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The Effect of Additional Holes and Knurling on Outer Comp Clutch CVT on Torque and Power of Honda Scoopy K93

Firdaus Audtiya Ramadhani[1*], Rizqi Fitri Naryanto[1], Abdurrahman[1], Hanif Hidayat[2]

1 Department of Automotive Engineering Education, Faculty of Engineering, Universitas Negeri Semarang, Indonesia
2 Graduate School of Technological and Vocational Education, National Yunlin University of Science and Technology, Taiwan
*firdaaudtiya@students.unnes.ac.id

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Abstract

Automatic motorbikes that have been used for more than five years tend to experience a decrease in responsiveness when starting due to wear on the CVT components, one way to improve the performance of automatic motorcycles are to optimize the power distribution from the engine to the wheels. This can be achieved through modifications to the CVT system, so that the power distribution process becomes more efficient and responsive, modifications are made to improve vehicle performance while reducing the impact of decline performance due to increasing age of use, which also has an impact on decreasing CVT performance. On the system CVT, the centrifugal clutch mechanism on the secondary pulley plays a role in connecting and disconnecting rotation from the secondary pulley to the wheel. The component that plays a role in receiving rotation from the clutch carrier is the outer comp clutch, one of the main causes of this problem is the presence of residual dust from the double clutch lining that is trapped inside the outer clutch, which causes slippage and disrupts clutch function. Modification by adding holes and knurling on the surface of the outer comp clutch friction plane is expected to overcome the problem of excessive vibration and slippage, as well as optimizing the performance of the CVT on automatic motorcycles, so that the torque and power produced can increase. The types of knurling applied to the outer comp clutch include straight, diagonal, and diamond knurling

1 Introduction

The high demand for transportation in Indonesia is followed by an increase in the use of motorbikes. According to data from the official website of the Central Statistics Agency, the total number of motorized vehicles in Indonesia in 2022 reached 148,261,817 units. The number of motorbikes in Indonesia in 2022 was recorded at 125,305,332 units, which covers 84.52% of the total motorized vehicles in the country. In addition, the number of motorbikes increased by 4.2% compared to 2021, with a total of 120,042,298 units [1]. Motorbikes are the most popular vehicles because they are able to support people's mobility in the midst of dense traffic and narrow roads, because of their slim shape and environmentally friendly nature. the total number of motorized vehicles in Central Java reached 20,320,743 units, with 17,917,660 of them being motorbikes. This makes motorbikes the most widely used type of vehicle in this province. As of April 2025, the number of motorized vehicles in Central Java reached 21,760,374 units, with motorcycles still being the largest type of vehicle. Motorcycles dominate in all regencies/cities in Central Java.

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The continuously variable transmission (CVT) transmission system has various advantages, one of which is providing comfort for the rider because it does not require manual gear shifting or clutch use. This automatic transmission allows the vehicle to move stably from low to high speeds without having to change gears, as is usually done on 4-stroke or 2-stroke manual motorcycles. The pulley on the CVT system is designed to automatically adjust the diameter to change the rotation ratio according to the vehicle's needs. This mechanism allows the transmission to adjust to the amount of gas traction given by the rider and the load carried, so that the power generated can be distributed optimally without the need for manual gear shifting. In addition to having advantages, the power generated by automatic motorcycles is not as responsive when compared to manual motorcycles, and its performance is considered less powerful. Test results show that motorcycle riders with automatic transmissions often complain about less-than-optimal responses when facing stop and go conditions, such as when stopping and starting again in traffic jams. One of the main factors causing this weakness lies in the transmission system, which has different characteristics compared to manual transmissions in terms of responsiveness and power distribution Based on research, it is stated that several automatic motorcycle owners complain about less responsive performance and excessive vibration when passing through winding roads and steep slopes, which require high power and torque, because if the power produced is too low, the motorbike will feel slow and lack power.

