

DESIGN AND FABRICATE A FLEXIBLE TOILET HOSE WITH
SPOOL

ABDULLAH MUNZIR BIN ZUL SAFARUDDIN

UNIVERSITI MALAYSIA PAHANG

UNIVERSITI MALAYSIA PAHANG

BORANG PENGESAHAN STATUS TESIS ♦

**JUDUL: DESIGN AND FABRICATE FLEXIBLE TOILET HOSE
WITH SPOOL**

SESI PENGAJIAN: 2011/2012

Saya, **ABDULLAH MUNZIR BIN ZUL SAFARUDDIN (910509-08-6525)**
(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)

Alamat Tetap:

**39, Psnr Wira Jaya Barat 34,
Tmn. Ipoh Jaya Timur,
31350 Ipoh, Perak**

Tarikh: **5 JANUARI 2012**

(TANDATANGAN PENYELIA)

AT TASNEEM BT MOHD AMIN
(Nama Penyelia)

Tarikh: **5 JANUARI 2012**

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.

DESIGN AND FABRICATE A FLEXIBLE TOILET HOSE WITH SPOOL

ABDULLAH MUNZIR BIN ZUL SAFARUDDIN

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

Faculty of Mechanical Engineering
UNIVERSITI MALAYSIA PAHANG

JANUARY 2012

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: At-Tasneem binti Mohd Amin

Position: Lecturer

Date: 5th January 2012

STUDENT'S DECLARATION

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

Signature:

Name: Abdullah Munzir bin Zul Safaruddin

ID Number: MB09097

Date: 5th January 2012

ACKNOWLEDGEMENT

Praise to Allah SWT for His guidance and help that I am able to finish the Final Year Project (FYP). I am grateful and am likely to express my gratitude to my supervisor, Miss At-Tasneem binti Mohd Amin for her useful advices and knowledge she shared from the beginning till the completion of this project.

I am also thankful to my beloved father, Zul Safaruddin bin Mat and mother, Azizah binti Ahmad for their help on encouraging me during the project progress. They have given so many supports on this project including financial and spiritual support.

Thousands of thanks to my fellow friends, especially to my classmate on helping and shared their knowledge during this FYP progress. I also would like to thanks people who have help during this FYP progress either directly or indirectly. I sincerely appreciate all of the given helps on this project.

ABSTRACT

This thesis explains the process of designing and fabricating of flexible toilet hose with spool. Firstly, the current toilet hoses are studied. The studies include the design, advantages, disadvantages, materials, and installation. Later, three concepts are suggested to be chosen and concept 3 is selected for further studies which involving three dimensional modelling using SolidWorks 2011 software. During the modelling process, the dimensioning of design product is decided. The fabrication method of flexible toilet hose with spool is later decided. The fabrication of this hose includes the process of shearing, cutting, roll bending, welding, drilling, grinding, filing, and finishing. The fabrication scale is 1:1 finely pilot design. The found out of problems also included. The problems covered from the start till project ends. Lastly, the conclusion of the project is documented and given some recommendation for further studies on the project.

ABSTRAK

Tesis ini menerangkan tentang proses reka bentuk dan pembuatan hos tandas fleksibel dengan kili. Pertamanya, kajian telah dilakukan ke atas hos tandas semasa. Kajian termasuk reka bentuk, kelebihan, kekurangan, bahan-bahan, dan pemasangan. Seterusnya, tiga konsep telah dicadangkannya untuk pemilihan dan konsep 3 telah dipilih untuk lanjutan kajian yang melibatkan pemodelan tiga dimensi menggunakan perisian SolidWorks 2011. Semasa proses pemodelan, dimensi reka bentuk produk telah ditetapkan. Kaedah pembuatan hos tandas fleksibel dengan kili kemudian diputuskan. Fabrikasi hos ini termasuk proses shear, pemotongan, lenturan membulat, kimpalan, penggerudian, pengisaran, pemfailan, dan kemas. Skala pembuatan berdasarkan produk akhir ialah 1:1. Masalah yang berlaku semasa perjalananan projek juga dinyatakan. Masalah-masalah yang dibincangkan adalah perkara yang berlaku dari awal hingga hujung projek. Akhir sekali, kesimpulan projek didokumenkan dan diberikan beberapa cadangan untuk lanjutan kajian atas projek tersebut.

TABLE OF CONTENTS

	Page
SUPERVISOR’S DECLARATION	ii
STUDENT DECLARATION	iii
ACKNOWLEDGEMENT	iv
ABSTRACT	v
ABSTRAK	vi
TABLE OF CONTENTS	vii
LIST OF TABLES	ix
LIST OF FIGURES	x
LIST OF ABBREVIATIONS	xi
CHAPTER 1 INTRODUCTION	
1.1 Background of Project	1
1.2 Problem Statement	1
1.3 Objective	2
1.4 Scopes	2
1.5 Gantt Chart	3
CHAPTER 2 LITERATURE REVIEW	
2.1 Introduction	4
2.2 Types of Toilet Hose	4
2.2.1 Rubber Toilet Hose	5
2.2.2 Flexible Toilet Hose	6
CHAPTER 3 METHODOLOGY	
3.1 Introduction	7
3.2 Flow Chart	8

3.3	Concept Selection	11
	3.3.1 Concept 1	11
	3.3.2 Concept 2	12
	3.3.3 Concept 3	12
	3.3.4 Concept Screening	13
3.4	Designation Method	13
3.5	Fabrication Method	14
	3.5.1 Material Selection	14
	3.5.2 Shearing	14
	3.5.3 Cutting	15
	3.5.4 Roll Bending	16
	3.5.5 Welding	16
	3.5.6 Drilling	17
	3.5.7 Grinding	18
	3.5.8 Filing	19
	3.5.9 Finishing	20
CHAPTER 4 RESULT AND DISCUSSION		
4.1	Introduction	22
4.2	Final Product Design	22
4.3	Final Product	24
4.4	Discussion	25
	4.4.1 Literature Review	25
	4.4.2 Material Preparation	25
	4.4.3 Designation Process	26
	4.4.4 Fabrication Process	26
	4.4.5 Material Wastage	26
CHAPTER 5 CONCLUSION AND RECOMMENDATION		27
REFERENCES		28
APPENDIX		
A	SolidWorks parts drawing with dimensioning	29

LIST OF TABLE

Table No.		Page
1.1	Gantt Chart	3
3.1	Concept Screening	13
3.2	List of Materials	14

LIST OF FIGURES

Figure No.		Page
2.1	Rubber toilet hose	5
2.2	Flexible toilet hose	6
3.1	Project flow chart	8
3.2	Concept 1	11
3.3	Gardening hose	11
3.4	Concept 2	12
3.5	Concept 3	12
3.6	Shear machine	15
3.7	Cutting sheet metal using hand saw	15
3.8	Roll bending process	16
3.9	MIG welding machine	17
3.10	Drilling using drill press	18
3.11	Cutting grinder	19
3.12	Filing tools (From left: Triangular bastard, flat bastard, and round smooth)	20
3.13	Spray paint can	21
4.1	CAD drawing using SolidWorks 2011 Software	22
4.2	Orthographic view of project design using SolidWorks 2011	23
4.3	Exploded view of project design using SolidWorks 2011	23
4.4	Front view of fabricated product	24
4.5	Side view of fabricated product	24
4.6	Top view of fabricated product	25

LIST OF ABBREVIATIONS

FYP	Final Year Project
CAD	Computer Aided Design
PVC	Polyvinyl chloride
D	Diameter
R	Radius
BD	Bore diameter
OD	Outer diameter
MIG	Metal inert gas

CHAPTER 1

INTRODUCTION

1.1 Background Of Project

There are many types of hose use in the entire world. Some is used for toilet purpose, gardening purpose, emergency purpose (fire hydrant), and etc. The hose is used to elongate the water ways by transferring the water from pipe to the end of hose through the length hose.

The hose have experienced some improvement in design and function. The improvement is done by manufacturers in order to compete with others to ensure their product is more advanced to get the market domination. The new ideas is depends on the hose design and function place of use.

For toilet purpose, the things that need critically to be considered are space. Toilet hose is designed to ease people whether for the body cleanliness or for the toilet cleaning purpose. Toilet hose should be easier to be found and easy to be managed. Public toilet owner faced the problem with the storing of the hose.

1.2 Problem Statement

There is currently no flexible toilet hose design available in the market. Therefore, new designs of toilet hose that can roll around the spool are needed to ease people when using toilet hose.

1.3 Objectives

The objectives of this project are to design and fabricate a flexible toilet hose with spool that fit in a narrow toilet.

1.4 Scope

The project scope is as followed:

- (i) This project is focused on designing and fabricating a flexible toilet hose with spool.
- (ii) The hose is made up of PVC.
- (iii) The hose is 1.2m rubber hose in length.
- (iv) The hose is suitable for narrow space toilet.
- (v) The design is suitable for Western and Asian toilet.

CHAPTER 2

LITERATURE REVIEW

2.1 INTRODUCTION

This chapter investigates different types of toilet hoses design that currently available at the market. Each toilet hose have different design, specification, and specialty, but the function is same, to help in cleaning purpose.

2.2 TYPES OF TOILET HOSE

There are two types of toilet hose present in the market and been common to be used by people. These toilet hose are rubber toilet hose and flexible toilet hose. The descriptions on the toilet hose on materials, advantages and disadvantages are as follow.

2.2.1 Rubber Toilet Hose



Figure 2.1: Rubber toilet hose

Source: Google image

Figure 2.1 shows the picture of rubber toilet hose. This hose is made up of thin rubber and widely used in domestic nowadays. The hose is made up of any or combination of many different materials. These materials are commonly nylon, polyurethane, polyethylene, PVC, or synthetic or natural rubber. The material selection is chosen based on environment condition and pressure.

The advantages of using this type of hose is it is cheap in term of price, easily to fix and remove from tap and oneself determined length which the hose can be cut off easily.

The disadvantages of using this type of hose are it can leaked and decayed after a long period of usage; the hose is loose easily from water tap if no clamp applied; water unable to run through if the hose is folded and the hose cannot control the water flow.

The hose does not have holder to hold the hose when not in use. The hose is either stored manually after each use or being left alone in the toilet.

2.2.2 Flexible Toilet Hose



Figure 2.2: Flexible toilet hose

Source: Google image

Figure 2.2 shows the flexible toilet hose. This hose is in common use in public toilet (but with no head connected) and domestic toilet. The hose can be bought in general store and hardware with a range of length from 1m to 1.5m each. The rubber hose inside is made up of the same material as in rubber toilet hose. The hose is covered by braided stainless steel, brass, and aluminium.

The advantages of using this flexible hose is it are higher tenacity than the rubber hose, longer lasting and the hose is able to control the water flow. The hose also have holder hence, the hose is systematically stored. The hose also not easily leaked due to the braided cover. The hose is also thick.

The disadvantage of the flexible hose is the price is slightly higher than the common rubber hose. The hose also cannot be attached the water tap. The hose storage also depends on human behaviour either to put back the hose to its holder or not.

