

DESIGN AND FABRICATE OF MICRO SPRAY NOZZLE

MUHAMMAD SYAFIQ BIN RAZALI

Report submitted in partial fulfilment of the requirements for the award of Diploma in  
Mechanical Engineering

Faculty of Mechanical Engineering  
UNIVERSITY MALAYSIA PAHANG

JANUARY 2012

## UNIVERSITI MALAYSIA PAHANG

### BORANG PENGESAHAN STATUS TESIS

**JUDUL: DESIGN AND FABRICATION OF MICRO SPRAY NOZZLE**

**SESI PENGAJIAN: 20011/2012**

Saya, **MUHAMMAD SYAFIQ BIN RAZALI ( 910315-11-5041 )**  
(HURUF BESAR)

mengaku membenarkan tesis Projek Tahun Akhir ini disimpan di perpustakaan dengan syarat-syarat kegunaan seperti berikut:

1. Tesis ini adalah hakmilik Universiti Malaysia Pahang (UMP).
2. Perpustakaan dibenarkan membuat salinan untuk tujuan pengajian sahaja.
3. Perpustakaan dibenarkan membuat salinan tesis ini sebagai bahan pertukaran antara institusi pengajian tinggi.
4. \*\*Sila tandakan (√)

**SULIT**

(Mengandungi maklumat yang berdarjah keselamatan atau kepentingan Malaysia seperti yang termaktub di dalam AKTA RAHSIA RASMI 1972)

**TERHAD**

(Mengandungi maklumat TERHAD yang telah ditentukan oleh organisasi / badan di mana penyelidikan dijalankan)

**TIDAK TERHAD**

Disahkan oleh:

\_\_\_\_\_  
(TANDATANGAN PENULIS)

\_\_\_\_\_  
(TANDATANGAN PENYELIA)

Alamat Tetap:

**No.18, KAMPUNG HILIR,  
PASIR GAJAH,  
24030 KEMAMAN.  
TERENGGANU DARUL IMAN.**

**HJ AMIRRUDDIN B. ABD KADIR**

Tarikh: 9 JANUARY 2012

Tarikh:

CATATAN: \* Potong yang tidak berkenaan.

- \*\* Jika tesis ini SULIT atau TERHAD, sila lampirkan surat daripada pihak berkuasa/organisasi berkenaan dengan menyatakan sekali tempoh tesis ini perlu dikelaskan sebagai SULIT atau TERHAD.

Tesis dimaksudkan sebagai tesis bagi Diploma secara penyelidikan atau disertai bagi pengajian secara kerja kursus.

## **SUPERVISOR'S DECLARATION**

I hereby declare that I have checked this project report and in my opinion this project is satisfactory in terms of scope and quality for the award of Diploma in Mechanical Engineering.

Signature:

Name of supervisor:

Position:

Date:

## **STUDENT DECLARATION**

I hereby declare that the work in this report is my own except for quotations and summaries which have been duly acknowledge. The report has not been accepted for any degree and is not concurrently submitted for award of other degree.

Signature:

Name: Muhammad Syafiq Bin Razali

ID number: MB09136

Date:

## **ACKNOWLEDGEMENT**

Praise to God for His help and guidance that I am able to complete the task of the Final Year Project. I am thankful and grateful to my supervisor, Mr. Amirruddin Bin Abdul Kadir for her advice and knowledge that she shared in the completion of the project. I appreciate her help for me while I am doing the Final Year Project from week 1 to the day I finished my Final Year Project.

I also would like to thank all my friends who have been really helpful during the course of conducting the Final Year Project. I also would like to thank to laboratory assistants and who have help me in conducting machine and sharing knowledge in conjunction with the project that I am conducting.

I sincerely grateful to my parents, Mr Razali Bin Omar and Mrs Arpinah Bt Selamat for they love and sacrifice that they had for me throughout my life and their support for me in all activities that I have done. I also wanted to that people who have directly or indirectly help in the completion of my Final Year Project. I sincerely appreciate all of your help.

## **ABSTRACT**

This report shows the design and fabricate of a micro spray nozzle. The objective of the report is to design and fabricate a micro spray nozzle. This report also described the micro spray nozzle which is available among the lecturer or tester or maybe a gardener around the world with its satisfying criteria. Design generation is showed and solid three dimensional structures modelling of the micro spray nozzle was developed with computer aided design software. This report also explains the fabrication process that is needed for this project. Material that is being used in this project is round aluminium hollow metal, rubber hose, nozzle, spray and nozzle connector. The problem encountered during completion of this project is also show in the report. An idea of improvement for the micro spray nozzle is also provided to further improve of the micro spray nozzle. The expected result for this project can solve the entire stated problem statement.