To overcome the problem of excessive vibration caused by the CVT system, one modification that can be done is to add holes and knurling to the surface of the outer comp clutch friction plane. The addition of holes functions to remove dust from the friction of the double clutch, so that it is not trapped in the outer comp clutch and is expected to improve the performance and grip of the centrifugal clutch. Meanwhile, the addition of knurling aims to increase friction force, so that the double clutch is expected to be coupled faster with the outer comp clutch, reducing slippage, and being able to eliminate vibration when the motorbike starts moving

2 Research

Research is a systematic process of collecting information with scientific and rules and regulations used and with the applicable period for good and valuable research. Research design is defined as the design of data collection, processing, analysis, and presentation carried out objectively and systematically to solve problems or test hypotheses for technical development [2]. The method used in this study is the experimental method. Research with an experimental approach is usually based on a position paradigm that analyzes the causes and effects of variables, as well as the need for intervention for research that is measured and observed. The positivist paradigm is a science that uses measurement methods, variable reduction, hypotheses, and the causes and effects of making actual statements Observations and tests of this research theory are the author through the results of the use of torque and power generated by the Honda Scoopy K93. The preparation of this research test is aimed at collecting all the needs required during testing such as tools, materials, instruments, and research infrastructure. In addition, a literature study is a collection of information through journals, books, and previous research that is relevant to the research that supports and facilitates the research. This research is carried out through various steps as follows:

1. Preparation of the study

a. Preparing the standard outer comp clutch and the one that has been treated

b. Tuning up the motorcycle before testing
c. Preparing Pertalite fuel with 90 octane
d. Preparing the tool to replace the outer comp clutch
e. Preparing the test result data table

f. Placing the motorcycle on the dynamometer with the front wheel in the slot and adjusting the position until the rear wheel is right above the roller.
g. Securely tying the motorcycle to the dynamometer.
h. Connecting the tachometer cable to the spark plug cable to measure RPM.

2. Steps for testing torque and power
a. Filling Pertalite fuel (RON 90) according to the compression ratio listed in the Scoopy motorcycle specifications.
b. Warming up the engine until it reaches the ideal working temperature of 80ºC-90ºC. c. Replacing the outer comp clutch
1) Standard outer comp clutch
2) Straight hole and knurling outer comp clutch
3) Diagonal hole and knurling outer comp clutch
4) Diamond hole and knurling outer comp clutch
d. Open the throttle until the engine reaches the highest rotation (limit), which can be monitored via a computer monitor screen connected to the chassis dynamometer.
e. Read the engine rotation data directly on the monitor, which displays torque, power, and RPM.
f. Save the test results in the form of tables and graphs that include torque and power at each RPM.
g. Conduct torque and power tests three times for each variation, then calculate the average to obtain accurate results.
h. Repeat the same procedure for each variation tested.
i. Present the data in the form of a test result table, then arrange it in a graph.
j. Tidy up the equipment and materials that have been used so that they return to their original state.

Experimental research method is one type of research used to evaluate the impact of a treatment on other variables in a controlled situation. In this study, researchers apply treatment or make changes to one or more independent variables, then observe the effect on the dependent variable. This method is often applied in physics research because the variables can be carefully selected, and the factors that influence the experiment can be well controlled. As part of the quantitative method, experimental research has special characteristics, especially in the use of control groups. The main characteristic of this method is its ability to directly test the impact of one variable on another variable and to test the hypothesis of a cause-and-effect relationship. In general, a variable refers to anything that is determined by the researcher to be studied in order to obtain information that can be used to draw conclusions. In this study, the variable that received treatment was the outer comp clutch which had been given holes and knurling on the surface of its friction plane [3–6]. The knurling variations used were with straight, diagonal, and diamond patterns. The results obtained were in the form of torque and power of the Honda Scoopy K93 motorcycle using a dynamomete