CHAPTER 3

METHODOLOGY

3.1 INTRODUCTION

Chapter 3 will covers process in methodology throughout this project designation and fabrication progress. The content in this chapter includes project flow chart, concept selection among 3 concepts designed, and designation of project using SolidWorks 2011 software and fabrication process including shearing, cutting, roll bending, welding, drilling, grinding, and filing.

3.2 FLOW CHART

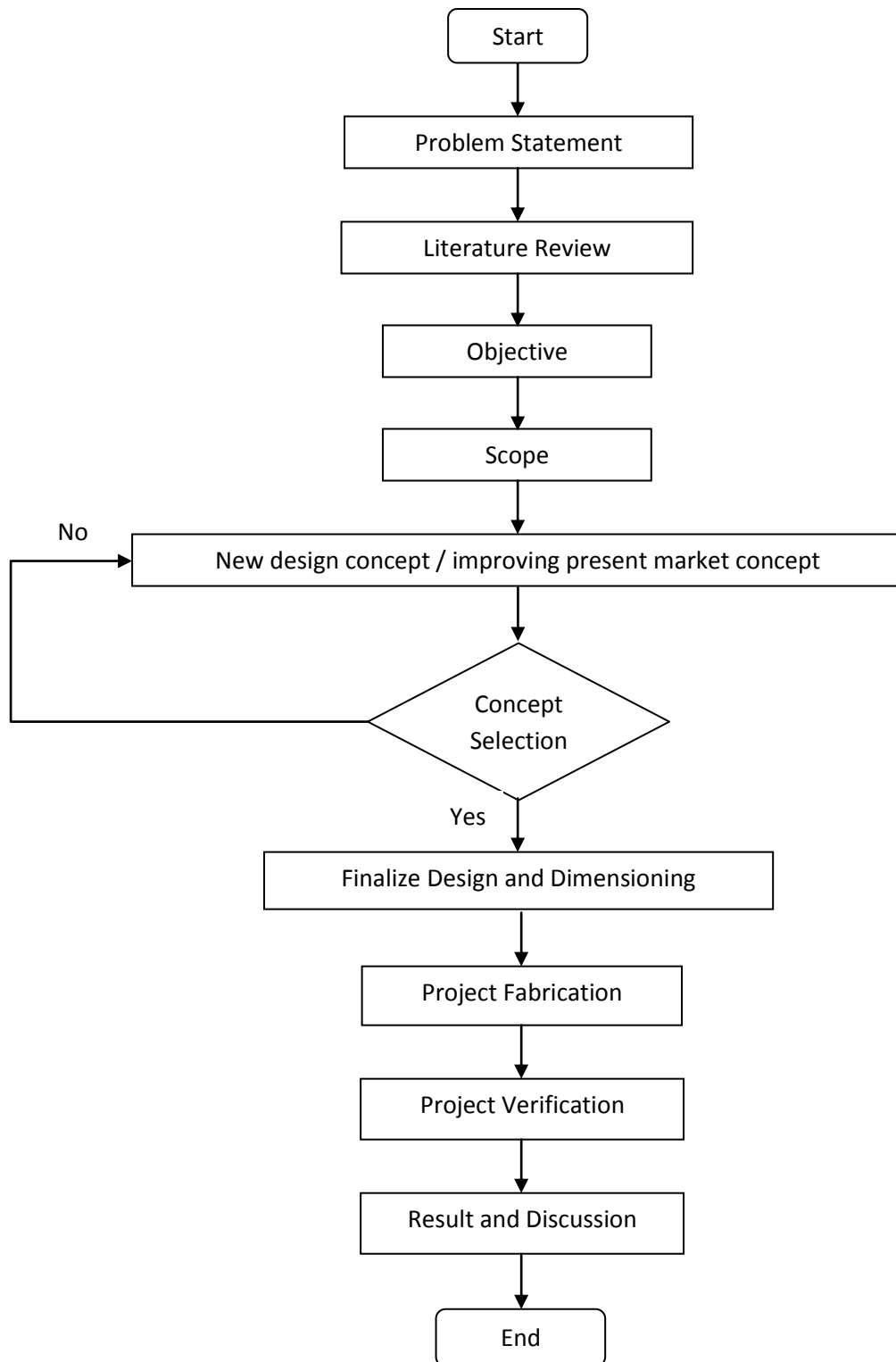


Figure 3.1: Project flow chart

The project starts problem statement. Problem statement is important to identify the waypoint of this project. Literature review is focus on the project background. This part covers about the existing product in current market and their specifications. Project objective is then identified. Project objective is the step what to achieve throughout the project.

The next step will continue with identifying the project scope. Project scope is the boundaries of research or project. This scope will helps in designing project and during the fabrication process. The scope will control the range of the project.

Next step is either generating new ideas or concepts; or improve present market product. Later, the new concept is chosen by analyzing each concept which includes concept screening. These steps will help in concept selection by comparing the concepts in criteria to be compared to.

If the concept fulfil each criteria and have better score compared to the reference product, then the concept is proceed to the next step which is finalizing the design and dimensioning. If no then new ideas on concept should be recreate and another analysis will be done.

Finalizing the design is done by designing using Computer Aided Design (CAD) software and dimensioning of each component in new product. Dimensioning should be clear and include all of the parts in the product.

Project fabrication is a step where the product is fabricates and finish completely. This step is the most critical part which determined whether the product is considered done or undone. Fabrication process includes shearing, cutting, roll bending, welding, drilling, grinding, filing and finishing.

Project verification is the final step of fabrication. In this step, the product is tested and evaluate. The product is tested to ensure it fulfil the characteristic that stated in concept selection. Evaluation process is to determine whether the product have achieved the characteristic in concept designed earlier.

The last step is result and discussion. Result of the project is the final product that has been produced. Discussion of project is about the material of product whether the material is suitable to be used for the product for selling purpose and other improvement that should be done to the end product.

3.3 CONCEPT SELECTION

For concept selection, there are 3 concepts to be compared and selected. The best among these 3 sketches will be chosen, design using software and fabricate.

3.3.1 Concept 1

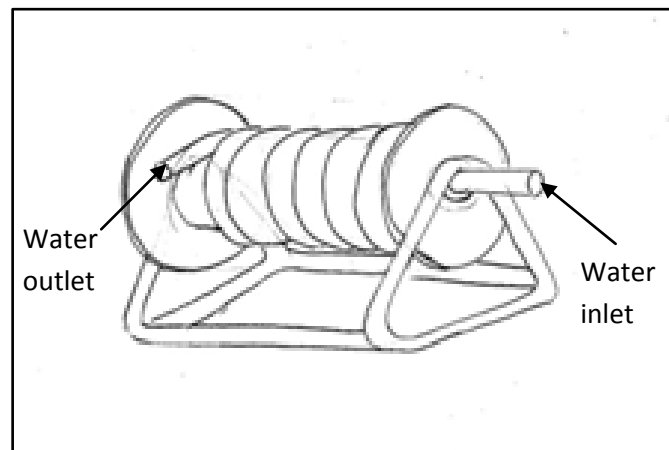


Figure 3.2: Concept 1



Figure 3.3: Gardening hose

Source: www.shutterstock.com

Idea of concept 1 is generated from spool gardening hose. The hose can roll around the spool easily. The hose is mobile.

3.3.2 Concept 2

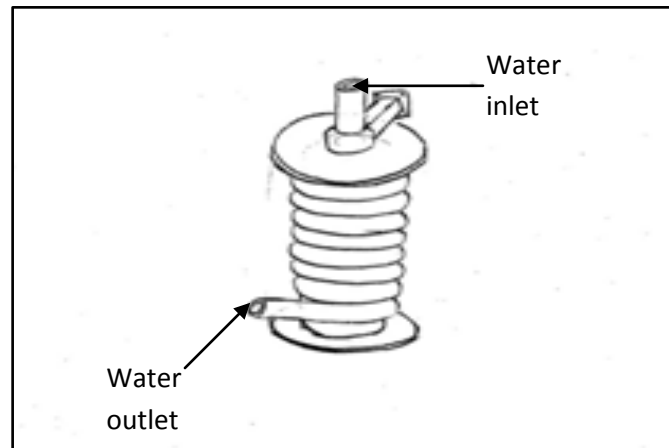


Figure 3.4: Concept 2

Concept 2 is fixing to the wall. This hose roll around the spool. The hose is not mobile.

3.3.3 Concept 3

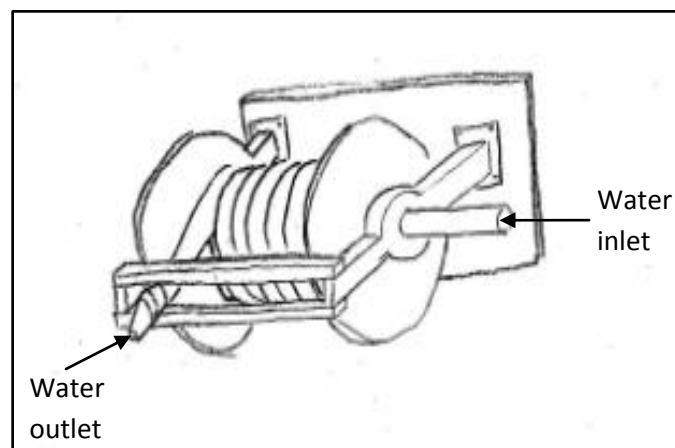


Figure 3.5: Concept 3

Concept 3 also fix to the wall. The hose can roll around the spool. The hose is not mobile and have stopper to hold the hose tip.

3.3.4 Concept Screening

Concept screening is the narrow the number of concepts and determining the selection criteria to be compared. Table 3.1 shows the concept screening compared to flexible toilet hose (as a datum).

Table 3.1: Concept Screening

Selection Criteria	Concepts		
	1	2	3
Spool	+	+	+
Size	-	-	+
Ease of use	+	+	+
Safety	+	+	+
Ease of manufacture	-	-	-
Sum +’s	3	3	4
Sum 0’s	0	0	0
Sum –’s	2	2	1
Net Score	1	1	3
Rank	2	2	1
Continue?	No	No	Yes

From Table 3.1, we can choose between these concepts which have good criteria. Concept 1 is not chosen due to the size of the hose which cannot fit the narrow space toilet. Concept 2 has bigger size but it fix to the wall. Concept 3 is the best concept to be chosen and need some custom modification.

3.4 DESIGNATION METHOD

For designing the project, SolidWorks 2011 software is used to design flexible toilet hose with spool which is SolidWorks 2011. This software has helps in designing 3D drawing and dimensioning of each part of the product.

3.5 FABRICATION METHOD

3.5.1 Material Selection

In this project, mild steel metal sheet is used as the material for the spool, PVC for the pipe, and hollow bar. Table 3.2 shows the parts, material for the respective parts and their dimensions.

