UNIVERSITI TEKNIKAL MALAYSIA MELAKA

BORANG PENGESAHAN STATUS LAPORAN PROJEK SARJANA MUDA

TAJUK: Design And Analysis of Muffler of Car Exhaust System Based On Solidwork Express.

SESI PENGAJIAN: 20010/11 Semester 2

Saya **KHAIRUL HAFIZ BIN MEGAT BOHRI**

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ABSTRACT

An exhaust system is usually tubing used to guide reaction exhaust gases away from a controlled combustion inside an engine or stove. The entire system conveys burnt gases from the engine and includes one or more exhaust pipes. Depending on the overall system design, the exhaust gas may flow through one or more of cylinder head and exhaust manifold, a turbocharger to increase engine power and a catalytic converter to reduce air pollution. An exhaust pipe must be carefully designed to carry toxic and/or noxious gases away from the users of the machine. Indoor generators and furnaces can quickly fill an enclosed space with carbon monoxide or other poisonous exhaust gases if they are not properly vented to the outdoors. Meanwhile, one part of exhaust system which is it has a negative way where causes noise or discomfort while the car engine is running. Besides that, the whole exhaust system's design will also affected to the vibration level of the exhaust system. In this project, the flow in a component of the exhaust system, muffler is simulated by using Solidwork Simulation Flow (SSF). SSF is a powerful Computational Fluid Dynamics (CFD) tool that enables to quickly and easily simulate fluid flow, heat transfer, and fluid forces when these interactions are critical to the success of design. Solidwork Flow Simulation examines the flow through components, over components, or via a combination of internal and external flows. It used to track behaviour of particles suspended in a flow.

ABSTRAK

Satu sistem ekzos biasanya adalah tiub yang digunakan untuk membawa gas-gas ekzos untuk bertindak balas jauh dari satu pembakaran terkawal di dalam sebuah jentera atau dapur. Keseluruhan sistem itu membawa gas- gas terbakar dari enjin itu termasuk satu atau lebih paip ekzos. Bergantung pada reka bentuk keseluruhan system, gas ekzos boleh mengalir melalui satu atau lebih blok silinder dan pancarongga ekzos, sebuah pengecas turbin dapat meningkatkan kuasa enjin dan satu pengubah mangkin dapat mengurangkan pencemaran udara. Sebuah paip ekzos telah direka bentuk dengan teliti untuk membawa toksik dan gas-gas beracun jauh dari pengendali mesin. Generator-generator tertutup dan relau boleh cepat memenuhi satu tempat tertutup dengan kabon monoksida atau gas-gas ekzos beracun lain jika ia tidak dilepaskan dengan betul ke luar. Sementara itu, satu bahagian sistem ekzos knalpot mempunyai atur cara yang negatif di mana menyebabkan bunyi bising dan tidak selesa ketika enjin kereta sedang berfungsi. Selain iu, reka bentuk sistem ekzos juga akan terjejas kepada tahap getaran system ekzos. Dalam projek ini, aliran dalam komponen dari sistem knalpot akan disimulasikan dengan menggunakan Aliran Simulasi Solidwork. Solidwork Simulasi aliran merupakan dinamika cecair pengkomputeran yang kuat (CFD), alat yang membolehkan mensimulasikan aliran bendalir, perpindahan panas, dan interaksi ini sangat penting untuk keberkesanan rekabentuk. Ia boleh membuat aliran arus dalam atau luar,untuk mengesan aliran tersebut.

DECLARATION

I hereby, declared this report entitled “Design and analysis of muffler of car exhaust system based on solidwork express” is the result of my own research except as cited in references.

Signature : …….....

