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Engine Performance Characteristics

Vehicle Technology (ACHA4004)

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Contents

1. Introduction	3
2. Dynamometer	4
2.1 Advantages of Dynamometer Testing.....	4
2.2 Equipment operated	4
3. Methodology	5
4. Discussion	6
5. Conclusion	10
5. References	11

1. Introduction

This report will clarify how important it is to test the engine performance and how to understand the engine results. This will also cover different types of methods to test the engine. The engine that was tested is 1.6 litre Honda VTEC engine from early 2000s. The engine was tested on Eddy current dynamometer. This dyno can provide more accurate results, measurements, and response compared to other dynamometers. It is a great advantage to have an accurate result from the engine in order to make further investigation.

2. Dynamometer

In general, principals of the dynamometers are same but the accuracy of the outcomes are different. The most known dynamometers are Eddy current dyno, a water brake dyno, hydraulic dynos and friction brake dyno. The Eddy current flow is a dynamometer method that based on the principle of Faradays' Law of electromagnetic induction (Electronics Projects Focus, 2022). When the rotor spins and make current in order to measure and it can increase the load on the engine. This system can be controlled behind the computer.

The friction brake dynamometer is rarely used because the results and figures it produces are inaccurate compared to the other dynamometers. The reason is because the coefficient of friction on two materials cannot keep up with high speed and torque (Prabhakar Purushothaman, 2014).

Water brake dynamometer is similar to the friction brake dynamometer except that the flywheel is suspended from the water drum. friction dynamometer is that you can add an adjustable load to the engine by adjusting the amount of water in the flywheel chamber.

2.1 Advantages of Dynamometer Testing

The purpose of dynamometer is to measure the torque, force and the horsepower of the engine and provide the accurate numbers (Auto Scope, 2022). Nowadays many car enthusiasts and engineers use this device to modify or adjust the vehicles engine based on the result of it. The great advantage is that the engine results will be saved and can be compared in future engine dyno testing.

2.2 Equipment operated

The Eddy current dyno was used to test 1.6 litre Honda VTEC engine. The engine dynamometer testing was operated by workshop technician in engine workshop at University of Wales Trinity Saint David. The operation was recorded and the data was provided to the engineering students.

3. Methodology

The 1.6-liter Honda VTEC engine from early 2000s is put through a series of tests on dynamometer at UWTSD by workshop technician, including dyno force to determine the engine's torque value at different rpm, dyno speed to determine the engine's power value at different rpm, the flow rate of fuel is captured so liters per 45 seconds at different rpm to determine specific fuel consumption, and at last pressure readings to determine engine pressure at different rpm. The tests mentioned above will offer information on the engine's performance as well as data on the peak torque and power at certain rpm.

4. Discussion

The discussion will focus on the data gathered from Matlab calculations and the relation to the video of the data capture, there are few interesting areas that draw attention in accordance with the engine. Figure 1, Torque and Power under full load, shows the correctly calculated torque and power at different RPM at full load. Showing at 3,000 RPM the graph indicates a clear peak torque. The engines torque output behaves as increasing sharply at first under full load then diminishes at a gradual rate with increased RPM. (Hadi and Susilo, 2020) both explain petrol engines usually produce a torque output within an engine speed between 1,000 to 1,200 RPM and peak torque measurement from 2,500 to 4,000 RPM which also can be seen from the figure. This explains that the engine is a naturally aspirated engine according to (Mercedes Benz, 2021) the torque peak is caused by maximum volumetric efficiency which occurred when the engine pulled as much as air, then after the peak the engine spins rapidly for the intake air to keep up resulting a drop. The power under full load shows a gradual increase where this indicates that the inertia forces are acting along to the RPM in accordance to the inside of the petrol engine.

