"I admit that I have read this report and in my opinion this report is sufficient from the perspective of the scope and quality for awarding purposes Bachelor of Mechanical Engineering (Thermal Fluid)"

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Date : 13/12/05

BRAKE PADS WEAR AND TEAR INDICATOR

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"I hereby declare that the word or the sentences in this thesis is of my own except for quotations and summarize which have been acknowledge."

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ABSTRACT

Using the indicator of sensing wear of brake pads for vehicles front brake (disc brake) has its own advantages. This is because the techniques are able to detect wear ness without dissembling the disc brake to inspect brake pads. Warning lights which equipped in front of meter for the vehicles act on massager to the driver that the brake pad has excite the wear. As for the result, vehicles front meter perform warning lights which means the brake pads started to excite the maximum wear ness and it is advice to replace it with the new one. The test rig is design and made in KUTKM to use as the experiment method. The tests are also made in KUiTTHO with the difference caliper design and additional apparatus as the invertors and 5.5 hp 3 phase AC motor. This project there are two indicator with different method to find the worn of lining pads. There are proximity sensor and limit switch. Proximity sensor is added in brake pads and it will not damage the rotor disc. There are two brake pads are uses pads and the new lining pads. The difference pressure and speed of AC motor are applied in the test to investigate and analyze the sensor. The pressure are that apply are depend on the speed of rotation AC motor. The other indicator is limit switch are use in this project. This switch is the contact indicator but it use in the different way to detect the worn of lining because it use in the driver cockpit and use the brake pads movement has the way to detect the brake pads wear lining. These method are use when there relation with brake pedal movement and brake pads when the driver knows there are have a problem when the touch or give the force to brake pedals. The distant of the brake pedals movement will give the impact of the thickness of lining friction material.

ABSRAK

Dengan menggunakan alat pengesan kehausan *brake pads* mempunyai kelebihannya yang tersendiri Salah satu kelebihannya ialah alat pengesan ini tidak merosakkan rotor atau *disc* kerana projek ini menggunakan alat pengesan tanpa sentuh atau "Non Contact". Lampu amaran yang akan dipasang akan menyala sebagai penunjuk bahawa *pads* adalah mencapai tahap kehausan yang harus ditukar untuk memastikan kecekapan semasa membrek adalah di tahap yang dikehendaki. Selain keistimewaan untuk projek ini adalah ia boleh digunakan untuk kaedah pembelajaran menggunakan teknik amali dan boleh diaplikasikan tentang sistem brek *disc*. Kerangka uji kaji direka bentuk dan dihasilkan di KUTKM untuk menjalankan kajian terhadap alat pengesan. Uji kaji juga dijalankan di KUITHHO dengan cara yang berbeza iaitu kerangka uji kaji menggunakan alat kawalan dan ACM motor 3 fasa. Projek ini telah menggunakan dua alat pengesan dengan cara penggunaan yang berbeza untuk mengesan kehausan pada *brake pads* iaitu *'Proximty sensor'* dan *'Limit switch'. Proximity sensor* diletakan pada *brake pads* yang tidak akan merosakkan permukaan rotor. Penggunaan dua jenis pad telah digunakan iaitu pad yang baru dan yang telah digunakan. Tekanan yang berbeza dan kelajuan pusingan motor dilakukan untuk kajian dan analisis pada sensor terbabit. Satu lagi alat pengesan adalah *limit switch.* Alat ini adalah pengesan sentuh tetapi menggunakan cara yang berbeza daripada alat pertama kerana ia mengaplikasikan pergerakan padel. untuk mengesan kehausan. Kaedah ini berhubung kait antara pemandu kerana terdapat beberapa tip apabila tekanan dikenakan pada padel. Jarak pergerakan padel akan memberi kesan atas pengesanan kehausan pad.

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CHAPTER 1

INTRODUCTION

One of the reason road accidents occur is because of the brake system. It occurs because of some factor. One of it is the air trapped into the brake line in the brake system that probably grease at the piston wheel cylinder stick. The most unknown factor to the driver is what happens to the brake pads (expirer usage) usually the brake pads must be change at appropriate time, the question is when? This is to avoid less efficiency of the brake when the brake is being used. This study can be done to find the efficiency.

