

The effect of use of tzm racing exhaust on exhaust emissions and noise on Nmax motorcycles

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Abstract. The Yamaha Nmax is one of the motorbikes that is often used to experience modification racing exhaust. However Thus, impact modification racing exhaust against exhaust emissions and levels noise can cause motorbikes don't fulfil applicable rules. Study This use method experiment with variable Bound that is level ex- haust emissions (CO, HC, NOx) and levels noise (dB). Fuel used that is Per- tamax RON 92. Test results exhaust standard Yamaha Nmax meets emission and noise limits permitted by regulations government. CO emissions are 2.22642 g/kWh and HC are 0.4585 g/kWh, and noise of 72.72 dBa. In contrast, the Nmax and TZM racing exhausts do not fulfil standard, with CO emissions of 36.9873 g/kWh and noise of 96.98 dBa, far exceeds the permitted limits. Therefore, That's the exhaust standard more friendly environmental and appropriate regulations, temporary racing exhaust does not fulfil criteria the.

1 Introduction

Modification Racing exhausts on motorbikes are increasingly sought after by lovers automotive, especially in Indonesia [1]. Yamaha Nmax is one of the most popular motor bikes experience modification racing exhaust [2]. Alteration This often purposeful For increase performance and sound machine. Yamaha Nmax, with its sporty design and reliable performance, become choice main for Lots riders who want increase experience drive they. However Thus, impact modification racing exhaust against exhaust emissions and levels noise still need researched more carry on for ensure his obedience to applicable regulation as well as impact to environment and health humans [3,4].

Exhaust gas emissions vehicle motorized , incl motorbikes , is one of them source main pollution air in urban areas [5–7]. Exhaust gas produced vehicle motorized contain various pollutant like carbon monoxide (CO), hydrocarbons (HC), and nitrogen oxides (NOx) which can impact negative to health humans and the environment [8–11]. The Indonesian government has set standard quality exhaust emissions vehicle motor- ized through Minister of Environment and Forestry Regulation No. P.20/MENLHK/SETJEN/KUM.1/3/2017 which regulates regarding exhaust emission limits For vehicle motorized type new [11].

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Apart from exhaust emissions, noise is produced by vehicles motorized also became attention important [12,13]. Noise Then cross can cause disturbance comfort and health, incl disturbance hearing , stress , and problems sleep [14,15]. The Indonesian government has set noise threshold vehicle motorized through Minister of Environment Regulation no. 7 of 2009 concerning Noise Threshold Vehicle Motorized New Type [16]. Study previously show that use racing exhaust on motorbikes can increase level noise until exceeds the specified limit.

Study This aim For analyze influence use racing exhaust against exhaust emissions and noise on motorbikes. With understand impact from modification This is expected can give outlook for fan automotive as well as maker policy For take the right steps in manage use racing exhaust.

2 Material and Methods

Research methods use method experiment . Experimental method is approach systematic that can be used for investigate a connection cause and effect between variables in a research [17]. Variable Free namely exhaust type (standard and racing), variable Bound that is level exhaust emissions (CO , HC, NOx) and levels noise (dB). Steps study in a way complete can seen in Figure 1 flow study.

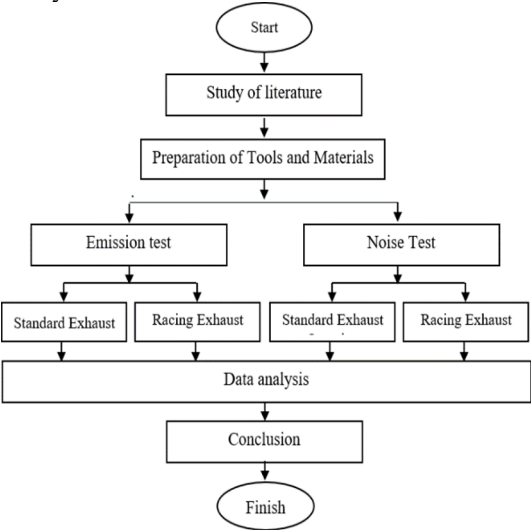


Fig. 1 Research Flowchart

2.1 Literature Study

Literature study namely a systematic process in frame for collect, evaluate, and synthesize information from sources relevant like from journal scientific, books, and publications other. The goal is for understand development latest related with study regarding “Influence use racing exhaust against exhaust emissions and noise on bicycles motorbike” forget comprehensive understanding.

2.2 Preparation of tools and materials

Study This use Nmax motorbike with two variations exhaust for compared, ie exhaust standard and Tzm racing exhaust. Tools and materials used in study This in a way complete can seen in Table 1.

