UNIVERSITI TEKNIKAL MALAYSIA MELAKA

THE EFFECT OF PISTON HEAD ON THE PERFORMANCE OF ENGINE

This report submitted in accordance with requirement of the UniversitiTeknikal Malaysia Melaka (UTeM) for the Bachelor Degree of Engineering Technology Automotive
(Department of Mechanical Engineering Technoogies) (Hons.)

by

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DECLARATION

I hereby, declared this report entitled "The Relation Between Piston Head With Performance" is the results of my own research except as cited in references.

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APPROVAL

This report is submitted to the Faculty of Engineering Technology of UTeM as a partial fulfillment of the requirements for the degree of Bachelor of Engineering Technology (Department of Mechanical Engineering Technologies) (Hons.). The member of the supervisory is as follow:

……………………………….

Adnan Bin Katijan

(Project Supervisor)

ABSTRACT

Piston is one of the important components in the system dalam.Piston combustion engine acts as the transmitter power value resulting from the burning of fuel and air mixture in the combustion chamber. Nowadays there are various forms produced by the form piston head piston.

The objective of this study was to examine the engine performance in horsepower and torque produced by the different shape of the head piston in an internal combustion engine which consists of 3 types of piston domes, mugs, and standard.

Experiments carried out using an internal combustion engine mounted on Honda EX5. The engine will run on a chassis dynamometer testing to determine the results. Piston performance will be evaluated based on the maximum available torque, maximum horsepower.

The results obtained through the experiment will be analyzed and plotted on a graph and table. Factors that influence the decision also discussed. as the conclusion of the study found that a domed piston head of the piston produces high horsepower and torque.

ABSTRAK

Piston merupakan salah satu komponen yang penting dalam sistem enjin pembakaran dalam.Piston berperanan sebagai ajen penghantar kuasa yang terhasil daripada proses pembakaran campuran minyak dan udara didalam kebuk pembakaran. Pada masa kini terdapat pelbagai bentuk piston yang dihasilkan berdasarkan bentuk kepala piston.

Objektif kajian ini dijalankan adalah untuk mengkaji prestasi enjin dalam kuasa kuda dan daya kilas yang dihasilkan oleh bentuk kepala piston yang berbeza dalam enjin pembakaran dalaman yang terdiri daripada 3 jenis kubah omboh, cawan, dan standard.

Eksperimen dijalankan menggunakan enjin pembakaran dalaman yang dipasang di Honda EX5 . Enjin akan berjalan dalam ujian chasis dinamometer untuk menentukan keputusan. Prestasi omboh akan dinilai berdasarkan tork ada maksimum, kuasa kuda maksimum.

Keputusan yang diperolehi melalui experimen akan dikaji dan diplotkan pada graf dan juga table. Faktor faktor yang mempengaruh keputusan juga dibincangkan. sebagai kesimpulan dari kajian ini mendapati kepala piston yang berbentuk kubah omboh menghasilkan kuasa kuda dan torque yang tinggi.

DEDICATIONS

I dedicate this thesis to my beloved parents who have been supporting and giving encouragement to the full during the period of my studies hard to produce this thesis. Not to forget the supervisor , Mr. Adnan Bin Katijan which also has a lot of help during the process of thesis in progress.

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LIST OF SYMBOLS AND ABBREVIATIONS

ICE	=	Internal Cobustion Engine
TDC	=	Top Dead Center
BDC	=	Bottom Dead Center
K	=	Kelvin
KW	=	KiloWatt
C.R	=	Compression Ratio
GDI	=	Gasoline Direct Injection
ROHR	=	Rate Of Heat Release
km	=	Kilometer
kPa	=	KiloPascal
Nm	=	Newom.meter
bhp	=	Brake horsepower
SP	=	Standard Piston
SP(1.5)	=	Standard Piston with 1.5mm Gasket
LCP	=	Low Compression Piston
HCP	=	High Compression Piston
RPM	=	Rotation Per Minutes

CHAPTER 1
INTRODUCTION

1.0 Introduction

Internal combustion engine is the most popular used nowadays in our vehicle. In this chapter will focus on one of the important part in the ICE it is piston. The piston used can effect the engine performance.