1.1 Objective

i. Design and fabricate a test rig brake system
ii. Find the indicator system.
iii. Study on the brake system in vehicle.

1.2 Scope

i. This system implemented only to cars and it's only installed to the front brake (disc brake).
ii. Define the new indicator.
iii. To give warning signal to the to driver
iv. To cut cost and easy the maintenance.
v. 1 set of brake pads are used to test the wear ness and to determine the safety level.

CHAPTER 2

LITERATURE REVIEW

2.1 LITERATURE THEORY

2.1.1 Braking System

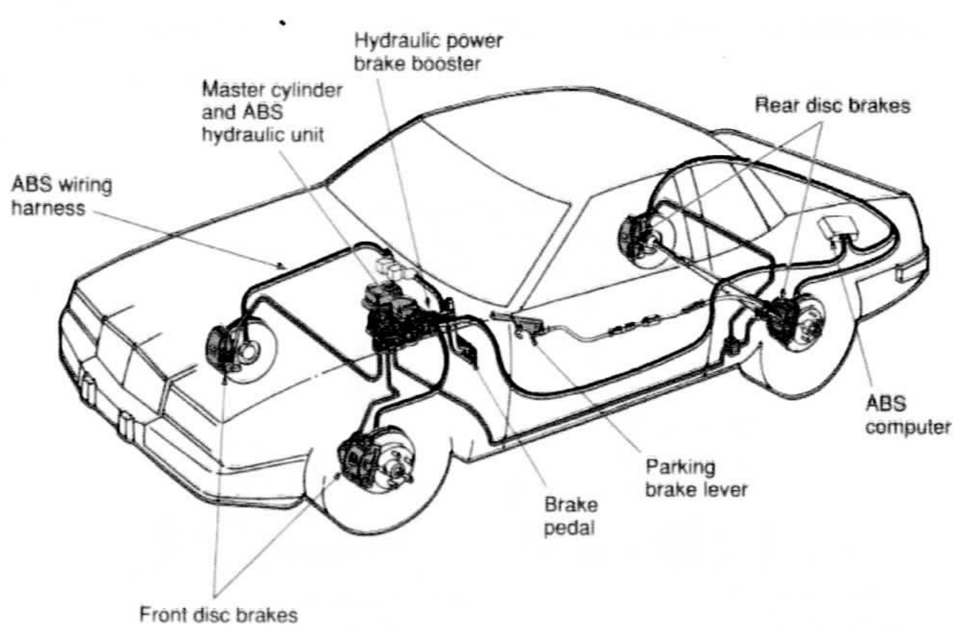

Figure 2.1.1 The complete brake system

The braking system used to stop the vehicle and also to control the vehicle that we need to able to start it moving, make it turn, accelerate and decelerate and of the major importance stop it. Because of it the braking system is considered by many people the most important system involved in the operation of a vehicle and many of research and improvement are make to provide the best among the better of braking system. The ideal braking system is one that will allow the driver to bring a vehicle to a stop in the shortest possible distance. The complete brake system consists of the major complements has shown in figure 2.1.1.

2.1.2 Hydraulic Brake System

Has we know that automotive brake systems have complex hydraulic circuits the basic principle hydraulic system is force applied at one point is transmitted to another point using an incompressible fluid, almost always an oil of some sort. Most brake systems also multiply the force in the process. The pressure applied at the brake pedal is transmitted to the brake mechanism by a liquid. To understand how pressure is transmitted by a hydraulic braking system, it is necessary to understand the fundamentals of hydraulics.

