COMPARATIVE STUDY OF IDEAL ENGINE TEST CELL SYSTEM AT PROTON AS COMPARED TO FKM, UTEM

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"I admit that have read this work and in my opinion this work was adequate from scope aspect and quality to award in purpose Degree of Bachelor of Mechanical Engineering (Automotive)"

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This technical report is submitted in accordance with the requirements of the Bachelor of Mechanical Engineering (Automotive)

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MAY 2010

DECLARATION

"I hereby, declare this thesis entitled Comparative Study of Ideal Engine Test Cell System at PROTON as compared to FKM, UTeM is the result of my own research except as cited in the reference"

Signature : ……
Author name : SYED EDDY AFIFI BIN SYED ABDULLAH
Date : 24 MAY 2010

DEDICATION

To my beloved father,
Tuan Hj Dr. Syed Abdullah Bin Syed Sulaiman
And to my beloved mother,
Puan Hajjah Nor Asmah Binti Hj. Ishak
who keep me continuously motivated with their great support and encouragement throughout my Bachelor Degree program.

ACKNOWLEDGEMENT

Alhamdullillah, thanks to Allah S.W.T for its guidance and opportunity that He give to me to finish up this project. It is been a challenging moment for me to do this project but with help and guidance from my supervisor, Mr. Noreffendy Tamaldin and Mr Wan Zalimi, I have done this project successfully. I am also wanted to appreciate Mr Shakir, our university technician for his kindness to help me with the research study. His help has been a great boost for my Projek Sarjana Muda (PSM) as information on FKM, UTeM engine test cell is totally important for my research.

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I also want to thank my family for give confidence and support me during my torrid time doing this project. Their love has encouraged me to step up and inspire me to do an excellent job on all occasion. Thanks to all my friends for given an enjoyable moment during this project time. Last but not least, I thank everyone who involved directly and indirectly in this project. The sacrifice and commitment given towards me earning my bachelor's degree are indescribable and without them, this PSM thesis would have been impossible.

ABSTRACT

Engine test cell is one of the main tools in engine testing within automotive industry. FKM, UTeM also has an engine test cell facility for their student's uses. This current engine test cell faced so many problems and need to be analyzed. This project objective is to analyze and evaluate the performance of this engine test cell and make a comparative analysis with an industrial standard engine test cell at PROTON Shah Alam facilities. An ideal working principle of an engine test cell is investigated and studied. Various systems will be discussed including data collection system, ventilation and air conditioning system, engine cooling system, fire alarm and safety precaution system, electrical system, fuel system and engine exhaust system. An engine testing capabilities is listed down to differentiate types of testing that both test cells are capable of. The engine testing requirement for both test cell is studied based on the parameters monitored, operational procedure, data logging, engine cooling and safety precaution. From the analysis and observation of a typical engine test procedure performed at PROTON facilities, the operating procedure was analyzed. As a result, the main components of an industrial standard engine test cell were identified. The function and operating procedure of these components were listed and compared with the existing engine test cell configuration in FKM. Later on, improvement modification was identified and compiled as a list of recommendation to further improve the existing engine test cell system and operating procedure in FKM, UTeM engine test cell system.

ABSTRAK

Sel ujian enjin merupakan salah satu alat utama dalam ujian enjn di dalam industri Automotif. FKM, UTeM juga turut mempunyai sel ujian enjin untuk kegunaan para pelajar. Sel ujian enjin yang sedang digunapakai kini mempunyai pelbagai masalah dan perlu dianalisa. Matlamat projek ini ialah untuk menganalisa dan menilai prestasi sel ujian enjin ini dan membuat perbezaan secara analisis dengan sel ujian enjin yang mengikut piawaian industri di PROTON Shah Alam. Kaedah kerja yang ideal dalam mengendalikan sel ujian enjin ini juga dikaji dan difahami. Pelbagai sistem akan dibincangkan termasuklah sistem penyimpanan data, sistem pengudaraan dan penghawa dingin, sistem penyejukan enjin, sistem keselamatan dan kecemasan kebakaran, sistem elektrikal, sistem minyak dan sistem ekzos enjin. Keupayaan melakukan ujikaji enjin disenaraikan untuk membezakan jenis-jenis ujikaji yang boleh dijalankan di kedua-dua sel ujian enjin. Keperluan untuk melakukan ujian enjin untuk kedua-dua sel ujian enjin dikaji berdasarkan parameter yang dipantau, prosedur operasi, penyimpanan data, penyejukan enjin dan langkah-langkah keselamatan. Prosedur operasi turut dianalisa berdasarkan daripada analisis dan pemerhatian yang dibuat terhadap prosedur ujian enjin yang biasa dilakukan di PROTON. Hasilnya, bahagian-bahagian utama sel ujian enjin yang mengikut piawaian industri dikenalpasti. Fungsi dan prosedur operasi komponen-komponen ini telah dicatat dan dibandingkan dengan konfigurasi sel ujian enjin yang sedia ada di FKM. Kemudian, pengubahsuaian penambahbaikan dikenalpasti dan disusun sebagai senarai cadangan untuk meningkatkan tahap sistem sel ujian enjin dan prosedur operasi yang ada di sel ujian enjin FKM, UTeM.

