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STUDY ON NOISE LEVEL FROM THE EFFECT OF CNG TANK INSTALLATION  
IN VEHICLES

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This report is being proposed as a  
Partial fulfillment in the requirement for bestowal of  
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MAY 2009

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

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For My Family

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## ABSTRACT

Compressed Natural Gas (CNG) is a substitute for gasoline (petrol), diesel, or propane fuel. It is considered to be a more environmentally "clean" alternative to those fuels and it is much safer than other motor fuels in the event of a fuel spill: natural gas is lighter than air, so it disperses quickly when leaked or spilled (Wikipedia, 2008). As we know that all vehicles including vehicles that install with CNG tank produce unwanted noise due to the several operated systems. The unwanted noise can be harmful or not. This report mainly focuses on the measurement of noise in vehicles that are running on the installation of the CNG tank and the vehicles that are not install with CNG tank. Beside that, this report also compares and analyzes the differences between the vehicles that will be studied. This study can be done by collecting data by using the device that called sound level meter. This report also afterwards might be useful in further studies of the NGV improvements system.

## ABSTRAK

Gas Asli Mampat (CNG) adalah pengganti untuk gasolin (minyak petrol), minyak diesel, atau bahan api propane. Ia dianggap sebagai lebih bersih kepada alam persekitaran berbanding bahan api yang lain: udara biasa adalah lebih ringan daripada udara, ia meleraikan dengan cepat bila bocor atau tumpah (Wikipedia 2008). Seperti yang kita tahu, semua kenderaan termasuk kenderaan-kenderaan yang dipasang dengan tangki CNG menghasilkan bunyi bising yang tidak dikehendaki disebabkan oleh beberapa sistem yang dijalankan. Bunyi bising yang tidak dikehendaki boleh memudaratkan atau tidak. Laporan ini tumpukan kepada pengukuran bising di kenderaan-kenderaan yang dipasangkan tangki CNG dan kenderaan-kenderaan yang tidak dipasang dengan tangki CNG. Selain itu, laporan ini juga membandingkan dan analisa perbezaan antara kenderaan yang terlibat dalam kajian ini. Kajian ini dibuat untuk mengumpul data dengan menggunakan alat pengesan bunyi. Laporan ini juga mungkin berguna dalam menyambung kajian dalam peningkatan-peningkatan sistem NGV.

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## LIST OF SYMBOLS

$L_{Aeq}$  : The equivalent continuous dBA level which has the same energy as the original fluctuating noise for the same given period of time.

$L_{Amax}$  : Maximum noise level measured.

$L_{Amin}$  : Minimum noise level measured.

$L_{A10}$  : A specified dBA levels which is exceeded ten percent of the time during the whole period of measurement.

$L_{A50}$  : A specified dBA levels which is exceeded fifty percent of the time during the whole period of measurement.

$L_{A90}$  : A specified dBA levels which is exceeded ninety percent of the time during the whole period of measurement.

## CHAPTER 1

### INTRODUCTION

#### 1.1 Background

In common use, the word noise means unwanted sound or noise pollution or in environmental problem associated with world wide. There are great effort all been done all around the world in noise studies and surveys (Anyogita et al, 2003). The outcome of that surveys express that the vehicular traffic has been identified as a major factor to contribute of the noise. The effect of this noise can be harmful and annoying to human. It is found that many studies have been conducted in outdoor noise measurement, but studies on the noise levels inside vehicles especially in natural gas vehicles (NGV) are very little. There are studies done by Anyogita et al. (2003) which have focused to determine the noise in CNG driven modes of transport in New Delhi. In Malaysia, there are only few studies and researches that have been done on the subject of noise pollution (Yusoff and Ishak, 2005). This are happen because the awareness towards the noise pollutions is still low.



The development of NGV in Malaysia began few years ago with a project of Natural Gas Vehicles pioneered by small group taxi cars in Kuala Lumpur. This project is a success to Malaysia as developing country by participating along the energy consumption development in the world. PETRONAS was the leading organization to embark the development of natural gas vehicles in Malaysia. NGV was started being used as a pilot program implemented by PETRONAS (1986-1988) in Kertih, Terengganu. In 1991, PETRONAS implemented the Natural Gas for Vehicles Program (NGVP) in the high density Klang Valley area to coincide with the completion of the PGU II project (Zulkifli et al, 2002). The studies of the noise level inside vehicles are also rarely being done in Malaysia. Therefore it is important to undertake the present study to examine the levels of noise in CNG drove vehicles on roads.

## 1.2 Problem Statements

This project is carried out to determine and identify the sequences of the installation of the CNG tank and focus it from the aspect of noise level that have been produced by the vehicles. It is know that, vehicles which used Compressed Natural Gas (CNG) or Natural Gas Vehicles (NGV) has been proven more economic from the petrol or diesel driven vehicles respectively, but there are a few researches conducted on the effect of noise level from the installation of CNG tank on the vehicles which can harmful the owner or passenger of the vehicles (Anyogita et al. 2003). In this study, noise level from NGV will be determined and analyzed in order to categorize it whether it is harmful or not to human.

