UNIVERSITI TEKNIKAL MALAYSIA MELAKA

STUDY ON EFFECT OF INTAKE AIR FILTER SYSTEM ON ENGINE PERFORMANCE ON NATURALLY ASPIRATED ENGINE

This report submitted in accordance with requirement of the Universiti Teknikal Malaysia Melaka (UTeM) for the Bachelor Degree of Engineering Technology (Automotive Technology) (Hons.)

by

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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 (Automotive Technology) (Hons.). The member of the supervisory is as follow:

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ABSTRAK

Penapis udara enjin pembakaran dalaman adalah salah satu bahagian utama untuk meningkatkan prestasi enjin dan meningkatkan pembakaran. Walau bagaimanapun, keadaan penapis udara akan menjejaskan prestasi dan pelepasan emisi ekzos. Tujuan kajian ini adalah untuk mengkaji jenis kesan penapis udara pada kenderaan prestasi dan kesan ke atas pelepasan ekzos. Prestasi kereta dipengaruhi oleh udara yang penting untuk membuat pembakaran yang sempurna. enjin perlu campuran yang sempurna daripada bahan api dan udara untuk enjin silinder untuk pembakaran. Penapis udara enjin pembakaran dalaman adalah salah satu bahagian utama untuk meningkatkan prestasi enjin dan meningkatkan pembakaran. Walau bagaimanapun, keadaan penapis udara akan menjejaskan prestasi dan pelepasan emisi ekzos. Tujuan kajian ini adalah untuk mengkaji kesan jenis penapis udara pada enjin dari segi prestasi dan pelepasan ekzos dengan menggunakan casis dinamometer dengan perisian pro dyno-max dan penganalisis gas ekzos. penapis udara penapis udara telah menggunakan tiga jenis penapis, ia tersumbat dengan penuh dengan debu dan kotoran, penapis OEM udara baru dan juga prestasi penapis udara. Hasilnya, penapis udara tersumbat merakam hidrokarbon yang tinggi (HC), karbon monoksida tinggi dan rendah untuk oksigen. pelepasan HC yang lebih tinggi, membawa kepada sistem pernafasan manusia memberi kesan seperti asma, lapisan ozon yang lebih rendah kesan atmosphere.CO daripada pembakaran tidak lengkap bahan api. CO mengurangkan keupayaan darah untuk membawa oksigen dan boleh menyebabkan sakit kepala, masalah pernafasan dan pada kepekatan yang tinggi, juga kematian. Penapis prestasi udara menawarkan aliran udara yang lebih baik dan penapisan udara yang lebih baik untuk memasuki enjin dan membakar bahan api dengan sempurna.

ABSTRACT

The air filter internal combustion engine is the one of main part to enhance engine performance and improve combustion. However, the condition of air filter will affect performance and the exhaust emission release. The aim of this research is to study the effect types of air filter on performance vehicle and the effect on exhaust emission. The car performance is influenced by air which is important to make a perfect combustion. an engine need a perfect mixture of fuel and air to cylinder engine for combustion. The air filter internal combustion engine is the one of main part to enhance engine performance and improve combustion. However, the condition of air filter will affecting performance and the exhaust emission release. The aim of this research is to study the effect of type air filters on the engine in terms of performance and exhaust emission by using chassis dynamometer with dyno-max pro software and an exhaust gas analyzer. The air filter was using three type filter, it is clogged air filter with is full of dust and dirt, new OEM air filter and also performance air filter. As a result, clogged air filter record the high hydrocarbon (HC), High carbon monoxide and low for oxygen. The higher HC release, lead to human respiratory system affect like asthma, lower ozone layer of atmosphere.CO effect from incomplete combustion of fuel. CO reduces the ability of blood to carry oxygen and can cause headaches, respiratory problems and, at high concentrations, even death. The performance air filter offer better air flow and better air filtration to enter the engine and burn the fuel perfectly.

DEDICATION

I dedicate this final year project report to my father and mother, Mr. Jusoh Bin Salleh & Madam Rogayah Binti Wook for stay strong to care on my life journey and also to my lovely family.