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NOMENCLATURE

A.C	=	Alternate Current
AG	=	Air Gap
AHU	=	Air Handling Unit
BIPO	=	Break In and Pass Off
CO_2	=	Carbon Dioxide
D.C	=	Direct Current
DGEC	=	Dry Gap Eddy Current
DTC	=	Digital Throttle Control
ECU	=	Electronic Control Unit
F	=	Force, N
FCU	=	Fuel Controller Unit
FKM	=	Fakulti Kejuruteraan Mekanikal
FMS	=	Fuel Measurement System
IGBT	=	Insulated Gate Bipolar Transistor
LVDT	=	Linear Variable Displacement Transducer
MUT	=	Machine under Test
MD	=	Mustang Dynamometer
NVH	=	Noise, Vibration, Harshness

P	=	Power, kW
PID	=	Proportional, Integral, Derivative
PLC	=	Programmable Logic Controller
PROTON	=	Perusahaan Otomobil Nasional Sdn Bhd
PRT	=	Platinum Resistance Thermometers
R	=	Distance, m
S	=	Shaft speed, rpm
SAE	=	Society of Automotive Engineering
T	=	Torque, Nm
TDC	=	Top Dead Centre
UTeM	=	Universiti Teknikal Malaysia Melaka
VAC	=	Volt Alternate Current
WOT	=	Wide Open Throttle

CHAPTER I

INTRODUCTION

1.1 Problem Statement

Engine dynamometer is a dynamometer that coupled directly to an engine that has been removed from a vehicle and it been used to measures power and torque directly from the engine crankshaft or flywheel. Engine dynamometer is usually placed in the test cell which has sufficient system to support engine dynamometer when running. A standard test cell is equipped the engine dynamometer with various system such as ventilation system, cooling system, control console and data acquisition system, fire and safety precaution system, fuel system, electrical system and engine exhaust system.

At FKM in UTeM, the engine dynamometer test cell is equipped with water cooling tower system, data acquisition system, fuel supply and measurement system, engine coolant system, throttle actuators, intake air, exhaust extraction and sump pumps. Currently, this engine dynamometer test cell have various problem related to these systems and required an analysis to identify the problem. In order to enhance its performance, comparative analysis with other engine dynamometer test cell is required.

1.2 Objectives

The goal for this project is to investigate an ideal working principle of an engine test cell and to perform comparative analysis of the existing engine test cell in FKM, UTeM and the engine test cell at PROTON facilities. The objectives of this project also include performing recommendation and provide benchmark of engine testing procedure for existing engine test cell in FKM, UTeM.

1.3 Scopes

The scopes for this project is involving running a sample of engine testing at PROTON and obtained a typical engine testing data for analysis. Identification of the weaknesses in engine test cell system in FKM also needs to be done. The scope also includes analyzing the problem with the current testing procedure in FKM, UTeM. Finally, this standard operating procedure obtained could be use as reference in running any engine testing in FKM engine test cell.

1.4 Chapter Summary

1.4.1 Chapter 1: Introduction

This chapter discusses the problem statement, objective and scope of this project. In general, this project is about to compare the current FKM, UTeM test cell with the PROTON test cell as to find the problem of the FKM, UTeM test cell.

1.4.2 Chapter 2: Literature Review

This chapter explains about the standard engine test cell setup including explanation on the system related to the test cell and type of engine dynamometer that can be used.

1.4.3 Chapter 3: Methodology

This chapter describes the methodology used in order to achieve the project's objective. In this project, research on the FKM, UTeM test cell and PROTON test cell is performed to understand both test cell system. This study also involves the testing capabilities of both test cells in order to run various types of testing and the engine testing requirements for both test cells. In an engine testing requirements, there are few consideration been made based on before running the engine testing such as parameter monitor, operational procedure, data logging, engine cooling and safety precaution.

1.4.4 Chapter 4: Results and Discussion

This chapter brief the output from the research and study that been made regarding FKM, UTeM test cell and PROTON test cell. The comparative analysis on both test cell system and engine testing requirement is explain. Based on the comparative analysis, the FKM, UTeM test cell problems are identified. The important components of an ideal engine test cell system were also identified and their function operating procedures were included. The important of their existent in an engine test cell system was also emphasizing.

1.4.5 Chapter 5: Conclusion and Recommendation

This chapter concludes the overall project study by state that the FKM, UTeM test cell have several problems which require an improvement and modification. Recommendation on the current FKM, UTeM test cell is brief based on the test cell problems. A recommended test cell operational procedure is also included in this chapter.

