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Internal Combustion Engine: Honda CRX Dyno Testing

Motorcycle Technology ACHA4003

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Contents Page

1	Introduction	1
1.1	Aims	1
1.2	Objectives	1
2	Experimental Procedure	2 - 4
3	Results and Discussion	5
4	Conclusion	6
5	References	7

1. Introduction

There are several important elements that determine the range of available engine designs, namely the working cycle, engine configuration, fuel type, ignition method, combustion chamber design, load control method, etc. For internal combustion engines, there are two known ignition methods the Spark-Ignition *SI* widely used for petrol/gasoline engines, and Compression-Ignition *CI* commonly utilised in a diesel fuel operation. Modern engines and various old engine models execute the widely known four-stroke cycle, which consists of intake, compression, power, and exhaust stroke, which are directly proportional to the engine geometry and performance. The following engine parameters determine the engine geometry, cylinder head, cylinder volume, piston area, connecting rod, and crankshaft. Consequently, performance can be defined by fuel efficiency, thermal efficiency, torque, and brake power, over the range of engine speed available (Heywood, J. 2018).

1.1 Aim

With the completion of the study, the author must gain knowledge and a better understanding of internal combustion engines and their fundamental elements, and the author must also be able to apply the knowledge to calculate and analyse the gathered data from the dynamometer session experiment.

1.2 Objective

The author must use the gathered data from the dynamometer session and use relevant equations to calculate the brake power, torque, fuel energy, mechanical energy, engine efficiency, and specific fuel consumption to produce graphical results, as well as further reading of relevant topics must be done to support the calculations presented in this study.

2 Experimental Procedure

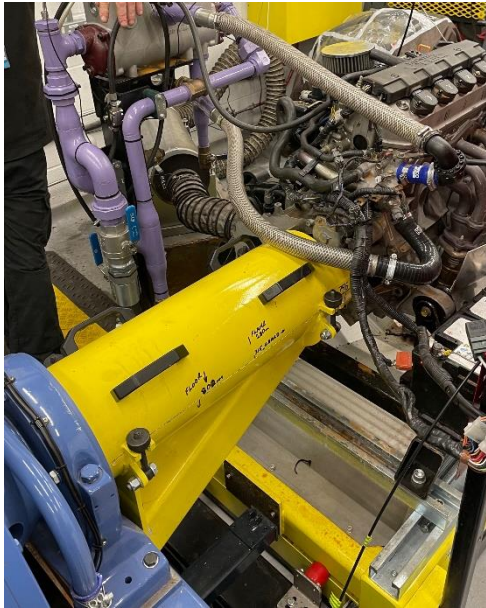


Figure 1. Honda CRX engine mounted on the ECD (Aganon, 2023)



Figure 2. Honda CRX engine mounted on the ECD (Aganon, 2023)

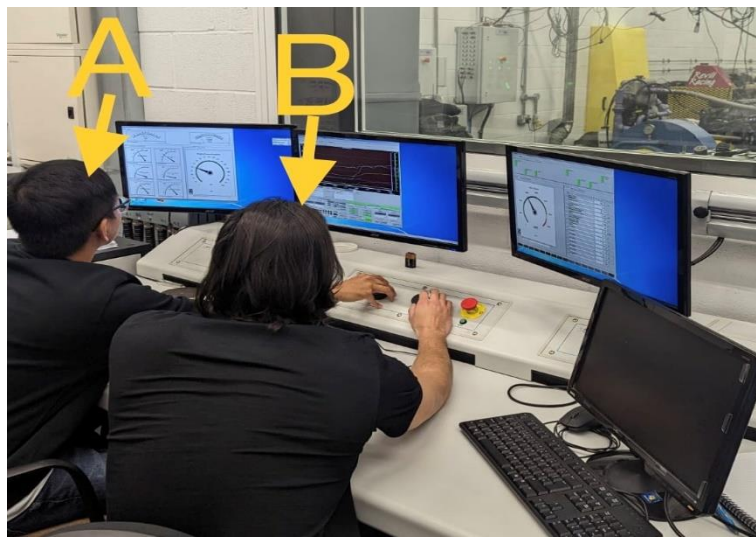


Figure 3. Dyno Control Panel (Aganon, 2023)