Table 3.2: List of materials

Part	Material	Dimension (mm)
Cylinder spool	Mild Steel	D: 100 x 120 x 1
Round side plate	Mild Steel	150 x 150 x 1
Right pipe	Mild Steel	R10.75 x 1
Left pipe	Mild Steel	R10.75 x 1
Bearing	Stainless Steel	BD: 22 OD: 44
Flexible toilet hose	PVC	D: 10 Length: 1200
Pipe connector (straight)	PVC	D: 24 Length: 45
Pipe connector (L-shaped)	PVC	D: 24
Front Panel	Galvanized Iron	250 x 10 x 10
Front Side Panel	Galvanized Iron	90 x 10 x 10
Back Side Panel	Galvanized Iron	80 x 10 x 10
Back Panel	Mild Steel	300 x 150 x 1

3.5.2 Shearing

Shearing is a metal fabricating process used to cut metal material. Shearing process is done by using shear machine which is available in FKM laboratory. Shearing process is applied to cut sheet metal.



Figure 3.6: Shear machine

Source: www.made-in-china.com

3.5.3 Cutting

Cutting process is a process to separate a material into two portions through an application of an acutely directed force. Cutting process is done using hand saw and vertical band saw.



Figure 3.7: Cutting sheet metal using hand saw.

3.5.4 Roll Bending

Bending is a metal working process that leads to metal forming process on metal. The bended metal will experienced plastic deformation which cannot be roll back. In roll bending, the end product of the process will be in cylindrical shape; whether in full round shape or semi-round shape.

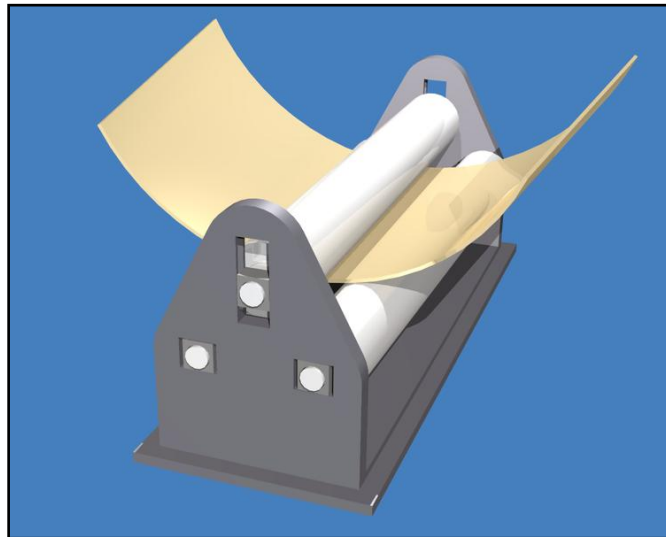


Figure 3.8: Roll bending process.

Source: <http://upload.wikimedia.org/wikipedia/commons/c/cc/Rundwalzen.png>

3.5.5 Welding

Welding is a fabrication method to join materials. This is often done by melting the workpieces and adding a filler material to form a pool of molten material that cools to become a strong joint. Welding process involve melting a lower-melting-point material between the workpieces to form a bond between them, without melting the workpieces. Welding type used for this project is MIG welding.



Figure 3.9: MIG welding machine.

Source: <http://www.modularparts.com/ELECTRONICS-/New-millermatic-252-951066-mig-welder-with-30A-spoolgun-displayImage.jpg>

3.5.6 Drilling

Drilling is a process of making holes on the workpiece. Drilling process can be done using hand drill and drill press depending on suitability. Drill points come in different sizes that allow us to drill the workpiece using different drill points for different sizes. Drill press is used to make hole on the workpiece.



Figure 3.10: Drilling using drill press.

3.5.7 Grinding

Grinding is an abrasive machining process that uses grinding wheels as the cutting tool. The end product has very fine finishes and accurate dimension. Grinding is suitable to cut hollow bars in rapid. Grinding process involves the use of cutting grinder and angle grinder.



Figure 3.11: Cutting grinder

Source: <http://gandhiappliances.com/images/BOSCH-GCO14-2enl.jpg>

3.5.8 Filing

Filing is also known as deburring process is a material removal process in metalworking. Filing process is suitable for finishing process and can be applied to wide range of materials. Filing helps to achieve workpiece function by removing some excess material and deburring the surface. Files used for the operation are flat bastard, flat smooth, round second out, and round smooth.



Figure 3.12: Filing tools (From left: Triangular bastard, flat bastard, and round smooth)

Source: <http://www.execulink.com/~lfoord/100032a.jpg>

3.5.9 Finishing

Finishing process is the final process of fabrication. During finishing process, the fabricated product is sprayed to make the product more attractive. The spray paint used is Kangaroo Acrylic Spray Paint. The colour type is 68 silver. The spray is done twice. The first spray round is to coat the product with silver colour, and the second spray round is to finish up the product with silver colour overall.



Figure 3.13: Spray paint can

CHAPTER 4

RESULT AND DISCUSSION

4.1 INTRODUCTION

This chapter will covers about the result of this project. The result of project includes final CAD design, final product, and discussion about flexible toilet hose with spool project. Discussion will focused on the problem occurred during this project is held.

4.2 FINAL PRODUCT DESIGN

The final toilet hose design in CAD drawing and orthographic view are shown in Figure 4.1 and Figure 4.2 respectively.

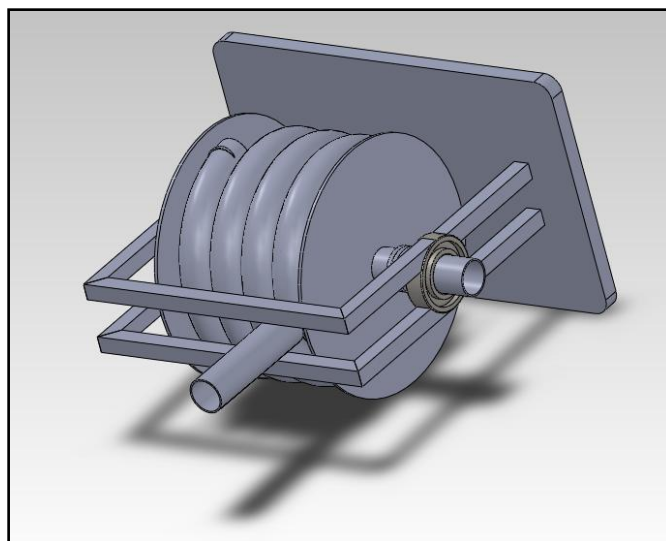


Figure 4.1: CAD drawing using SolidWorks 2011 Software.

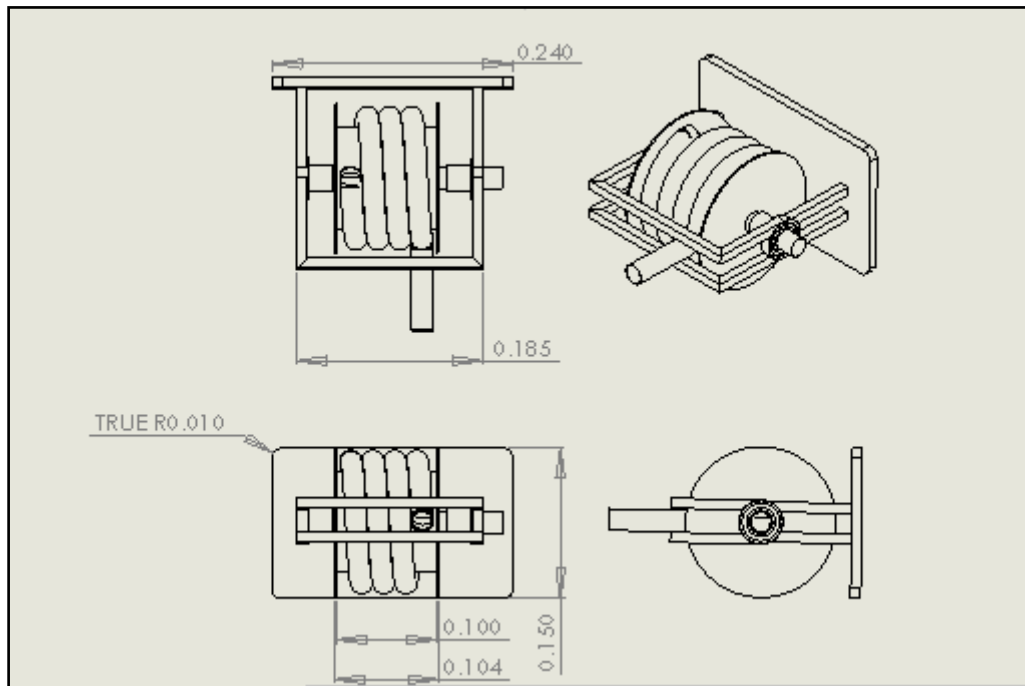


Figure 4.2: Orthographic view of project design using SolidWorks 2011.

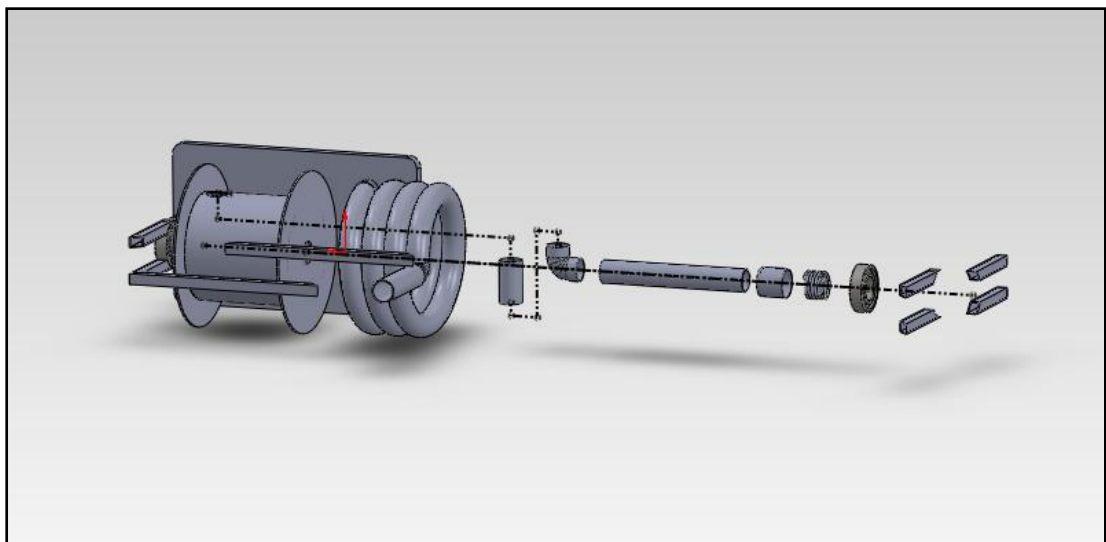


Figure 4.3: Exploded view of project design using SolidWorks 2011.

4.3 FINAL PRODUCT

The following figures show the final product that fabricated.

