Outlook

Fw: CI3 2023 notification for paper 5498

De: ci32023@easychair.org en nombre de CI3 2023 <ci32023@easychair.org>
Enviado: Sunday, August 6, 2023 6:40:31 PM
Para: Vicente Manopanta <ingenieriatecnicamc@hotmail.com>
Asunto: CI3 2023 notification for paper 5498

Dear Vicente Manopanta:

We are pleased to inform you that your work "Trucaje De Culata De Un Motor Encendido provocado Y Validación En Un Dinamómetro De Rodillo Para La Verificación De Su Potencia" has been accepted for oral presentation and publication at the IV International Conference on Research and Innovation - CI3 2023, to be held from August 30 to September 1 of this year.
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Do not hesitate to contact us if you need more information (info@ci3.tech).

We look forward to hearing your presentation at CI3 2023!

Regards,

Ph.D. Marcelo Zambrano V.
GENERAL CHAIR
CI3 2023

SUBMISSION: 5498
TITLE: Trucaje De Culata De Un Motor Encendido provocado Y Validación En Un Dinamómetro De Rodillo Para La Verificación De Su Potencia

REVIEW 1
SUBMISSION: 5498
TITLE: Trucaje De Culata De Un Motor Encendido provocado Y Validación En Un Dinamómetro De Rodillo Para La Verificación De Su Potencia
AUTHORS: Vicente Manopanta

Overall evaluation SCORE: 2 (accept)
TEXT:
Es importante recalcar que para ser publicado el artículo debe ser escrito en idioma inglés.
Revisar la plantilla. El documento debe cumplir estrictamente con la plantilla de referencia. Por ejemplo: no es necesario incluir los títulos académicos de los autores en la filiación.
De manera general, el documento está bien escrito, lo cual, facilita su lectura. Se puede evidenciar el trabajo realizado por los autores.
Se recomienda ampliar las referencias y de ser posible, incluir un comparativo con otros trabajos semejantes.

REVIEW 2
SUBMISSION: 5498
TITLE: Trucaje De Culata De Un Motor Encendido provocado Y Validación En Un Dinamómetro De Rodillo Para La Verificación De Su Potencia
AUTHORS: Vicente Manopanta

Overall evaluation SCORE: 2 (accept)
TEXT:
The document does not comply with the format or the language required for its acceptance in the event, however, the investigation comes across an interesting and highly applicable topic at a regional level.

References are short.

It is recommended to accept the document as long as the recommendations are met.

Cylinder Head Tuning Of A Spark-Ignition Engine And Validation On A Chassis Dynamometer To Verify Its Power

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Abstract. The research is motivated by the high levels of contamination and lack of efficiency, especially due to the exponentially increasing vehicle fleet in Ecuador, the proposal is to modify several components and characteristics of the cylinder head such as the combustion chamber, the valve mechanism system, the intake and exhaust system of the spark-ignition engine, which will result in changes to the power of the engine and thus the vehicle and this was measured in the chassis dynamometer since this result can be obtained directly through the vehicle. With the present research you can achieve a bulwark of machining in the elements of the engine where the calculated theory is reflected in practice and in the chip starting that will be given to the cylinder head linking fuel consumption and compression ratio, the engines look good or bad according to the power sought experimentally. In conclusion, from the measurements made, in general there is an increase in the power performance of 30.08% with the modifications and specifically at the maximum power at 4400 rpm, measured in the chassis dynamometer, which were the result of the modifications of the cylinder head of the engine with respect to the standard cylinder head of the vehicle's engine.

Keywords: Cylinder head tuning, Spark-ignition engine, Compression ratio, Power, Chassis dynamometer.

1 Introduction

A small portion of vehicles are replaced by new models every year. Standards for passenger cars, for example, now cover almost two-thirds of their overall energy use, up from 50% a decade ago. For some developing countries that have not yet established standards, the import of second-hand vehicles is an important feature of their market with many of these imports no longer meeting the standards of the exporting country [1].