1.1 Background

The purpose of this project is to study the types of piston used in internal combustion chamber. As we know, piston is one of the important part in the engine either there is diesel or petrol engine. The pistons have many types of design and material used in market according to the usage. The function of the piston in the engine used to compress the air fuel mixture in the engine before the mixture burned.

The piston was designed according to the usage relate with the performance needed. In the market there have many type of piston that called high compression piston, standard piston, and low compression piston. The different of these three pistons are the shape of piston head. The different of these three designed will be effect the performance of the engine in term of power, horsepower, torque, the engine speed and fuel consumption.

In this project I would like to study the relation between the effect of piston head with the performance produced by the engine in the form of torque and horsepower.

1.2 Objective

1.2.1 To study the relation between the shape of piston head with the horsepower

1.2.2 To study the relation between the shape of piston head with the torque.

1.3 Problem Statement

There is confusion among consumers regarding the piston available in the market. Each piston being used must be appropriate to the user's daily use. This can help to increase the engine life time and the performance.

1.4 Work Scope

The scope of work done for this project is to determine the effect of the piston head shape to the horsepower and torque. In this project we used 3 types of piston with different in head design. There are low compression piston, high compression piston and standard piston. The piston will install in 4-stroke internal combustion engine that used in a motorcycle. The motorcycle will be tested with a chassis dynamometer to determine the result. The test will be repeated to all pistons. All the result will be recorded, besides that the information about the engine conditions, milages when the test was held and the type of lubricant use also recorded.

CHAPTER 2

LITERATURE REVIEW

2.0 Introduction

This chapter will discuss mainly on the theory and current development in piston head design and the effect of the piston head shape in the internal combustion engines.

2.1 Internal Combustion Engine

An internal combustion engine (ICE) is heat engine that produces the power or work from the burning the air fuel mixture in the combustion chamber. In an internal combustion engine the expansion of the high-temperature and high-pressure gases produced by combustion apply direct force to some component of the engine.

In an internal combustion engine the expansion of the high-temperature and high-pressure gases produced by combustion apply direct force to some component of the engine.

2.1.1 4-Stroke Engine

The actions in the 4 stroke engine can be divided into four parts. Each part consists of a piston stroke. This is the movement of the piston from bottom dead center to top dead center, or from top dead center to bottom dead center. The complete cycle of events in the engine cylinder requires four piston strokes. These are intake, compression, power and exhaust. The crankshaft makes two complete revolutions to complete the four piston strokes. This makes the engine a four stroke-cycle engine. It is also called a four strokes or four-cycle engine. (Hacisevki, n.d.)

Every movement of the piston from top dead center to bottom dead center or from bottom dead center to top dead center, known as cycles. For the movement from top dead center to bottom dead center known as intake cycle, which the air fuel enter into the combustion chamber when the intake valve opened. Then the piston will move from bottom dead center to top dead center. The air fuel in the combustion chamber will compress due to closed valve for both and those known as compression cycle. For the power cycle, the spark plug will ignite the spark and the compressed air fuel burnt. The power produced by burning process the piston pushed from top dead center to bottom dead center. For the last cycle, the piston will move from the bottom dead center to top dead center and the burning air fuel will flow out from the combustion chamber through the opened exhaust valve.