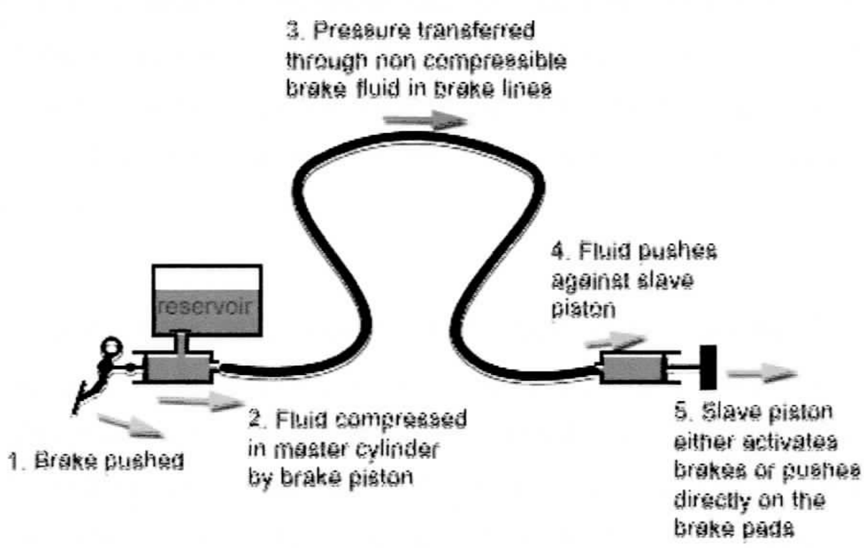

Figure 2.1.2 Single-circuits hydraulic

There are two common types of hydraulic brake systems used on modern vehicles drum and disc brakes. Hydraulics, often called fluid power, is a method of transmitting motion or force. Hydraulics is based on the fact that liquids can flow easily through complicated paths, yet cannot be compressed (squeezed into a smaller volume). A simple hydraulic system has liquid, a pump, and lines to carry the liquid, control valves, and an output device. The liquid must be available from a continuous source, such as the brake fluid reservoir or a sump. In a hydraulic brake system, the master cylinder serves as the main fluid pump and moves the liquid through the system. The lines used to carry the liquid may be pipes, hoses, or a network of internal bores or passages in a single housing, such as those found in a master cylinder. Valves are used to regulate hydraulic pressure and direct the flow of the Liquids. The output device is the unit that uses the pressurized liquid to do work. In the case of a brake system, the output devices are brake drum wheel cylinders (Figure 2.1.2) and disc brake calipers

2.1.3 Disc Brake

With the demands for increased safety in the operation of automotive vehicles, many are now equipped with disc brakes. The major advantage of the disc brake is a great reduction in brake fade and the consequent marked reduction in the distance required to stop the vehicle. Braking with disc brakes is accomplished by forcing friction pads against both sides of a rotating metal disc, or rotor. The rotor turns with the wheel of the vehicle and is straddled by the caliper assembly.

When the brake pedal is depressed, hydraulic fluid forces the piston sand friction linings (pads) against the machined surfaces of the rotor. The pinching action of the pads quickly creates friction and heat to slow down or stop the vehicle. Disc brakes do not have servo or self-energizing action. Therefore, the applying force on the brake pedal must be very great in order to obtain a brake force comparable to that obtained with the conventional drum brake. Consequently, disc brakes are provided with a power or booster unit and a conventional master cylinder. In many installations, disc brakes are used only on the front wheels and drum brakes are continued on the rear. However, you may on occasion find disc brakes used on all four wheels.

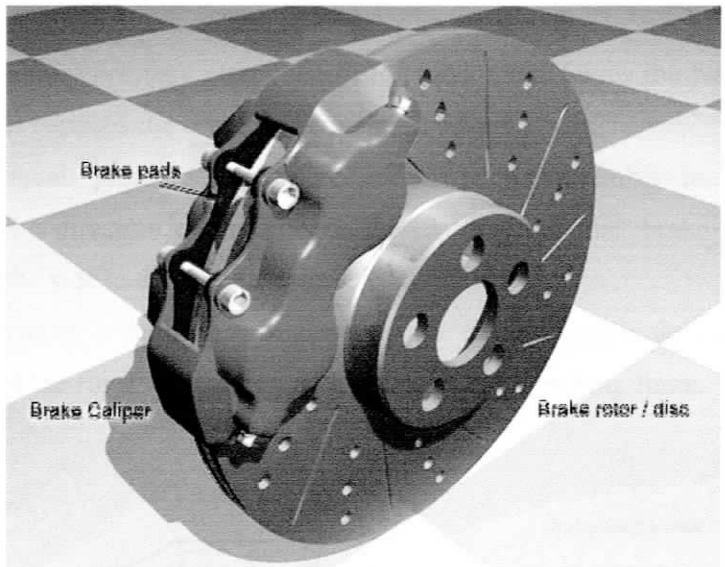

Figure 2.1.3 Disc brake assembly

2.1.4 Brake Disc.

Also called brake rotor, the brake disc uses friction from the brake pads to slow or stop the vehicle. Made of cast iron, the rotor may be an integral part of the wheel hub. However, on many front-wheel drive vehicles, the disc and hub are separate units. The brake disc may be a ventilated rib or solid type. The ventilated rib disc is hollow that allows cooling air to circulate inside the disc.

