



UNIVERSITI TEKNIKAL MALAYSIA MELAKA

**PERFORMANCE ANALYSIS OF CAR AIR CONDITIONING
SYSTEM UNDER SCHEDULED MAINTENANCE**

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

by

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ABSTRACT

Automotive air-conditioning system has been a major concern in servicing issues to keep the quality of air and give a comfortable to the passengers. A variety of tools have been developed which include the experimental studies to tackle the problem. The aim of this project is to investigate the scheduled and unscheduled maintenance performance of the car air conditioning system by using the design of experiments (DOE) method in the static instability of a car leading to their performance. A present methodology is introduced whereby a 3M Series Environmental Monitor is carried out to monitor the temperature and dust level within the air conditioner in the AC system of Proton Wira. The study of the ambient indoor temperature is investigated in to predict the right pressure inside the system since the different surrounding temperature have an affect towards the performance of the car air conditioning system. An experimental investigation using a thermometer is also carried out to measure the panel register airflow temperature which leads to a validation of the results. Measurements for the present experimental investigation were set for the period of 16 minute. Parametric settings on the changing the expansion valve, receiver drier and cleaning the evaporator coil fins effect determine the performance of each of these factors to air conditioning system. The results of the temperature, pressure and the dust level inside car cabin area are extracted from the experimental work and show a significant decrease. The approach then can be used as a reference to evaluate AC performance for most type of vehicle.

ABSTRAK

Sistem penyaman udara automotif telah menjadi kebimbangan utama dalam menangani masalah untuk menjaga kualiti udara dan memberi keselesaan kepada para penumpang. Pelbagai alat telah dibangunkan yang merangkumi kajian eksperimen untuk mengatasi masalah ini. Tujuan projek ini adalah untuk menyiasat prestasi penyelenggaraan berjadual dan tidak berjadual sistem penyaman udara kereta dengan menggunakan reka bentuk kaedah percubaan (DOE) dalam ketidakstabilan statik kereta yang membawa kepada prestasi mereka. Metodologi yang sedia ada diperkenalkan di mana Monitor Alam Sekitar 3M dijalankan untuk melihat suhu dan tahap habuk di dalam sistem penghawa dingin AC Proton Wira. Kajian terhadap suhu luaran kereta diselidik untuk meramalkan tekanan yang tepat sepatutnya berada di dalam sistem kerana suhu persekitaran yang berbeza akan menjejaskan prestasi sistem penghawa dingin kereta. Penyelidikan eksperimen menggunakan termometer juga dilakukan untuk mengukur suhu aliran udara register panel yang mengarah ke pengesahan hasil yang dinyatakan oleh peneliti lain. Pengukuran telah diambil dalam tempoh percubaan selama 16 minit untuk suhu dalaman yang berbeza. Pengaturan parametrik pada perubahan injap pengembangan, penghawa penerima dan membersihkan kesan sirip penyejat penyejat menentukan prestasi setiap faktor ini kepada sistem penghawa dingin. . Keputusan suhu, tekanan dan tahap habuk di dalam kawasan kabin kereta pada dasarnya didapati dari kerja eksperimen dan menunjukkan penurunan ketara. Pendekatan ini boleh digunakan sebagai rujukan untuk menilai prestasi AC terhadap kebanyakan jenis kereta.

DEDICATION

To my beloved parents, my supervisor, lecturer and my cherished friends.

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LIST OF SYMBOLS

D, d	-	Diameter
F	-	Force
g	-	Gravity = 9.81 m/s
I	-	Moment of inertia
l	-	Length
m	-	Mass
N	-	Rotational velocity
P	-	Pressure
Q	-	Volumetric flow-rate
r	-	Radius
T	-	Torque
Re	-	Reynold number
V	-	Velocity
w	-	Angular velocity
x	-	Displacement
z	-	Height
q	-	Angle

LIST OF ABBREVIATIONS

PCA	Principal Component Analysis
A/C	Air-Conditioner
OT	Orifice Tube
HVAC	Heating Ventilation and Air-Conditioning
COP	Coefficient of Performance
FDC	Fixed Displacement Compressor
VDC	Variable Displacement Compressor
DOE	Design of Experiment
TXV	Thermostatic Expansion Valve

LIST OF PUBLICATIONS

CHAPTER 1

INTRODUCTION

1.1 Overview

The air conditioning system plays a major role in a vehicle for cooling the passengers and the driver throughout driving period. Now, cars have implemented modern technology in an air conditioning system to give a comfortable driving. There are several types of automotive air conditioning systems that available in a marketplace but only two major that are used in the vehicle. The first one is using the receiver drier – expansion valve system and the other one used accumulator – orifice tube system (Shah, 2006). In an air conditioner's refrigeration system, the refrigerant continuously changes its phase from liquid to gas and then back to liquid again. The air conditioning system consists of a compressor, condenser, evaporator coil, receiver drier and thermostatic expansion valve or orifice tube and accumulator (Lee and Yoo, 2000).

The system can adjust the temperatures and humidity of the air, besides controlling the temperature of the surrounding inside the cabin and provides fresh outdoor air. This happens to improve comfort and increase the efficiency of air circulation (Limperich *et al.*, 2005). Like in a human body, the heart is the key organ in the circulatory system. Same goes for compressor's role in car air conditioning system which continuously cycles on and off to provide cooling requirements for the cabin car (Kaynakli and Horuz, 2003). As car regular required maintenance on engine system, thus like air conditioning system. Keeping the performance of the system is important in terms of comfort, safety and

economy (Datta *et al.*, 2014). So, it depends on how proper attention to its maintenance and service needs to keep the system running smoothly. There are many types of service maintenance guide in the automotive world because of different types of car. One of it is Infiniti where the air conditioning system of the car needs to inspect for every 12 months (Infiniti, 2009).

Since this system in the vehicle filters both outside and recirculate air if a car drove in heavy traffic in an urban area that has poor air quality, cabin air filter “In-Cabin Micro-filter” needs to replace annually or for every 15,000 miles (Nissan, 2015). Dirty or clogged filters can cause a variety of problems, it is crucial to replace the filter before it gets bad. The new cabin air filter will help to trap any road dust, bacteria and other air pollutants from reaches dashboard vents, so that the driver and the passengers can breathe easier (Nissan, 2015).

1.2 Research Background

The air conditioner is functioning as the mechanism to transfer heat from a cabin of the vehicle to the surrounding. Due to this operation in the system, it helps to retain the low-temperature condition in the vehicle and prevent hot temperature condition. This project focuses on the analysis performance of car air conditioning involved the experiment on the system by measuring the coefficient of performance (Wang *et al.*, 2005). The experiment will be done by taking the reading of temperature and pressure of a certain place in air conditioning system inside the engine like has been done by (Wang *et al.*, 2005).