Each country's economy is directly or indirectly dependent on fossil fuels, gradually shrinking through massive industrialization, transportation and population growth [2]. In addition, concerns about climate imbalances, global warming and the commitments made by developed countries to improve the security of energy supply and encourage the use of renewable energies are just some of the factors that make biodiesel an interesting alternative [3].

The addition of bridges and bores in the cylinder head proves to be very effective as it considerably reduces emissions [4]. In addition, a slight change in the configuration of the bridges and bores can change the flow directions and patterns and vary the way the gases react, which can further reduce emissions [5][6]. The effect of speed, load, and blend ratio on the competence of a multi-cylinder indirect injecting diesel power unit was investigated by Adam et al. (2015), using statistical tool, Box-Behnken design (BBD) based on RSM to predict and assess their net effects on the responses, such as torque, power, BSFC, and BTE. Blends of 5-20% volume of BDF (prepared from a mixture of palm and rubber seed oils) to diesel fuel were prepared Load was found to be the most effective input, both individually and in combination, in contrast to the blending and speed variables [7]. A strong influence of speed on the results was observed, except for torque, while their combined effect was not vital, except for BSFC and BTE [8].

Sha et al. (2015) [9]experimentally investigated the effects of pre-chamber volume and nozzle diameter on the resultant ignition characteristics. It was found that a larger pre-chamber provides higher ignition energy, which results in shortened flame development angle and combustion duration. At a given pre-chamber volume, nozzle diameter mainly affects the combustion duration [10].

The research was initiated in response to the high levels of contamination and lack of efficiency, especially in the automotive fleet [11], due to the scarce energetic use of organic materials as energy sources that guarantee an optimal performance in internal combustion engines. The main objective of this project is the modification of the cylinder head of a spark-ignition engine and validation in a chassis dynamometer for the verification of its developed power after the adjustments in these variables.

2 Method

2.1 Applied test vehicle

For the experimental investigations, a Citroën 1.4 Standard K2d 4-cylinder 1,360 cm^3 gasoline engine, with indirect injection in the intake manifold, naturally aspirated and equipped with a conventional three-way catalytic converter from 1998 was used; selected because it is one of the most sold automobiles in Ecuador in those years [12]. Table 1 describes the specifications of the vehicle.

Table 1. Citroën 1.4 Standard K2d Technical Data Sheet

Characteristics	Units
Make	Citroën
Model	Saxo
Year	1998
Compression Ratio	9.3 / 1
Torque	114 Nm
Horsepower	75 CV

Bore	75 mm
Top Speed	164 km/h
Acceleration, 0-100 km/h	14.8 s
Max Power	76 CV DIN AT 5800 rpm
Displacement	1360 cmˆ3
Max Torque	111 Nm DIN AT 3400 rpm
Valves	8 valves
Fuel	Gasoline
Engine	Inline four
Firing order	1-3-4-2

2.2 Characteristics of the cylinder head for the combustion chamber area

The design of the cylinder head is simple, easy to reproduce and install [13]; given the intake stroke, the mixture reaches the cylinder with little speed, the turbulence is almost null, the combustion is slow and prone to detonation due to the long length of the flame [14]. Figure 1 shows the measurement of the combustion chamber volume, as the main value in this tuning process, in addition to the calculation of the engine compression ratio measured, applying the following equations.

Piston volume measurement

$$Piston\ Vol. = 10\ cm^3$$

$$Compressed\ Vol. = \text{Piston}\ Vol. + Chamber\ Vol. + \text{Gasket Vol.} \tag{1}$$

