

**TECHNIQUES IN MAKING MASTER MODEL FOR SPIN CASTING  
TECHNOLOGY**

**THESIS**

Submitted as Partial Fulfill of the Requirements  
to Obtain the Bachelor of International  
Industrial Engineering Degree



Arranged by:

DAHANA PAMUNGKAS  
Student Number: 04 14 04272

INTERNATIONAL INDUSTRIAL ENGINEERING PROGRAM  
FACULTY OF INDUSTRIAL TECHNOLOGY  
UNIVERSITAS ATMA JAYA YOGYAKARTA  
YOGYAKARTA  
2009

**STATEMENT OF WORK'S ORIGINALITY**

I honestly declare that this thesis which I wrote does not contain the works or parts of the works of other people, except those cited in the quotations and bibliography, as a scientific paper should

Yogyakarta, June, 2009

Dahana Pamungkas



**A BACHELOR OF  
INTERNATIONAL INDUSTRIAL ENGINEERING THESIS  
On**

**TECHNIQUES IN MAKING MASTER MODEL FOR SPIN  
CASTING TECHNOLOGY**

Has been Examined and Approved  
On June, 2009

Adviser,

T.B. Hanandoko, S.T., M.T.

Co-Adviser,

A. Tonny Yuniarto, S.T., M.Eng.

Board of Examiners,  
Chairman,

T.B. Hanandoko, S.T., M.T.

Member,

P. Wisnu Anggoro, S.T., M.T.

Member,

Ir. B. Kristyanto, M.Eng., Ph.D

Yogyakarta, June, 2009  
Dean of Faculty of Industrial Technology  
Universitas Atma Jaya Yogyakarta

Paulus Mudjihartono, S.T., M.T.

**ACKNOWLEDGEMENT**



**Dedicated for:**

**My parents**

**MY siblings**

**Myself**



Enfin, je peux finir mon rapport

## FOREWORD

This final report is one of the prerequisite to finish the undergraduate study program in Industrial Engineering Department, Industrial Technology Faculty, Atmajaya Yogyakarta University.

I am so grateful to many people who encouraged, and help me to finish this final report. On this opportunity, I would like to thank:

1. Jesus Christ, for His blessing and guidance.
2. Mr. Paulus Mudjihartono, S.T., M.T, as the Dean of Industrial Technology Faculty, Atmajaya Yogyakarta University.
3. Mr. Parama Kartika Dewa SP, S.T., M.T., as the Head of Industrial Engineering Department, Industrial Technology Faculty, Atmajaya Yogyakarta University.
4. Mr. Hadi Santono, S.T., M.T., as the Head of International Class of Industrial Engineering, with those never ending break through.
5. Mr. Theodorus B. Hanandoko, S.T., M.T., as first adviser, who had spent plenty of time to give guidance, direction, inputs and correction in writing this final report.
6. Mr. A. Tonny Yuniarto, S.T., M.Eng., as first adviser, who had inputs and correction in writing this final report .
7. Mr. Paulus Wisnu Anggoro, S.T., M.T., thanks for all those advice and jokes.
8. Mr. Ir. B. Kristyanto, M.Eng., Ph.D as head of LPPM, thanks for supports.

9. Mr. Ashari and his crews at Hari Mukti Teknik Workshop, thank you for the input, the idea of machine construction, and warm welcome.
10. Mas Budi who always help me at process production laboratory.
11. Friends at thesis research, Eko, Geovanni, and William. We had struggled for obtaining quality thesis report. Thanks for the input, support, and togetherness.
12. My parents, thanks for supporting my life. Dad, your junior now ready to take over you.
13. My siblings who always support me. Thanks for everything.
14. My friends TIKI Batch 2004, finally, we're in the same level. Thank you.
15. All those who haven't mentioned, thank you.

I realize that this final report has not perfect but I hope that this final report can be useful and can be developed in a further research.