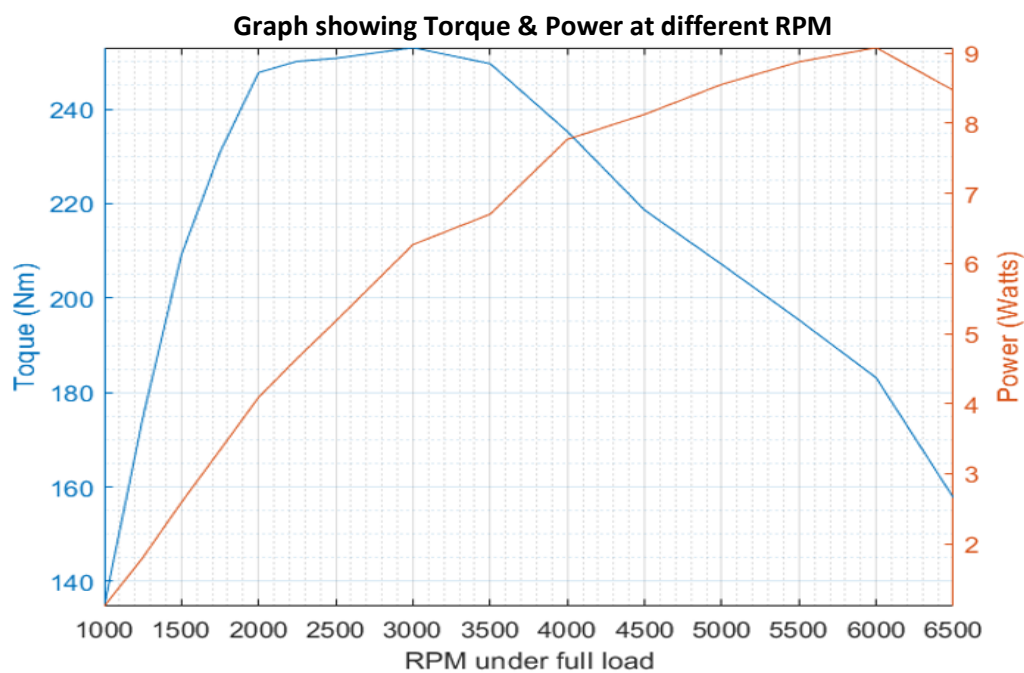


Figure 1

Figure 2, break mean effective pressure (BMEP) and thermal efficiency at various RPM has been calculated, as the peak BMEP is at 3,000 RPM shows the engine is performing at an increased speed. As thermal efficiency shows various of peaks and lows, the highest is at 4,500RPM and lowest performing at 6,000RPM. Although the graph shows various of peaks and troths, with a thermal efficiency ranging from 30 to 27 percent is recorded as an average. Thus it also explains that he engine is burning more fuel to heat and losing power.