$$Compressed\ Vol. = 10 + 25.5 + 6.87 = 42.37 cm^3$$

Calculation of the compression ratio of the engine

$$Rc = \frac{Compressed\ Vol. + Displacement\ Vol.}{Compressed\ Vol.} \tag{2}$$

$$Rc = \frac{42.37 + 343.67}{42.37} = 9.11\ a\ 1$$

$$Chamber\ Vol. = 25.5 cm^3$$

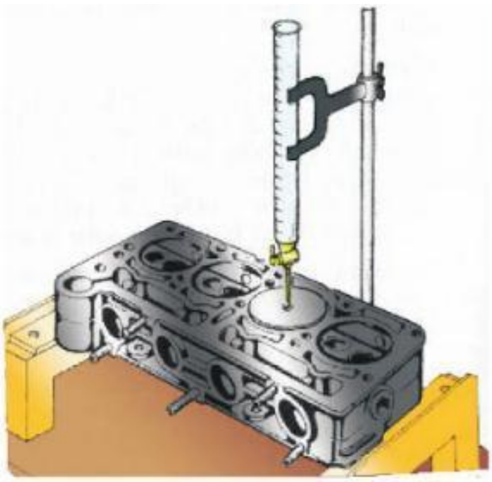

Fig. 1. Measurement of the combustion chamber volume

As a consequence of the calculations, we obtain the tuned or modified compression ratio that will show the results of this experiment [15], as described in Table 2.

Table 2. Compression Ratio Calculations

	ENGINE WITHOUT MODIFICATION	ENGINE WITH MODIFICATION
Displacement Vol.	**343.67 cm^3**	**343.67 cm^3**
Gasket Vol.	**6.87 cm^3**	**6.87 cm^3**
Chamber Vol.	**25.5 cm^3**	**24.8 cm^3**
Piston Vol.	**10 cm^3**	**10 cm^3**
Compressed Vol.	**42.37 cm^3**	**41.67 cm^3**
Compression Ratio	**9.11 : 1**	**9.25 : 1**

2.3 Valve mechanism system

The valve system performs an exhaustive work in the recirculation of gases and manages a proper combustion. Table 3 shows several characteristics of the valves both in standard form and in modified or tuned form applied in the study proposed in this research [16].

Table 3. Valve System

	STANDARD CONDITION	MODIFIED CONDITION
Intake Valve Measurement		
Retainer Diameter	36.5 mm	36.5 mm
Valve Length	112.69 mm	112.69 mm
Valve Stem	0.7 mm	0.6 mm
Valve Seat	45°	30°
Exhaust Valve Measurement		
Retainer Diameter	29.2 mm	29.2 mm
Valve Length	112.5 mm	112.5 mm
Valve Stem	0.7 mm	0.6 mm
Valve Seat	45°	30°

2.4 Intake and exhaust system of the spark-ignition engine

The cylinder head has several ducts that are mainly useful for the recirculation of gases and managing a proper combustion. Table 4 shows several features measured for both standard form and modified or tuned form that characterize the study proposed in this research [17]. In addition, Figures 2, 3 and 4 show the measurement processes established to obtain the data in the cylinder head [18].

Fig. 2. Measurement of the exhaust manifold nozzle diameter

Fig. 3. Measurement of the intake manifold nozzle diameter

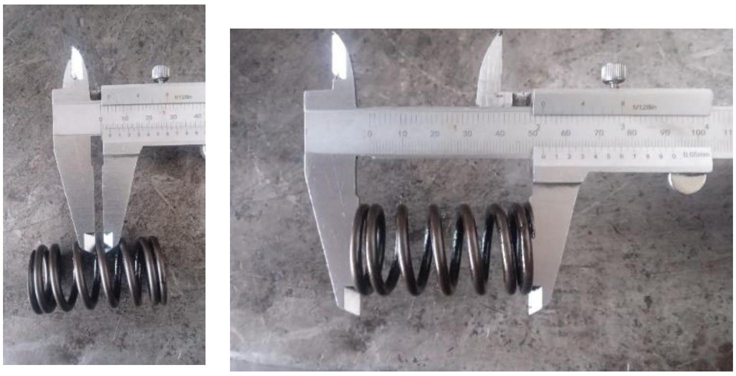

Fig. 4. Measurement of the cylinder head springs

Table 4. Gas recirculation cylinder head ducts and valve springs

	ENGINE WITHOUT MODIFICATION			ENGINE WITH MODIFICATION		
Cylinder head intake nozzles						
	Diameter (mm)	Length (cm)	Volume (cm^3)	Diame-ter (mm)	Length (cm)	Volume (cm^3)
CYLINDER 1	29.40	8.5	66.5	31	8.5	67.2
CYLINDER 2	29.40	8.5	66.5	31	8.5	67.2
CYLINDER 3	29.40	8.5	66.5	31	8.5	67.2
CYLINDER 4	29.40	8.5	66.5	31	8.5	67.2
Cylinder head exhaust nozzles						
	Diameter (mm)	Length (cm)	Volume (cm^3)	Diame-ter (mm)	Length (cm)	Volume (cm^3)
CYLINDER 1	28.0	6	45.0	33	6	47.0
CYLINDER 2	28.0	6	45.0	33	6	47.0
CYLINDER 3	28.0	6	45.0	33	6	47.0