**TABLE OF CONTENTS**

	<b>Page</b>
<b>SUPERVISOR'S DECLARATION</b>	<b>ii</b>
<b>STUDENT 'S DECLARATION</b>	<b>iii</b>
<b>ACKNOWLEDGEMENTS</b>	<b>iv</b>
<b>ABSTRACT</b>	<b>v</b>
<b>TABLE OF CONTENTS</b>	<b>vi</b>
<b>LIST OF TABLES</b>	<b>x</b>
<b>LIST OF FIGURES</b>	<b>xi</b>
<b>CHAPTER 1</b>	<b>INTRODUCTION</b>
	1.1 Introduction 1
	1.2 Background of the Project 1
	1.3 Problem Statement 2
	1.4 Objective 2
	1.5 Scope 2
	1.6 Flow Chart 3
	1.7 Gantt Chart 5

## **CHAPTER 2            LITERATURE REVIEW**

2.1	Introduction	6
2.2	Type of nozzle	6
2.2.1		7
2.2.2		7
2.2.3		8
2.2.4		9
2.3	Type of Safety	
2.3.1	nut	10
2.3.2	quick fit	11
2.4	Fabrication Planning Process	
2.4.1	Bending	12
2.4.2	Cutting	13
2.4.3	Glue	14

## **CHAPTER 3            METHODOLOGY**

3.1	Introduction	15
3.2	Process Flow	15
3.3	Phase 1 – Establish Target Specification	16
3.4	Phase 2 – Design Concept	16
3.4.1	Design Concept 1	17
3.4.2	Design Concept 2	17
3.4.3	Design Concept 3	18
3.5	Phase 3 – Select Final Design	18
3.6	Phase 4 – Searching Material for the Product	21
3.7	Phase 5 – Fabrication of the Product	21



**CHAPTER 4            RESULT AND DISCUSSION**

4.1	Introduction	24
4.2	Final Product	24
4.2.1	Component of Final Product	25
4.2.2	Function of Final Product Component	26
4.3	How to Use This micro spray nozzle	26
4.4	Project Problem	27
4.4.1	Literature Review	27
4.4.2	Designing and Sketching	27
4.4.3	Material Preparation	27
4.4.4	Fabrication Process	28
4.5	How this Project Achieve the Objective	
	And Solves the problem Statement	28

<b>CHAPTER 5</b>	<b>CONCLUSION AND RECOMMENDATION</b>	
5.1	Introduction	29
5.2	Conclusion	29
5.3	Recommendation	30
<b>REFERENCES</b>		30
<b>APPENDIX</b>		
A.	Gantt Chart	31
B.	Each Part of the Project with Dimension	32
C.	Machine use	35

## **CHAPTER 1**

### **INTRODUCTION**

#### **1.1 INTRODUCTION**

CHAPTER 1 is the introduction chapter of this subject. Generally, it discuss about the project background, problem statement, the objective, scope of project, project flow and project Gantt chart.

#### **1.2 BACKGROUND OF THE PROJECT**

Nozzle is one of the component that usually can be seen in our daily life. Usually its can seen many at factory. Nozzle is a gadget build up by more than one component from specific and suitable material.

Nozzle is device designed to control the direction or characteristic of a fluid flow. Especially to increase velocity as it exists or enters an enclosed chamber or pipe. Some nozzle are produced in many shaped. It depend on their shaped included length, diameter and etc. used to control rate of flow, speed and the direction.

Nozzle carry out a few function and the common function of nozzle is used for converting fluids pressure energy into kinematic energy, if a fluid passed through a tapered pipe its velocity is higher at the outlet as compared to inlet.

#### **1.3 PROBLEM STATEMENT**

When using spray nozzle, i think the main problem is the mist get airbourne. I decide to fabricate that to used micro nozzle and to get my system using very small quantities of air/water.

#### 1.4 OBJECTIVE

The objective of this project is :

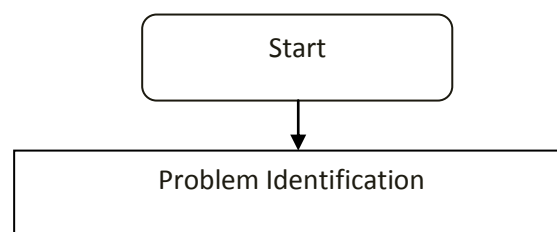
- To fabricate the spray and get light-weight spray.
- used micro spray nozzle at spray nozzle

