

**DESIGN AND DEVELOPMENT OF PORTABLE SPARK  
PLUG TESTER FOR MOTORCYCLE USER**

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## SUPERVISOR DECLARATION

“I hereby declare that I have read this thesis and in my opinion this report is sufficient in terms of the scope and quality for the award of the degree of Bachelor of Mechanical Engineering (Design and Innovation)”

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DESIGN AND DEVELOPMENT OF A PROTABLE SPARK PLUG TESTER FOR  
MOTORCYCLE USER

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This report is being submitted as a  
Partial fulfillment in the requirements for the award of a  
Bachelor of Mechanical Engineering (Design and Innovation)

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JUNE 2013

## DECLARATION

“I hereby, declare this thesis is the result of my own research except as cited in the  
References”

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Specially dedicated for my father and mother

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## ABSTRACT

Ignition system is one of the most important parts in motorcycle spark ignition (SI) engine. If problems occur on this system, the combustion process cannot be done and these results the engine cannot be start. Typically motorcycle users do not use a proper tool to diagnose the problem. Thus they are exposed to high voltage shock hazard. A tool is needs to diagnose the problem. The main purpose of this report is to design and develop a spark plug tester for motorcycle user to test the spark plug and ignition wire connectivity. Thus the risk of high voltage shock will be minimized. This report will show the process design and development of the portable spark plug tester. The development of this device is start from product architecture that descripts all function and elements of the components in this device. Morphological chart is use to generated the comprehensive solution for the spark plug tester's concept. The concept then is analyze by Failure modes, effects and critical analysis (FMECA) to identifying the potential problems of the concepts and then the concept is draw using Computer Aided Design (CAD) software. The prototype of this concept is developing to test out the conceptual design.

## ABSTRAK

Sistem pencucuhan adalah salah satu bahagian yang paling penting dalam percikan pencucuhan (SI) enjin motosikal. Jika masalah berlaku pada sistem ini, proses pembakaran tidak boleh dilakukan dan ini menyebabkan enjin tidak boleh berfungsi. Biasanya pengguna motosikal tidak menggunakan alat yang betul untuk mendiagnosis masalah. Oleh itu, mereka terdedah kepada bahaya kejutan voltan tinggi. Alatan yang betul diperlukan untuk mendiagnosis masalah ini. Tujuan utama laporan ini adalah untuk mereka bentuk dan membangunkan penguji palam pencucuh untuk pengguna motosikal untuk menguji palam pencucuh dan sambungan wayar pencucuhan. Oleh itu risiko kejutan voltan tinggi akan dikurangkan. Laporan ini akan menunjukkan proses reka bentuk dan pembangunan mudah alih penguji percikan palam. Pembangunan alat ini adalah permulaan dari seni bina produk yang menerangkan semua fungsi dan unsur-unsur komponen yang ada didalam alat ini. Carta morfologi adalah digunakan untuk menghasilkan penyelesaian yang menyeluruh bagi konsep penguji palam pencucuh ini. Konsep ini kemudian dianalisis dengan mod kegagalan, kesan dan analisis kritikal (FMECA) untuk mengenal pasti masalah yang mungkin berlaku daripada konsep dan kemudian konsep ini akan dilukis menggunakan Rekabentuk Berbantuan Komputer (CAD) perisian. Prototaip konsep ini membangun untuk menguji reka bentuk konsep.



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## CHAPTER 1

### INTRODUCTION

#### 1.0 INTRODUCTION

Motorcycle is one of the most affordable motorized forms of transport in Malaysia and many parts of the world. They are also rates as the most common type of motor vehicle. Majority the motorcycle produce on this day are using Spark ignition (SI) engine, where the combustion process of air-fuel mixture is ignited by a spark from spark.

Most of motorcycle user will be facing the same problem of their motorcycle engine, especially when it is not been serviced regularly. The most crucial parts that can cause the malfunction of the engine is the ignition system parts. Ignition system parts are the most important parts in Spark ignition (SI) engine. If the problem occurred on this system, the combustion process cannot be done and engine not able to turned on.

Proper tools need to be used to diagnose the problem. This project will show the development and the design of spark plug tester that will help motorcycle user to check the sparking of spark plug and ignition circuit connectivity. These tools are designed to ease the motorcycle user and give the safety when diagnose the problem.

## 1.1 PROBLEM STATEMENTS

Ignition system is one of the most particular parts of motorcycle that causes of the malfunction of an engine. The most crucial parts of this system are the spark plug. The spark plug need to supply a proper spark to the engine. If the proper spark not being supplied to the engine, the combustion process cannot be done. The problem of ignition circuit connectivity may prevent the engine from being turned on because it cannot allow the current to spark plug. These will caused the spark plug cannot able to create the spark to start the combustion process.

The critical factor of this problem is that it must be identified at an early stage of the diagnosis before repairing. Typically, motorcycle user does not use a proper tool to test the spark plug thus they are exposing themselves to the risk of high voltage shock. They also need to use multimeter to check the connectivity of ignition circuit.



Figure 1: The typical way of a motorcycle user to check the spark of spark plug (Geobikes.com)



Figure 2: Check the connectivity of ignition circuit by using multimeter (Geobikes.com)

A special tool is needed to properly diagnosing the problem. Hence, there is a need to design and develop a spark plug tester for a motorcycle user to test the wire and spark plug conductivity.

## 1.2 OBJECTIVE

The objective of this project is to design and develop a portable spark plug tester for the motorcycle user that allow the motorcycle user to test the connectivity of ignition wire and spark plug without exposing themselves to the risk of high voltage shock.