CYLINDER 4	28.0	6	45.0	33	6	47.0
Cylinder head springs						
	Diameter (mm)	Length (mm)	Thick-ness (mm)	Diame-ter (mm)	Length (mm)	Thick-ness (mm)
CYLINDER 1	28.80	52.10	3.60	32.40	47.30	4.50
CYLINDER 2	28.80	52.10	3.60	32.40	47.30	4.50
CYLINDER 3	28.80	52.10	3.60	32.40	47.30	4.50
CYLINDER 4	28.80	52.10	3.60	32.40	47.30	4.50

The measurements of the manifold nozzles are relevant to observe its modification as a consequence of the new performance to be obtained in the vehicle's engine, according to Table 5.

Table 5. Manifold nozzles and cylinder head height

	ENGINE WITHOUT MODIFICATION	ENGINE WITH MODIFICATION
Measurement of the cylinder head height		
	mm	mm
Height	111.2	110.4
Measurement of the exhaust manifold nozzle diameter		
	Diameter (mm)	Diameter (mm)
CYLINDER 1	31	34.80
CYLINDER 2	31	34.80
CYLINDER 3	31	34.80
CYLINDER 4	31	34.80
Measurement of the intake manifold nozzle diameter		
	Diameter (mm)	Diameter (mm)
CYLINDER 1	27.5	27.5
CYLINDER 2	27.5	27.5
CYLINDER 3	27.5	27.5
CYLINDER 4	27.5	27.5

2.5 Determination of the developed power

The main test in this study is the chassis dynamometer, where the chassis dynamometer SAENZ PERFORMANCE INERTIAL CHASSIS DYNOS-N 08-19 was used, which allows simulating a speed profile as a function of time to perform dynamic tests on diesel and gasoline vehicles [19]. It allows to upload different test cycles of the different legislations or self-designed cycles in order to be able to determine exactly the amounts of developed power. Figure 5 shows schematically the model of the testing process performed on the vehicles. The torque and power tests were performed on the chassis dynamometer [20].