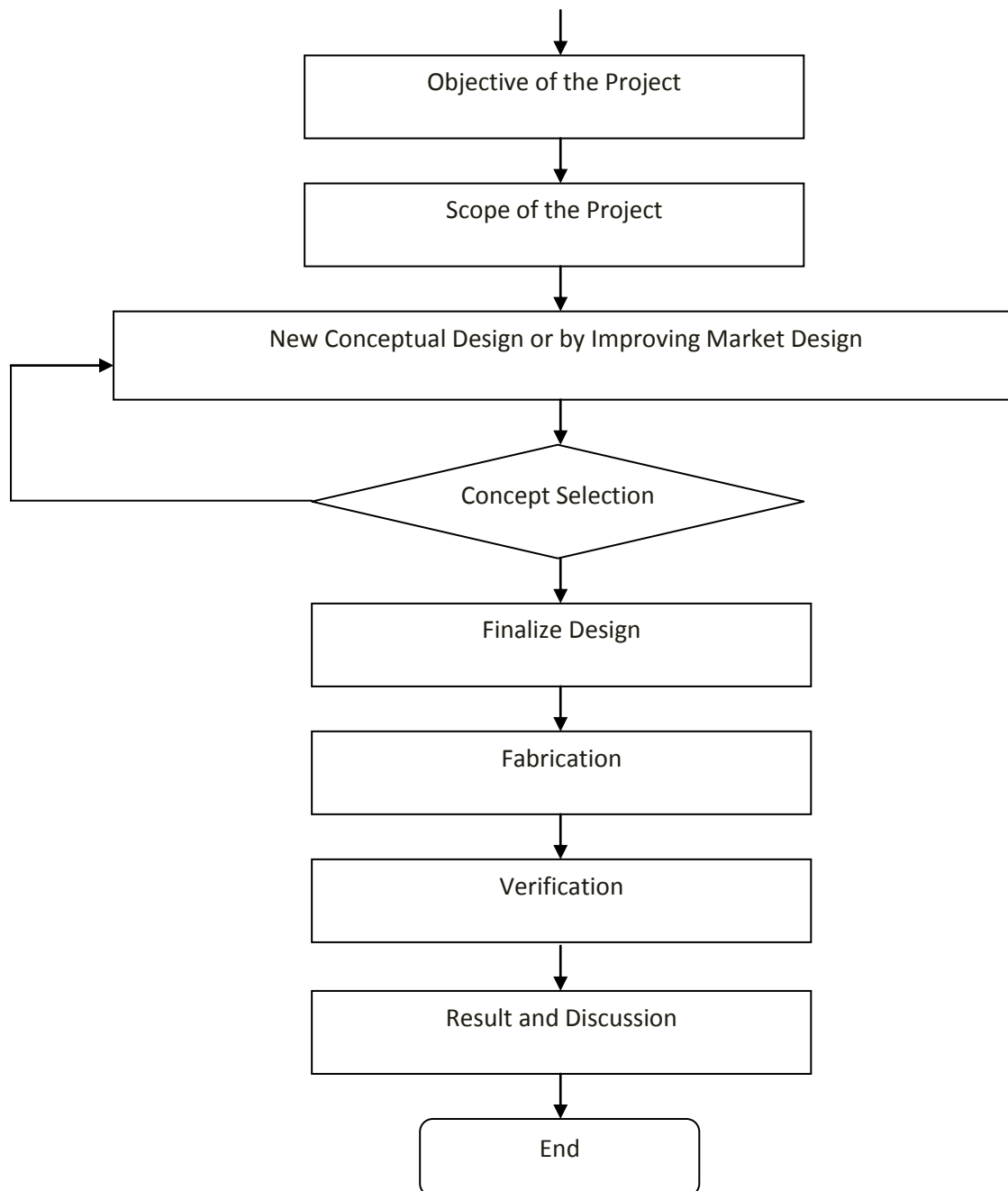
#### 1.5 SCOPE

In this project, scope performed a range in the completion of a project. The scope of this project are :

- This study is focused on fabricate a spray nozzle.
- Function of spray nozzle.

#### 1.6 FLOW CHART





**Figure 1.1:** Flow Chart

The project starts identify the problem. It is a step for the project flow in order to find the problem in current product. This step helps to create a different design to improve the product.

After identify the problem for the project, project continues with identify the objective. The objective is very important in every work because every procedure to make a

project will depend on it. It will help to know the main point to make the project success or not.

The project continues with identify the scope of the project because this scope can help the progress to create the new product design for the project and to make sure the method chose will be within the range and achievable objective.

Next continue it with literature review and research about the title. This is consists a review of the design of spray nozzle. These tasks have been done through research on the internet.

From the flow chart, start to design new concept. Use datum as reference. Then improve the design. Try to come with several concepts. Then compare the criteria from each design which are the best. If the best design chosen still needed to be improved go back to the previous step. If no improvement is needed go to next step. Produce the drawing together with dimension of the product and the type of materials needed.

After completing the previous tasks, start the fabrication process. Gather the parts needed for the project to proceeds the fabrication process.

Here come the testing and evaluation process. The micro spray nozzle will be test to see is it fulls the requirement such as safety, ability and strength. During testing, if a problem occurs, the process of fabrication the holder will step back to the previous process. The reason to step back is to fix the error.

After all parts had been joined together and no error, here comes the phase of result and discussion. In this part, how spray nozzle function will be informs. Beside, how to achieve objective and solve problem statement of the project will be discuss in this phase.

## **1.7 GANTT CHART**

Gantt chart is an important to guide work process during this project. With gantt chart what need to be done first can be plan accordingly. Other than that, this project will run smoothtly and finish on time. Refer Appendix A to see a gantt chart that being used for this project.

## **CHAPTER 2**

### **LITERATURE REVIEW**

#### **2.1 INTRODUCTION**

CHAPTER2 is the literature review of the project. In this chapter, there is the type of micro spray nozzle and safety. Beside that, it is consists with design which were were available at the market. Other than that, in this chapter also have the method that will use to fabricate the chosen one later

## **2.2 TYPES OF MICRO SPRAY NOZZLE**

There are many types of micro spray nozzle in the market. To making groups or classification of spray nozzles are always complicated due to fact that nozzles can be classified in respect to several criterias.

When considering thousands of spray nozzles with changing parameters, nozzles users may easily get confused. On the other hand, some of the spray nozzles suppliers take this point to confuse endusers' minds and repeating the same nozzles in their catalogues over and over again.

Spray nozzles can be classified in order that define nearly all the spray nozzles use in industry.

### **2.2.1 FLAT JET NOZZLES**

This nozzle is based on Figure 2.1, it made from stainless steelmajor metals and also have plastics). The pressure range is (0,5-20 bars) and the spray angle range is (0-150 degrees). The application is the most of the washing, surface treatment in paint lines, cooling, water curtains, cleaning with steam, oil spray and etc.