## 1.3 SCOPE

The scopes of this study include:

1. Come out with a design of a portable spark plug tester with dual functions
2. Draw a complete design in the Computer aided design (CAD) software
3. A development of a prototype to test out the conceptual design

## **CHAPTER 2**

### **LITERATURE REVIEW**

#### **2.0 LITERATURE REVIEW**

Literature review is a published research or information that will be used as reference and guide for a new research. This literature review covers the previous study and information that are related to this project. The information will be used as value added or reference for this project. The information can be found from book, internet, journal, paper work and so on.

## 2.1 MOTORCYCLE IGNITION SYSTEM

In early motorcycle internal combustion engine design development there are three elements that are important. The elements of engine design are ignition, carburetion and lubrication. To achieve the rotational force it is necessary to make the engine crank by using force from explosion of a substance. The substance that is most commonly used is a mixture of fuel and air and ignition source that will cause the explosion. In early development of internal combustion engine, both mixing of fuel- air mixture and igniting are quite tricky and dangerous. (Steven E. Alford, Suzanne Ferriss , 2007)

Early design of ignition system undergoes three type of system that is flame, hot tube and magneto ignition. Between all the system, the magneto system is commonly use because it has a controlled spark that ignites the mixture. These systems use an external power like battery, rather than using an internal flywheel magnet to create a spark to ignite the mixture. These technologies lasted until 1960s because introduced of more advanced ignition system. (Steven E. Alford, Suzanne Ferriss, 2007). For more advanced ignition system, the first modern spark ignition systems use in motorcycle is beginning in late 1960s were of points and condenser type. This ignition system was used for a long time as it facilitate and have a great reliability but being mechanical, it has some inherent failings. Later it is enhanced to electronic ignition system. (Adam Wade, 2004)

The main purpose of an ignition System is a spark that will ignite the air and fuel mixture in the combustion chamber. For each cylinder in the engine, the ignition system has three main functions that are to generate enough electrical spark to ignite the mixture in combustion chamber, must maintain the spark to allow complete combustion, and it has to deliver the spark on time to each cylinder. (Edward Abdo , 2012)

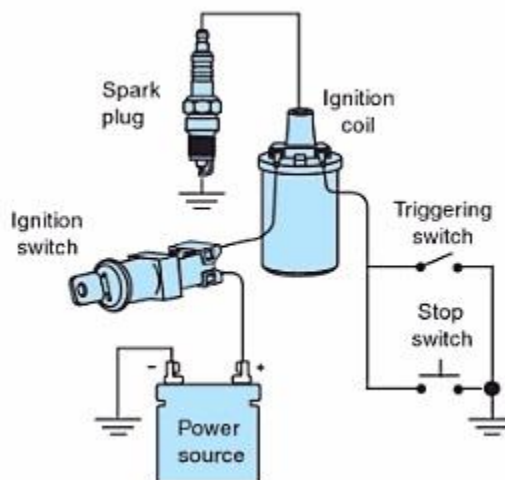


Figure 3: Simplified drawing of the basic components of an ignition system ( EdwardAbdo , 2012)

Figure 3 shows the basic component of ignition system and the connections and interactions between components to allow the system to be functional. The functions of all components are different. Power source uses the magnetism principle to produce a voltage and ignition switch allows the power source to provide electrical power to the ignition system. In ignition coil the current will pass through the transformer. From 12 volt input, the ignition coil will produce 20,000 to 60,000 volts or even more and the high voltage is connected to the spark plug. Then spark plug will create the spark to start the combustion of air-fuel mixture. (Edward Abdo , 2012)

## 2.2 SPARK PLUG

Spark plug is the one of the components in ignition systems. The function is to provide the spark in combustion chamber to ignite the mixture of air- fuel. This section will be discussed more detail about spark plug.

### 2.2.1 Component of Spark Plug

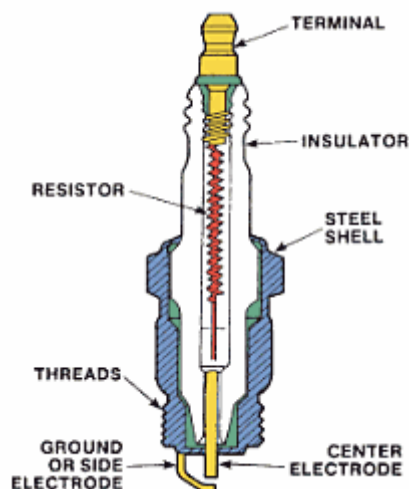


Figure 4: Illustration of cross sectional of spark plug (Gilles, 2011)

The Figure 4 shows the illustration of cross sectional of a typical spark plug. That figure shows the important parts in a spark plug that is ground or side electrode, center electrode, threads, resistor, insulator, steel shell, and terminal.

The shell holds the ceramic core and electrodes in a gas-tight assembly and the threads are used to install the spark plug in the engine. The insulator material is made by using ceramics materials to give the durability and strength of the spark plug. Current manufacture spark plug mostly has a resistor between the top terminal and the center electrode and normally the size of the resistor is about 5000 ohms. Some of the spark plugs are using semiconductor materials to act as resistor. The terminal parts of spark plug are used to connect the spark plug to spark plug cable. (Edward Abdo , 2012)

### 2.2.2 Working Principle of Spark Plug

Spark plug working principle is quite simple. They conduct high voltage of electricity created in the ignition coil to the inside combustion chamber. Spark plug also provide a space between side electrode and center electrode that called as gap thus the electric current can jump across to create the spark as shown in Figure 5 below that ignite the mixture of air – fuel in combustion chamber. (Autocorner.ca)



Figure 5: A spark on the spark plug (Abdo, 2012)