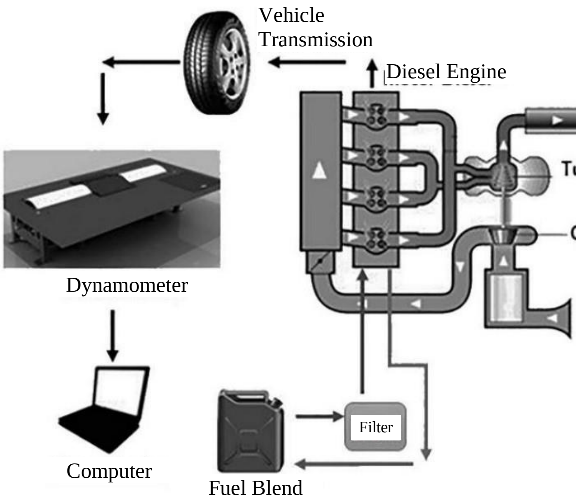

Fig. 5. Test setup on the chassis dynamometer

Power and torque test protocol. The evaluation of the performance obtained on the output shaft through the dynamometer was performed under ISO 1585 and ISO 3173 standards [3]; following the test protocol: verify that the diameter of the wheels is equal to or greater than 13 rim and that they comply with the weight capacity established by the manufacturer; place the test vehicle on the dynamometer rollers; verify that the tire tread is free of stones; lower the lift and leave the wheels resting on the rollers; check the alignment of the wheel assembly with respect to the dynamometer rollers by rotating the wheels at a maximum speed of 20 km/h; secure the vehicle with straps to prevent it from slipping off the rollers; check the safety of the test area; enter the technical data concerning the vehicle to be tested into the software; check the gear and transmission ratio of the unit, which must be 1:1; make sure that the engine temperature is the normal operating temperature, otherwise it must pass an engine warm-up period to reach such temperature; start the cooling fan of the dynamometer; start the measurement test; accelerate the vehicle with the pedal fully depressed in the test gear until reaching the desired speed called "rpm cut" (4500 - 6000 rpm); when the "rpm cut" has been reached, depress the clutch, leaving the gear engaged. The dynamometer decelerates to a stop [21].

3 Results

3.1 Vehicle power without modification of the cylinder head

The power parameters generated by the engine of the Citroën 1.4 vehicle with the different tests. The static test with load was carried out, using the chassis dynamometer, under the ISO 1585 Standard, performing three tests for each case and obtaining the result to be evaluated. Figure 6 shows the evolution of the tests on the equipment [22]. Here are the results of the measurement of the power obtained for the vehicle with the dynamometer. The test was run three times in a row using premium gasoline. In this test, it can be observed that the curves generated do not show a major difference according to the values.

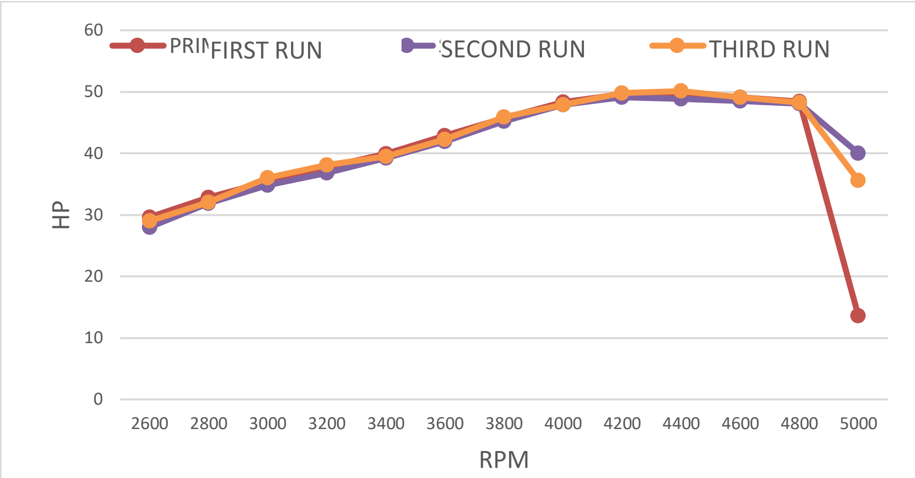

Fig. 6. Vehicle power without the cylinder head modification during three runs

3.2 Vehicle power with the cylinder head modification

The power parameters generated by the engine of the Citroën 1.4 vehicle with the different tests. The static test with load was carried out, using the chassis dynamometer, under the ISO 1585 Standard, performing three tests for each case and obtaining the result to be evaluated [23]. Figure 7 shows the power curves obtained with the dynamometer. The test was run three times in a row using premium gasoline. In addition, it can be observed that there is not a major difference among the values [24].