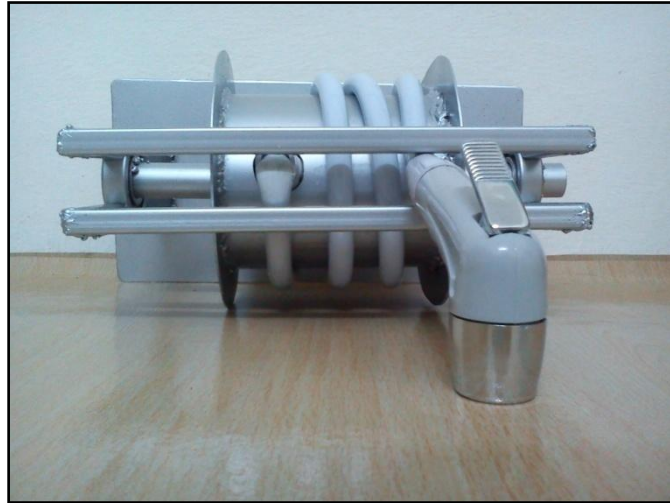


Figure 4.4: Front view of fabricated product.

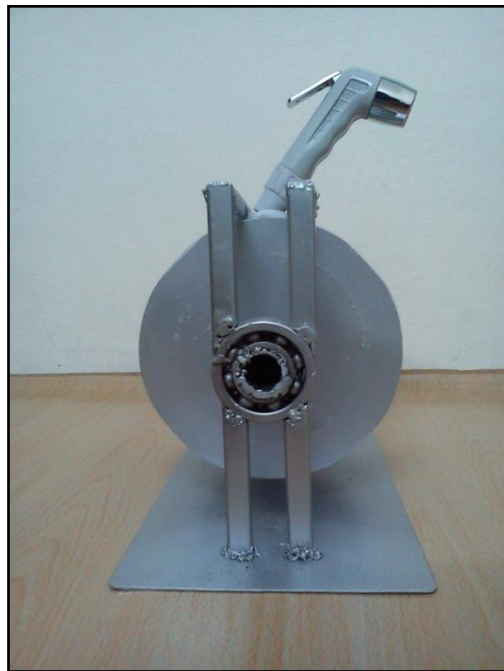


Figure 4.5: Side view of fabricated product.

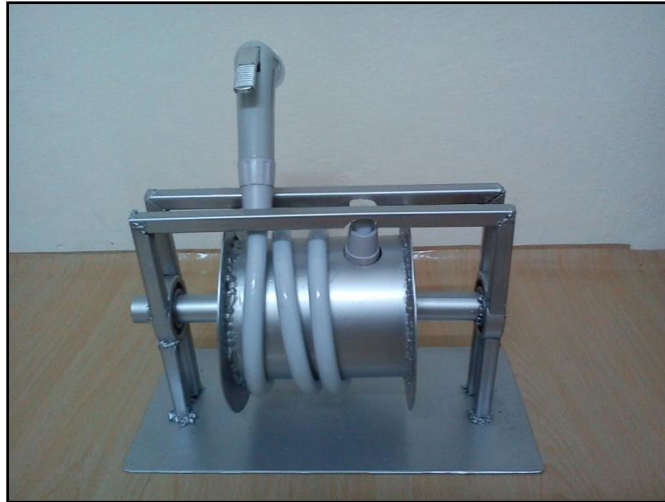


Figure 4.6: Top view of fabricated product.

4.4 DISCUSSION

The following information show about problem occurred during the period of this project progress:

4.4.1 Literature Review

The project's literature review is not very wide due to the number of toilet hose available in the market. Toilet hoses that are currently in the market are only rubber toilet hose and flexible toilet hose. So, the comparing and generating ideas process is limited.

4.4.2 Material Preparation

Flexible toilet hose obtained is large in diameter size. Hence, the hose cannot be attached to the fabricated spool and frame. Thus, the solution is buying hose with smaller diameter which is 10mm diameter.

4.4.3 Designation Process

During designing the hose, problem occurred when drawing the pipe. The pipe design is not smooth and has some defects. The problem happens due to the lack of skills and experiences in using SolidWorks 2011 CAD software.

4.4.4 Fabrication Process

During assembly process, the hose location is no longer suitable due to the type of hose use. The location of hose connector should be inside the spool, not on the surface of spool.

The welding process is not beautifully finished. The welded parts also not strongly bonded due to tap welding process applied to the parts. This is due to lack of experienced and skill of welding.

The actual dimension of product is different from the product design due to the preparation of flexible toilet hose. The dimension of current product is based on 15mm diameter flexible toilet hose with approximate 1.2m length.

4.4.5 Material Wastage

After the fabrication process, material wastage happened to the spool. The spool dimension is based on the 15mm diameter hose with 1.5m length. The available hose for the project is 10mm diameter with 1.2m length. To overcome the problem, it is either to add the length of hose or reduced the width of spool to avoid material wastage.

The length of mild steel pipe on each side required is shorter than the fabricated one. This is due to the initial project planning to attach spring on each side of the spool. But, the plan cannot be stick due to the absentees of spring which cannot be obtained from local hardware store.

CHAPTER 5

CONCLUSION AND RECOMMENDATION

As a conclusion, the objective to design the flexible toilet hose with spool is achieved. The toilet hose is successfully design by using CAD software. The second objective which to fabricate a flexible toilet hose with spool is also achieved.

The following are recommendations on current project that should be repaired to improve the project:

- (i) Material used for this project is mild steel. Aluminium alloy is a better metal to be replaced with mild steel due to its properties that will not corrode and strong enough for this purpose. Aluminium alloy is lighter than mild steel.
- (ii) The retractable mechanism in this hose should design. Retractable mechanism in measuring tape is possible to be attached to the design.
- (iii) To smooth the movement of the hose, the stopper should be in round shape not in square shape as fabricated or use roller as the stopper.
- (iv) The gap between stopper and the spool needs to be wider to ensure the hose movement is smooth. To complete this task, the length of square bar needs to be longer than fabricated
- (v) The flexible toilet hose material which is PVC is not recommended and should be replace with other material that have more flexibility and milder to fit with the spool shape.

REFERENCES

Karl T. Ulrich and Steven D. Eppinger. 2008. *Product Design and Development*.
New York: Mc Graw. Hill International Edition

Hose (Tubing). http://en.wikipedia.org/wiki/Hose_%28tubing%29

Toilet Flexible Hose. <http://www.alibaba.com/showroom/toilet-flexible-hose.html>

Metal Fabrication. Shearing Metals Processes.

<http://www.advantagefabricatedmetals.com/shearing-process.html>

Bending (Metalworking). Roll Bending.

http://en.wikipedia.org/wiki/Bending_%28metalworking%29#Roll_bending

Grinding (Abrasive Cutting).

http://en.wikipedia.org/wiki/Grinding_%28abrasive_cutting%29

Filing (Metalworking). http://en.wikipedia.org/wiki/Filing_%28metalworking%29

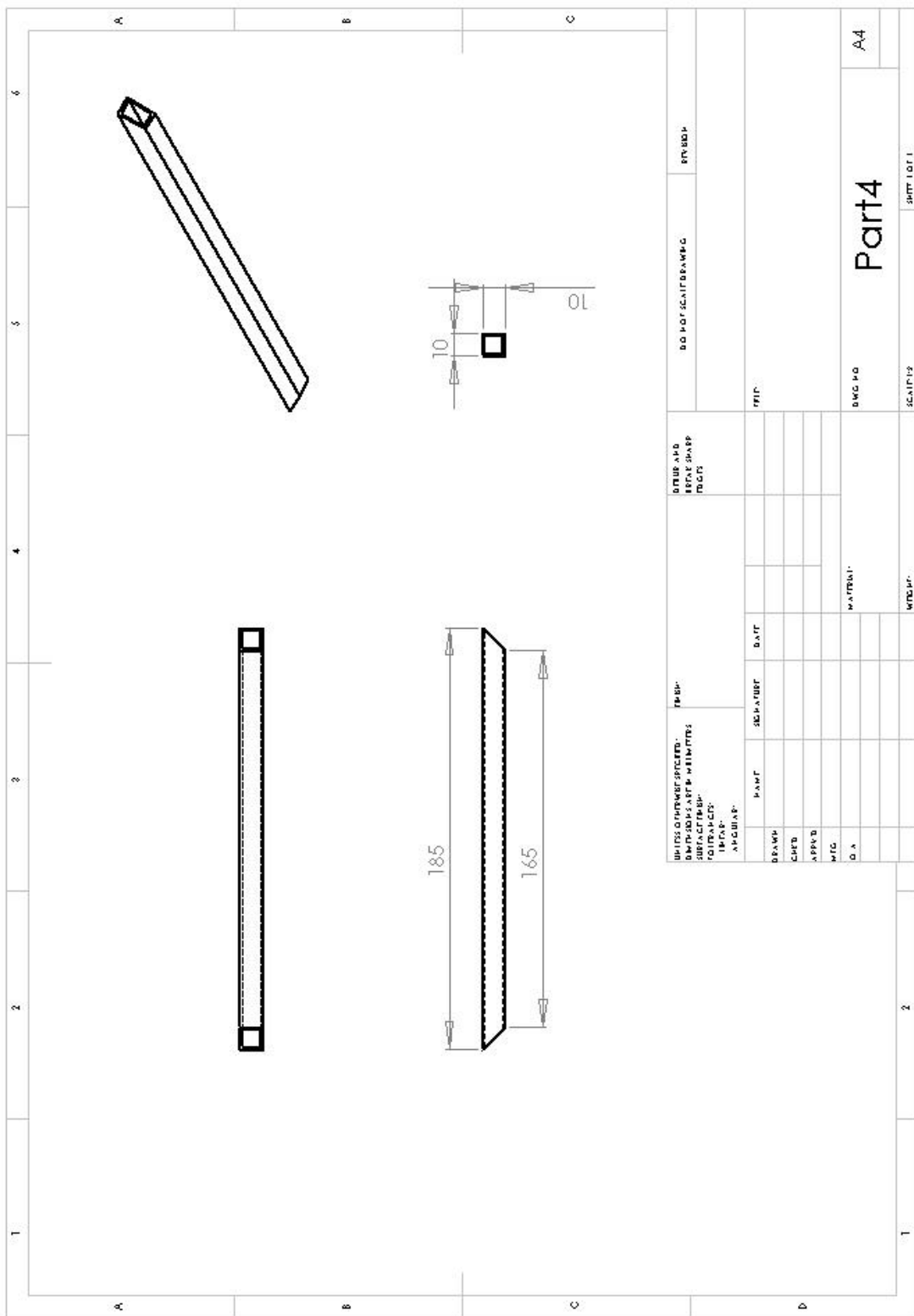
File (Tool). http://en.wikipedia.org/wiki/File_%28tool%29