CHAPTER II

LITERATURE REVIEW

2.1 Engine Dynamometer Test Cell

A test cell is a room used to develop, characterize and test engines. The facility allows engine operation in different operating condition and offers measurement of several physical variables associated with the engine operation. In almost all engine test cells, an open thermodynamics system is used where it helpful in considering the total behavior of a test cell. With this concept, all the mass and energy flows into and out of the system is identified through balance sheet. Figure 2.1 shows the schematic diagram of an open thermodynamic system. Figure 2.2 shows the diagram of the standard engine test cell with regenerative electrical dynamometers. Figure 2.3 shows the output diagram of cell thermal analysis software.

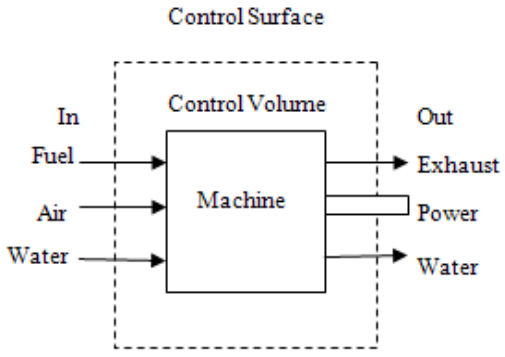

Figure 2.1: Open Thermodynamic System
(Martyr, A and Plint, M.A, (2007))