Table 1. Experimental Setup (Aganon, 2023)

Experimental Setup	
Piston Area (m^3)	0.004417865
Torque Arm (m)	0.815775
Baro (Bar)	0.0010189
Humidity (%)	46
Ambient Temperature (K)	300.15
Calorific Value of Fuel (J/kg)	45000
Number of Cylinders	4
Bore ϕ (m)	0.075
Stroke (m)	0.09
Engine Displacement (cm^3)	1590

In this report, a dyno experiment was performed using a 1987 Honda CRX Spark-Ignition SI engine mounted on the W-series Eddy Current Dynamometer, as shown in figures 1 and 2. In figure 3, the dial gauges of the dyno control panel are being controlled by Student A who is controlling the load that is being delivered to the engine from the dyno, while Student B is controlling the engine speed, by turning both dial gauge clockwise it increases the load and engine speed, and by turning it anti-clockwise will do the opposite. At the end of the experiment, the dyno produced relevant data such as engine load, engine speed, fuel flow rate, and lambda, these data will then be used to calculate the following parameters:

- **Torque** $T = W \times R$

W = engine load

R = radius where the load acts upon

- **Power** $P = \frac{2\pi NT}{60}$

N = engine speed

T = torque

- **Fuel Energy** $FE = M' \times CV \times 10^3$

M' = fuel mass used per hour

CV = Calorific Value

- **Mechanical Energy** $ME = P(Watts) \times 3600$

P = power in watts

- **Corrected Power** $P_S = \frac{P \times 1.01325}{P_a} \times \sqrt{\frac{T_a}{293}}$

P_s = corrected power

P = power in watts

P_a = ambient pressure

T_a = ambient temperature

- **Engine Efficiency** $EF = \frac{ME}{FE}$

ME = mechanical energy

FE = fuel energy

- **Thermal Efficiency** $TE = \frac{BP(kW)}{SFC \times CV}$

BP = brake power in kilowatt

SFC = specific fuel consumption

CV = calorific value

- **Specific Fuel Consumption** $SFC = \frac{M'}{BP}$

M' = mass of fuel used per hour

BP = brake power

Torque T is the scale of an engine's ability to do work, and Power P is the proportion at which work is done, during the expansion stroke inside the engine cylinder gas pressures force the piston down which then creates work. Specific Fuel Consumption SFC is used to measure how efficient an engine generates work with the provided fuel at a particular application. A considered good amount of SFC for SI engines are approximately $65 \mu g/J = 235 g/kW \cdot h = 0.41 lbm/hp \cdot h$. Undoubtedly, lower SFC value is advantageous (Ferguson, and Kirkpatrick, 2015)

3 Results and Discussion

Table 2. SFC against RPM (Aganon, 2023)

