



**UNIVERSITI TEKNIKAL MALAYSIA MELAKA**

**DESIGN AND ANALYSIS OF A JIG TESTING FOR**

**AUTOMOTIVE COIL SPRING STATIC**

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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FACULTY OF MECHANICAL AND MANUFACTURING ENGINEERING

TECHNOLOGY

2018

**BORANG PENGESAHAN STATUS LAPORAN PROJEK SARJANA MUDA**

Tajuk: DESIGN AND ANALYSIS OF A JIG TESTING FOR AUTOMOTIVE COIL  
SPRING STATIC

Sesi Pengajian: Semester 1 2018/2019

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## **APPROVAL**

This report is submitted to the Faculty of Mechanical and Manufacturing Engineering Technology of Universiti Teknikal Malaysia Melaka (UTeM) as a partial fulfilment of the requirements for the degree of Bachelor of Mechanical Engineering Technology (Automotive) with Honours. The member of the supervisory is as follow:

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## ABSTRAK

Pegas gegelung bertindak sebagai kusyen penyerap hentakan semasa kenderaan melalui jalan yang tidak rata. Untuk meningkatkan prestasi dan mengelakkan pegas gegelung dari kegagalan ketika beroperasi, pengeluar perlu melakukan ujian bagi menguji keupayaan pegas gegelung. Jenis ujian yang dijalankan adalah ujian mampatan dengan menggunakan Mesin Penguji Universal, tetapi jig untuk menempatkan pegas gegelung ketika ujian dijalankan tidak disediakan pada mesin tersebut. Tujuan penyelidikan ini adalah untuk merekabentuk, menganalisis dan fabrikasi jig bagi gegelung pegas automotif statik. Jig merangkumi dua bahagian iaitu jig atas dan bawah. Setiap jig mempunyai tiang sebagai pemegang jika berlaku kegagalan pada pegas gegelung atau patah apabila ujian mampatan dilakukan. Perisian Catia V5 digunakan untuk mereka bentuk kedua-dua jig dalam 3D. Reka bentuk produk, dipilih keluli sebagai bahannya. Beberapa penambakan dan peningkatan pada reka bentuk telah dilakukan untuk mencapai pengurangan berat produk. Jig mempunyai tiga reka bentuk dan reka bentuk yang ketiga diluluskan sebagai reka bentuk akhir sebelum analisis. Analisis terhadap reka bentuk jig dilakukan dengan menggunakan Catia Analisis Struktur Generatif dan dipilih sebagai analisis statik untuk menentukan nilai maksimum jig melalui von mises stress (nilai nod). Apabila penentuan produk analisis dicapai, ia membolehkan prosedur fabrikasi melibatkan memotong, kimpalan dan proses akhir untuk jig. Untuk selongsong ia melibatkan proses membengkok dan menggerudi. Ujian sebenar jig pada mesin UTM dilakukan bagi menentukan tekanan dan ketegangan untuk pegas gegelung dengan menggunakan ujian mampatan. Hasil pemerhatian pada ujian mampatan menunjukkan jig tidak gagal seperti lenturan atau patah pada mana-mana bahagiannya.

## ABSTRACT

Coil spring is the main part on suspension system to act as a cushion to absorb the shock when bumping on the road. To increase performance of coil springs and avoid spring failure when running on the road, manufacturer needs to perform test. Type of test performed is compression test. By using Universal Testing Machine this type of test may be perform but there is no jig to place coil spring when compression test. Focused on this research to design, analysis and fabricate jig testing for automotive coil spring static. The jig was involve in designing include two part which is upper and lower jig. Each jig has a pole act as holder if spring failure or fracture when compression test. Catia V5 software use to design both jig in 3D. The product design, assigns as steel. Some refinement and improvement on the design was done to achieve weight reduction. The jig has three design and third design approved as a final design before analysis. The analysis of design performed by using Catia Generative Structure Analysis selected static analysis to determine jig maximum value of von mises stress (nodal value). The determination of analysis product is achieved, that allow fabrication procedure involves cutting, welding and finishing process for jig. For casing it involve bending and drilling process. Actual test of jig on UTM machine was perform to determine stress and strain for coil spring by using compression test. The result of observation on compression test show the jig did not failure such as bending or fracture.