3 Result and Discussion

Data description is a presentation of a research process that has been ongoing in order to provide an overview of the effect of modifying the outer comp clutch CVT by adding holes and knurling on the Honda Scoopy K93 motorcycle with torque and power testing. This test uses a Pro DYNO 130 HP Smart Power SP-1 ver 3b Sport Devices Interna Electronic Kits dynamometer which is used to determine torque and power, this test is carried out using a standard motorcycle and only the modification variables are given treatment [7–9], namely on the outer comp clutch CVT section which aims to determine the increase in torque and power to be compared with the use of factory default standards and those that have received treatment. This test is carried out on each variable 3 times in order to obtain the most stable data, then from the existing results it will be divided using the average to then obtain the average torque and power results for each variable. The results of this test will be presented in a graphic table with the aim of obtaining clear and easy-to-understand information, so that readers and writers can easily understand the data presented. In this study using an experimental method that aims to determine the effect of adding holes and knurling on the outer comp clutch CVT on the calculation of torque and power. The outer comp clutch used for this modification is by adding holes and knurling then compared using the standard Outer comp clutch aims to compare with those that have received treatment, for the type of modification used in each variable, namely Outer Comp Clutch holes and straight knurling, Outer Comp Clutch Holes and Diagonal Curling, Outer Comp Clutch Holes and Diamon knurling, testing was carried out using a Honda scoppy K95 in standard conditions. The control variables in this study are all parts of the motorcycle that are in standard condition, except for the CVT part that has been given treatment, namely the Outer Comp Clutch component. The results of the tests that have been obtained will then be analyzed and described, so that researchers can compare between normal conditions and conditions that have been treated according to the independent variables that have been determined. The resulting data will then be analyzed before being presented in the form of a graphic table, the purpose of this is so that researchers can draw conclusions in answering previously determined research questions.

1. Torque

Motorcycle power test results with standard Outer Comp Clutch variations, straight holes and Knurling, diagonal holes and Knurling, dinamond holes and Knurling Motorcycle torque test results are shown in the Table 1.

Table 1. Torque

	Torque (Nm)			
RPM	Standard	Variation 1	Variation 2	Variation 3
2000	2,74	2,94	3,16	3,66
2500	2,13	3,55	3,12	3,75
3000	2,19	3,94	4,34	4,24
3500	3,75	5,12	4,99	5,51
4000	3,97	6,19	5,01	7,12
4500	4,21	6,84	6,01	8,05
5000	4,43	7,62	7,25	8,47
5500	5,34	7,78	7,47	9,04
6000	5,63	8,92	7,98	9,45
6500	6,06	8,54	8,09	8,82
7000	6,22	7,74	8,01	7,96
7500	6,31	7,33	7,37	7,48
8000	5,85	6,42	6,16	6,34

The standard outer comph clutch tends to be heavier than the other 3 variables because in other variables that are treated with additional holes and knurling, they undergo a lathe process so that there is material removal which causes weight loss. This has an impact on the centrifugal force on the secondary pulley where the outer comp clutch component is located, the lighter the outer comp clutch, the faster the rotation of the primary pulley so that the resulting torque will increase [10]. The addition of holes to the variables given this treatment also aims to facilitate the removal of friction residue from the break disc with the outer comp clutch so that there is no dust that causes slippage. This test was carried out on a Honda Scoopy K93 motorcycle with standard conditions; nothing was changed except for those that received treatment from this study during testing

It is concluded from the graph that the effect of adding holes and knurling the highest torque value when using the standard outer comph clutch is 6.31Nm when the engine speed reaches 7500 RPM while the lowest torque is 2.74 Nm at 2000 RPM. The standard torque value is a comparison with other variables given treatment, Outer comph clutch standard tends to have a low torque when the initial rotation to the middle rotation is 2.74 - 3.97 Nm at 2000 - 4000 RPM. The standard torque value is used as a comparison with other variables that are given treatment. The increase in torque obtained is more dominated by the outer comph clutch hole and knurling variables, in the outer comp clutch variation Hole and Knurling straight with 8.92 Nm with engine speed 6000 RPM with the lowest torque of 3.16 Nm with engine speed 2000 RPM, then the variation of outer comp clutch holes and diagonal knurling with engine speed 7.89 Nm at 6000 RPM with the lowest torque of 2.94 Nm with engine speed 2000 RPM, outer comph clutch holes and diamond knurling is 9.45 Nm with engine speed 6000 RPM and the lowest torque 3.66 with engine speed 2000 RPM. The diagram of comparison can be seen in the Figure 1.