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TABLE OF CONTENT

LIST OF FIGURES

LIST OF TABLE

CHAPTER 2

CHAPTER 3

CHAPTER 4

LIST OF ABBREVIATIONS, SYMBOL AND NOMENCLATURE

AFR	-	Air/fuel Ratio
HP	-	Horsepower
OEM	-	Original Equipment
PPM	-	Part Per Million
RPM	-	Revolution Per Minute
HC	-	Hydrocarbon
CO_2	-	Dioxide
NO_2	-	Nitrogen Oxide
O_2	-	Oxygen

CHAPTER 1
INTRODUCTION

1.0 Introduction

The air filter intake system is an appliance that is constituted of fibrous matter which removes solid particle and microorganisms from the air that prevent any matter from enter the engine cylinder. Air intake systems are the first point in the process that makes the engine produces the power that moves the vehicle. One of the main parts an intake system in a vehicle's is air filters which affect a vehicle performance, horsepower, fuel economy and exhaust emission. In order to improve combustion efficiency to enhance engine performance, introducing more the air into the air fuel mixture is an effective way(Nik Rosli Abdullah, 2014). However, the bad condition of air filter like clogged air filter will make the engine performance less which reduce the fuel economy and acceleration(Kevin Norman, 2009). Then the capacity to filter function of air into the engine is reduced when air filter become clogged. A clean air filter will increase engine life, better acceleration, lower emission and improved engine performance. Not only does an air filter clean the air entering on engine but also prevent debris from entering on the engine, and causing damage.

There are many types of air filter that used in automotive that from various material. Two types of common air filter use, which is a drop in and open pod. Drop in air filter give advantage on less noise and more fuel efficient. However, there are cons, it still hinder the movement of wind power normal or increased slightly for the drop in performance air filter. Besides, the second air filter is Open-pod type which gives benefit of more power, puffs of wind better and RPM easier ride. Disadvantages of this type is produces noise, possibility of inhaling hot air directly from the engine if without heat shield and cold air intake, easy dirty because open, less fuel efficient cause itchy feet fun kid press the pedal to the high RPM. For the type of air filter there are different category are used for each type. Air filter category is stock air filter and performance aftermarket air filter. Generally, naturally aspirated engine car usually

using a stock original air filter (OEM) from a manufacture that not most efficient in allowing air circulation and cannot used for a long time. Different with a performance air filter, which are high performance and also more efficient in allowing maximum of air circulate in an engine which is that turbo engine used. The stock filter will offer good enough airflow and overall performance when it's new and clean, but will become worse very quickly when it clogs up. Differs with performance air filter that is reusable through washing it and improve engine horsepower and also enhance fuel consumption.

1.1 Problem Statement

Generally, the NA engine uses the stock standard air filter that some research show the standard air filter cannot stay for a long time, also cannot be reused where waste money and less performance. While, performance air filter can offer better airflow and better filtration of the air that entering the engine. The performance aftermarket air filter of filtration can increase air intake pressure by high speed on the engine where increase performance engine, increase air flow due to increasing acceleration and increase fuel economy. This is because of the type of material used in developing a good air filter.

In order to researches the effect on NA engine, the change of stock original air filter to performance air filter are needed to know how air filter type will affect the torque, horsepower and exhaust emission. This is the easiest way to improve airflow to the engine is by replacing the stock air filter with a performance air filter. The low performance and durability of engine air cleaner are effect if using any low performing serviceable aftermarket air filter. Then, the better design of air filter is required to maximize filtration performance, improve flow management, and improve engine durability. Other than that, with change air filter to proven that performance air filter will save consumer money and the comparison of these air filters.

1.2 Objective

- To study the effect of type air filters on the engine in terms of performance and exhaust emission by using chassis dynamometer and an exhaust gas analyser.
- To compare the result between using clogged air filter, new OEM air filter and performance air filters.

1.3 Project Scope

This project will focus on study of engine performance on car model Perdana v6 by using clogged air filter, new OEM air filter and performance air filter. The chassis dynamometer test will be done to get the result on torque and horsepower. The exhaust emission analyzers are able to measure the exhaust emission result. This research project will compare the differences between the clogged air filter, new OEM air filter and performance air filter.