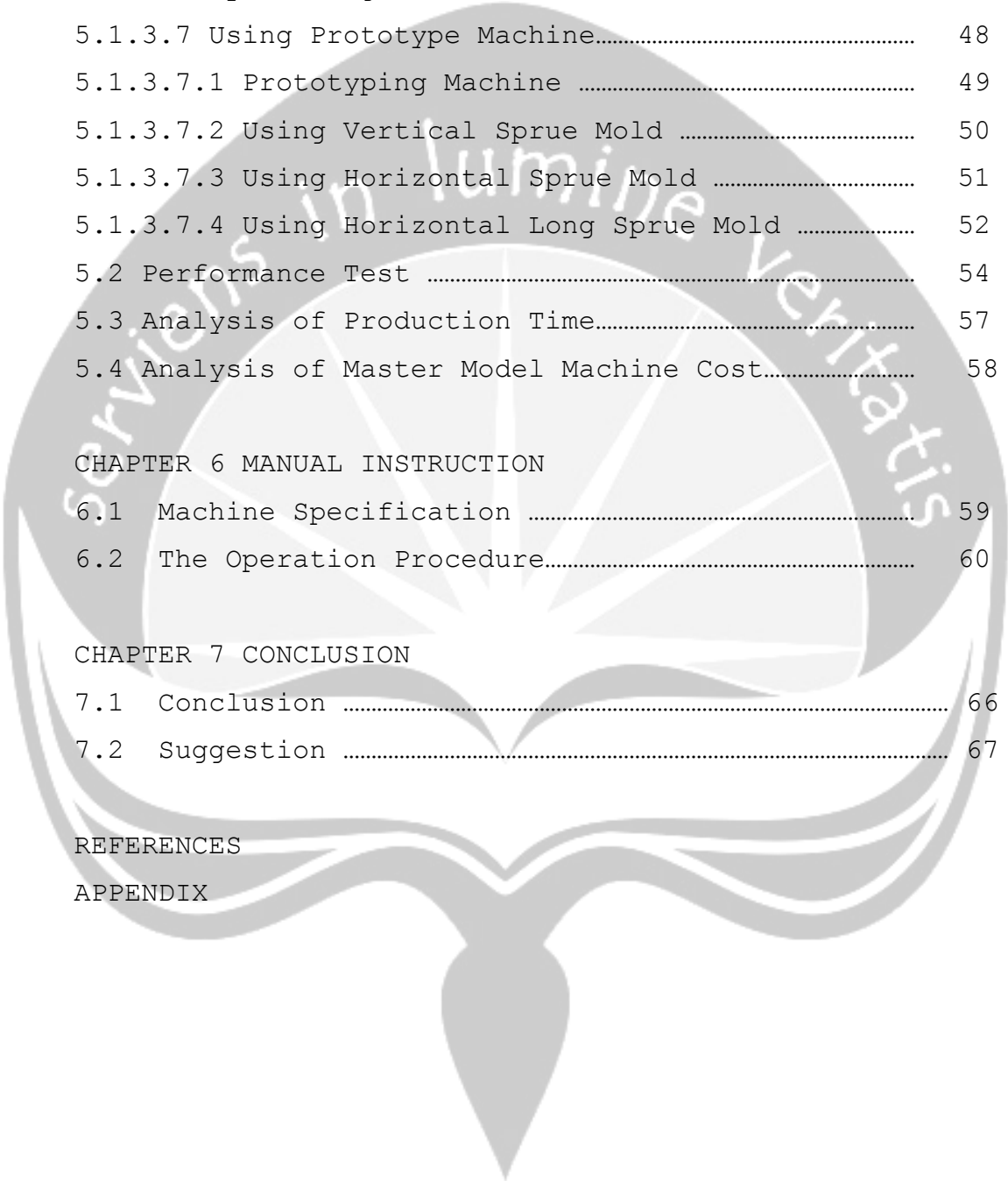
Yogyakarta, June 2009

## CONTENTS

COVER .....	i	
STATEMENT OF WORK'S ORIGINALITY .....	ii	
AUTHORIZATION .....	iii	
ACKNOWLEDGEMENT .....	iv	
FOREWORD .....	vi	
CONTENTS .....	viii	
TABLE CONTENTS .....	x	
FIGURE CONTENTS .....	xi	
APPENDIX CONTENT .....	xv	
ABSTRACT .....	xvi	
CHAPTER 1 INTRODUCTION		
1.1 Background .....	1	
1.2 Problem Statement .....	3	
1.3 Research Objectives .....	3	
1.4 Scope of Research .....	3	
1.5 Research Methodology .....	4	
1.6 Report Outline .....	5	
CHAPTER 2 LITERATURE REVIEW .....		6
CHAPTER 3 BASIC THEORY		
3.1 Spin Casting .....	8	
3.2 Silicone Rubber .....	13	
3.2.1 Silicone Rubber Classification .....	16	
3.2.2 Room Temperature Vulcanizing (RTV) Rubbers .....	16	
3.2.3 Advantages .....	17	