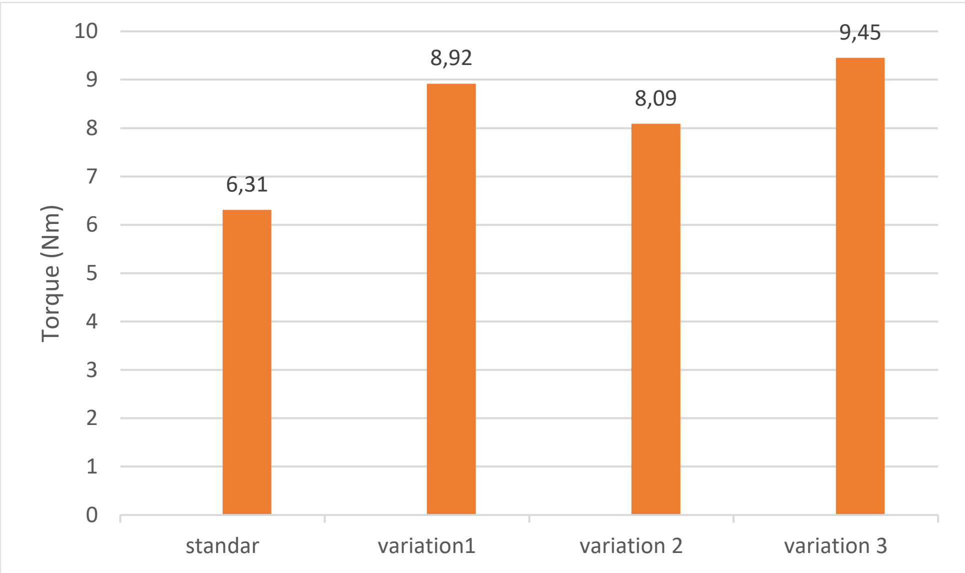

Figure 1. Diagram of torque comparison results

as follows the torque increases because between the Outer Comp Cluth and Clutch disc there is no slip due to the roughness on the surface of the friction plane [11], so that the centrifugal force channeled through the V-belt will move the primary pulley perfectly aimed at moving the rear wheels. The difference in the way of working between double and standard lining bowl knurling lies on the inner surface of the clutch bowl. In the standard bowl, the inner surface is smooth [12], so the double lining that expands due to centrifugal force only rubs normally against the surface. This can cause slippage, especially when the linings start to wear or are exposed to dust and oil, resulting in decreased acceleration of the motor [13].

2. Power

Motorcycle torque test results with standard Outer Comp Clutch variations, straight holes and Knurling, diagonal holes and Knurling, holes and Knurling dynamics.

Table 1. Power

	Power (KW)			
RPM	Standard	Variation 1	Variation 2	Variation 3
2000	0,57	0,60	0,67	0,77
2500	0,57	0,94	0,80	0,99
3000	0,70	1,37	1,39	1,37
3500	1,39	1,89	1,84	2,01
4000	1,67	2,59	2,11	3,01
4500	1,99	3,23	2,83	3,80
5000	2,34	3,83	3,83	4,45
5500	3,08	4,52	4,35	5,22
6000	3,55	5,57	5,05	5,87
6500	4,08	5,79	5,54	6,07
7000	4,37	5,82	5,82	5,92
7500	4,97	5,84	5,84	5,84
8000	4,92	5,22	5,22	5,34

The power value contained in the table is the average value of tests carried out three times on each variable using HP (Horsepower) units which will then be converted into KW units. The lowest power from the test results on the standard variable produces 0.57 kW of power with 2000 RPM engine speed, while the highest power on the standard variable gets 4.97 with 7500 RPM engine speed, the power increases during the initial to medium rotation at 2000 - 4500 RPM. However, the power is quite low compared to other variables that are given treatment and the test is both using a standard Honda scoopy K93. This data is used as a comparison with other variables that get treatment. To be able to know the increase in each variable tested as shown in the Figure 2.