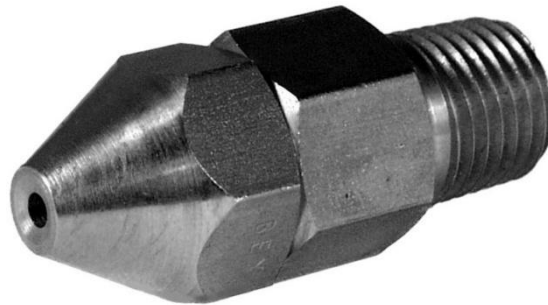


**Figure 2.1**

Source: google image

### **2.2.2 FULL CONE NOZZLES**

This nozzle is based on Figure 2.2, this type is made from stainless steel (major metals and also have plastics). The pressure range is (0,5-20 bars) and the spray angle range is (15-120 degrees). The application is for gas treatment, cooling, dust control, water treatment, and etc.



**Figure 2.2**

Sources: google image

### **2.2.3 HOLLOW CONE NOZZLES**

This nozzle is based on Figure 2.3, this types is made from stainless steel (major metals and also have plastics). The pressure range is (0,3-10 bars) and the spray angle range is (50- 130 degrees). The application is for gas treatment, air conditioning, gas cleaning, dust control are typical uses.



**Figure 2.3**

Sources: google image

#### **2.2.4 FIRE FIGHTING NOZZLES**

This nozzle is based on Figure 2.4, this types is made from major metals and some plastics. The pressure range is (1-100 bars) and the spray angle ranges is in all degrees. The application is for fire extinguishing spray nozzles and complementary equipments are quite large rangeserving for fire protection needs.



**Figure 2.4**

Sources: google image

## 2.3 TYPE OF SAFETY

Safety is the most important thing that we need to take care. Without safety, life is dangerous and might feel worry all the time because need to care a important thing by self. It have many types of safety and each type is depends on the thing that needs to be secured. Same goes to the micro spray nozzles. There must have safety to make sire several thing are in good condition such as the connection ranges of the nozzle must used nut, flanges and quick fit.

### 2.3.1 NUT

This nut is based on Figure 3.1. The basic function of nut is to join the part of components. Other than that, nut also use to tighten of the component.



**Figure 3.1**

Sources: google image

### 2.3.2 QUICK FIT

This quick fit is based on Figure 3.2. The function is easily to use than other to connect the nozzle from component. It just need to clip up one component to another which is nozzles to hose. It also use the ring rubber to prevent the leakage.

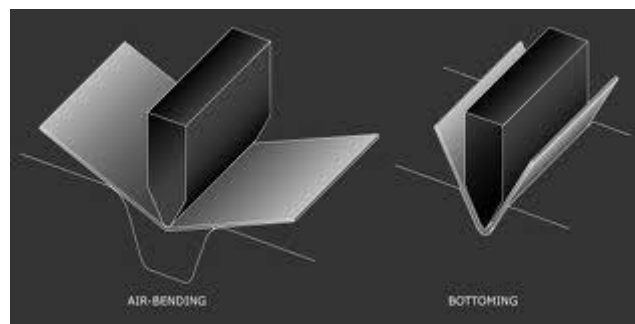


**Figure 3.2**

Sources: google image

## 2.4 FABRICATION PLANNING PROCESS

### 2.4.1 Bending



**Figure 4.1**

Source: Google image

Bending is a process by which metal can be deformed by plastically deforming the material and changing its shape. The material is stressed beyond the yield strength but below the ultimate tensile strength. The surface area of the material does not change much. Bending usually refers to deformation about one axis.

Bending is a flexible process by which different shapes can be produced. Standard die sets are used to produce wide variety of shapes. The material is placed on the die, and positioned in place with stops and or gages. It is held in place with hold down. The upper part of the press, the ram with the appropriately shaped punch descends and form the V-shaped bend.

For this project, I plan to use bending to make bend at aluminium round hollow bar.

## 2.4.2 Cutting



**Figure 4.2**

Source: Google image

Cutting process are those in which a metal is separated by applying a great enough force to cause the material to fail. The most common cutting process is performed by applying a cutting force, and is therefore sometimes referred to as cutting process.

The cutting process is performed on a cutting grinder , that can be operated manually by hand and electric power. A typical cutting grinder include a table with holder to hold and lock the metal, stops or guides to secure the metal.

The metal is placed at holder and lock that metal manually, which are then forced against the metal and cutting the material. In most devices, the cutting disc is forced downward. Also, the holder can used for angled what i need, so that the cut progress from one end to other, thus reducing the required force.

I plan to cut the aluminium round hollow bar according their size that i want by using cutting process.

### 2.4.3 Joining



**Figure 4.2**

Source: Google image

Glue is one of the joining processes that join part together to be a product. In joining process, i plan to used glue to join the component together in my product.

I used Glue because in my product, i used the aluminium and plastic to join together. I not used another joining process like welding to join the that together because welding process can't used when we used different material to join together such as to iron and plastic.

## CHAPTER 3

### METHODOLOGY

#### 3.1 INTRODUCTION

CHAPTER 3 is the methodology has been used to make Micro Spray Nozzle. In this chapter, a project flow chart is defined. The information that included is establish target specification, design concept, select final design concept, searching material for the product and fabrication of the product. It also allows others to replicate our study and run new and different studies that are based on our methodology.

#### 3.2 PROCESS FLOW

Table 3.1 shows below the process flow of making a Micro Spray Nozzle. The manufacturing process consists of 5 phases.

**Table 3.1:** Process flow

PHASE	TITLE
Phase 1	Establish target specification.
Phase 2	Design concepts.
Phase 3	Select final design.
Phase 4	Searching material for the product.
Phase 5	Fabrication of the product.