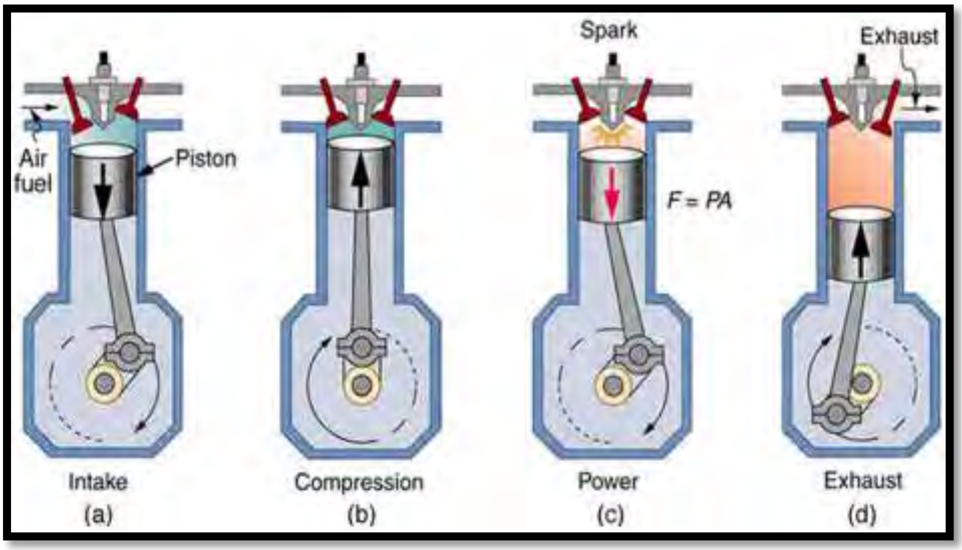

Figure 2.1: 4-Stroke Engine Cycle

2.1.2 Otto Cycle

The Otto cycle consists of four internally reversible cycles, that describe the process of an engine.

The thermal efficiency of the Otto-cycle increases with increasing compression ratio. When the Otto cycle is analyzed on a cold air standard basis an expression relating the compression ratio, temperature and pressure is obtained from isentropic properties. The compression ratio is a ratio of the volume displaced by the piston.

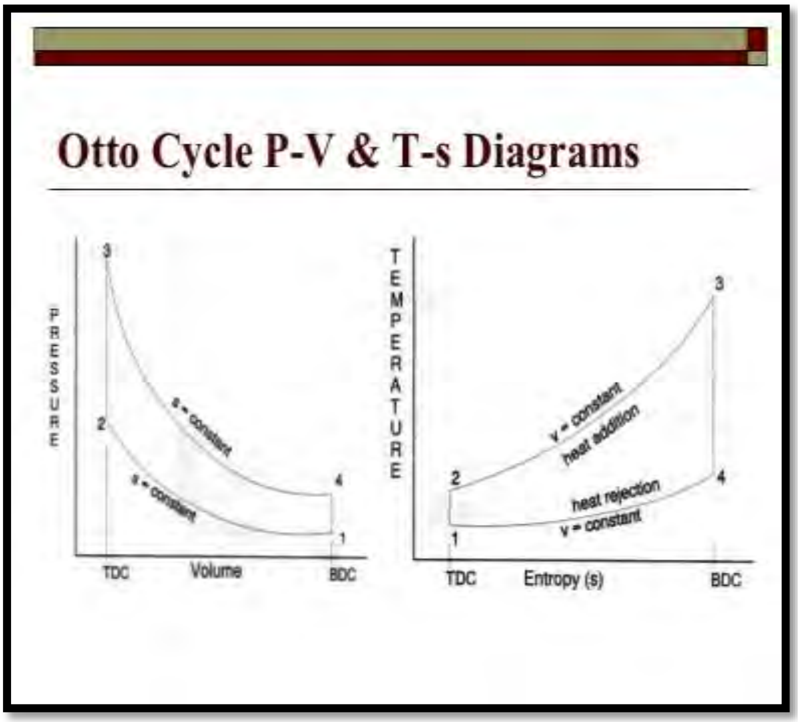

Figure 2.2: Otto Cycle P-V & T-s Diagrams

2.2 Piston

One of the important parts in internal combustion engine is the piston which used to convert the chemical energy after air fuel burning process into mechanical energy. The purpose of the piston is to help in conveying the gasses to crankshaft without loss of gas and the first part to begin a movement to transmit power to the crankshaft as a result of the pressure and energy generated by the combustion of fuel(Gupta & Tripathi, 2014).

The piston has a direct connection to the connecting rod and its free action at bottom side. At the top of piston known as piston head or crown at this part the piston will work at high pressure and temperature. Piston ring is one of the important components of the piston that provide a seal between the cylinder and the piston. The piston ring and the piston must able to work at low friction, high explosive forces and high temperature. During the reciprocating motion the piston must have enormous strength, but less weight to prevent the inertia forces.

2.2.1 Piston Head Design

The shape of the top of the piston depends on the shape of its combustion chamber and its compression ratio. Combustion chambers vary in shape depending on the manufacturer and type of engine for which it is intended. The top of the piston forms the bottom of the engine’s combustion chamber. The compression ratio is the difference between the volume in the combustion chamber above the piston when the piston is at bottom dead center (BDC) and the volume of the combustion chamber above the piston when the piston is at TDC. The compression ratio can be changed by using a piston with a different head design or a cylinder head with a different chamber size. This is because the sizes of the piston head and chamber affect the ratio between the volume at BDC and the volume at TDC within the combustion chamber. A taller piston head takes up some of the available volume in the combustion chamber as compared to a shallower piston head. The automotive engineer or manufacturer will select the correct piston head shape for the performance level desired.