Author’s name : KHAIRUL HAFIZ BIN MEGAT BOHRI

Date : 14 APRIL 2011

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LIST OF ABBREVIATIONS

SSF	-	Solidwork Simulation Flow
CFD	-	Computation Fluid dynamics
DFE	-	Design For Environment
CO	-	Carbon Monoxide
HC	-	Hydrocarbons
CO_2	-	Carbon Dioxide
NOx	-	Oxides of Nitrogen

LIST OF APPENDIX

APPROVAL

This report is submitted to the Faculty of Manufacturing Engineering of UTeM as a partial fulfillment of the requirements for the Degree in Bachelor of Manufacturing Engineering (Manufacturing Design). The member of the supervisory committee is as follow:

……

Supervisor

CHAPTER 1
INTRODUCTION

1.1 Background

Exhaust system performance complaints, such as excessive back pressure or a sticking exhaust control valve, are usually noticeable by their effect on engine performance. A visual inspection system usually will show the location of a leak. Look for holes, ruptured joints and eroded areas in the muffler(s), resonator(s), inlet pipe(s) and outlet pipe(s). The engine is like an air pump. Fuel requires air to burn and thus to produce energy. The more air that is available for combustion will also improve efficiency otherwise known as gas mileage. DFE can be defined as the systematic consideration of design performance with respect to environmental, health, safety, and sustainability objectives over the full product and process life cycle. Besides that, from other source, DFE is defined by nature a general heading for several types of efforts aimed at reducing the environmental load of a product over its total life cycle (Vaajoensuu, 2001). DFE also can define as method of looking at the design of a product or service and reducing the impact of the product life cycle has on the environment that involve raw materials, manufacturing wastes, shipping, use, manufacturing materials, packing, storage and disposal (Billatos, 2001). The author refer DFE as the planning that be made before the product are made which emphasize the natural condition as main concern in design and manufacturing process.

1.2 Problem Statement

Nowadays, the automotive industry has already known as a very competitive industry. But, automotive industry has been related to environmental issues such as air pollution, water pollution and sound pollution. In this research, car vehicle has been selected compared to other vehicle in this research due to facing greater market pressure to develop high quality and performance with concerns about environmental impact and the vehicle itself. The entire system conveys burnt gases from the engine and includes one or more exhaust pipes may causes air pollution and sound pollution. Besides that, the gases from most types of machine are very hot and it could burn and damage any near parts in the exhaust system. Another problem is a muffler causes noise or discomfort while the car engine is running. Lastly, the whole exhaust system‟s design will also affected to the vibration level of the exhaust system.

1.3 Objectives

Several objectives to achieve the project‟s target. There are;

1. To investigate current muffler of car exhaust system
2. Improve current muffler of car exhaust system base on solidwork express
3. To propose new design of muffler

1.4 Scope Of Product

The car exhaust system consists many parts begin from exhaust manifold, “Y” pipe, catalytic converter, resonator, exhaust pipe, muffler, till the tailpipe. For this project, one parts is selected to be improved which is muffler. The existing of these parts was analyzed based on Solidwork Simulation Express.

CHAPTER 2
LITERATURE REVIEW

2.1 Introduction

Literature reviews is a research or study that taken from primary and secondary data collection. Primary data is an investigation or direct search taken from discussion, site visit and interview with an expert of this field. The secondary data is a data from printed document such as books, journal, and recent design and also internet. An exhaust system is usually tubing used to guide reaction exhaust gases away from a controlled combustion inside an engine or stove. The entire system conveys burnt gases from the engine and includes one or more exhaust pipes. Depending on the overall system design, the exhaust gas may flow through one or more of Cylinder head and exhaust manifold, a turbocharger to increase engine power, a catalytic converter to reduce air pollution and A muffler (North America) / silencer (Europe), to reduce noise (Martyn, 2005) In process to do the research, investigation and design of a new product, literature review is an important guidance to support the acts and process of a research. The title of study, research, and applied method will be explained in sequence of authors‟ comprehension from the exhaust system, working procedure, and function until the design consideration.

2.2 Exhaust System

Exhaust system performance complaints, such as excessive back pressure or a sticking exhaust control valve, are usually noticeable by their effect on engine performance. An exhaust control valve that is stuck in the open position will result in poor engine performance during initial warm-up, because the heat passing through the intake manifold heat riser is insufficient for proper fuel atomization. On V-8 engines, if the valve is stuck in the closed position, the intake manifold will be supplied with excessive heat after the initial warm-up period. This will cause acceleration, a lack of power, and poor high speed performance. However, other defective, malfunctioning or improperly adjusted components have similar effects on engine performance and are characterized by the same symptom or complaint. External leaks in the exhaust system are often accompanied by noises or greyish-white smoke emitted from under the car. Small leaks are usually inaudible and not visible (Martyn, 2005). A visual inspection system usually will show the location of a leak. Look for holes, ruptured joints and eroded areas in the muffler(s), resonator(s), inlet pipe(s) and outlet pipe(s). Examine joints and connections for greyish white deposits that would be caused by exhaust gas leakage. A misaligned exhaust system is usually indicated by vibration, grounding, rattling, or binding of the components (Alvin, 2005).