CHAPTER 2
LITERATURE REVIEW

2.0 Naturally Aspirated Engine

A naturally aspirated engine is an internal combustion engine where the air intake depends merely on atmospheric pressure and which does not depend on forced induction through a turbocharger or a supercharger. Heat engine can divide into two types it is external combustion engine and an internal combustion engine. In external combustion, a heat engine in which ignition occurs outside the chamber in which heat is converted to mechanical energy. There are two categories of external combustion, which is steam system and turbine. Secondly, internal combustion (IC) consists of two types, petrol engine and diesel engine. Internal combustion engine is a heat engine that change chemical energy that keep in a fuel into mechanical energy, usually made on a rotating output shaft.

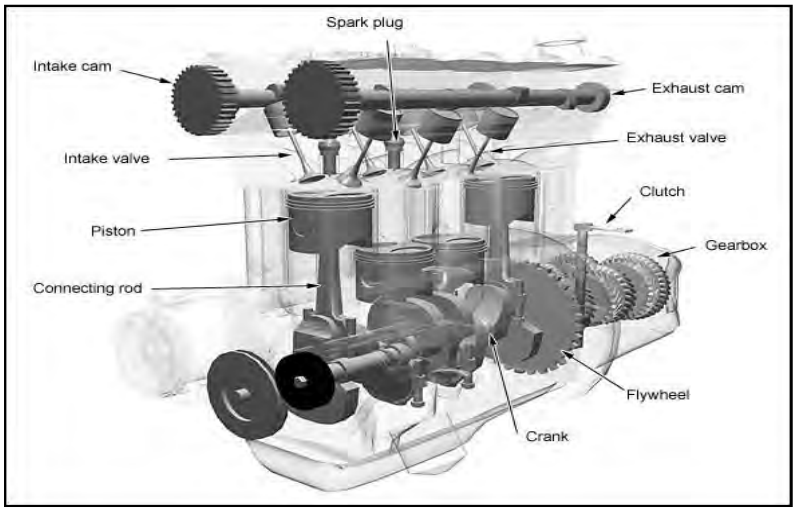

Figure 2-1 - Basic four stoke internal combustion

2.1 Major System in Internal Combustion

Every car had several systems for internal combustion in order to carry out specific activity and perform each duty for running engine perfectly. There are list the major system that include in internal combustion engine:

i. Intake system
ii. Exhaust system
iii. Lubricating system
iv. Electrical system
v. Cooling system
vi. Fuel system
vii. Hydraulic system
viii. Drive Train system

2.2 Intake system

An intake system is a set of part that essentially let an internal combustion engine to breathe in, in the same way that the exhaust system allows it breathe out. The intake system designed to increase engine performance, whether for power and torque which is air admission system are created to replace the OEM air-box of the car.

The old intake systems were simply duct that allowed air to pass unimpeded into the carburettor, for a modern naturally aspirated, air consumption framework has three fundamental parts air filter. It shapes an imperative part of a vehicle's admission framework through which the engine relaxes. Intake system has three main parts such as air filter, mass air flow sensor and throttle body.

The air filter is one of the main part because what are coming inside the engine are the factor engine can run smoothly or not also affect the performance of the engine. An engine needs a perfect mixture fuel and air to engine the cylinder for combustion. Every air need to enter intake air filter for dirt and any particle dust to be filtration. This catches foreign particles in the air are important to maintaining the performance engine and preventing dirt from entering the system and possibly damaging the engine (B.Payan Kumar Goud, 2014).

Mass Air Flow Sensor second main part of intake system that function to relay a signal to the engine control unit (ECU) and detects the amount of air drawn into the engine. Then, the proper amount of fuel to deliver to the engine was calculated by the signal.

Thirdly is throttle body. Throttle is a valve that directly controls the amount of air entering the engine. Simply it means throttle body is to control the intake air flow in an internal combustion engine to avoid engine from various problems. It also indirectly controlling the charge (fuel + air) burned on each cycle due to the fuel-injector or carburettor sustain a relatively constant fuel/air ratio.