Table 1. Tools and Materials

No	Name of Tool/Material	Brand/ Specifications
1	Yamaha Nmax Type ABS	Liquid cooled 4-stroke 155.09 cc, SOHC, VVA
2	Exhaust Standard	Standard
3	Racing Exhaust	Exhaust Tzm Project
4	Emission Test Equip-ment	Heshbon Exhaust Gas Analyzer HG-520
5	Noise Test Equipment	Benetech GM1352
6	Fuel gas	Pertamax RON 92
7	Shock Lock	14
8	Key Combination	14 and 17

Tzm Project racing exhaust material specifications are:

- Sliner material : SGCC galvanized plate
- Exhaust inlet : 28mm
- Neck material : stainless steel 304
- Filter diameter : length 35cm, filter pipe hole diameter 33cm, filter plate hole diameter 2mm, filter thickness 0.8 mm



Fig. 2. Exhaust standard and racing exhaust Muffler Tzm

2.3 Data Collection

- Measurement Exhaust Emissions : Uses tool gauge emission For measure CO and HC concentrations , from exhaust gas motorbike in condition operation .
- Measurement Noise : Use a sound level meter to measure level noise motor- bikes on various condition operation.
 - Implementation Experiment
 - 1) Do testing on a motorbike with exhaust standard and racing exhaust . Every motorbikes will tested in the same conditions For get consistent data .
 - 2) Testing carried out in the laboratory with controlled conditions For reduce data variability.
 - Data analysis
 - 1) Analysis Descriptive : Calculating averages and standards deviation from results measurement exhaust emissions and noise

2.4 Emission test vehicle

Emission test done For measure exhaust gas levels produced by the vehicle motorized. The main purpose of emissions testing This For prove that use racing exhaust will increase exhaust emissions and noise compared to with exhaust standard with use material burn Pertamina . Step by step testing emissions carried out is as following:

- Prepare necessary tools and materials like exhaust standard, racing exhaust, emission test equipment, noise test equipment, materials burn petrol, shock lock, key combination.
- Warm up the NMAX motorbike for (2-8 minutes), Process This done so that the machine reach temperature optimal work and emission test results more accurate .
- Zero calibration (auto) is performed For calibrate Heshbon Exhaust Gas Analyzer HG -520, so results testing more accurate .
- Then press “MEAS” to preparing the Heshbon Exhaust Gas Analyzer HG-520
- Insert the probe into in hole exhaust . Make sure the probe is in the right posi- tion For get accurate results .
- Let device do measurement during about 40 seconds . During period this, device will collect the necessary data .
- After time measurement done , device will displays results onscreen measurements . Check results the For ensure in accordance with desired standard
- After measurement completion and results has noted , remove the probe from location testing with Be careful.

2.5 Noise Test

Noise test exhaust aim For ensure that level noise vehicle motorized No exceeds the permitted limit , so can protect health public from danger noise . Noise test stages namely [18]:

- Prepare tool gauge sound (sound level meter) that has been calibrated , ruler , and form notes results measurement.
- Place tool gauge sound at a distance of 30 cm from end motorbike exhaust . Make sure microphone tool gauge voice No blocked by other objects .
- Start the motorbike with idle position , then measuring noise and repeat meas- urement as much as 5x

3 Results and Discussion

Test results exhaust emissions on Nmax motorbikes For measure exhaust gas con- centration such as CO and HC, are shown in units % or ppm by tool measure gas. In research , value This often changed to g/kWh units for adapt with standard . Table 2 provides formula conversion general For vehicle from exhaust gas concentration (ppm) to consumption material burn specific (g/kWh) [19].

Table 2. Conversion exhaust gas unit

Unit (g/kWh)	Unit (ppm or %)
CO (g/kWh)	$3,591.10^{-3} \times CO \text{ (ppm)}$
NOx (g/kWh)	$6,636.10^{-3} \times NOx \text{ (ppm)}$
HC (g/kWh)	$2,002.10^{-3} \times HC \text{ (ppm)}$
CO2 (g/kWh)	$63,470 \times CO2 \text{ (%)}$

3.1 Test results emission exhaust standard Nmax

Test results emission exhaust standard Nmax motorbike use material burn Per- tamax show some important parameters that measure level emission from exhaust . Testing done in accordance with procedures that have been done specified , including heating , calibratio, and measurement processes. Table 3 is results obtained.

Table 3. Test results emission exhaust standard Nmax

Vehicle gas emissions							
Test	CO %	HC (ppm)	CO ₂ (%)	O ₂ (%)	Lambda	AFR	Fuel
1	0.06	199	9.9	0.2	0.985	8.8	Pertamax
2	0.05	230	9.6	0.2	0.983	8.8	Pertamax
3	0.06	204	9.6	0.2	0.985	8.8	Pertamax
4	0.07	263	9.6	0.2	0.980	8.8	Pertamax
5	0.07	249	9.6	0.2	0.981	8.8	Pertamax
Aver- age	0.062	229	9.7	0.2	0.983	8.8	Pertamax

CO and HC values are next converted in accordance Table 2, and obtained results conversion as in the Table 4.