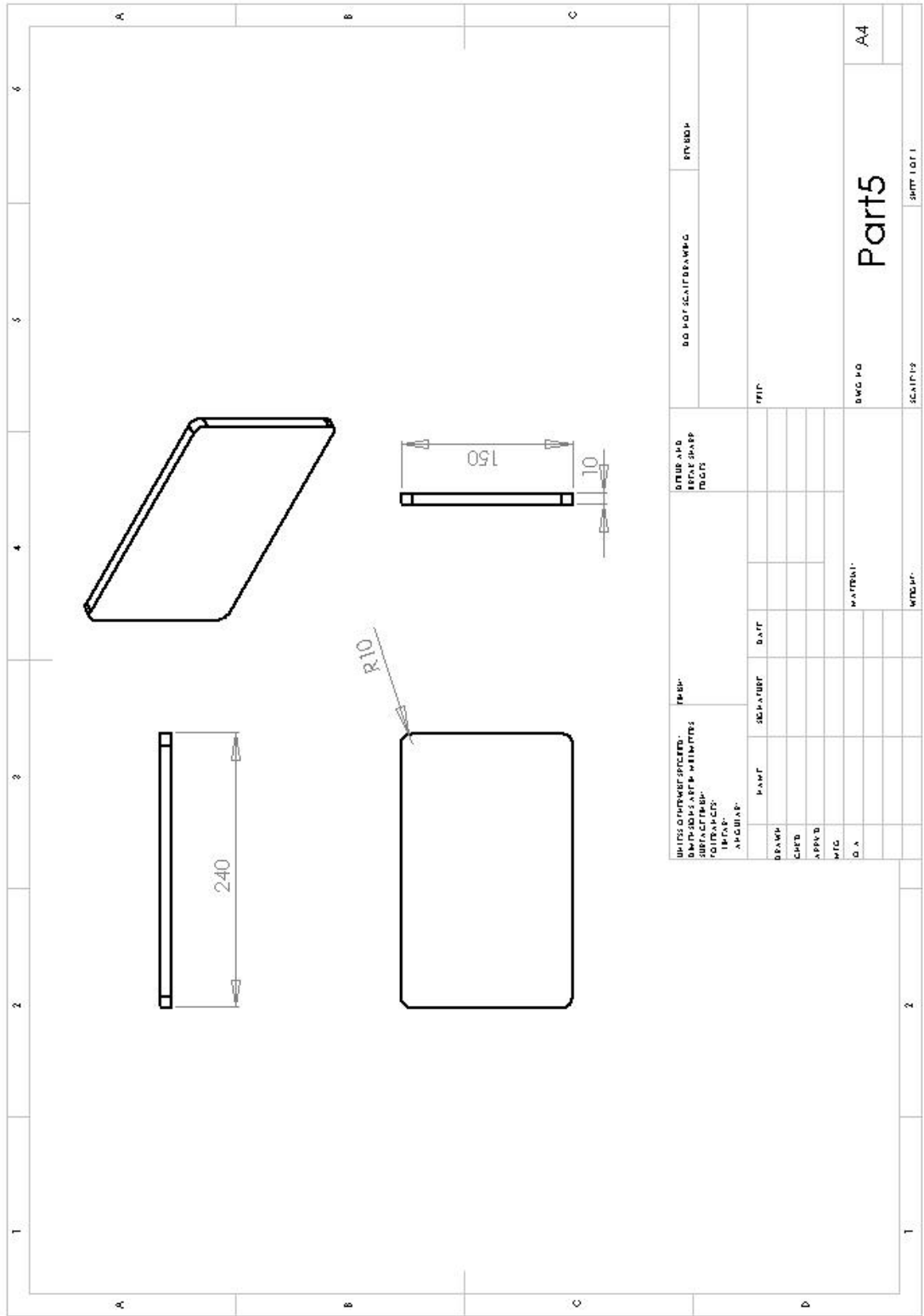
Welding. <http://en.wikipedia.org/wiki/Welding>

Cutting. <http://en.wikipedia.org/wiki/Cutting>

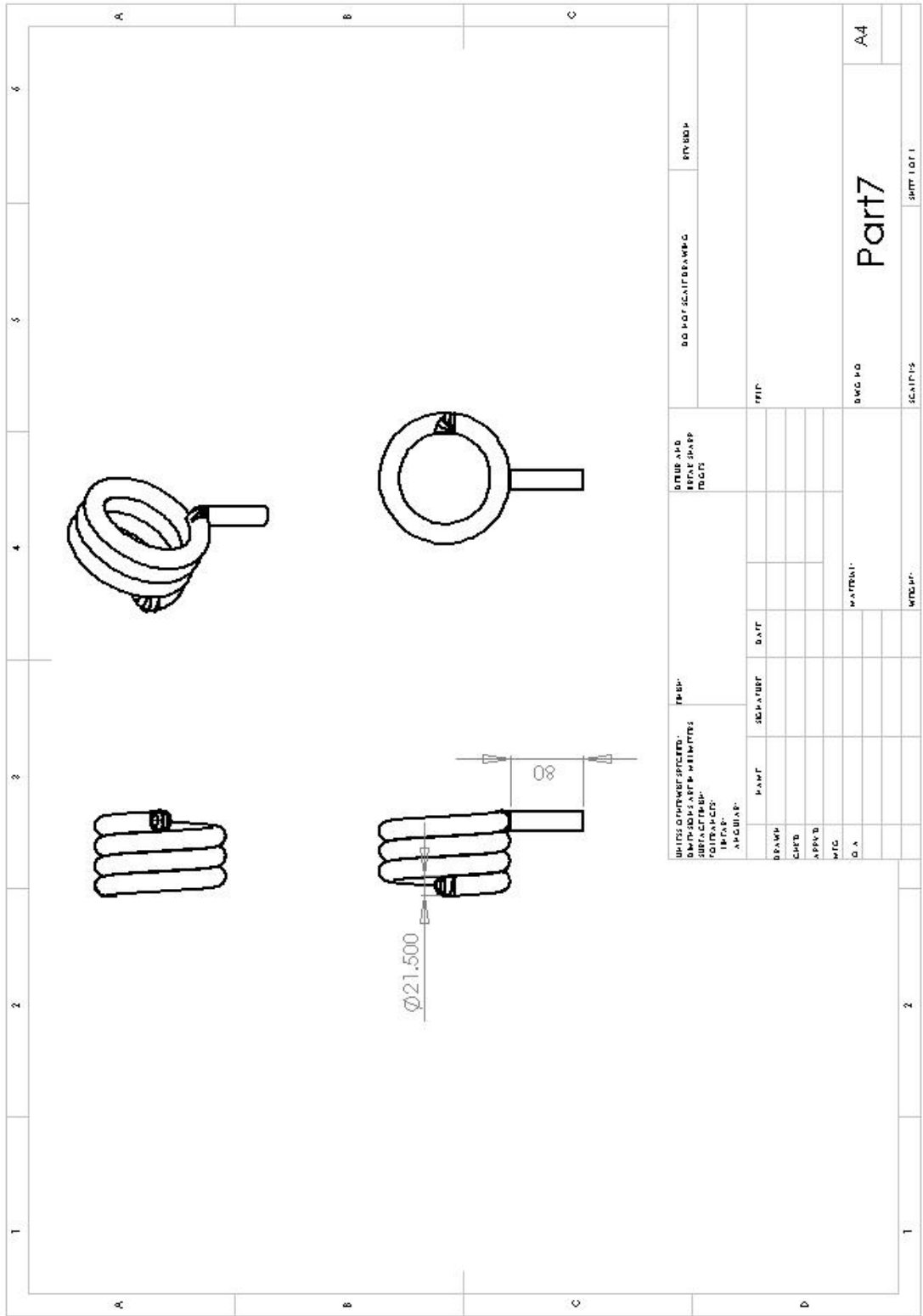
APPENDIX A

Appendix A shows about the SolidWorks parts drawing and their respective dimension. The parts that involved for the design is consist of 14 parts.





ШИТЪТ О ПРЪВЕТО СПЕЦИЕЛНО ВЪВЕЖДАЩЕТО НАИМЕНОВАНИЕ НА ЧАСТА ТИТЪЛЪТ АКСИОНАЛНО		ТИТУЛ НА ЧАСТА ДАТА		ДРУГО НАИМЕНОВАНИЕ НА ЧАСТА		ПРЪВЕТО	
ДЪЛЖИНА ШИРИНА ВЕС МАТЕРИАЛ	ДЪЛЖИНА ШИРИНА ВЕС МАТЕРИАЛ	ДЪЛЖИНА ШИРИНА ВЕС МАТЕРИАЛ	ДЪЛЖИНА ШИРИНА ВЕС МАТЕРИАЛ	ДЪЛЖИНА ШИРИНА ВЕС МАТЕРИАЛ	ДЪЛЖИНА ШИРИНА ВЕС МАТЕРИАЛ	ДЪЛЖИНА ШИРИНА ВЕС МАТЕРИАЛ	ДЪЛЖИНА ШИРИНА ВЕС МАТЕРИАЛ
				ЧАСТ Part5			
				МАТЕРИАЛ А4			
				ДЪЛЖИНА ШИРИНА ВЕС МАТЕРИАЛ			



ИМЯ ОТВЕТСТВЕННОГО ИМПЛЕКАТОРА ИЛИ ИМЕНИ КОМПАНИИ ИЛИ АНГЛИЙСКОЕ		ТИП СЕРИАЛ ДАТА		ДРУГОЕ ИЛИ ИЛИ ИЛИ ИЛИ		ДРУГОЕ ИЛИ ИЛИ ИЛИ ИЛИ	
ДИАМЕТР ДИАМЕТР ДИАМЕТР ДИАМЕТР	ДИАМЕТР ДИАМЕТР ДИАМЕТР ДИАМЕТР	ДИАМЕТР ДИАМЕТР ДИАМЕТР ДИАМЕТР	ДИАМЕТР ДИАМЕТР ДИАМЕТР ДИАМЕТР	ДИАМЕТР ДИАМЕТР ДИАМЕТР ДИАМЕТР	ДИАМЕТР ДИАМЕТР ДИАМЕТР ДИАМЕТР	ДИАМЕТР ДИАМЕТР ДИАМЕТР ДИАМЕТР	ДИАМЕТР ДИАМЕТР ДИАМЕТР ДИАМЕТР
МАТЕРИАЛ				ДИАМЕТР		ДИАМЕТР	
ДИАМЕТР				ДИАМЕТР		ДИАМЕТР	