#### 3.3 PHASE 1 - ESTABLISH TARGET SPECIFICATION

After the investigation of the objective, criteria selection will be developed. Criteria selection here means the criteria that what people will look on the product. It is focus on the existing product on the market. Then, when the new product is done,



compare it with the existing product on the market. The new good design should have better criteria than the product on the market.

This is the criteria that I had to use to the new design for the secure remote holder.

- a. Easy to use
- b. Safety
- c. Durable / long life time
- d. Lightweight
- e. Nice design
- f. High resistance to corrosion
- g. Low cost
- h. Strong

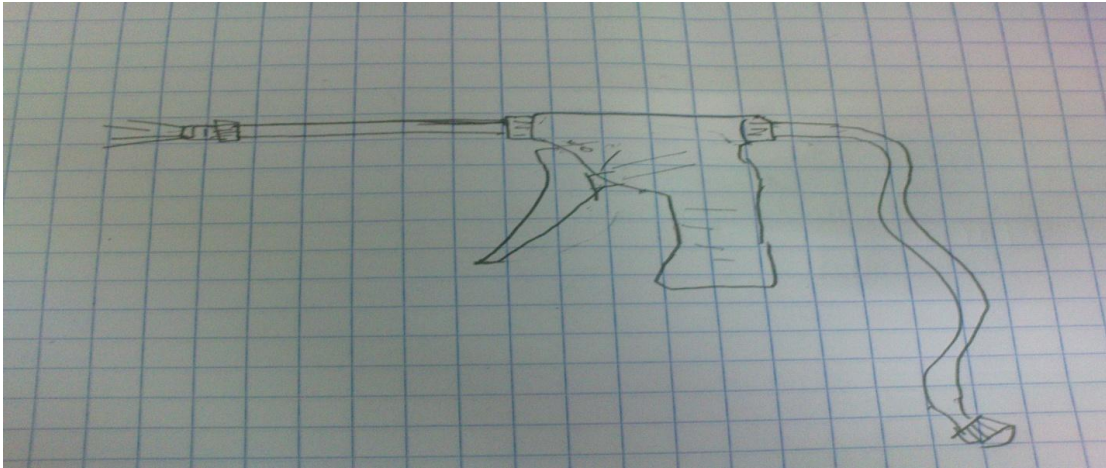
### **3.4 PHASE 2 - DESIGN CONCEPT**

The purpose of this project is to design Micro Spray Nozzle which function is multi-purpose in every spray. It is also should look more efficient than existing product on market. The motivation for this project is to improve the design of the micro spray nozzle with a safety issues. So the new design should have a mechanism which available and secure to use.

It will look more efficient and if people who use it, they could be interested in product because of the design this micro spray nozzle.

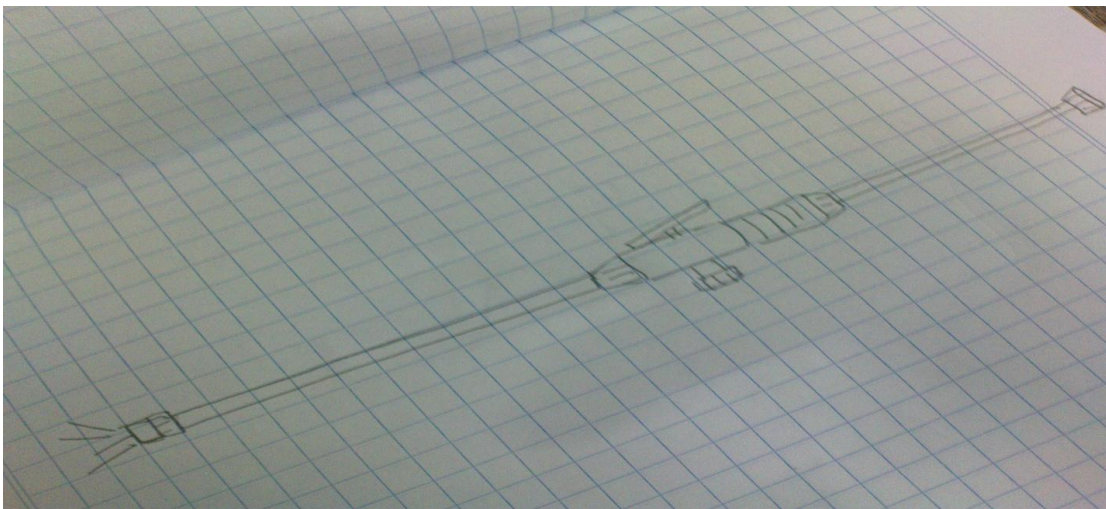
#### **3.4.1 DESIGN CONCEPT 1**

This concept design is use like gun spray. Comfortable when grab the hand hold to spray it.