Table 4. Conversion results exhaust CO and HC values standard

Test	Exhaust gas emissions	
	CO (g/kWh)	HC (g/kWh)
1	2.1546	0.3984
2	1.7955	0.4605
3	2.1546	0.4084
4	2.5137	0.5265
5	2.5137	0.4585
Average	2.22642	0.4585

From Table 4 it is obtained CO gas emissions are 2.22642 g/kWh and HC are 0.4585 g/kWh in the exhaust standard nmax Still enter to within permissible emis- sion limits, according to regulation service environment life no.P 20 of 2017 con- cerning standard quality exhaust gas emissions [20], maximum CO limit of 4 grams/kWh, HC 1.1 grams/kWh.

3.2 Nmax racing exhaust emissions testing results

Test results emission Nmax motorbike racing exhaust use material burn Pertamina shown in Table 5.

Table 5. Test results emission Nmax racing exhaust

Vehicle gas emissions							
Test	CO %	HC (ppm)	CO ₂ (%)	O ₂ (%)	Lambda	AFR	Fuel
1	0.96	304	7.4	0.0	0.923	8.3	Pertamax
2	1.00	330	7.5	0.0	0.920	8.2	Pertamax
3	1.06	326	7.4	0.0	0.917	8.2	Pertamax
4	1.04	329	7.4	0.0	0.918	8.2	Pertamax
5	1.08	325	7.5	0.0	0.917	8.2	Pertamax
Average	1.03	323	7.4	0.0	0.919	8.2	Pertamax

CO and HC values are next converted in accordance Table 2, and obtained results conversion as in the Table 6.

Table 6. Conversion results CO and HC values of racing exhaust

Test	Exhaust gas emissions	
	CO (g/kWh)	HC (g/kWh)
1	34.4736	0.6086
2	35.91	0.6606
3	38.0646	0.6526
4	37.3464	0.6586
5	38.7828	0.6506
Average	36.9873	0.6466

From Table 6 it is obtained CO gas emissions are 36.9873 g/kWh and HC are 0.6466 g/kWh in the Nmax racing exhaust No enter to within emission limits yeah permissible, according to Environmental Service regulation no.P20 of 2017 concerning quality clothing exhaust emissions Maximum CO limit is 4 grams/kWh, HC 1.1 grams/kWh. So that can concluded this racing exhaust No friendly to environment Because has CO of 35.9873 g/kWh.

3.3 Noise test results exhaust standard

Test results noise use sound level meter on the exhaust standard Nmax can seen in Table 7.

Table 7. Noise test results exhaust standard

Test	Noise (dBa)
1	71.8
2	72.1
3	78.0
4	70.9
5	70.8
Average	72.72

From Table 7, the average Yamaha NMAX standard exhaust noise level is 72.72 dBa. This value is still within the maximum limit permitted based on Minister of the Environment Regulation Number 56 of 2019 [20], which stipulates that the maximum noise level for motorized vehicles with an engine capacity of more than 50 CC is 77 dBa.

This shows that the Yamaha NMAX standard exhaust meets applicable noise regulations, so it is not only safe to use in terms of sound emissions, but also complies with environmental standards set by the government. These results also reflect that the Yamaha NMAX with a standard exhaust does not cause excessive noise, which could disturb the comfort of other riders and the surrounding community.

3.4 Test results noise racing exhaust

Results of noise testing using a sound level meter on the NMAX racing exhaust can seen in Table 8.

Table 8. Noise test results racing exhaust

Test	Noise (dBa)
1	98.5
2	99.0

3	94.9
4	95.7
5	96.8
Average	96.98

From the Table 8, the noise in the TZM racing exhaust is obtained average value amounting to 96.98 marks the No enter to within the maximum limits set inside Minis- ter of Environment Regulation Number 56 of 2019 [1] . According to regulation the maximum limit permitted noise For exhaust vehicle motorized aim For guard quality environment life and health public . Therefore that's the result testing This show that Good NMAX racing exhaust or TZM racing exhaust exceeds the permissible noise limits.

4 Conclusion

From the results testing, exhaust Standard Yamaha NMAX meets the emission and noise limits permitted by regulations government . CO emissions are 2.22642 g/kWh and HC are 0.4585 g/kWh, and noise of 72.72 dBa Still within the specified limits. In contrast, the NMAX and TZM racing exhausts do not fulfil standard, with CO emissions of 36.9873 g/kWh and noise of 96.98 dBa, far exceeds the permitted limits . Therefore That's the exhaust standard more friendly environmental and appropriate regulations, temporary racing exhaust does not fulfil criteria. the data show that ex- haust This No suitable used If want to guard quality environment life and health public. Therefore the, usage exhaust standard more recommended For fulfil regulations that apply and maintain environment still clean and comfortable.

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