2.3 Air Filter

A filter is a permeable membrane that gas or liquid is move through in order to split out the matter. Filters are important in automotive because they remove contaminants that get into mechanical and lubrication systems. Air is a type of pollution surround with all kinds of contaminant particles such as smog, fumes and others where these particle are usually not visible with the eye, but they are harmful to the engine and can lead to some damage of components (Albert K.Sunnu, 2013) . Without proper filtration, these contaminants would cause significant damage to mechanical components. It means air filter is a device to the appliance of fibrous material which removes particulates and prevents abrasive particulate matter from entering the engine cylinders.

There are two categories of air filter for a car which is air filter intake system and the cabin air filter. Cabin air filter is for a vehicle passenger compartment that

placed outside the air intake. In an automotive intake system, the air filter always sits ahead of the throttle body and mass air flow sensor and for old vehicle its location at above carburetor or throttle body. The air filter in an air intake system permanently removes unknown particles such as dust and sludge from the intake air, thereby maintaining the performance of the engine and protecting it from damage. A spotless air channel results in enhanced gas mileage, better speeding up, expanded engine life, lower discharges and general enhanced motor execution. Not just does an air channel clean the air entering the engine, however, it additionally keeps flotsam and jetsam from entering the engine and bringing about harm. As an air channel gets to be filthy, the limit for it to channel the air going into the engine is diminished (De Amaral, 2013). Once the air filter become clogged it will affect engine to work properly like emission control systems of the car; reducing air flow and causing a too rich air-fuel mixture which can foul the spark plugs also drivability problem. Two types of air filter that are available in a market which are open pod air filter and drop in air filter.

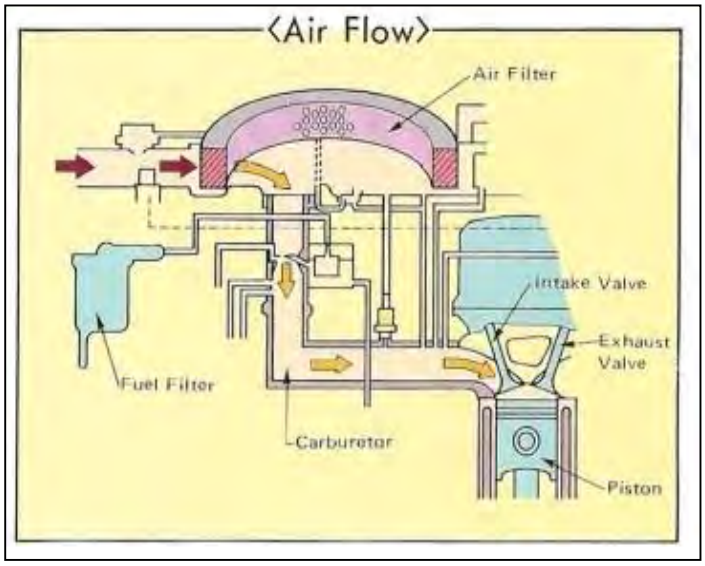

Figure 2-2 - Air Flow Intake System

2.3.1 Drop in Air Filter

Drop in air filter is easily to in term of replacement. This type is simple and can swap OEM air filter without modification necessary. Even the filtration not as good but for air intake is generally better than standard OEM air filter. The advantages of this air filter are less noisy, unusual appearance and more fuel efficient. However, disadvantage is it hinders the movement of wind, normal power or increased slightly for the drop in performance air filter.

Figure 2-3 - Drop-In Air Filter

2.3.2 Open Pod Air Filter

Open pod is larger in size and it need to remove of the whole standard air intake unit when changing the air filter. The open pod can give the best performance when it comes to air intake but lack filtration capabilities. Open pod pros are better inhalation of the wind, more power and easily increase speed. The disadvantages are it produces noise, the possibility to inhale hot air directly from the engine without heat shield and Cold air intake. Then, open pod air filter is easy to become dirty because of the open type, and cause less fuel efficient if pedal is always pressing at a high RPM.