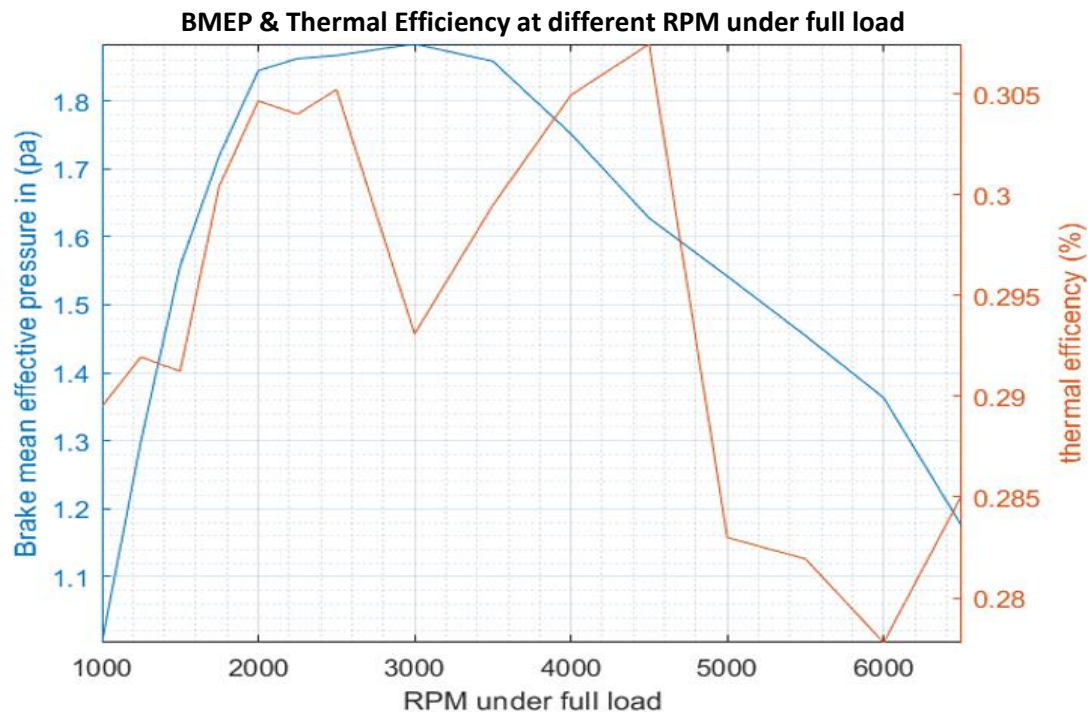


Figure 2

Figure 3, specific fuel consumption (SFC) is calculated against the engine load using a heat map. The graph represents the best SFC at 2,250 RPM and 40% load and worst performing SFC at 6,500RPM and 2% load. A SFC plays an important aspect in regard to the development of an engine for performance applications here the best value achievable is at a high RM and high load. In this instant, the value used for the petrol was 0.71 from a various of values as gravity can play a change in the factor. The lowest performance at 6,000 RPM and 4% load is because the RPM is at highest with no or little load resulting the engine to use high amount of fuel and the energy is not reaching its full potential with no or little load. The data also points out the engine is designed to be an efficient family car design performing at 2,250 RPM and 40% load where this would usually be cruising speed low loads and RPM.