## **DEDICATION**

This thesis is dedicated to all my family members, lecturers and fellow friends. To my beloved parents Mr. Mohd Said Bin Yahaya and Madam Norlida Bt Mohamed who keep on supporting me to achieve until this level and always be there whether I am in difficult or happy state. Their unconditional love reminds me that I could not easily disappoint them and even strive to be success. To all my respected lecturers that always patient and passion in order to give me a lot of knowledge during I am studying at UTeM. To all my fellow friends are deserved to be my companion in my success of the project especially my classmates. They have provided me a lot of favours and spirits which make me to become a better person.



## ACKNOWLEDGEMENTS

I feel grateful to Allah S.W.T for giving me a chance to complete this project to success. While completing this project, there several individuals that keeps giving me support and advises to complete this project successfully. I would like to express my deepest gratefulness and appreciation to my Project Supervisor and CoSupervisor, which are Mr Saiful Naim Bin Sulaiman and Mr. Mohammad Rafi Bin Omar and in all their guidance, teaching, advises and time for me. Without their constant supervision, I may be not able to complete this project. Thank you for the advices, guides, tips and generous support that you all have gave to me. To my friends, my special gratitude and thanks you for all the support and guidance. Also not forgotten to all lecturers and people who help me in completing this project whether it directly or not. Without all the support and help, this project may be cannot complete. Thank you

# TABLE OF CONTENTS

	<b>PAGE</b>
<b>TABLE OF CONTENTS</b>	x
<b>LIST OF TABLES</b>	xiv
<b>LIST OF FIGURES</b>	xv
<b>LIST OF APPENDICES</b>	xix
<b>LIST OF ABBREVIATIONS</b>	xx
<b>CHAPTER 1      INTRODUCTION</b>	<b>1</b>
1.1      Research Background	1
1.2      Problem Statement	2
1.3      Objective	2
1.4      Scope	3
<b>CHAPTER 2      LITERATURE REVIEW</b>	<b>4</b>
2.1      History of Spring	4
2.2      Basic Type of Helical Spring	5
2.2.1      Compression Spring	6
2.2.2      Extension Spring	7
2.2.3      Torsion Spring	8
2.2.4      Spring Guide	9

2.3	Design of Automotive Coil Spring	9
2.3.1	Design of Helical Coil Spring	10
2.3.2	End Type of Helical Spring	14
2.4	Standard Test for Spring	18
2.4.1	American Society for Testing and Material (ASTM)	19
2.4.2	International Organization for Standardization (ISO)	21
2.5	Position of Coil Spring in Vehicle with Suspension System	22
2.6	Review of Available Equipment on Coil Spring Testing Machine	24
2.6.1	Working Principle	25
<b>CHAPTER 3</b>	<b>METHODOLOGY</b>	<b>27</b>
3.1	Research Methodology	27
3.2	Determination of Jig's Design Requirement	29
3.2.1	Observation of UTM Machine	29
3.2.2	Observation of Coil Spring	31
3.3	Concept Design	32
3.3.1	Function	32
3.3.2	Idea of Product	33
3.3.3	Selection of Material	34

3.4	Product Design	34
3.5	Analysis of Jig	36
3.5.1	Catia Generative Structural Analysis	36
3.5.2	Static Analysis	37
3.5.3	Clamp	37
3.5.4	Creating Local Mesh Sags	38
3.5.5	Creating Distributed Force	39
3.5.6	Computing Static Solution	39
3.6	Fabrication Methodology	41
<b>CHAPTER 4 RESULT AND DISCUSSION</b>		<b>42</b>
4.1	Introduction	42
4.2	Design of Jig	42
4.2.1	Second Design of Jig	44
4.2.2	Third Design of Jig (final design)	47
4.3	Strength Analysis Result (Von Mises Stress)	53
4.3.1	Analysis Result on Final Design of Jig Spring	54
4.3.2	Safety Factor	55
4.4	Fabrication Process of Jig	56
4.4.1	Cutting Process	56
4.4.2	Welding Process	57

4.4.3	Finishing Process	57
4.5	Actual Test of Jig on UTM Machine	59
4.5.1	Standard of Procedure to Install Jig on UTM Machine	60
4.5.2	Result from Actual Test	62
<b>CHAPTER 5</b>	<b>CONCLUSION AND FUTURE WORK</b>	<b>63</b>
5.1	Introduction	63
5.2	Conclusion of Product Research and Development	63
5.3	Future Work and Recommendation	64
<b>REFERENCES</b>		<b>65</b>
<b>APPENDIX</b>		<b>68</b>