2.3 Analysis Of The Exhaust System In An Average Car

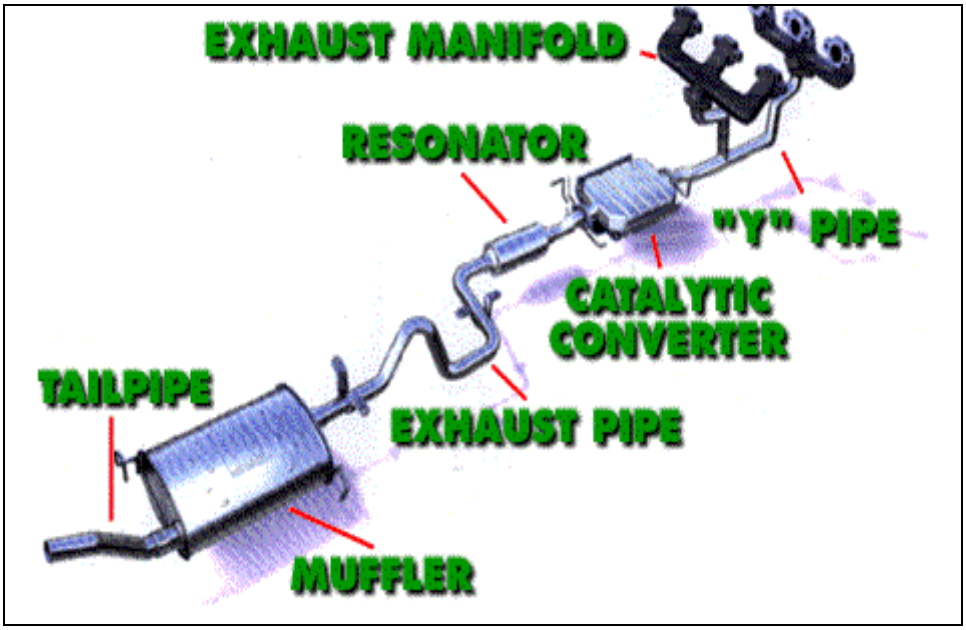

Figure 2.1: Diagram Exhaust System (Alvin 2005).

The Figure 2.1 shows the diagram of the major components of an exhaust system in a car. Exhaust system components are designed for a specific engine. The pipe diameter, component length, catalytic converter size, muffler size, and exhaust manifold design are engineered to provide proper exhaust flow, silencing, and emission levels on a particular engine. In this section it will explain more detail about the function and specifics of each component.

2.4 Part Of Car's Exhaust

2.4.1 Exhaust Manifold

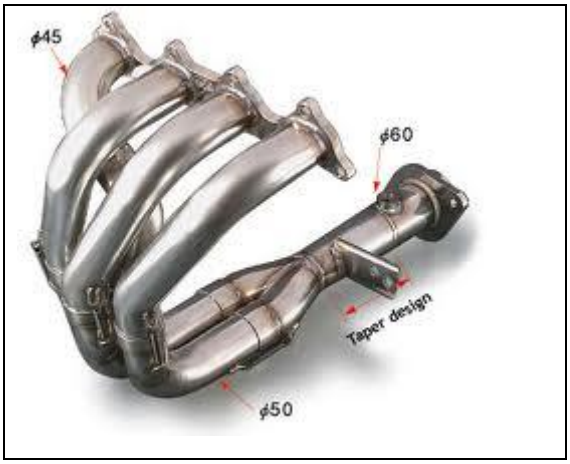

Figure 2.2 : Exhaust Manifold

The first step of the journey for exhaust gasses is the exhaust manifold is shown in Figure 2.2. This piece connects to the engine and consolidates the exhaust into one pipe. These pieces must withstand extremely high heat. The exhaust manifold is a pipe that conducts the exhaust gases from the combustion chambers to the exhaust pipe. Many exhaust manifolds are made from cast iron or nodular iron (Fengli and Long, 2010). Some are made from stainless steel or heavy-gauge steel. The exhaust manifold contains an exhaust port for each exhaust port in the cylinder head, and a flat machined surface on this manifold fits against a matching surface on the exhaust port area in the cylinder head.