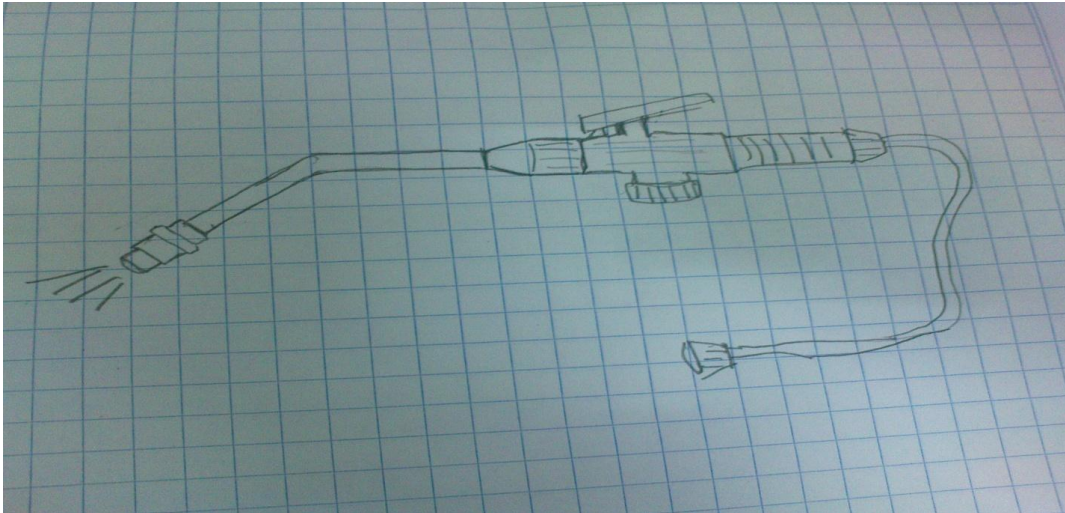
### 3.4.2 DESIGN CONCEPT 2

This concept design is use different spray, not same like concept 1. Use long aluminium rod to connect to the spray.



### 3.4.3 DESIGN CONCEPT 3

This design concept is same like concept 1 and 2. I decide to combined the concept 1 and 2 together but i bend (60 degree) the aluminium rod that connect to nozzle.



### 3.5 PHASE 3 – SELECT FINAL DESIGN

After the design concept, the best design is studied to relate it with criteria selection and then, making the decision which design is the best. For this project, two methods I used to choose the design which are scoring and screening method.

Table 3.2 used to select which criteria is the best.

Table 3.2: Screening and scoring method

Selection Criteria	Concept			
	Example 1	Example 2	Example 3	Reference
Safety	0	-	0	0
Easy to handle	+	-	0	0

Low cost	0	+	-	0
Long life time	0	-	0	0
Light weight	-	0	-	0
Nice design	+	-	+	0
Sum +'s	2	1	1	0
Sum 0's	3	1	3	4
Sum -'s	1	4	2	0
Net score	1	-3	-2	0
Rank	3	2	1	2
Continue?	Yes	No	Revise/Combine	Combine

		Concept					
		Example 1		Example 3 & Reference		Example 3	
Selection Criteria	Weight	Rating	Weighted score	Rating	Weighted score	Rating	Weighted score

Safety	25%	4	1.00	5	1.25	4	1.00
Easy to handle	25%	3	0.75	4	1.00	3	0.75
Low cost	15%	3	0.45	3	0.45	3	0.45
Long life time	10%	3	0.30	3	0.30	3	0.30
Light weight	10%	3	0.30	3	0.30	2	0.20
Nice design	15%	4	0.60	4	0.60	4	0.60
	Total Score		3.40		3.90		3.30
	Rank		2		1		3
	Continue?		No		Yes		No

### 3.6 PHASE 4 – SEARCHING MATERIAL FOR THE PROJECT

For this project, many suggestions that I receive from friends, supervisor and lab instructor and finally I choose several material to fabricate my project which is high sensitivity sensor holder. Table 3.3 show the material that I used to fabricate this project. I choose all these material because of the factor that based on my scoring and screening criteria.

**Table 3.3:** list of material

<b>Part</b>	<b>Material</b>	<b>Dimension (mm)</b>
Nozzle	Brass	-
Round aluminium hollow	Aluminium	Dia.7, length 11
Spray	Plastic	-
Wire hose	Rubber	Dia.7, length 120
Nozzle connector	Brass	-

### 3.7 PHASE 5 – FABRICATION OF THE PRODUCT

Firstly, gather all the material that needs to use such as round aluminium hollow and cut it based on the dimension needed by using cutting grinder. After that i bending that aluminium fo 60 degree.

**Figure 3.4:** round aluminium hollow**Figure 3.5:** nozzle connector



**Figure 3.6:** spray

After finished that, glue the nozzle connector and aluminium hollow together. Then glue aluminium and spray together.



**Figure 3.7:** rubber hose



**Figure 3.8:** nozzle

Lastly, i join all the part together.



**Figure 3.9:** final product

## **CHAPTER 4**

### **RESULT AND DISCUSSION**

#### **4.1 INTRODUCTION**

CHAPTER 4 is the discussion on the result for modification of this project and several problems occur to the project. This chapter also will mainly about the problems encountered during the whole project was been carried out.

#### **4.2 FINAL PRODUCT**



The final product design and final product in several views are shown in the figure 4.1 and figure 4.2

**Figure 4.1:** Drawing final design



**Figure 4.2:** Final product

#### **4.2.1 Component of Final Product**

The component for this product are nozzle, spray, rubber hose, round aluminium hollow and connector nozzle as shown in the figure 4.3



**Figure 4.3:** Component of final product

#### 4.2.2 Function of Final Product Component

Table 4.1 shows the function of every part on the product.

**Table 4.1:** Function of every part

PART	FUNCTION
Nozzle	To make water/air flow in small or bid quantities.
Spray	To control the water/air flow.
Rubber hose	To connect the hose to another connector pump.

---

#### 4.3 HOW TO USE THIS MICRO SPRAY NOZZLE?

First, take this nozzle and connect the wire hose to another connector (pump). Next, hold the spray, then spray it. The nozzle is used to control the water/air flow in small or big quantities.