## LIST OF TABLES

<b>TABLE</b>	<b>TITLE</b>	<b>PAGE</b>
Table 4.1:	Comparison between weights of jig using inertia measurement	51
Table 4.2:	Designs of jig comparison	52
Table 4.3:	Von mises stress and yield strength of steel value	55

## LIST OF FIGURES

<b>FIGURE</b>	<b>TITLE</b>	<b>PAGE</b>
Figure 2.1:	Variable of size and type compression spring	6
Figure 2.2:	Type and size of available extension spring	7
Figure 2.3:	Torsion spring size	8
Figure 2.4:	Spring guide	9
Figure 2.5:	Conical type of compression spring	10
Figure 2.6:	Barrel type of compression spring	11
Figure 2.7:	Condition of conical and normal compression spring when compressed under a pressure	12
Figure 2.8:	Hourglass type of compression spring	13
Figure 2.9:	Closed and squared end type of helical spring	14
Figure 2.10:	Closed and ground end type of helical spring	15
Figure 2.11:	Double closed end type of helical spring	16
Figure 2.12:	Open ends type of helical spring	17
Figure 2.13:	Buckle of spring under uncompressed and compress spring when test	19
Figure 2.14:	ASTM international logo	19
Figure 2.15:	Performance test carried out using ASTM A125 standard test	21
Figure 2.16:	ISO logo commonly used in 100 countries	21

Figure 2.17: Included angle for front and rear suspension system	22
Figure 2.18: Recommended angle for suspension system	23
Figure 2.19: Example of available spring testing kit machine	25
Figure 2.20: Fabrication of spring testing machine	26
Figure 3.1: Flowchart of experimental work	28
Figure 3.2: UTM machine Instron type	29
Figure 3.3: Anatomy of an electromechanical testing machine	30
Figure 3.4: Top and bottom of plate base UTM machine	30
Figure 3.5: Helical spring characteristic	31
Figure 3.6: Free length of Proton Preve coil spring	31
Figure 3.7: Outer and wire diameter of the Proton Preve coil spring	32
Figure 3.8: Sketching idea of product development 1	33
Figure 3.9: Sketching idea of product development 2	33
Figure 3.10: Progress design of the product using CATIA	35
Figure 3.11: Drafting of the progress product design	35
Figure 3.12: Generative structural analysis	36
Figure 3.13: Static analysis	37
Figure 3.14: Selected surface for clamp	38
Figure 3.15: OCTREE tetrahedron mesh size	38
Figure 3.16: Distributed force of force vector	39
Figure 3.17: Computation process is running to optimize the result	40



Figure 3.18: Von mises stress (nodal value) result	40
Figure 4.1: Inertia measurement to identify design characteristic of first lower jig design	42
Figure 4.2: The weight of first lower jig design	43
Figure 4.3: Inertia measurement to identify design characteristic of first upper jig design	43
Figure 4.4: The weight of first upper jig design	43
Figure 4.5: Parts of second lower jig	44
Figure 4.6: Upper jig for second design	45
Figure 4.7: Assembly of second lower jig	45
Figure 4.8: Inertia measurement to identify design characteristic of second lower jig design	46
Figure 4.9: The weight of second lower jig design	46
Figure 4.10: Inertia measurement to identify design characteristic of second upper jig design	47
Figure 4.11: The weight of second upper jig design	47
Figure 4.12: Parts of third lower jig	48
Figure 4.13: Upper jig for third design	49
Figure 4.14: Assembly of third lower jig	49
Figure 4.15: Inertia measurement to identify design characteristic of third lower jig design	50
Figure 4.16: The weight of third lower jig design	50

Figure 4.17: Inertia measurement to identify design characteristic of third upper jig design	51
Figure 4.18: The weight of third upper jig design	51
Figure 4.19: Analysis result von mises stress(nodal value) on lower jig	54
Figure 4.20: Analysis result von mises stress (nodal value) on upper jig	54
Figure 4.21: Part product after cutting process	56
Figure 4.22: Product after fabrication process (arc welding)	57
Figure 4.23: Polishing process to remove rust	58
Figure 4.24: Grinding process using abrasive stone to remove sharp edge	58
Figure 4.25: Finishing with spray painting to keep the product from rusting	59
Figure 4.26: Actual jig product after fabrication process	59