3.2.4 Disadvantages .....	18
3.2.5 Flexibility .....	18
3.3 Resin .....	19
3.3.1 Resin Uses .....	19
3.4 Process Decision Program Charts .....	20
3.5 The Cause and Effect Diagram (Fishbone Diagram)...	25
3.6 Arrow Diagram .....	27
3.7 Tin .....	29
3.7.1 Physical and allotropes .....	30
3.7.2 Chemistry and compounds .....	31
3.8 Machine Cost.....	32
3.9 Casting Defects.....	33
CHAPTER 4 SETTING EXPERIMENTS	
4.1 Equipments and Materials .....	34
4.1.1 Mold Making Peripherals .....	34
4.1.2 Supporting Materials for Experiments .....	35
4.1.3 Master Model Machine Specification .....	37
4.2 Parameter .....	38
4.3 Experiments Steps .....	38
4.4 Material and Components Price .....	39
CHAPTER 5 ANALYSIS AND DISCUSSION	
5.1 Identification of Problems during	
Reproducing Master Model .....	41
5.1.1 Reproducing Using Roland MDX 40 .....	41
5.1.2 Reproducing by Carving .....	41
5.1.3 Reproducing by Casting .....	42
5.1.3.1 Using Silicone Rubber Seal .....	42
5.1.3.2 Using RTV Silicone Rubber .....	43
5.1.3.3 Using Resin .....	44



5.1.3.4 Using Bench Vise .....	45
5.1.3.5 Using C-Clamp .....	46
5.1.3.6 By Heating the mold .....	47
5.1.3.7 Using Prototype Machine.....	48
5.1.3.7.1 Prototyping Machine .....	49
5.1.3.7.2 Using Vertical Sprue Mold .....	50
5.1.3.7.3 Using Horizontal Sprue Mold .....	51
5.1.3.7.4 Using Horizontal Long Sprue Mold .....	52
5.2 Performance Test .....	54
5.3 Analysis of Production Time.....	57
5.4 Analysis of Master Model Machine Cost.....	58
CHAPTER 6 MANUAL INSTRUCTION	
6.1 Machine Specification .....	59
6.2 The Operation Procedure.....	60
CHAPTER 7 CONCLUSION	
7.1 Conclusion .....	66
7.2 Suggestion .....	67
REFERENCES	
APPENDIX	

## TABLE CONTENTS

Table 2.1 Comparison of Previous and Present Research .....	7
Table 3.1 Silicone Rubber Mechanical Properties .....	16
Table 4.1 Mold Making Peripherals .....	34
Table 4.2 Supporting Materials for Experiments .....	35
Table 4.3 Master Model Machine Specification .....	37
Table 4.4 Material and Components Price .....	38
Table 5.1 Performance Test .....	54
Table 5.2 Production Time .....	58
Table 5.3 Machine Cost .....	58
Table 6.1 Specification.. ..	60
Table 7.1 Comparison Result.....	66

## FIGURE CONTENTS

Figure 1.1 Research Methodology Flow Chart .....	4
Figure 3.1 Parts are arranged on silicone rubber .....	8
Figure 3.2 Mold is assembled with locknuts and sprayed .....	9
Figure 3.3 Vulcanization .....	9
Figure 3.4 Gating and Venting .....	10
Figure 3.5 Spinning .....	10
Figure 3.6 Pouring .....	11
Figure 3.7 Pouring illustration inside spin casting machine .....	11
Figure 3.8 Removal Parts .....	12
Figure 3.9 Symbolic Shorthand Souvenir Life Cycle .....	12
Figure 3.10 Silicone Rubber Chain .....	15
Figure 3.11 Silicone Rubber Bonding .....	15
Figure 3.12 Oil resistant grades of silicone rubber with (left) nitride functional groups and (right) fluorine functional groups .....	19
Figure 3.13 Names and Meanings of Symbols .....	22
Figure 3.14 Possible Relative Positions of Start and Goal .....	23
Figure 3.15 Feedback Loops .....	23
Figure 3.16 PDPC .....	25
Figure 3.17 Illustration of Fishbone Diagram .....	26
Figure 3.18 Example of Arrow Diagram .....	27
Figure 4.1 Master Model Machine .....	37
Figure 4.2 Experiments Steps .....	38
Figure 5.1 Roland MDX 40 .....	41
Figure 5.2 Analysis of unaccomplished patterns.....	42