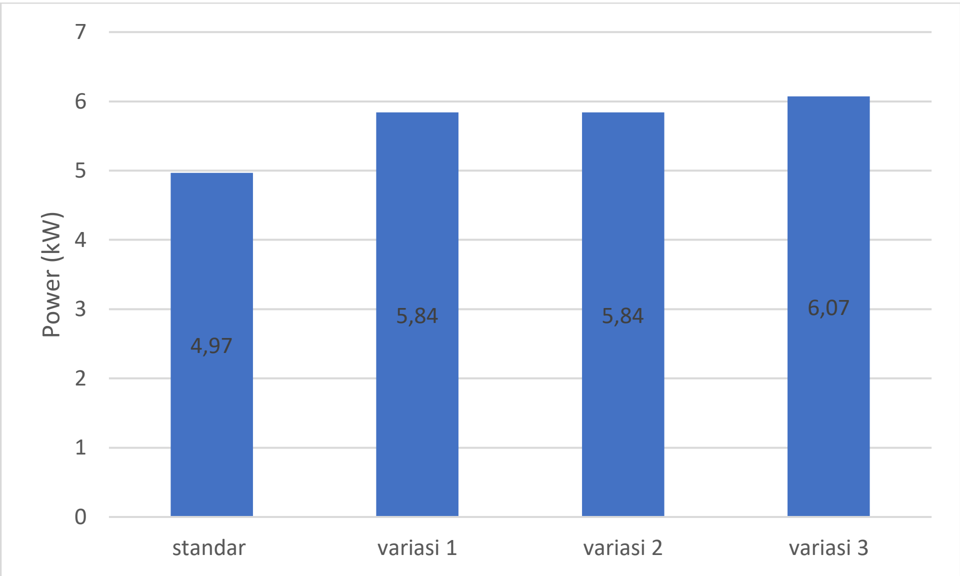

Figure 1. Diagram of power

The power increases because between the Outer Comp Cluth and Clutch disc there is no slip due to the roughness on the surface of the friction plane, so that the centrifugal force channeled through the V-belt will move the primary pulley perfectly aimed at moving the rear wheels. The difference in the way of working between double and standard lining bowl knurling lies on the inner surface of the clutch bowl [14]. In the standard bowl, the inner surface is smooth, so the double lining that expands due to centrifugal force only rubs normally against the surface. This can cause slippage, especially when the lining is worn or exposed to dust and oil, resulting in decreased acceleration of the motor [15].

4 Conclusion

The results of the research that has been carried out on the addition of holes and outer comp clutches to torque and power using a Honda Scoppy K93 motorcycle are obtained as the use of a standard outer comp clutch cannot deliver greater torque and power compared to the outer comph clutch with the addition of holes and knurling. Because of that the torque that is channeled is relatively smaller and not optimal. The change in the use of the outer comp clutch with the addition of holes and knurling proves the change in torque and power of the motorcycle by using the outer comp clutcth addition of holes and straight and dynamond knurling produces the best torque and power. Straight holes and knurling produce the best torque of 8.92 Nm at 6000 RPM and the best power at 5.84 kW at 7500 RPM, and diamond holes and knurling produce the best torque at 9.45 Nm at 6000 RPM and the best power at 6.07 at 6500 RPM. This happens because between the Outer Comp Cluth and Clutch disc coupling and there is no slip because there is roughness on the surface of the friction plane, so that the centrifugal force channeled through the V-belt will move the primary pulley perfectly, the addition of holes also removes friction and oil residues that can cause slip on these components. Changing the standard outer comp clutch to a variation of the outer comp clutch with the addition of holes and knurling results in improved characteristics

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