In designing an engine, the automotive engineer will create the design with a particular piston head in mind. The piston head must be able to work in accordance with the rest of the piston assembly, as well as with the structure of the combustion chamber and the valve train assembly because they all work together in obtaining the engineer's goals for engine output and performance. Different piston heads are used to accommodate variations in the combustion chamber and valve train designs. Variations in piston head shapes can also be used to change the compression ratio. The top of the piston may be flat, concave, dome shaped, or recessed.

Figure 2.3: Piston Head Design

2.2.2 Design The Piston of Internal Combustion Engine

When Pistons are operating, they directly touch the high temperature gas and their transient temperature can reach more than 2500K and generates the 18KW power. The piston is heated seriously and its heat transfer coefficient is 167 w/m ° C and its heat dissipation condition is poor, so the piston temperature can reach 600 ~ 700 K approximately and the temperature distributes unevenly. On the basis of these conditions, we will make thermal analysis for the piston.

The analysis of the operation, we can get the pistons temperature field distribution, as shown in figure below. The piston temperature, distributes unevenly. The maximum steady state temperature of the piston is 2500K under the temperature effect of the repeated changes in the high temperature gas. The highest temperature appears the top surface of the piston. The temperature of piston pin changes between 700K and 800K. The temperature of the first ring groove is the important evaluation index of thermal load of the piston and its temperature is between 1300 K and 1500K. The highest temperature differs by 1800 K from the minimum temperature, which will make piston cause larger thermal stress and thermal damage. From the diagram, we can find the piston temperature is gradient descent along the piston axis direction from up to down, but the temperature change of piston skirt is lesser. The diagram indicates that thermal deformation of the piston is bigger from bottom to top and heat distortion of the bottom is minimized. These findings are consistent with domestic researcher's results. In very high temperature Nox will produce, so in designing piston thermal tests is important because we can determine each material or design can produce lower heat or absorb heat and reduced it.

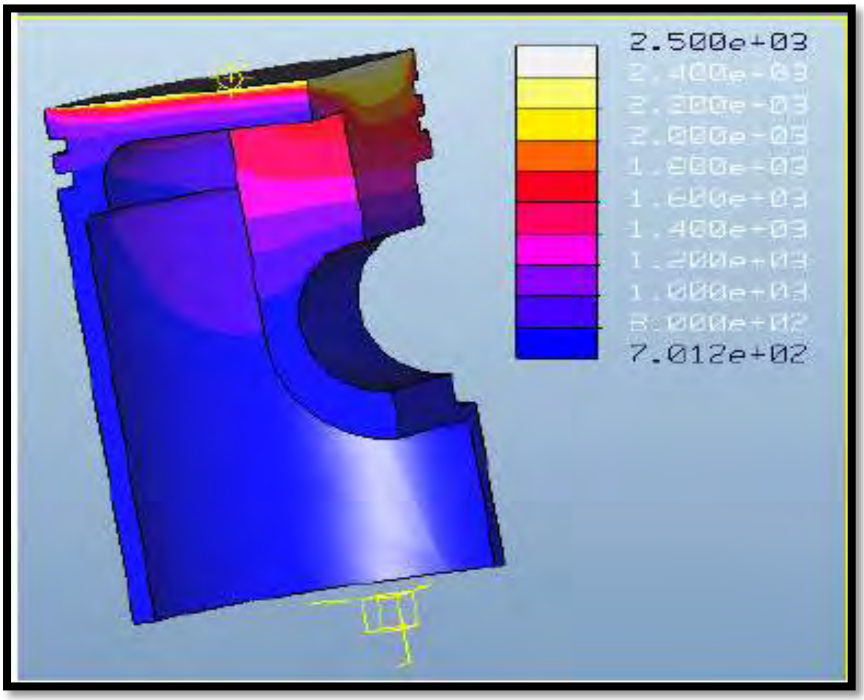

Figure 2.4: Piston Temperature Distribution

2.2.3 Squish Piston

There is much ongoing research into ways to improve the thermal efficiency of engines. Have a various ways to improve the thermal efficiency of engines such