### 1.3 Objective

The objectives of this study are:

1. To determine noise level of vehicles as a result of CNG tanks installation and compare with uninstalled vehicles.
2. To study the category of noise level whether it is harmful or not to human.

### 1.4 Scope

The scopes of this study include:

1. Collection of noise level data by experimental study on several vehicles including NGV.
2. Comparison on the differences between the vehicles that not install CNG tank.

## 1.5 PSM Flow Chart.

Figure 1.1 shows the flow chart of activities for Projek Sarjana Muda (PSM) .On other hand; the Gantt chart for PSM is available as in Appendix A.

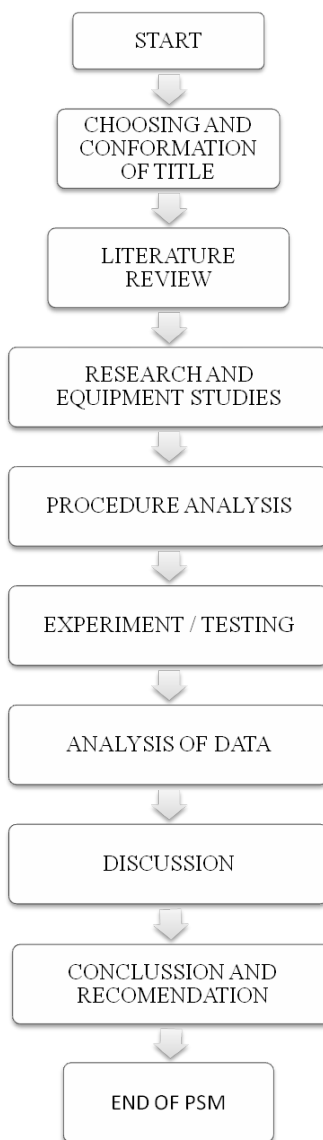


Figure 1.1: Flow Chart of PSM

## CHAPTER 2

### LITERATURE REVIEW

#### 2.1 Natural Gas

Natural gas is a mixture of hydrocarbons mainly methane ( $CH_4$ ) and is produced either from gas wells or in conjunction with crude oil production. Natural gas is consumed in the residential, commercial, industrial, and utility markets. The interest in natural gas as an alternative fuel stems mainly from its clean burning qualities, its domestic resource base, and its commercial availability to end users. Because of the gaseous nature of this fuel at ambient conditions, it must be stored onboard a vehicle in either a compressed gaseous state (CNG) or in a liquefied state (LNG) to provide sufficient fuel storage for reasonable driving range. According to Energy Information Association (Internet reference, 10/08/2008), it is estimated that the storage of natural gas will be able to be supplied as for consumption for more than fifty (50) years assuming current consumption rates.

## 2.2 Process of Natural Gas

Most natural gas consumed in the United States is domestically produced. Gas streams produced from reservoirs contain natural gas, liquids, and other materials. Processing is required to separate the gas from petroleum liquids and to remove contaminants. In addition, natural gas (methane) can also come from landfill gas and water/sewage treatment. Natural gas processing starts with the gas being separated from free liquids such as crude oil, hydrocarbon condensate, water, and entrained solids. The separated gas is further processed to meet specified requirements. For example, natural gas for transmission companies must generally meet certain pipeline quality specifications with respect to water content, hydrocarbon dew point, heating value, and hydrogen-sulfide content (Internet reference, 11/08/2008).

## 2.3 Definition of Natural Gas Vehicle (NGV)

The NGV or Natural Gas Vehicle is a vehicle that runs on natural gas (i.e. the same natural gas used in domestic cooking and heating). NGV look and perform like petrol and diesel vehicles, but they produce less pollution. There are three types of NGV: Dedicated, Bi-Fuel and Dual Fuel. Dedicated vehicles run on natural gas only. Bi-Fuel vehicles operate on CNG whilst retaining the ability to use petrol as a reserve fuel. The engine can operate on either fuel but not on both simultaneously. The compression ratio of the engine must remain at a level suitable for petrol. Currently this type of engine is used almost exclusively on vehicles below 3,500kgs. Dual Fuel engines are derived from diesel engines. A small amount of diesel is retained as a pilot source of ignition. The primary fuel Natural Gas is mixed with the incoming air as the bulk fuel. Dual Fuel engines are auto ignited by compression and require no spark plugs. Natural Gas is not an alternative fuel of the future but a very real opportunity here and now. It is both technically viable and economically attractive as well as having good environmental credentials. Furthermore, natural gas can be used in current engines so

there is no requirement for OEMs (**Original Equipment Manufacturer**) to engage in major re-tooling expenditure. There are two types of natural gas suitable for use as a road fuel CNG (Compressed Natural Gas) and LNG (Liquefied Natural Gas) (Internet reference, 9/08/2008).