2.1.5 Disc Brake Types **"Floating Caliper"**

Disc brakes can be classified as floating, sliding, and fixed caliper types. Floating and sliding are the most common types. The fixed caliper may be found on older vehicles. The floating caliper type disc brake is designed to move

laterally on its mount. This movement allows the caliper to maintain a centered position with respect to the rotor. This design also permits the braking force to be applied equally to both sides of the rotor. The floating caliper usually is a one-piece solid construction and uses a single piston to develop the braking force.
Operation of a floating caliper is as follows:

i. Fluid under pressure enters the piston cavity and forces the piston outward. As this happens the brake pad contacts the rotor.
ii. Additional pressure then forces the caliper assembly to move in the opposite direction of the piston, thereby forcing the brake pad on the opposite side to contact the rotor.
iii. As pressure is built up behind the piston, it forces the brake pads to tighten against the rotor. This action develops additional braking force.

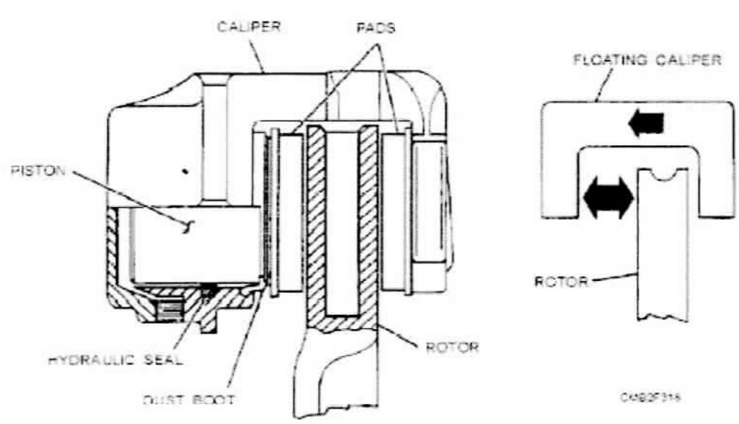

Figure 2.1.4 - Floating caliper

2.1.6 Master Cylinder

The master cylinder is sealed at one end, and the movable pushrod extends from the other (Figure 2.1.5).The pushrod moves a pair of in-line pistons that produce the pumping action. When the brake pedal lever moves the pushrod, it moves the pistons to draw fluid from a reservoir on top of the master cylinder. Piston action then forces the fluid under pressure through outlet ports to the brake lines. All master cylinders for vehicles built since 1967 have two pistons and pumping chambers. Motor vehicle safety standards require this in order to provide hydraulic system operation if one hose, line, or wheels brake assembly loses fluid. Because the brake hydraulic system is sealed, all the lines and cylinders are full of fluid at all times. When the master cylinder develops system pressure, the amount of fluid that is moved is only a few ounces

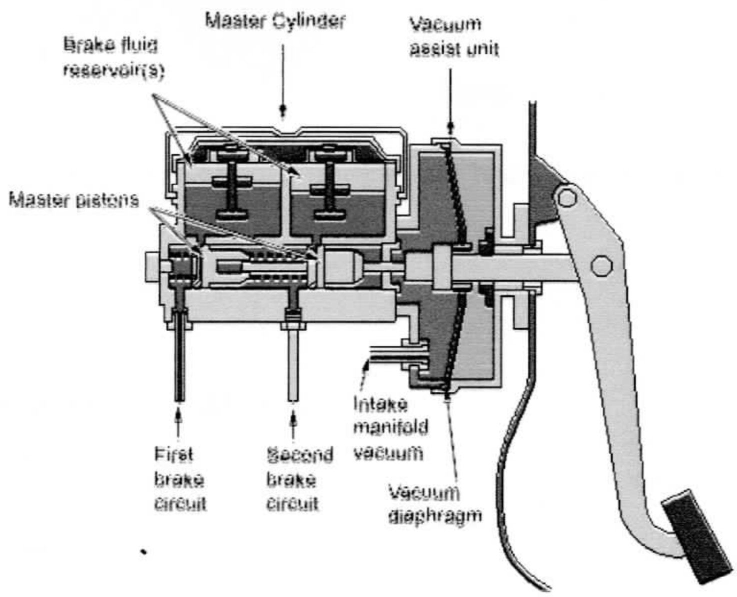

Figure2.1.5 : Diagram for assembly master cylinder and pedal.