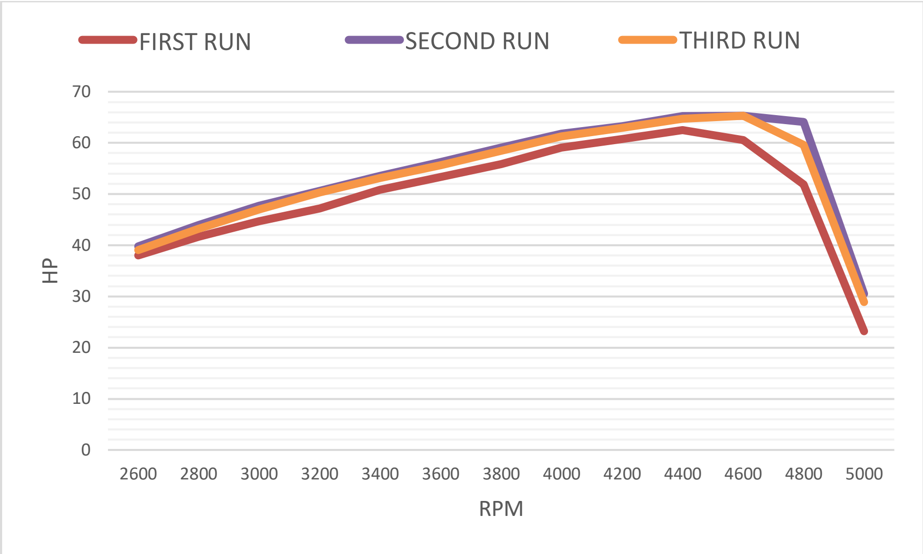

Fig. 7. Vehicle power with the cylinder head modification during three runs

3.3 Discussion of the results on the obtained power

The tests carried out and the values obtained are used to analyze the behavior of the vehicle, which will be used to develop the pertinent analysis regarding the performance of the engine. We will proceed as follows, working with the average power values obtained [25]. Figure 8 shows the power variation differences for the standard working tests and the cylinder head modification, clearly evidenced in the chassis dynamometer.

It is then established according to the measurements made that there is an increase of 30.08% in the performance at 4400 rpm with respect to the engine power with the modifications of the cylinder head, and it is clearly seen in the comparative graph the difference between the performance of power before and after the modifications of the cylinder head. All the tests were carried out with the premium gasoline that is commercialized in the country [26]. Several authors show similar data, confirming the increased engine efficiency [5].

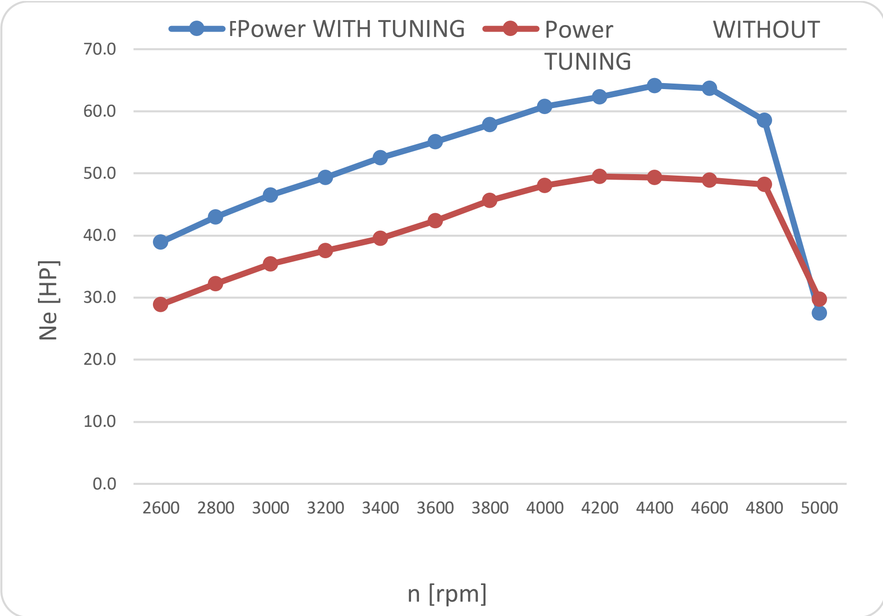

Fig. 8. Developed powers before and after the engine cylinder head tuning.

4 Conclusions

In conclusion, a research analysis is made about the modifications in the engine cylinder head to find the best configuration and the best performance. In the studies analyzed, it has been found that the valve, nozzles and ducts of the cylinder head are truly relevant and have the greatest influence on the engine performance.

The measurements performed show an increase in power performance in general during the course of the engine operation from idle to maximum power. Therefore, with the modifications and specifically at the maximum power at 4400 rpm, an increase of 30.08% measured in the chassis dynamometer was observed as a result of the modifications of the engine cylinder head with respect to the standard cylinder head of the vehicle's engine.

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