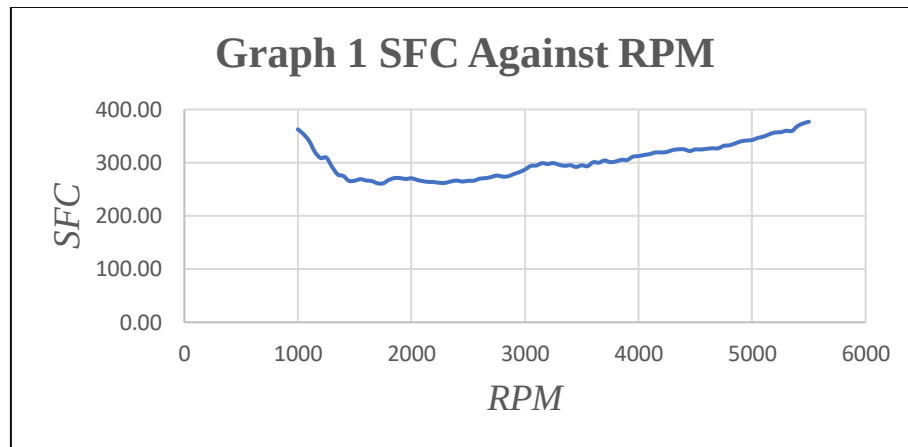


Table 3. Torque against RPM (Aganon, 2023)

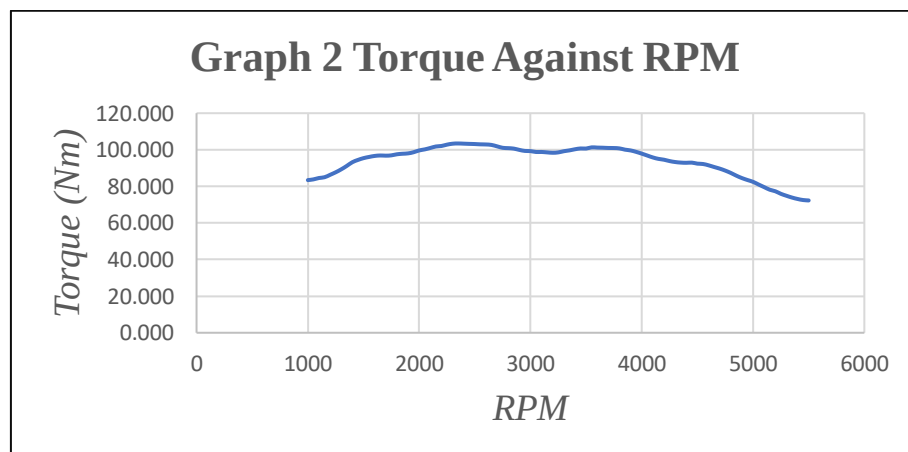
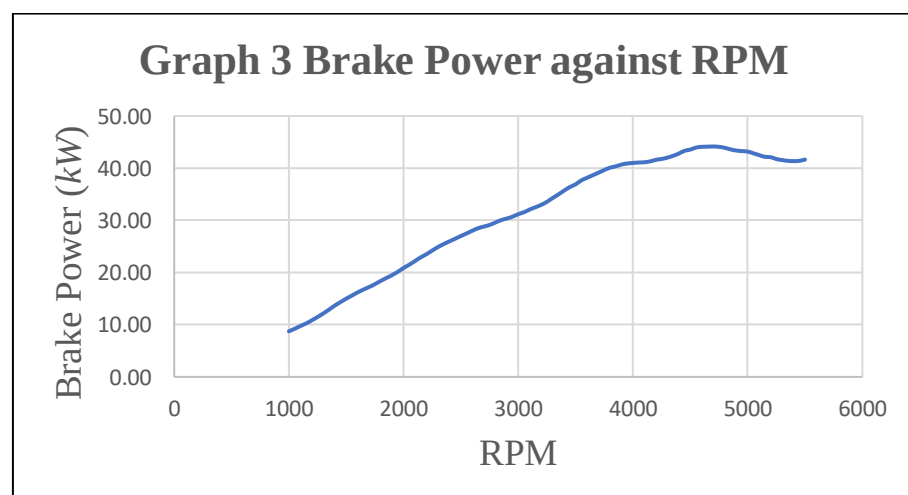


Table 4. Brake Power against RPM (Aganon, 2023)



4 Conclusion

5 References

Ferguson, C.R. and Kirkpatrick, A.T., 2015. *Internal combustion engines: applied thermosciences*. John Wiley & Sons.

Heywood, J. (2018) *Internal combustion engine fundamentals*. 2nd edition. New York, N.Y: McGraw-Hill Education.