Some exhaust manifolds have a gasket between the manifold and the cylinder head, as can be seen in the Figure 2.3;

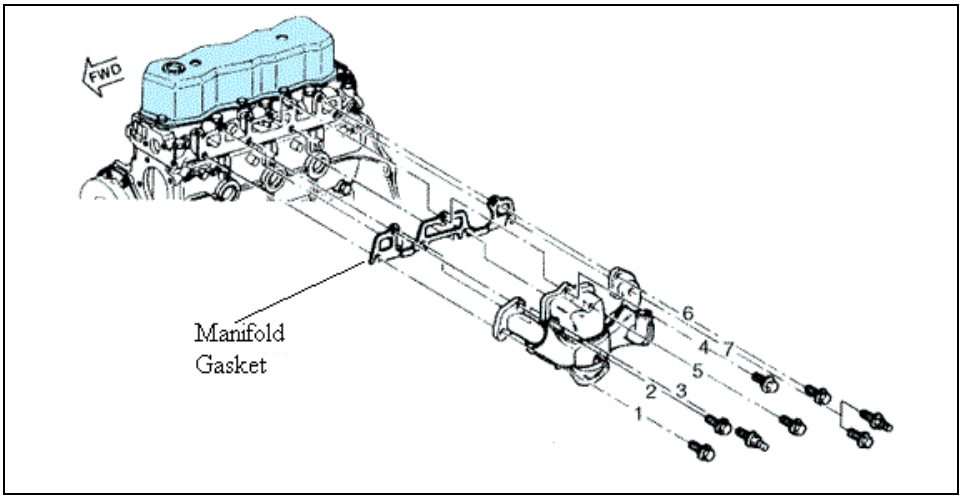

Figure 2.3 : Exhaust Manifold And Gasket On An In-Line Engine (Fengli and Long, 2010).

Gaskets are meant to prevent leakage of air/gases between the manifold and cylinder heads. The gaskets are usually made out of copper, asbestos-type material, or paper (Fengli and Long, 2010). In other applications, the machined surface fits directly against the matching surface on the cylinder head. The exhaust passages from each port in the manifold join into a common single passage before they reach the manifold flange. An exhaust pipe is connected to the exhaust manifold flange. On a V-type engine an exhaust manifold is bolted to each cylinder head.