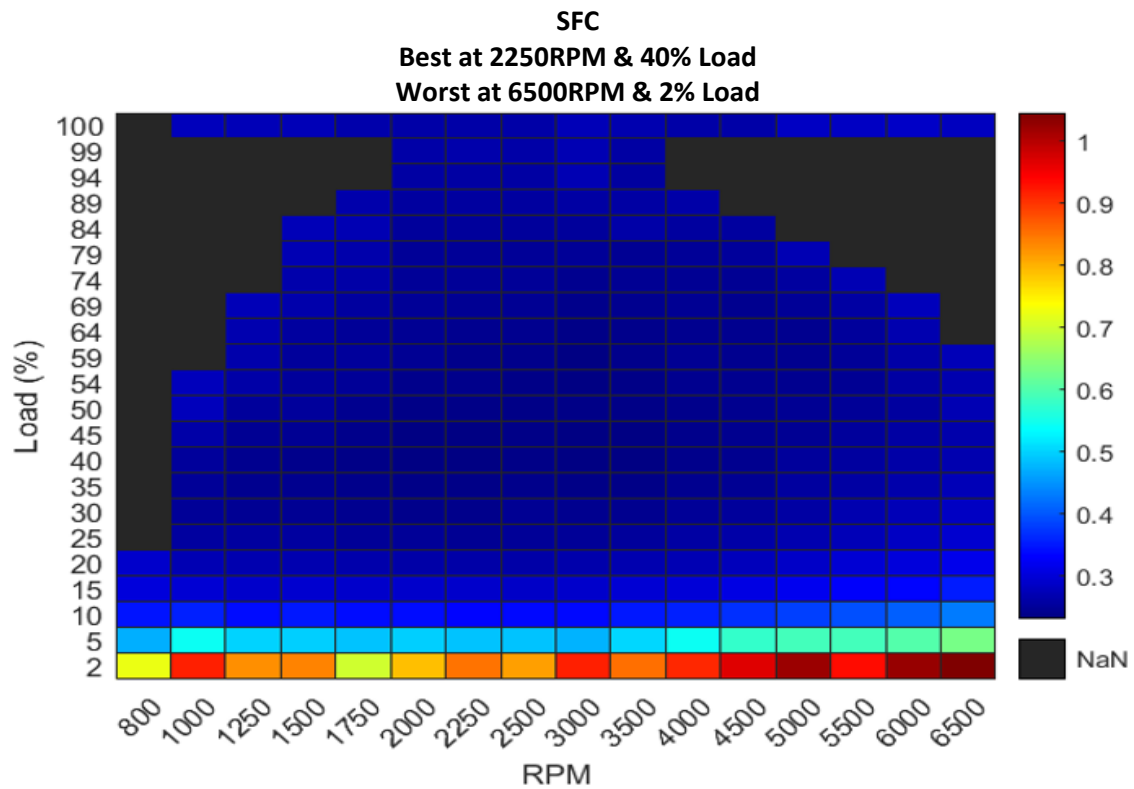
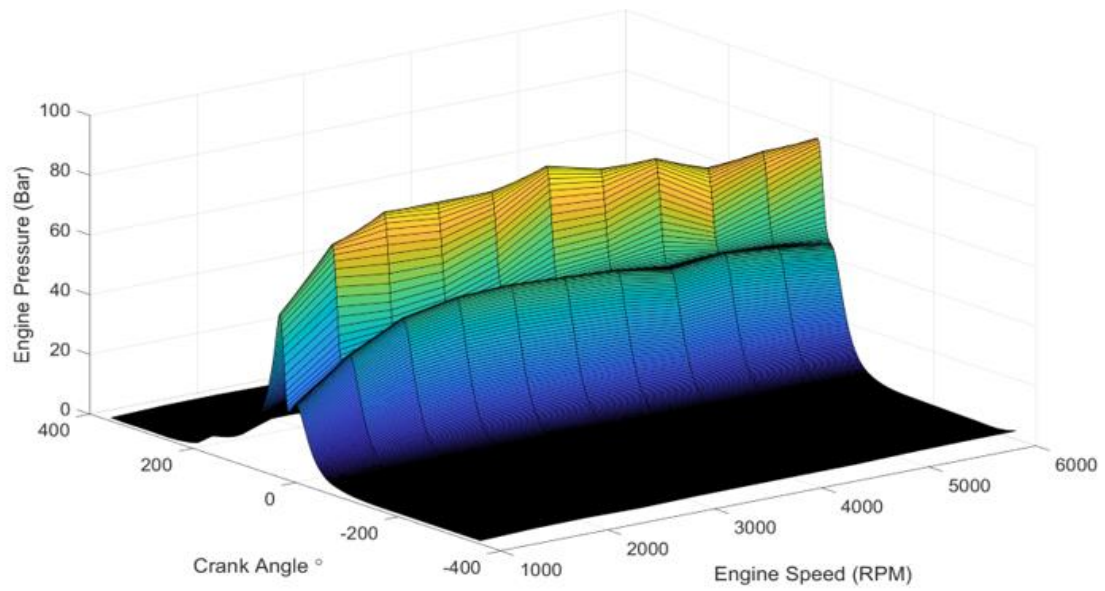


Figure 3

Figure 4 shows a 3D graph using various of pressure inside the combustion chamber across all RPM and crank angles. The graph shows the highest crank angle is at 33 with 3,500RPM, which the combustion process would be in progress as it had reached full stroke meaning the pressure has been mechanically increased at its peak and after its combustion it results in a rapid expansion. However, the lowest performs at 1,000RPM and 253 crank angle, where this could be at the end of its exhaust stroke. This is where the inlet and outlet are open and its reducing the pressured inside the combustion chamber. From peak RPM at 3,500 and then begins to decrease.

Plot of Pressure against Crank Angle & RPM



5. Conclusion

The outcome of the dyno testing and the MATLAB calculation is both indicate the 1.6 litre Honda VTEC engine is an economical, family friendly and a city car engine rather than a powerful or performance car engine as its performance results ranging at best specific fuel consumption with 2,250RPM, peak BMEP at 3,000RPM. In real world, the engine would not constantly have forced to work under pressure comparing to the dyno testing. The other factor of this test is that the car engine has to be separated from the chassis in order to process which is not an ideal for non-performance vehicles unless it is necessary. In future, engineers may make more efficient device that it can test the engines.

5. References

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