

FINAL PROJECT
COMPARISON ANALYSIS PERFORMANCE OF
GASOLINE ENGINE USING ACTIVE AND
NON-ACTIVE i-VTEC SYSTEM



ABSTRACT

**Submitted as a Partial Fulfillment of the Requirements for Getting
the Bachelor Degree of Engineering in Automotive Department**

by
FAIZAL HIDAYAT
D200 080 203

MECHANICAL ENGINEERING DEPARTMENT
INTERNATIONAL PROGRAM
IN AUTOMOTIVE/MOTORCYCLE ENGINEERING
MUHAMMADIYAH UNIVERSITY OF SURAKARTA
July 2013

DECLARATION OF RESEARCH AUTHENTICITY

I assert verily that the research entitles:

COMPARISON ANALYSIS PERFORMANCE OF GASOLINE ENGINE USING ACTIVE AND NON-ACTIVE i-VTEC SYSTEM

That made to fulfill some of requirements to get Bachelor Degree of Engineering in Automotive Department of Muhammadiyah University of Surakarta, as far as I know is not a plagiarism of a research that has been published, except the information source that to solve the problems.

Surakarta, July 2013

Researcher,

A handwritten signature in black ink, appearing to read 'Faizal Hidayat', written over a horizontal line.

Faizal Hidayat

APPROVAL

The Final Project entitles "**Comparison Analysis Performance Of Gasoline Engine Using Active And Non-Active i-VTEC System**" has been approved by supervisors and authorized by Secretary of International Program as partial fulfillment of the requirements for getting the Bachelor Degree of Engineering in Automotive Department of Muhammadiyah University of Surakarta.

Written by:

Name : **Faizal Hidayat**

NI M : **D200 080 203**

Has approved and legalized on:

Day : Wednesday

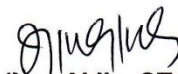
Date : 24 July 2013

Supervisor I




(Ir. Subroto, MT.)

Supervisor II



(Nur Aklis, ST.M.Eng.)

Admitted by,
Secretary of International
Program



(Wijianto, ST.M.Eng.Sc.)

VALIDATION

The Final Project entitles “**Comparison Analysis Performance Of Gasoline Engine Using Active And Non-Active i-VTEC System**” has been defended in front of examiners team and approved as a partial fulfillment of the requirements for getting the Bachelor Degree of Engineering in Automotive Department of Muhammadiyah University of Surakarta.

Written by:

Name : **Faizal Hidayat**

NIM : **D200 080 203**

Has been approved and legalized on:

Day/ Date : *Wednesday, 24 July 2013*

Team of Examiners:

Chair Person : **Ir. Subroto, MT.** (*[Signature]*)

Member 1 : **Nur Aklis, ST.M.Eng.** (*[Signature]*)

Member 2 : **Ir. Sartono Putro, MT.** (*[Signature]*)

Dean,

Head of Department,

[Signature]
(**Ir. Agus Riyanto, MT.**)

[Signature]
(**Ir. Sartono Putro, MT.**)

DEDICATION

This Research paper is dedicated to:

Allah SWT,

Thanks for the best everything that You have given for me and thanks for Your love that always make me to never give up to do the best. I believe that You will always give me the best for everything.

My beloved Mom and Dad,

Thanks for your prayer, love, support and affection.

You always give me happiness but often I made you disappointed.

I am sorry and I promise to give you the best in the future.

My Siblings (Taufiq Hidayat, Titis Dwi Wahyuni, Arum Sukmawati),

Thanks for your supports.

It is make me strong to get something more and more.

My closed friend (Eka Adistiana),

Thanks for your love, support, attention, spirit, care, and advice.

As long as I know you, you make me to be better and adult.

My all family,

Thanks for your prayer, love, support and everything.

All my friends (Automotive Engineering '08, etc)

Thanks for your supports and love me.

MOTTO

[5] For indeed, with hardship [will] be ease, [6] Indeed, with hardship [will be] ease
(Al-Insyirah: 5-6)

[7] Then shall anyone who has done an atom's weight of good, see it! [8] And
anyone who has done an atom's weight of evil, shall see it.

(Al-Zalzalah: 7-8)

[7]"And remember! Your Lord caused to be declared (publicly): "if ye are grateful, I
will add more (favours) unto you; but if ye show ingratitude, truly My punishment is
terrible indeed." (Q.S. Ibrahim: 7)

Allah will not change the condition of a people until they change what is in
themselves. (Q.S. Ar-Ra'd : 11)

The Prophet (sallallahu alaihi wasallam) said "A single day under a just ruler
(Khaleefah) is better than 60 years of ibadah"

(HR. Bayhaqi/Tabarani)

People are always learning will be very respected and strength not based on
knowledge wills collapse.