#### 2.4 The System of NGV

The compressed natural gas is stored on board the vehicle in cylinders installed in the rear, undercarriage, or at top of the vehicle. When natural gas is required by the engine, it leaves the cylinders and travels through a high pressure pipe to a high pressure regulator which most often located in the engine compartment, where the pressure is reduced. In carbureted engines, the fuel enters the carburetor that have special fuel/air mixer at close to atmospheric pressure through a specially designed natural gas mixer where it is properly mixed with air. In fuel injected vehicles the natural gas enters the injectors at relatively low pressure up to about six (6) bar (90-100 psi). In either case, natural gas then flows into the engine's combustion chamber and is ignited to create the power required to drive the vehicle. Special solenoid valves prevent the gas from entering the engine when it is shut off. In bi-fuel vehicles, a fuel selector switch controls the flow of either natural gas or petrol. In some systems the switchover is done automatically when the vehicle is out of natural gas. A fuel gauge is provided on the dashboard or it is incorporated into the normal fuel gauge so the driver can determine the amount of natural gas remaining in the fuel tanks (Internet reference, 10/08/2008). Figure 2.1 illustrates NGV sequential injection system.

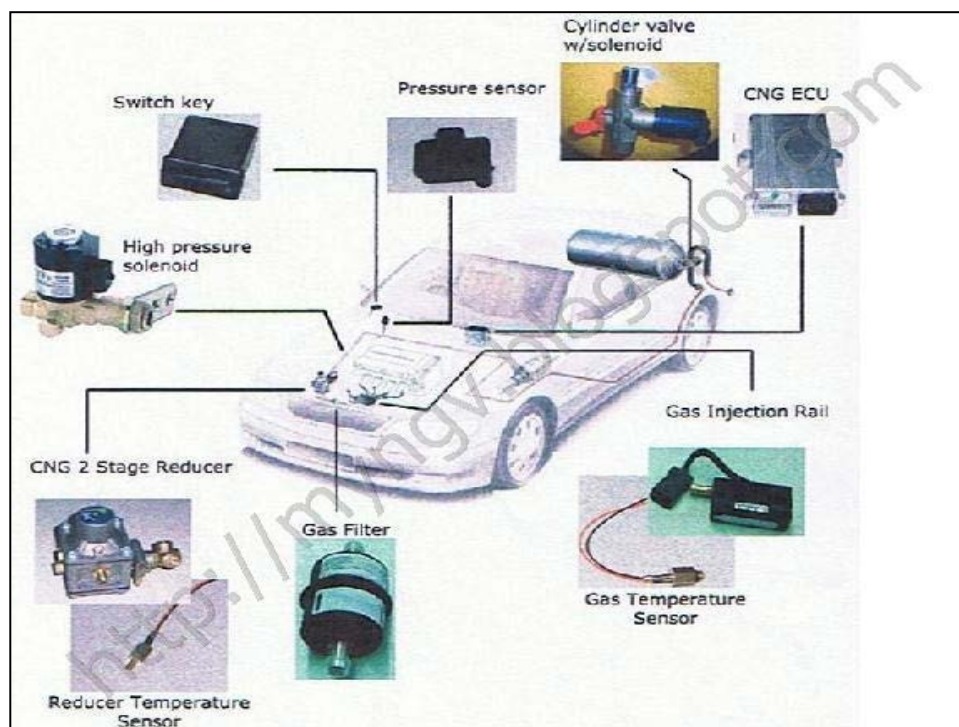


Figure 2.1: NGV Sequential Injection System

(Source: Internet reference, 10/08/2008)

## 2.5 CNG Tank

CNG has evolved as an alternative to liquid based high pollution fuels at a very fast pace especially in the transport industry. A majority of natural gas vehicles operate using compressed natural gas (CNG). CNG Tanks are typically placed inside the boot of the vehicle, attached to the rear, top, or undercarriage of the vehicle in a tube shaped storage tank. Even a CNG tank is refuelled in a similar manner, and in a similar amount of time, to a gasoline tank. In a Compressed Natural Gas (CNG) Tank, natural gas is stored in gaseous form, hence, a larger than conventional tank is required to achieve a practical range, but, with an increase in the size of the tank, the weight also increases. However, present day innovations and inventions have replaced metal tanks with tanks

made from a lightweight composite material. The tank itself is 1/3 the weight of an equivalent aluminium one while providing for increased capacity.



Figure 2.2: Example of CNG Tank Installed in Kancil  
(Source: *Internet Reference*, 11/08/09)

## 2.6 Type of Cylinder for CNG tank.

There are a few type of cylinder that used for CNG tank. The types of cylinder are:

- Type 1: This is an all metal - cylinder made of steel. There is no covering, other than paint, on the outside of the cylinder. This is the most common type of cylinder.
- Type 2: This is a metal cylinder (steel or aluminum) with a partial wrapping that goes around the cylinder. The wrapping is usually made of glass, aramid or carbon, contained in an epoxy or polyester resin.
- Type 3: This type of cylinder is fully wrapped with the same kind of material used for the partial wrapping of a Type 2 cylinder. This type of cylinder has a metal liner usually aluminum.