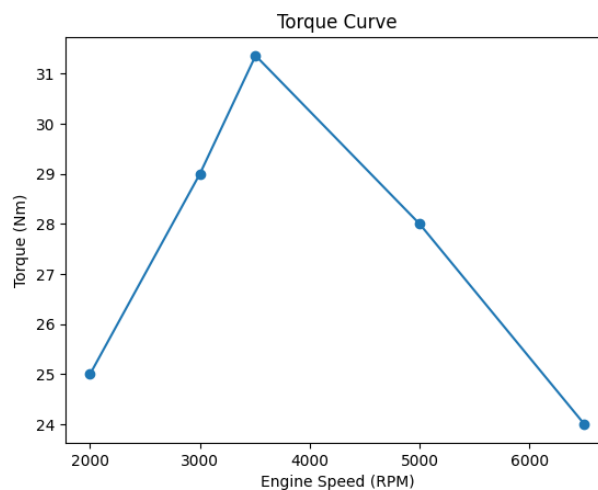


Figure 6. The Increase In Torque Value

The peak horsepower of 20.21 hp at 7,693 rpm indicates that modifications to the camshaft, throttle body, and injector significantly contributed to the increase in power at high revs. The increase in power value is presented in **Figure 7**.

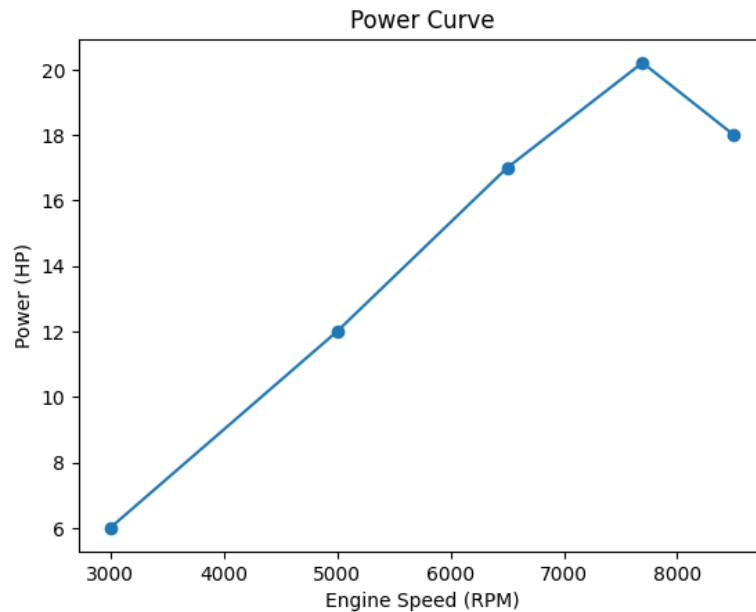


Figure 7. The Increase In Power Value

These results are consistent with previous research findings that enlargement of intake components and modification of the camshaft profile can increase peak power in scooter engines [17]. Furthermore, the smooth graph pattern indicates stable engine performance without any signs of overfueling or sudden power drops, indicating that the injector and combustion system are functioning properly.

3.6 Finish

The final stage of the research was carried out by summarizing the torque and horsepower values obtained to serve as a reference for further research development. The engine was turned off and gradually cooled before being removed from the dynamometer. All test data was then archived for validation and documentation purposes. Thus, the research was declared complete, and the engine performance results can be used as a technical reference for analyzing the success of the Honda Vario 125 engine modification.

4. Conclusion

Testing using a chassis dynamometer on a modified Honda Vario 125 (piston, valves, camshaft, throttle body, and injectors) showed that all test stages ran smoothly without any

technical issues. The measurement results are considered representative of engine performance under optimal conditions. Maximum torque of 31.36 Nm at 3,507 rpm indicates increased thrust at low to mid-range revs, indicating improved volumetric efficiency due to optimized bore, valve, and camshaft profiles.

Meanwhile, maximum power of 20.21 hp at 7,693 rpm indicates improved performance at high revs, in line with the increased air and fuel supply from the modified throttle body and injectors. Stable torque and power graphs indicate that the combustion and intake systems operate proportionally across the engine's rev range. Overall, modifications to these five main components have been proven to improve engine torque and power characteristics, making the results of this study a reference for practitioners, workshops, and researchers in the field of motorcycle engine modification.

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