Part7

A4

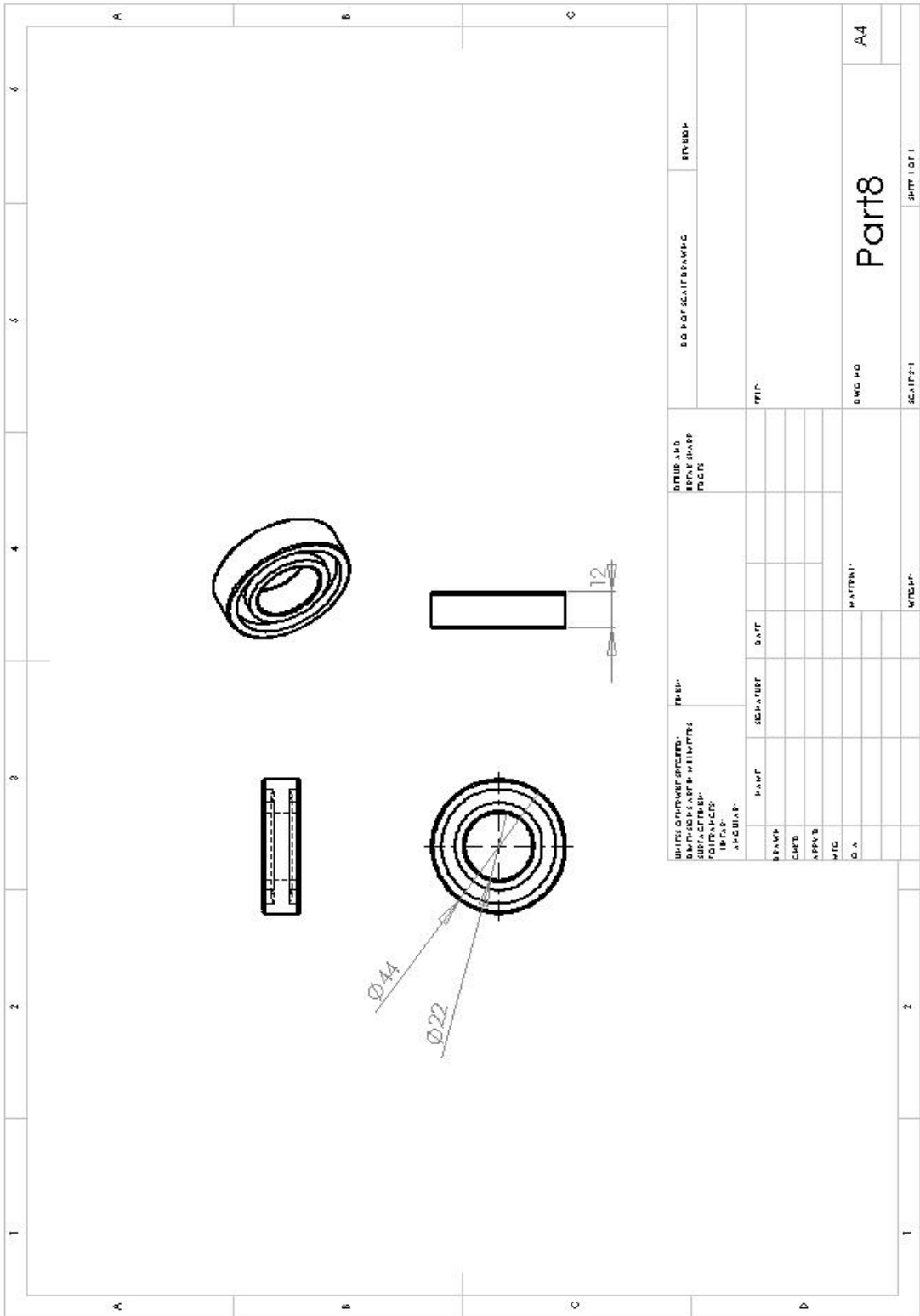
СЧЕТЧИК

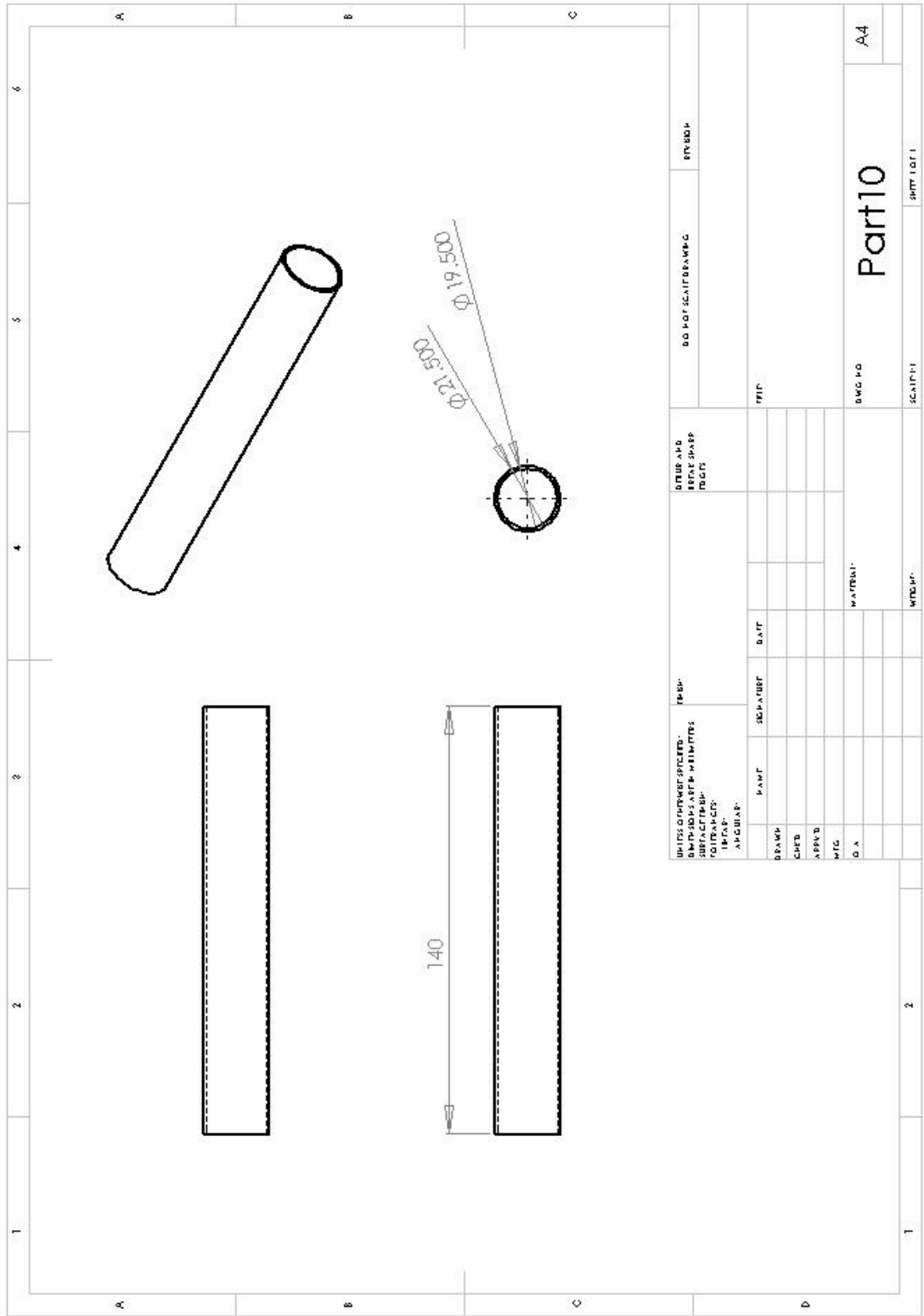
СЧЕТЧИК

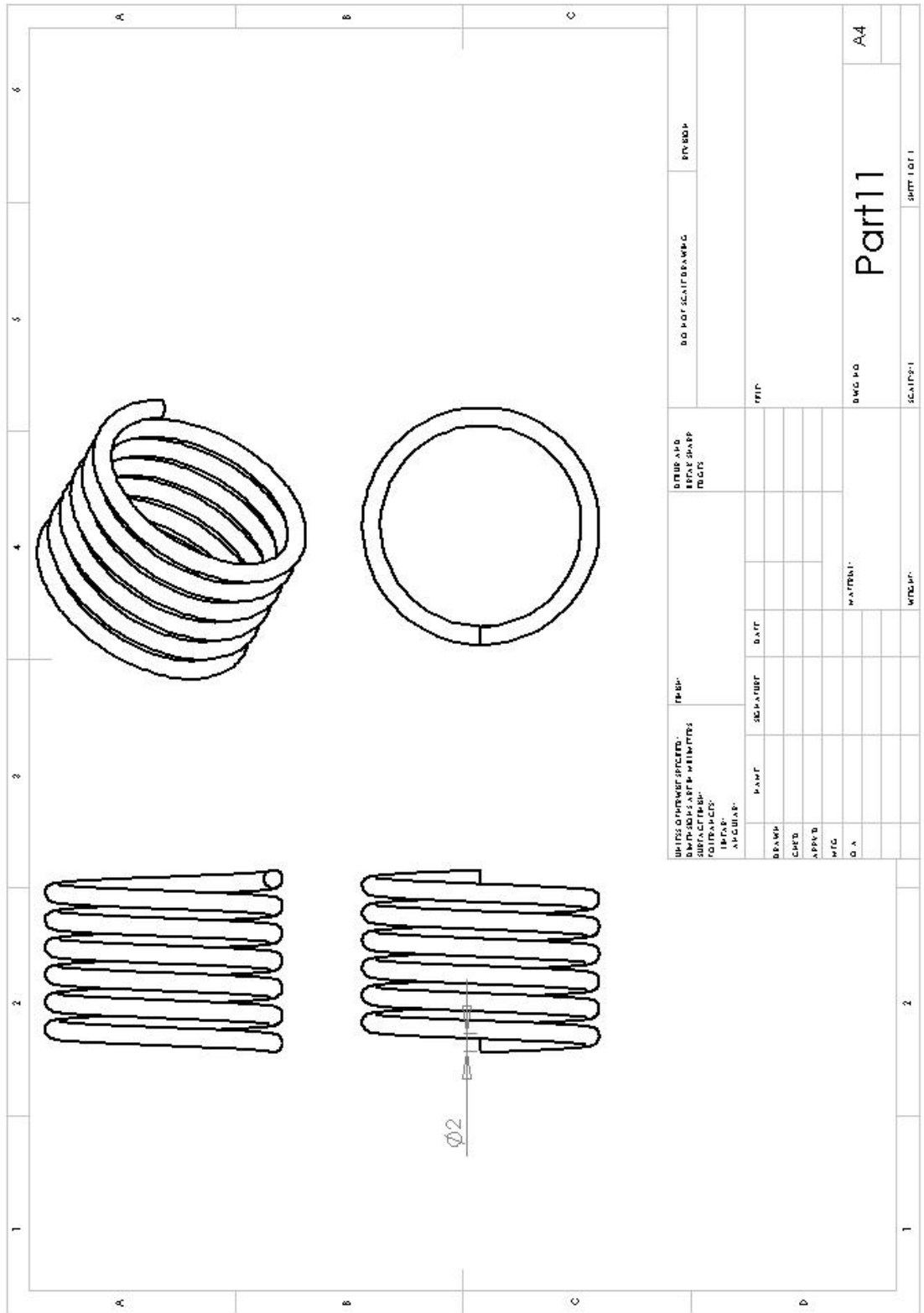
СЧЕТЧИК

СЧЕТЧИК

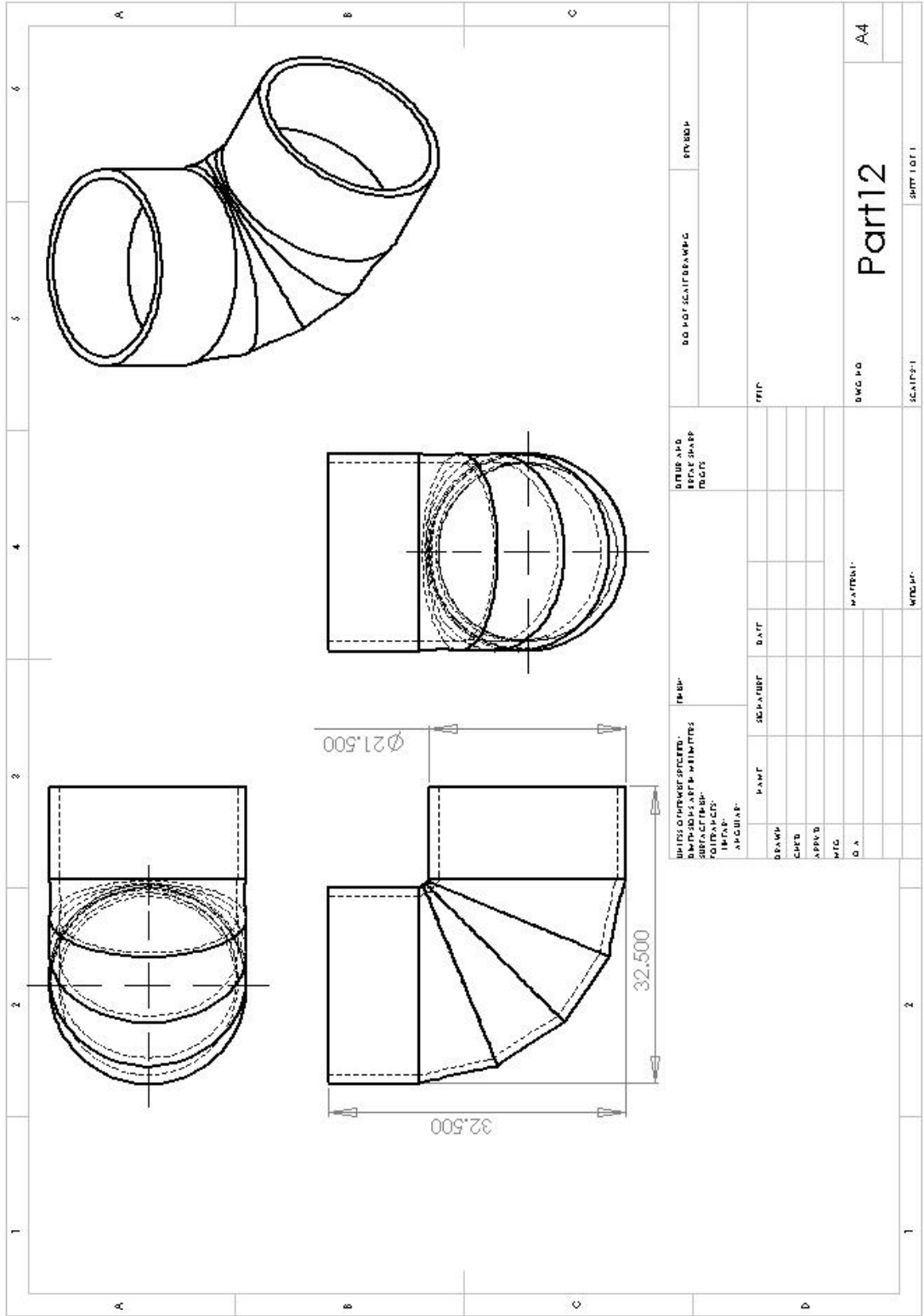
СЧЕТЧИК







UNITES OTHERWISHT SPECIFED: DIMS: DIMS ARE IN MILLIMETRES TOLERANCES: FRACTIONAL ANGULAR:			TRASH:		DATE AND REVISIONS LOGS		DO NOT SCALE DRAWING		NUMBER			
DESIGN	PART	SERIALS	DATE			REV.						
CHECK												
APPRO												
MFG												
D.A.												
							MATERIAL		DWG NO		A4	
					SCALE: 1:1			SHEET: 11		SHEET TOTAL		

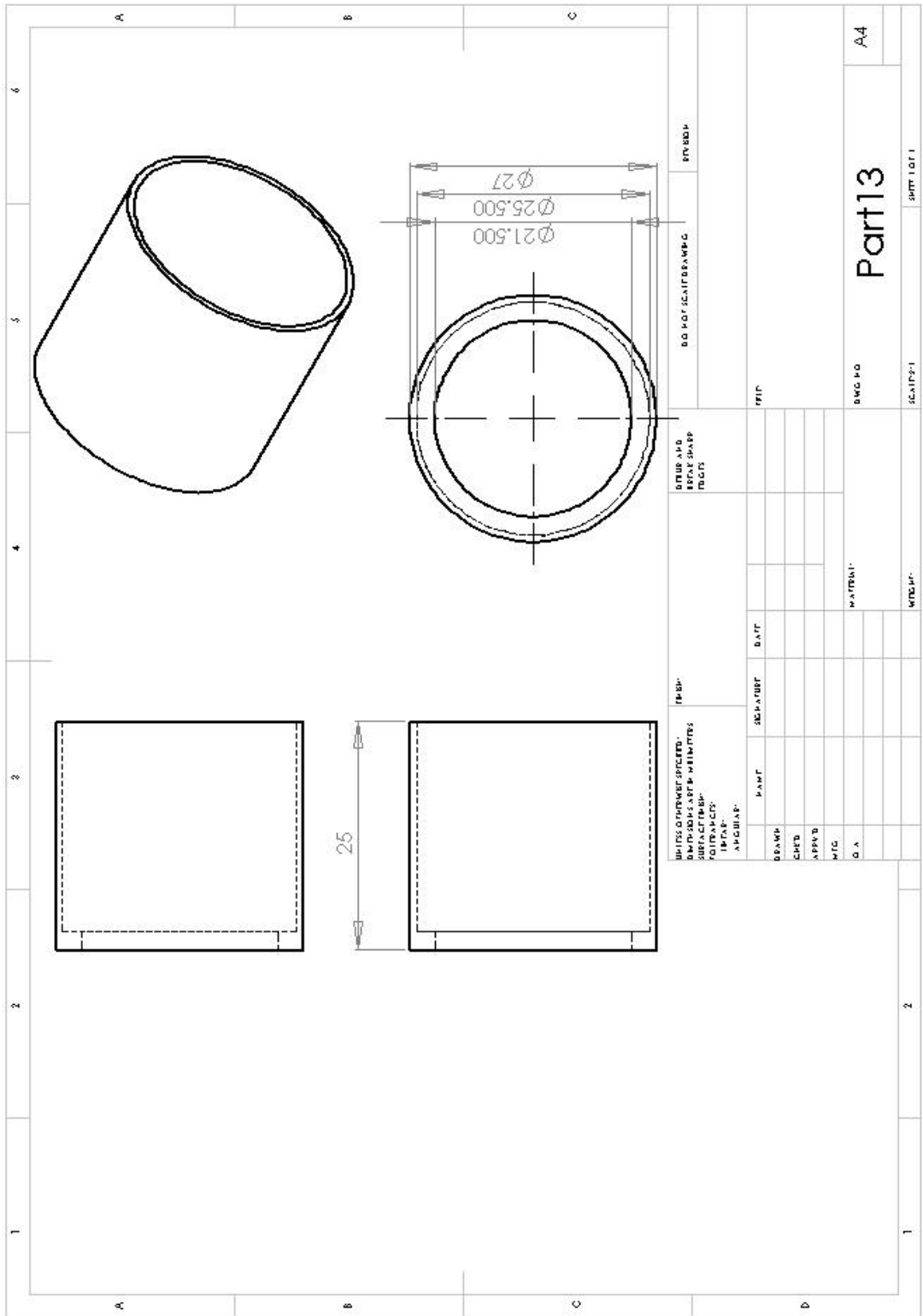