## LIST OF APPENDICES

APPENDIX	TITLE	PAGE
Appendix 1	Bill of material	68
Appendix 2	Drafting of jig casing	68
Appendix 3	Drafting of lower jig	69
Appendix 4	Drafting of upper jig	69
Appendix 5	Drafting of upper jig pole	70
Appendix 6	Actual test load using UTM machine Instron type	70
Appendix 7	Actual weight of lower jig	71
Appendix 8	Actual weight of upper jig with pole	71
Appendix 9	Actual weight before and after fabricate process	71

## LIST OF ABBREVIATIONS

UTM	Universal Testing Machine
ISO	International Organization for Standardization
ASTM	American Society for Testing and Materials
DIS	Draft International Standard
BSI	British Standards Institution
IEC	International Electrotechnical Commission
DIN	Deutsches Institut für Normung
ANSI	American National Standards Institute
AFNOR	Association Française de Normalisation
ISA	International Federation of the National Standardization Association

# CHAPTER 1

## INTRODUCTION

### 1.1 Research Background

The coil spring is the main part in suspension system to act as a cushion to absorb the shock when bumping on the road. The spring stored the energy of movement. Some of coil spring having a failure when running on the road. This situation may affect the performance of suspension system.

To increase the performance of coil spring, the manufacturers need to perform a test. Usually the machine to perform the coil spring test is come out with the jig and it can perform various type of coil spring. In UTM machine it also can do compression and tensile test for spring, but the UTM machine did not have a jig to place the coil spring.

This project is focused to produce a jig that can place the coil spring when running the experiment using UTM machine. This product must be fitted into a various type of coil spring. So, the design of this jig need to considers a diameter and type of end the coil spring. The manufacturers produce various type of end coil spring to counter the performance problem.

## **1.2 Problem Statement**

In laboratory or workshop session, subject of suspension system commonly need to run test for coil spring. Some of student and teaching engineer need to perform a test on coil spring using UTM machine but there is no jig or base to place coil spring when running the experiment.

The focused on this project is produce a jig which is be able to help them using UTM machine when running coil spring compression test. This is because UTM machine is available for tensile and compression test. This testing equipment was design due to the available type of coil spring in market.

Method to design the product is using CAD software which is CATIA and analysis. The analysis will identify the problem of material and designing stress and force. When analysis process was completely successful, then there is fabrication process to produce the product that may be able to use on UTM machine.

## **1.3 Objective**

Thus in this research, the parameters of coil spring and UTM machine need to be consider. Then the identified parameter will determine the output of product design and related to the objective. The following objectives are as follow:

1. To study standard testing for coil spring
2. To design and fabricate a testing equipment to perform standard testing
3. To test the spring as a sample for testing measurement

## **1.4 Scope**

The main consideration of parameter to perform this project is the type of coil spring and dimension of base UTM machine. So, the design and output of product was determined by parameter that state below:

1. Type of end and diameter of coil spring
2. The dimension of UTM machine (top and bottom plate base)
3. Designing of product due to the analysis that can achieve the objective
4. The fabrication process to produce the jig product

## CHAPTER 2

### LITERATURE REVIEW

#### 2.1 History of Spring

There are two main types of spring that a non-coiled and spring coiled. A great example of a spring that non-coiled is the bow and arrow. Bow and arrows are there to help with food and shelter. This is one of the earliest spring technologies. Anytime the string is tightened to make a bounce, which can be considered a "spring". In the year 1300 there was a spring technology used in the car. The car has a spring system and a complex suspension, which helps give more miles. R. Tradwell in 1763 invented the first coil spring. The revolutions of coil spring begin from the leaf spring types. (Coiling technologies, 2012).

In automotive industry, modern vehicles use a number of different types of spring medium, but the most popular is the coil spring. Coil springs used in vehicle suspension system are made from round spring-steel bars. The heated bar is wound on a special former and then heat-treated to obtain the correct elasticity (springiness). The coil spring can withstand any compression load, but not side thrust. It is also difficult for a coil spring to resist braking or driving thrust. Suspension arms are used to resist these loads (Denton, 2011).