(AL-Ghozali)

Anyone who pursue the path to knowledge therein, Allah
paves the way for him to heaven (Narrated by Muslim)

We only have one future, and it will be made of our dreams, if we have the courage
to challenge convention (Soichiro Honda)

Enjoying your work is essential. If your work becomes an expression of your own
ideas, you will surely enjoy it (Soichiro Honda)

ACKNOWLEDGMENT



Assalamu'alaikum Warohmatullahi Wabarokatuh

Alhamdulillahirobbil'alamiin. Praise and gratitude be to Allah SWT, The Lord of universe, because of His blessing and guidance The Research Paper can be done.

The Final Project entitles "Comparison Analysis Performance Of Gasoline Engine Using Active And Non-Active i-VTEC System" can be done because of helping and supporting from other people. Therefore, writer sincerely would like to say thanks and appreciation to:

1. Ir. Agus Riyanto, MT., as the Dean of Engineering Faculty of Muhammadiyah University of Surakarta.
2. Ir. Sartono Putro, MT., as the Head of Mechanical Engineering of Muhammadiyah University of Surakarta.
3. Wijianto, ST., M.Eng.Sc., as Secretary of International Program of Muhammadiyah University of Surakarta.
4. Ir. Subroto, MT., as the first supervisor who has given the researcher inspiration, spirit, advices, suggestions, and corrections to the paper completion.
5. Nur Aklis, ST.M.Eng., as the second supervisor who has given the researcher guidance, suggestions, and correction wisely.
6. All lectures of Automotive Engineering Department for the guidance during the study in the university.
7. His beloved Mother and Father who always give enormous pray, biggest support, care, affection and great attention.
8. His Brothers and sisters for suggestions and advices.

9. His closed friend “Eka Adistiana” thanks for your support and advices.
10. His best friends “Automotive Engineering 2008” thanks for your laugh, funnies experiences and supports, I will never forget you.
11. Head of PT. RS Tuning Lestari Motor, thank you so much for the place and equipments that used to do the experiment.
12. The Employers of PT. RS Tuning Lestari Motor thank a lot for your helpfulness
13. All students of International program of Automotive Department, thanks a lot for the best suggestion and advice, hope we can the best engineer.
14. His friends and staffs in PESMA K.H. Mas Mansur. Thanks for accompany him during his study.
15. Those who cannot be mentioned one by one, writer wants to say his thank and appreciation to all of them.

The writer realizes that this research paper is far from being perfect, so the writer sincerely welcomes any constructive comment, criticism, and suggestion from anyone.

Wassalamu’alaikum Warohmatullahi Wabarokatuh

Surakarta, July 2013

The Writer

A handwritten signature in black ink, appearing to read 'Faizal Hidayat', written in a cursive style with a horizontal line underneath.

Faizal Hidayat

TABLE OF CONTENT

	Page
TITLE.....	i
DECLARATION OF RESEARCH AUTHENTICITY	ii
APPROVAL	iii
VALIDATION	iv
DEDICATION	v
MOTTO	vi
ACKNOWLEDGMENT	vii
TABLE OF CONTENT.....	ix
LIST OF FIGURES.....	xii
LIST OF TABLES	xii
ABSTRACT	xiv
CHAPTER I: INTRODUCTION	
1.1. Background	1
1.2. Problem Statement	2
1.3. Objectives	2
1.4. Benefit Of Study	3
1.5. Problem Limitations	3
CHAPTER II: REVIEW OF LITERATURE	
2.1. Literature Study	4
2.2. Fundamental of Theory	6
2.2.1 Valve Mechanism	6

2.2.2	Combustion	8
2.2.3	Ideal Otto Cycle	10
2.2.4	Engine Performance Parameter	14
2.2.5	Parameters Of Engine Performance	15
2.2.6	Engine Performance Characteristic	18
2.3	DOHC And SOHC i-VTEC	21
2.3.1	DOHC i-VTEC	21
2.3.2	SOHC i-VTEC	22
2.4	Camshaft	22
2.4.1	Valve Lift	25
2.4.2	Lobe Separation Angle	25
2.5	Valve Timing.....	26
2.6	Debit	28
2.7	Overlapping	29
2.8	Volumetric Efficiency	30
2.9	I-VTEC Engine Mechanism	33
2.9.1	Construction	34
2.9.2	Operation Of i-VTEC	41
2.9.2.1	VTEC System	41
2.9.2.2	i-VTEC System	42
2.10	Dynamometer	44
2.10.1	Principle Of Operation	44