ИТЕМС О ПРИБОРАХ СПЕЦИАЛ. ВЪВЕДИТЕ ИМЕНА ИЛИ ИДИОМИ ПОДЪЕМНОСТИ ИЛИ ПОДЪЕМНИ ПОДЪЕМНИ АБСОЛЮТНО			ИМЕНА ДИАМЕТР ДАТГ			ИМЕНА ИЛИ ИДИОМИ ПОДЪЕМНИ ПОДЪЕМНИ АБСОЛЮТНО			ИМЕНА ДИАМЕТР ДАТГ			ИМЕНА ИДИОМИ ПОДЪЕМНИ ПОДЪЕМНИ АБСОЛЮТНО	ИМЕНА ИДИОМИ ПОДЪЕМНИ ПОДЪЕМНИ АБСОЛЮТНО
ИМЕНА	ДИАМЕТР	ДАТГ	ИМЕНА	ДИАМЕТР	ДАТГ	ИМЕНА	ДИАМЕТР	ДАТГ	ИМЕНА	ДИАМЕТР	ДАТГ	ИМЕНА	ДИАМЕТР

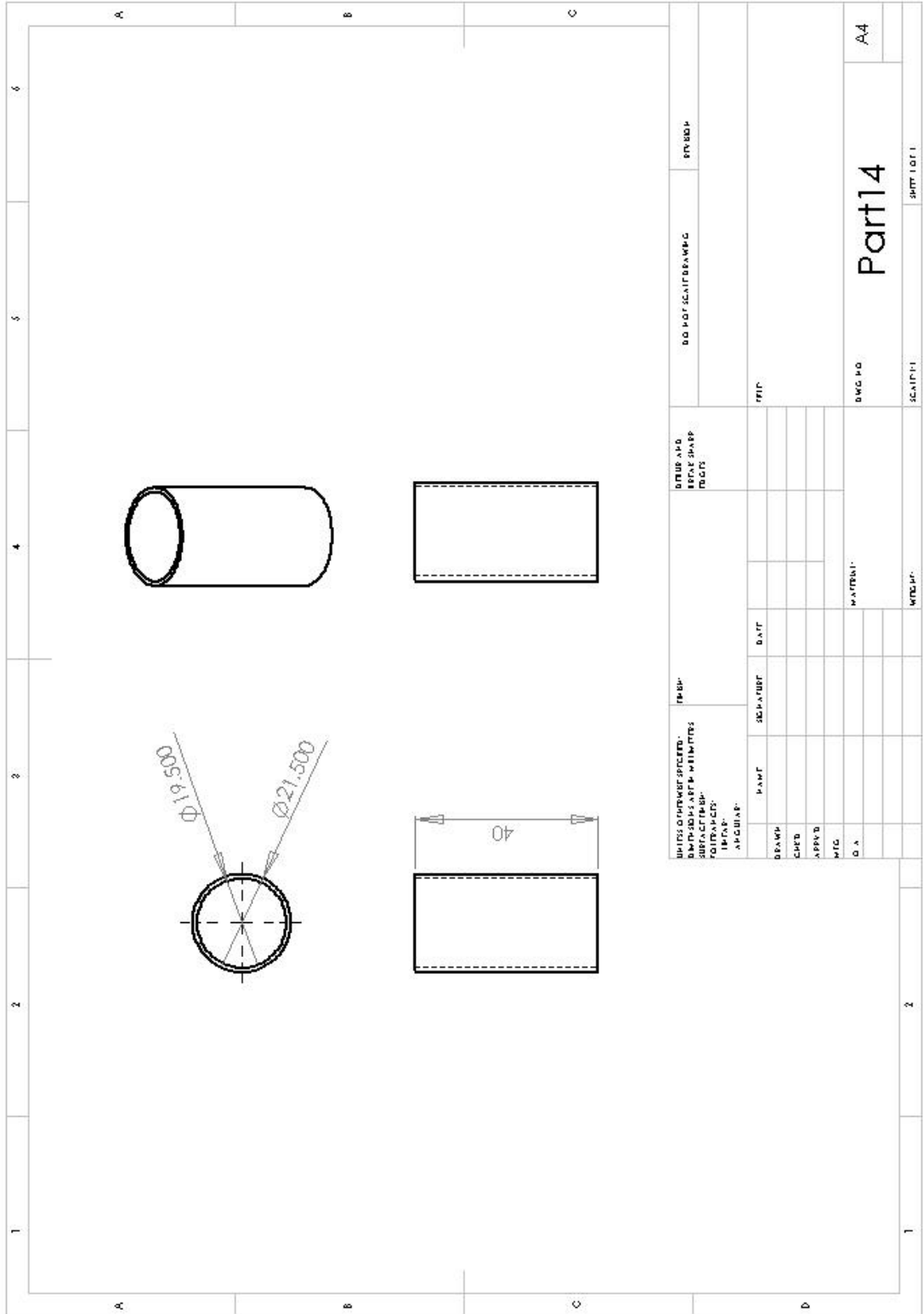
ИМЕНА ИЛИ ИДИОМИ ПОДЪЕМНИ ПОДЪЕМНИ АБСОЛЮТНО		ИМЕНА ИЛИ ИДИОМИ ПОДЪЕМНИ ПОДЪЕМНИ АБСОЛЮТНО
ИМЕНА ИЛИ ИДИОМИ ПОДЪЕМНИ ПОДЪЕМНИ АБСОЛЮТНО	ИМЕНА ИЛИ ИДИОМИ ПОДЪЕМНИ ПОДЪЕМНИ АБСОЛЮТНО	ИМЕНА ИЛИ ИДИОМИ ПОДЪЕМНИ ПОДЪЕМНИ АБСОЛЮТНО