2.1.7 Power Boosters

Nearly all late-model brake systems have a power booster that increases the force of the driver's foot on the pedal. Most cars and light trucks use a vacuum booster that uses the combined effects of engine vacuum and atmospheric pressure to increase pedal force. Some vehicles have a hydraulic power booster that may be separate from the brake system and supplied with fluid by the power steering system or a part of the brake system and driven by an electric motor.

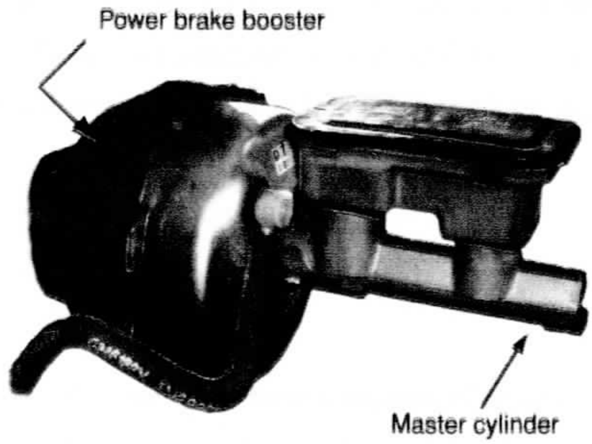

Figure 2.1.6 : The power brake booster increase the brake pedal force applied to the master cylinder

2.1.8 Type of Brake Friction Materials.

i. Organic Linings

Organic linings are made from nonmetallic fibers bonded together to form a composite material. In the cast, asbestos was the main ingredient in organic linings but is no longer used in shoes. Today's organic brake linings contain the following types of materials:

- Friction materials and friction modifiers, some common examples of which are graphite, powdered metals, and even nut shells.
- Fillers, which are secondary materials added for noise reduction, heat transfer, and other purposes.
- Binders, which are glues that hold the other materials together.
- Curing agents that accelerate the chemical reaction of the binders and other materials.

Organic linings have a high coefficient of friction. They are economical, quiet, wear slowly, and are only mildly abrasive to drums. However, organic linings fade more quickly than other materials and do not operate well at high temperatures. High-temperature organic linings are available for high-performance use but they do not work as well at low temperatures and wear faster than regular organic linings.

ii. Semimetallic Linings

Semimetallic materials are made from a mixture of organic or synthetic fibers and certain metals molded together; they do not contain asbestos. Semimetallic linings are harder and more fade resistant than organic materials are but require higher brake pedal effort. Most semimetallic linings contain about 50 percent iron and steel fibers. Copper also has been used in some semimetallic linings and, in smaller amounts, in organic linings. Semimetallic linings operate best above 200°F and must be warmed up to bring them into full efficiency. Consequently, semimetallic linings are typically less efficient than organic linings at low temperatures. Semimetallic linings were sometimes used on older heavy or high-performance vehicles with four-wheel drum brakes. Currently, semimetallic linings are used only on front disc brakes of passenger cars and light trucks. The lighter braking loads on rear brakes, particularly on FWD vehicles, might never heat semimetallic linings to their required operating efficiency. Semimetallic linings also have a lower static coefficient of friction than do organic linings, which makes semimetallic linings less efficient with parking brakes. Semimetallic linings often are blamed for increased rotor wear, but this is not entirely true. Early semimetallic linings were more abrasive than current materials, which may cause no more wear with the properly matched rotors than organic materials. Also, the better heat transfer characteristics of semimetallic linings can reduce rotor temperatures and help to counteract abrasiveness. Many small, FWD cars built since the early 1980s have smaller front brakes that require the better high-temperature friction characteristics and heat transfer abilities of semimetallic linings.