2.4.2 Oxygen Sensor

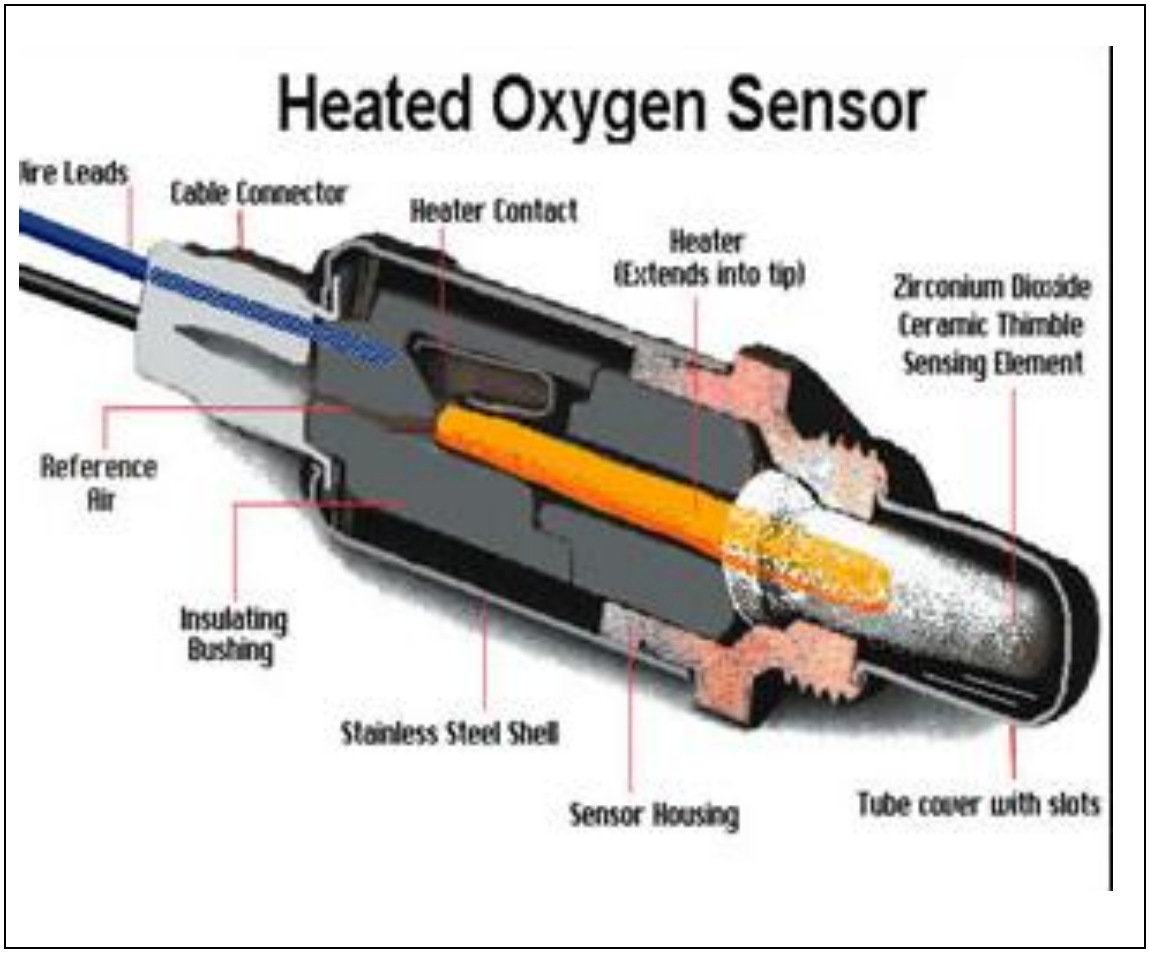

Figure 2.4 : OxygenSensor (Tsinoglou 2004).

The oxygen sensor is a part of the car's computer system as illustrate in Figure 2.4. The sensor analyzes how much oxygen is present in the exhaust gasses. This enables the vehicle to adjust the fuel to oxygen ratio, which can result in improved fuel economy and a reliable power output. The sensor is mounted either in the exhaust pipe or the exhaust manifold.

2.4.3 Catalytic Converter

Figure 2.5 : Catalytic Converter

The catalytic converter helps to clean the exhaust gasses of the car a illustrate in Figure 2.5. It can remove or reduce the amount of carbon monoxide, hydrocarbons and nitrogen oxides that a car emits. This piece is located between the exhaust manifold and the muffler. All new cars must have catalytic converters or they will not pass inspection. Three major automotive pollutants are carbon monoxide (CO), unburned hydrocarbons (HC), and oxides of nitrogen (NOx). When air and gasoline are mixed and burned in the combustion chambers, the by-products of combustion are carbon, carbon dioxide (CO2), CO, and water vapour. Gasoline is a hydrocarbon fuel containing hydrogen and carbon. Since the combustion process in the cylinders is never 100% complete, some unburned HC are left over in the exhaust. Some HC emissions occur from evaporative sources, such as gasoline tanks and carburettors.

Oxides of nitrogen (NOx) are caused by high cylinder temperature (Alvin, 2005). Nitrogen and oxygen are both present in air. If the combustion chamber temperatures are above 1,371 degrees Celsius, some of the oxygen and nitrogen combine to form NOx. In the presence of sunlight, HC and NOx join to form smog.

Catalytic converters may be pellet-type or monolithic-type. A pellet-type converter contains a bed made from hundreds of small beads, and the exhaust gas passes over this bed Figure 2.6. In a monolithic-type converter, the exhaust gas passes through a