Part12

A4



ШИШС ОННЕРМЕР СПИЦЕРС: ДАТУМ-САСТВА-НАИМЕРС ДИМАНСИОНС МАТЕРИАЛ		ТИП- СКА-УРЕГ ДАТ		ДИМЕ АНД БЕРС СКАР ТУС		Д.О. ПОТ.САТИСАНС ПРИБУ	
ДЕМР	СА-УРЕГ	ДАТ	ТИП				
СМТ							
АФКВ							
МТ							
О.А.							
				МАТЕРИАЛ		ДМС ПО	
				ВМС		СКИП-1	
						ШИТЛОТ	
						A4	



ИМЯ ОТДЕЛА ПРОЕКТА		ИМЯ		ИМЯ ОТДЕЛА ПРОЕКТА		ИМЯ ОТДЕЛА ПРОЕКТА		ИМЯ ОТДЕЛА ПРОЕКТА		ИМЯ ОТДЕЛА ПРОЕКТА		ИМЯ ОТДЕЛА ПРОЕКТА		
ОБЪЕМ РАБОТЫ	ИМЯ ОТДЕЛА ПРОЕКТА	ИМЯ ОТДЕЛА ПРОЕКТА	ИМЯ ОТДЕЛА ПРОЕКТА	ИМЯ ОТДЕЛА ПРОЕКТА	ИМЯ ОТДЕЛА ПРОЕКТА	ИМЯ ОТДЕЛА ПРОЕКТА	ИМЯ ОТДЕЛА ПРОЕКТА	ИМЯ ОТДЕЛА ПРОЕКТА	ИМЯ ОТДЕЛА ПРОЕКТА	ИМЯ ОТДЕЛА ПРОЕКТА	ИМЯ ОТДЕЛА ПРОЕКТА	ИМЯ ОТДЕЛА ПРОЕКТА	ИМЯ ОТДЕЛА ПРОЕКТА	
ИМЯ ОТДЕЛА ПРОЕКТА	ИМЯ ОТДЕЛА ПРОЕКТА	ИМЯ ОТДЕЛА ПРОЕКТА	ИМЯ ОТДЕЛА ПРОЕКТА	ИМЯ ОТДЕЛА ПРОЕКТА	ИМЯ ОТДЕЛА ПРОЕКТА	ИМЯ ОТДЕЛА ПРОЕКТА	ИМЯ ОТДЕЛА ПРОЕКТА	ИМЯ ОТДЕЛА ПРОЕКТА	ИМЯ ОТДЕЛА ПРОЕКТА	ИМЯ ОТДЕЛА ПРОЕКТА	ИМЯ ОТДЕЛА ПРОЕКТА	ИМЯ ОТДЕЛА ПРОЕКТА	ИМЯ ОТДЕЛА ПРОЕКТА	
ИМЯ ОТДЕЛА ПРОЕКТА	ИМЯ ОТДЕЛА ПРОЕКТА	ИМЯ ОТДЕЛА ПРОЕКТА	ИМЯ ОТДЕЛА ПРОЕКТА	ИМЯ ОТДЕЛА ПРОЕКТА	ИМЯ ОТДЕЛА ПРОЕКТА	ИМЯ ОТДЕЛА ПРОЕКТА	ИМЯ ОТДЕЛА ПРОЕКТА	ИМЯ ОТДЕЛА ПРОЕКТА	ИМЯ ОТДЕЛА ПРОЕКТА	ИМЯ ОТДЕЛА ПРОЕКТА	ИМЯ ОТДЕЛА ПРОЕКТА	ИМЯ ОТДЕЛА ПРОЕКТА	ИМЯ ОТДЕЛА ПРОЕКТА	
ИМЯ ОТДЕЛА ПРОЕКТА	ИМЯ ОТДЕЛА ПРОЕКТА	ИМЯ ОТДЕЛА ПРОЕКТА	ИМЯ ОТДЕЛА ПРОЕКТА	ИМЯ ОТДЕЛА ПРОЕКТА	ИМЯ ОТДЕЛА ПРОЕКТА	ИМЯ ОТДЕЛА ПРОЕКТА	ИМЯ ОТДЕЛА ПРОЕКТА	ИМЯ ОТДЕЛА ПРОЕКТА	ИМЯ ОТДЕЛА ПРОЕКТА	ИМЯ ОТДЕЛА ПРОЕКТА	ИМЯ ОТДЕЛА ПРОЕКТА	ИМЯ ОТДЕЛА ПРОЕКТА	ИМЯ ОТДЕЛА ПРОЕКТА	
ИМЯ ОТДЕЛА ПРОЕКТА	ИМЯ ОТДЕЛА ПРОЕКТА	ИМЯ ОТДЕЛА ПРОЕКТА	ИМЯ ОТДЕЛА ПРОЕКТА	ИМЯ ОТДЕЛА ПРОЕКТА	ИМЯ ОТДЕЛА ПРОЕКТА	ИМЯ ОТДЕЛА ПРОЕКТА	ИМЯ ОТДЕЛА ПРОЕКТА	ИМЯ ОТДЕЛА ПРОЕКТА	ИМЯ ОТДЕЛА ПРОЕКТА	ИМЯ ОТДЕЛА ПРОЕКТА	ИМЯ ОТДЕЛА ПРОЕКТА	ИМЯ ОТДЕЛА ПРОЕКТА	ИМЯ ОТДЕЛА ПРОЕКТА	
ИМЯ ОТДЕЛА ПРОЕКТА			ИМЯ ОТДЕЛА ПРОЕКТА			ИМЯ ОТДЕЛА ПРОЕКТА			ИМЯ ОТДЕЛА ПРОЕКТА			ИМЯ ОТДЕЛА ПРОЕКТА		
ИМЯ ОТДЕЛА ПРОЕКТА			ИМЯ ОТДЕЛА ПРОЕКТА			ИМЯ ОТДЕЛА ПРОЕКТА			ИМЯ ОТДЕЛА ПРОЕКТА			ИМЯ ОТДЕЛА ПРОЕКТА		
ИМЯ ОТДЕЛА ПРОЕКТА			ИМЯ ОТДЕЛА ПРОЕКТА			ИМЯ ОТДЕЛА ПРОЕКТА			ИМЯ ОТДЕЛА ПРОЕКТА			ИМЯ ОТДЕЛА ПРОЕКТА		
ИМЯ ОТДЕЛА ПРОЕКТА			ИМЯ ОТДЕЛА ПРОЕКТА			ИМЯ ОТДЕЛА ПРОЕКТА			ИМЯ ОТДЕЛА ПРОЕКТА			ИМЯ ОТДЕЛА ПРОЕКТА		
ИМЯ ОТДЕЛА ПРОЕКТА			ИМЯ ОТДЕЛА ПРОЕКТА			ИМЯ ОТДЕЛА ПРОЕКТА			ИМЯ ОТДЕЛА ПРОЕКТА			ИМЯ ОТДЕЛА ПРОЕКТА		
ИМЯ ОТДЕЛА ПРОЕКТА			ИМЯ ОТДЕЛА ПРОЕКТА			ИМЯ ОТДЕЛА ПРОЕКТА			ИМЯ ОТДЕЛА ПРОЕКТА			ИМЯ ОТДЕЛА ПРОЕКТА		
ИМЯ ОТДЕЛА ПРОЕКТА			ИМЯ ОТДЕЛА ПРОЕКТА			ИМЯ ОТДЕЛА ПРОЕКТА			ИМЯ ОТДЕЛА ПРОЕКТА			ИМЯ ОТДЕЛА ПРОЕКТА		
ИМЯ ОТДЕЛА ПРОЕКТА			ИМЯ ОТДЕЛА ПРОЕКТА			ИМЯ ОТДЕЛА ПРОЕКТА			ИМЯ ОТДЕЛА ПРОЕКТА			ИМЯ ОТДЕЛА ПРОЕКТА		
ИМЯ ОТДЕЛА ПРОЕКТА			ИМЯ ОТДЕЛА ПРОЕКТА			ИМЯ ОТДЕЛА ПРОЕКТА			ИМЯ ОТДЕЛА ПРОЕКТА			ИМЯ ОТДЕЛА ПРОЕКТА		
ИМЯ ОТДЕЛА ПРОЕКТА			ИМЯ ОТДЕЛА ПРОЕКТА			ИМЯ ОТДЕЛА ПРОЕКТА			ИМЯ ОТДЕЛА ПРОЕКТА			ИМЯ ОТДЕЛА ПРОЕКТА		
ИМЯ ОТДЕЛА ПРОЕКТА			ИМЯ ОТДЕЛА ПРОЕКТА			ИМЯ ОТДЕЛА ПРОЕКТА			ИМЯ ОТДЕЛА ПРОЕКТА			ИМЯ ОТДЕЛА ПРОЕКТА		

Part 14

DWG NO: 14

SCALE: 1:1

СHEET 1 OF 1