CHAPTER III: ENGINE TEST METHODOLOGY

3.1	Flow Chart of Engine Test	46
3.2	Material	49
3.3	Place And Time of Research	50
3.4	Tools	50
3.5	Experiment Procedures	51

CHAPTER IV: ANALYSIS

4.1	Analysis of Torque	52
4.2	Analysis of Power	54

CHAPTER V: CONCLUSION AND SUGGESTION

5.1	Conclusion	57
5.2	Suggestion	58

BIBLIOGRAPHY	59
--------------------	----

APPENDIX

LIST OF FIGURES

	Page
Figure 2.1 Basic geometry of the reciprocating internal combustion engine	6
Figure 2.2 Exhaust Strokes	8
Figure 2.3 Components of Basic Combustion	9
Figure 2.4 Ideal air-standard otto cycle, 6-1-2-3-4-5-6, which approximates the four-stroke cycle of an SI engine P-V diagram	11
Figure 2.5 Schematic of principle of operation of dynamometer	16
Figure 2.6 Typical SI Engine Performance Curves	19
Figure 2.7 DOHC mechanism	21
Figure 2.8 SOHC mechanism	22
Figure 2.9 Operating system of camshaft	23
Figure 2.10 Valve lift of intake and exhaust.....	24
Figure 2.11 Lobe Separation Angle (LSA)	25
Figure 2.12 Valve Timing Diagram (Retard and Advance)	26
Figure 2.13 Lift of valve on the intake stroke.....	28
Figure 2.14 Mechanism of Overlapping.....	29
Figure 2.15 i-VTEC System.....	33
Figure 2.16 Trochoid Type	34
Figure 2.17 Strainer Oil	35
Figure 2.18 Oil Filter.....	35
Figure 2.19 Cranshaft Position Sensor (CKP).....	36
Figure 2.20 Electronic Control Unit (ECU) Mechanism.....	37
Figure 2.21 The Camshaft.....	37
Figure 2.22 The Rocker Arm	38

Figure 2.23 Solenoid Valve	39
Figure 2.24 Spool Valve	40
Figure 2.25 Show the mechanism at low speed	41
Figure 2.26 Show the mechanism at high speed.....	42
Figure 2.27 Mechanism of Advance Condition	43
Figure 2.26 Mechanism of Retard Condition	44
Figure 3.1 Engine Test Flow Chart	46
Figure 3.2 Scheme of Dynamometer	41
Figure 3.3 HTS Installation on motorcycle	42
Figure 4.1 Graphic of Torque Toward RPM	53
Figure 4.2 Graphic of Power Toward RPM	55

LIST OF TABLES

	Page
Table 3.1 Specification of Honda Jazz Engine	49
Table 4.1 Torque And RPM data from dyno test	52
Table 4.2 Power And RPM data from dyno test	54

COMPARISON ANALYSIS PERFORMANCE OF GASOLINE ENGINE USING ACTIVE AND NON-ACTIVE i-VTEC SYSTEM

Faizal Hidayat

Mechanical Engineering Department
International Program In Automotive/Motorcycle Engineering
Muhammadiyah University of Surakarta
Jl. A. Yani Tromol Pos I Pabelan Kartasura, Surakarta 57102
E-mail: faizal.hidayat10@yahoo.com

ABSTRACT

Nowadays, many demands from consumers to have a car with powerful engine and low of gasoline so vehicle manufactures think how to make engine like that. Vehicle manufactures develop technology which can increase of performance and the engine can have a great power and torque. Intellegence Variable Timing and Lift Electronic Control (i-VTEC) can be used to problem solve above because it can control timing valve. I-VTEC can increase engine performance that can make the gasoline engine will increase power and torque.

Research target that is to know influence variable valve timing to engine performance at four stroke engine 1497cc. Research uses four stroke engine with two types of engine with active i-VTEC and engine with non-active i-VTEC. Two types of four stroke engine will testing above engine dynamometer. Calculation is conducted after got data of testing result.

Base testing and analysis can be concluded that engine use active i-VTEC have higher performance than engine with non-active i-VTEC. From dynamometer test was get maximum torque from engine use i-VTEC is 148 Nm at 5000 rpm and maximum torque from engine with non-active i-VTEC is 142 Nm at 5000 rpm. Maximum power from engine use active i-VTEC is 120.6 BHP at 6500 rpm and maximum power from engine with non-active i-VTEC is 115.2 BHP at 6500 rpm. I-VTEC organizes timing of valve which can make overlapping on the machine. Overlapping make number of air-fuel mixture in combustion chamber will increase which can make performance will increases.

Keywords: *gasoline engine, i-VTEC, performance, torque, power*