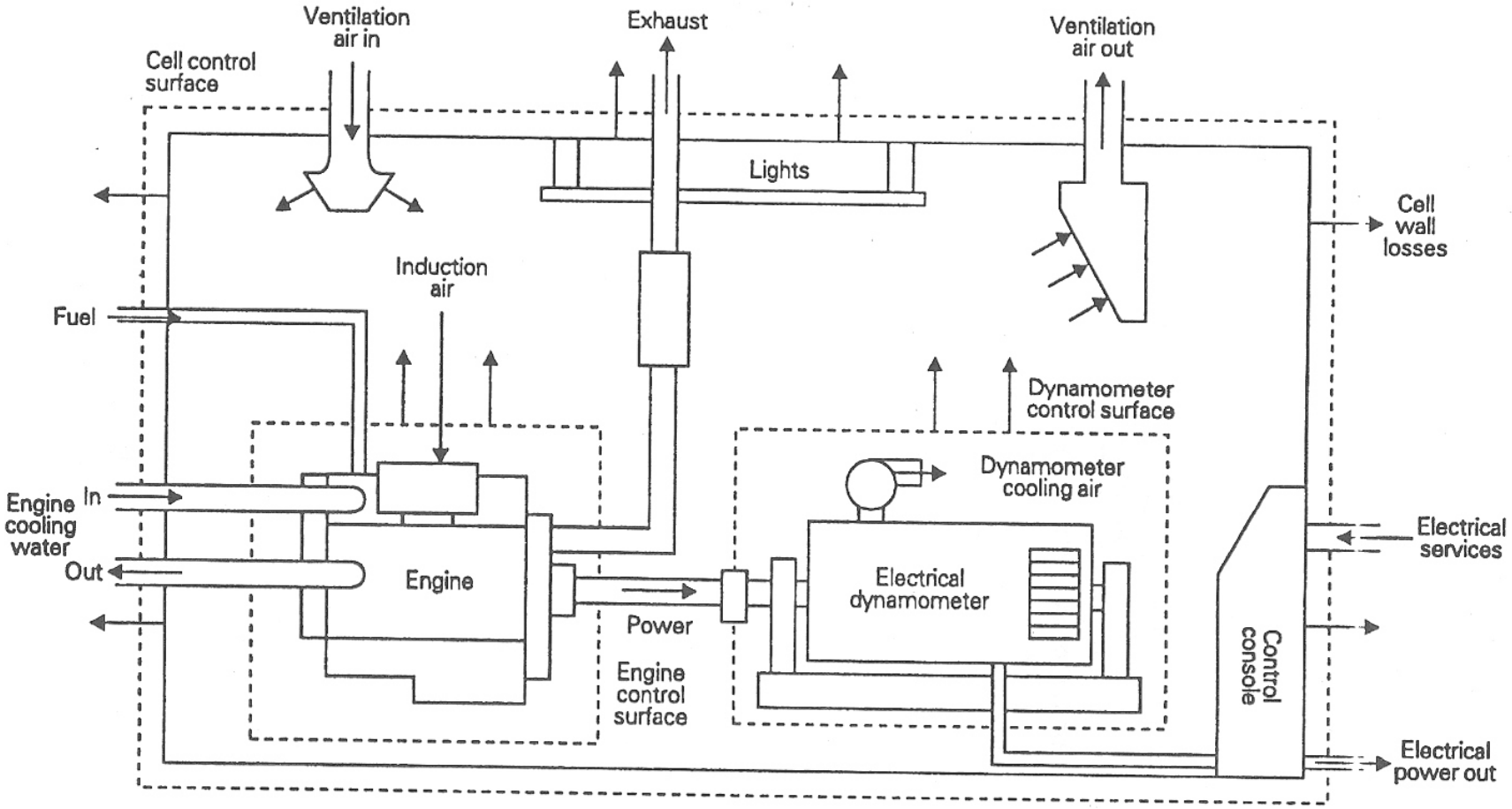

Figure 2.2: Test Cell with Regenerative Electrical Dynamometer

(Martyr, A and Plint, M.A, (2007))

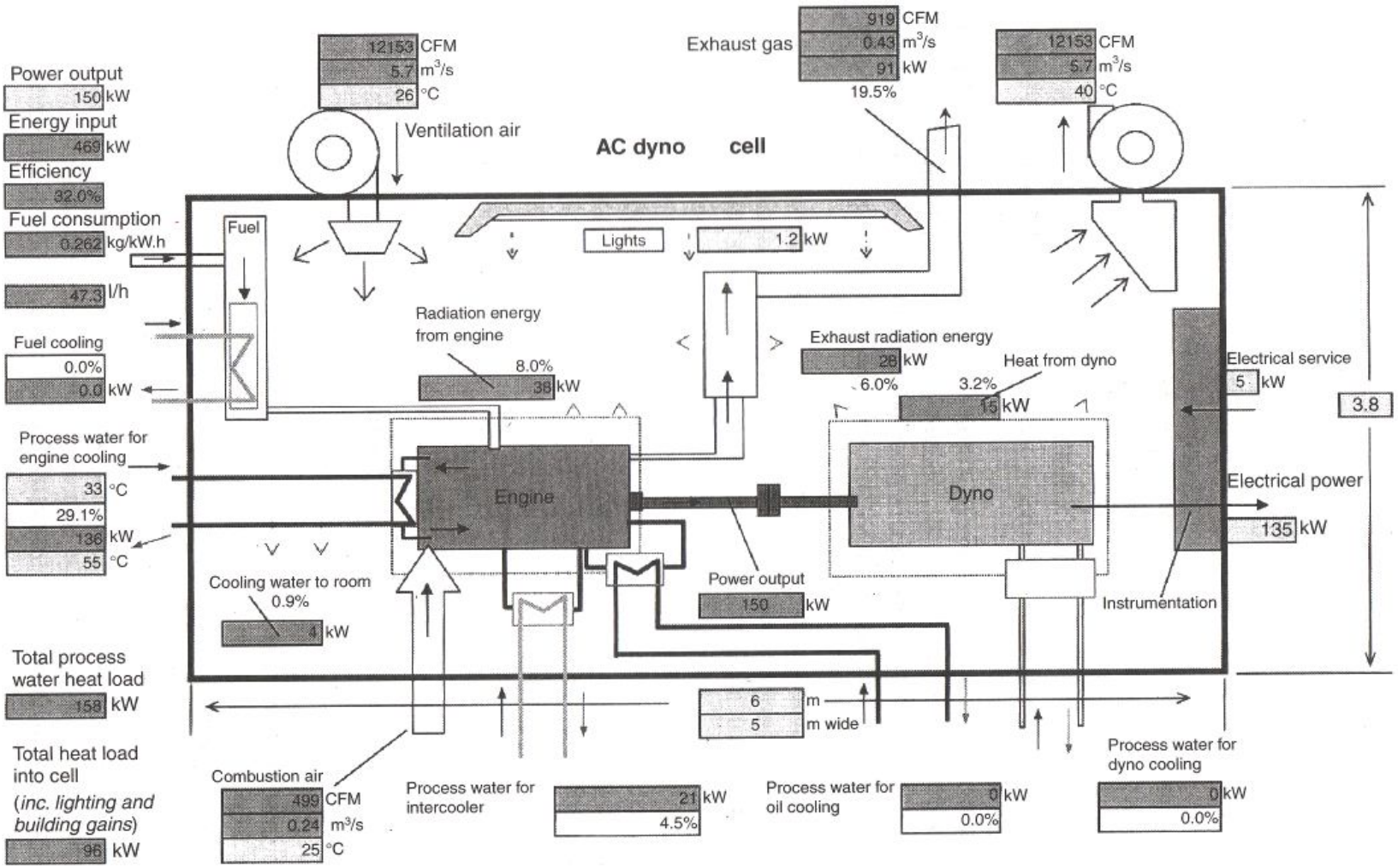

Figure 2.3: Output Diagram of Cell Thermal Analysis Software

(Martyr, A and Plint, M.A, (2007))