#### **4.4 PROJECT PROBLEMS**

##### **4.4.1 Literature review**

The concept and ideas review for this project are not very wide because it is not widely modified by the manufacturer. Student should come with their own ideas on this project.

##### **4.4.2 Designing and Sketching**

In the market, there is currently no spray nozzle that light-weight and comfortable when used it. So there are no references the can be referred. All the drawing and dimension need to generate by student itself.

##### **4.4.3 Material Preparation**

In faculty central store there are limited resources on type of material. Therefore, I have to change my first plan which is using many type of material to one type of material only which is aluminium.

#### **4.4.4 Fabrication Process**

Firstly, gather all the material that needs to use such as round aluminium hollow and cut it based on the dimension needed by using cutting grinder. After that i bending that aluminium fo 60 degree. When bending it, i must change the angle first and setting it for 60 degree.

After finished that, glue the nozzle connector and aluminium hollow together. Then, glue aluminium and spray together.

Lastly, i join all the part together. The other part is easy join because it used the thread to join the other connector.

#### **4.5 HOW THIS PROJECT ACHIEVES THE OBJECTIVE AND SOLVES THE PROBLEM STATEMENT?**

The problem statement for this project is there is currently no micro spray nozzle that light-weight, and easy to used. To solve the problem, idea to produce micro spray nozzle efficient look had come. The spray nozzle can be use on water or air pump without any problem.

A several new concept designs were come out to solve the problem. Those new concept designs are create based on the objective. Then, they were comparing to look, which of them could be the final design that will be fabricate.

The user can use it easily will feel this product is very suitable and that means the objective of the product had been achieved.

## **CHAPTER 5**

### **CONCLUSION AND RECOMMENDATION**

#### **5.1 INTRODUCTION**

**CHAPTER 5** is the conclusion and recommendation of this project. In this chapter, it will include the objective of this project is fulfilled and some weakness that need to be improve.

#### **5.2 CONCLUSION**

The project finish and the micro spray nozzle is working properly. The objective of the project is achieved at the end of the design and fabrication.

### 5.3 RECOMMENDATION

The micro spray nozzle has its weakness which will need to be improved to get a better result. First, the design is so simple and it can look better when make the bottle as a tank and join that together with spray nozzle used rubber hose.

### REFERENCES

1. Micro Spray Nozzle, Online, <http://www.alibaba.com/>
2. 7. Bending: Introduction, Online,
3. [http://www.efunda.com/processes/metal\\_processing/bending.cfm](http://www.efunda.com/processes/metal_processing/bending.cfm)
4. <http://www.toolingu.com/class-200140-cutting-processes.html>
5. <http://www.spray.com/>
6. <http://www.rubberhoses.org/>

## APPENDIX A

Task \ Week	Week													
	1	2	3	4	5	6	7	8	9	10	11	12	13	14
Data collection	Yellow	Yellow												
	Green	Green	Green											
Interpreting data		Yellow												
		Green	Green											
Project sketching		Yellow												
			Green	Green										
Project drawing			Yellow	Yellow	Yellow	Yellow	Yellow							
					Green	Green	Green							
Material selection							Yellow	Yellow						
						Green	Green	Green						
Project fabrication								Yellow	Yellow	Yellow	Yellow	Yellow		
									Green	Green				
Project assembly												Yellow		
											Green	Green		
Design testing												Yellow		
												Green		
Finishing												Yellow	Yellow	
													Green	
Slide preparation													Yellow	Yellow
												Green	Green	Green
Report														Yellow
													Green	Green
Planning	Yellow													
Actual	Green													