Figure 5.3 Unaccomplished patterns .....	42
Figure 5.4 Analysis of blow defects .....	43
Figure 5.5 Blow defects.....	43
Figure 5.6 Analysis of obtain the broken mold .....	44
Figure 5.7 The broken mold .....	44
Figure 5.8 Using Bench Vise .....	45
Figure 5.9 Analysis of blow defects emerge the result .....	45
Figure 5.10 Blow defects emerge on the result .....	45
Figure 5.11 Using C-Clamp .....	46
Figure 5.12 Analysis of blow defects on the product.....	46
Figure 5.13 Blow defects on the product .....	47
Figure 5.14 Oven the mold .....	47
Figure 5.15 Analysis of blow and pin holes defects on the product .....	48
Figure 5.16 Blow and pin holes defects on the product .....	48
Figure 5.17 Prototype Machine .....	49
Figure 5.18 Vertical Sprue .....	50
Figure 5.19 Analysis of blow defects at center on the product .....	50
Figure 5.20 Blow defects at center on the product ...	50
Figure 5.21 Horizontal Sprue .....	51
Figure 5.22 Analysis of cold shut defect .....	51
Figure 5.23 Cold shut defects on product surface .....	52
Figure 5.24 Mold Frame .....	52
Figure 5.25 Analysis of accomplished details.....	52
Figure 5.26 Product Result.....	53
Figure 5.27 Arrow Diagram of Casting Process .....	57
Figure 6.1 Machine Specification .....	59

Figure 6.2 Open Top Enclosure .....	60
Figure 6.3 Load silicone rubber .....	61
Figure 6.4 Fasten the mold frame .....	61
Figure 6.5 Close Top Enclosure .....	61
Figure 6.6 Connect machine to regulator .....	62
Figure 6.7 Plug the electrical plug .....	62
Figure 6.8 Turn the switch on .....	62
Figure 6.9 Set the regulator at maximum voltage to activate electric motor .....	63
Figure 6.10 Set the regulator at 125 volt to get constant speed .....	63
Figure 6.11 Pour the molten metal .....	63
Figure 6.12 Set the regulator at 0 volt .....	64
Figure 6.13 Pull the plug out .....	64
Figure 6.14 Turn the switch off .....	64
Figure 6.15 Open Top Enclosure .....	65
Figure 6.16 Remove mold frame .....	65
Figure 6.17 Open silicone rubber mold .....	65

APPENDIX CONTENT

Master Model Machine

Master Model Machine Component

Process Decision Program Chart



## ABSTRACT

A master model is required before a product is actually processed in a machine. One technique to produce this master model is using Roland MDX 40 machine which is already used in ADTC. However, duplicating master model by using this machine is not recommended because : (1) Producing a master model using a Roland MDX 40 machine consumes a long time (depend on product complexity) due to metal material used for producing the master model is a heat resistant material, hence requires more time to shape; (2) Roland MDX 40 machine are high costly to use. The time consumption in the process of making the master model would burden the cost of electricity and replacing the cutter all the time when it is not sharp anymore; (3) A Roland MDX 40 machine also requires a machine operator to always stand by to frequently giving the machine and cutter oil lubricant during the process.

This research use PDPC (Process Decision Program Chart) to depict all of the techniques that did in ordering to obtain the best technique in making master model. Fishbone diagram used to analyze the problems that occur on every technique. Arrow diagram used to detect the sequence of production process and obtain production time.

By the end of the research, A prototype machine was built to produce a master model of UAJY keychain. This machine operates at 1400 rpm, with power of 187,5 watt, price of IDR 4.500.000,00 and machine cost per hour is IDR 1.650,00.