## APPENDIX B

**UNITS OF MEASUREMENTS:** DIMENSIONS ARE IN MILLIMETERS

**TOLERANCES:** LINEAR: ANGULAR:

**FINISH:**

**DIMENSIONS AND SURFACE FINISH:**

**DO NOT SCALE DRAWING**

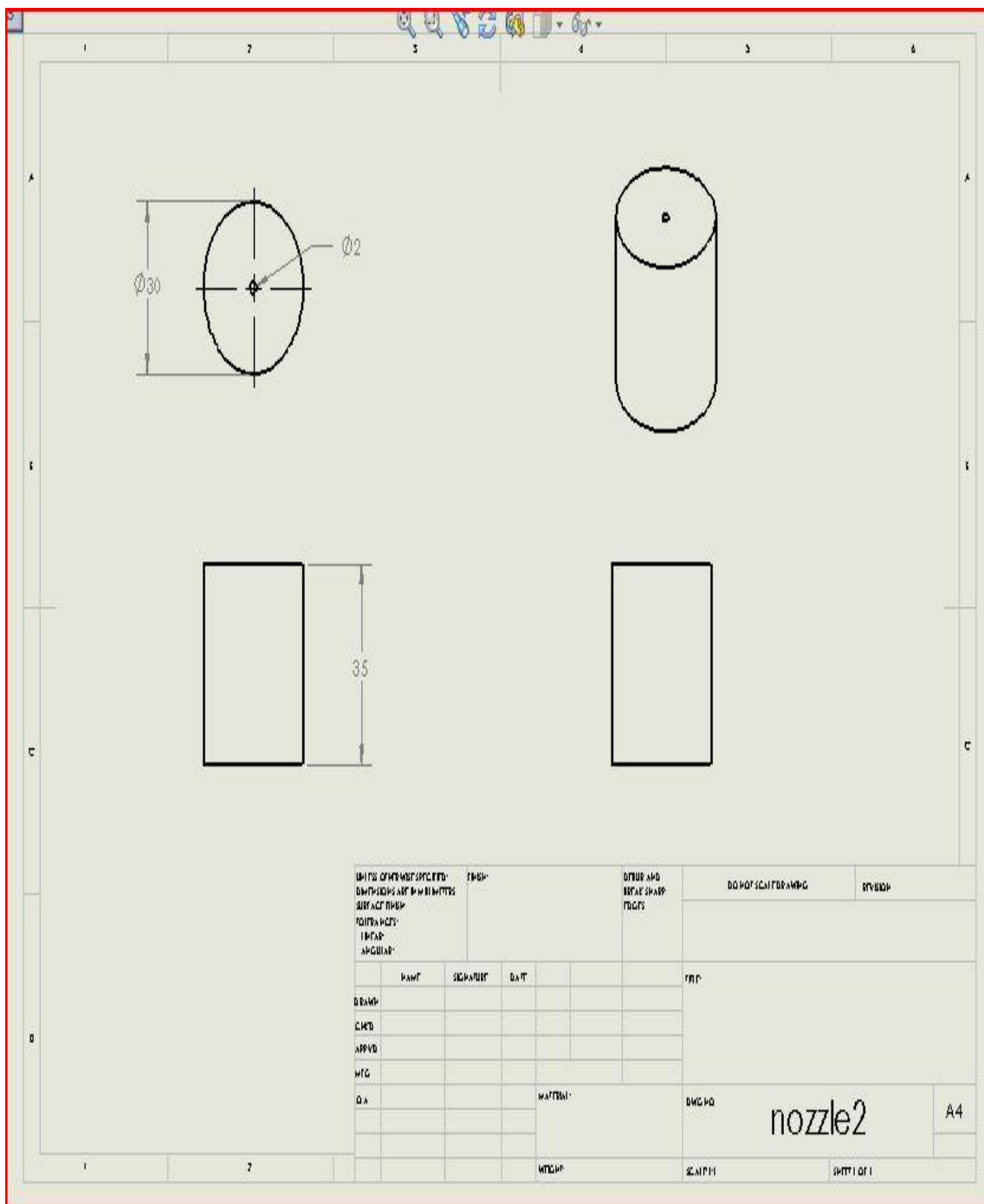
**REVISION:**

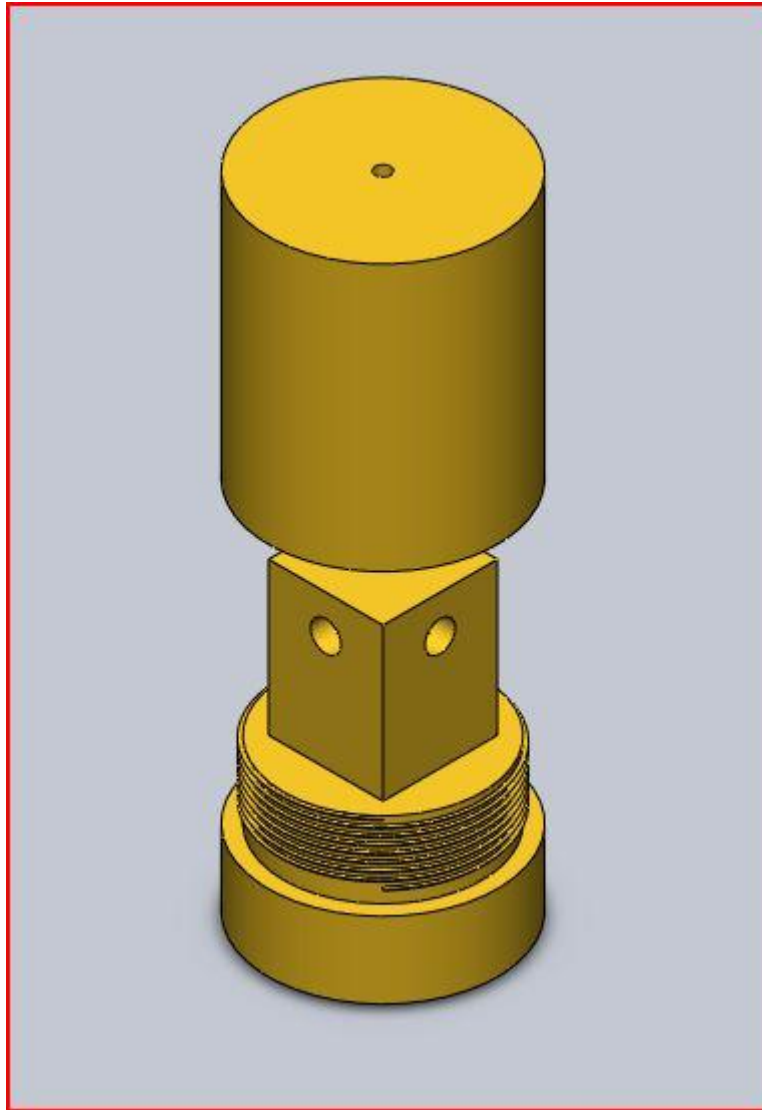
	NAME	SIGNATURE	DATE		TYPE
DESIGN					
CHD					
APPVD					
ENG					
QA				MATERIAL:	ENCL 40
				SCALE:	SHEET 1 OF 1

nozzle

A4







## APPENDIX C



**CUTTING**



**BENDING**

