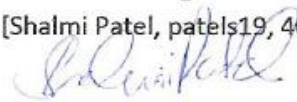
As a future member of the engineering profession, the student is responsible for performing the required work in an honest manner, without plagiarism and cheating. Submitting this work with my name and student number is a statement and understanding that this work is my own and adheres to the Academic Integrity Policy of McMaster University and the Code of Conduct of the Professional Engineers of Ontario. Submitted by [Shalmi Patel, patels19, 400023762]



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Technical Report

1C03
Dr. Doyle

Group 41

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Table of Contents

Team Contributions and Meetings

Team Contributions	
Member Names	**Contributions**
Ali Shah	Content and Report Compilation
Kylee Schram	Calculations and Solid Models
Shalmi Patel	MapleSIM and Drawings
All members	Physical model assembly

Team Meetings		
Meeting Number	**Members Present**	**Meeting Objective**
1	Ali, Kylee, Shalmi	Project Outline
2	Kylee, Shalmi	Solid Models
3	Ali, Kylee	Milestone I
4	Kylee, Shalmi	Signatures
5	Ali, Kylee	Milestone II
6	Kylee, Shalmi	MapleSIM
7	Ali, Kylee	Technical Report
8	Ali, Kylee, Shalmi	Conclusion

Introduction

We have been hired by company XYZ Mechanisms and tasked with the modification of a CD player's power train design. Previously used components are now obsolete, thus a design change is necessary. The player's motor had a set operating speed, 8610 rpm, which needed to provide a linear output velocity of 0.105m/s at the read-head. Using gear ratio equations, specifications were calculated. The final assembly uses a minimal number of gears to transmit the required velocity to the read-head while remaining within the space constraints of the chassis.

As a secondary requirement, a scaled-up, 3D-printed model of the mechanism was produced. A mounting bracket was also fabricated to compliment the prototype.

Mechanism Overview

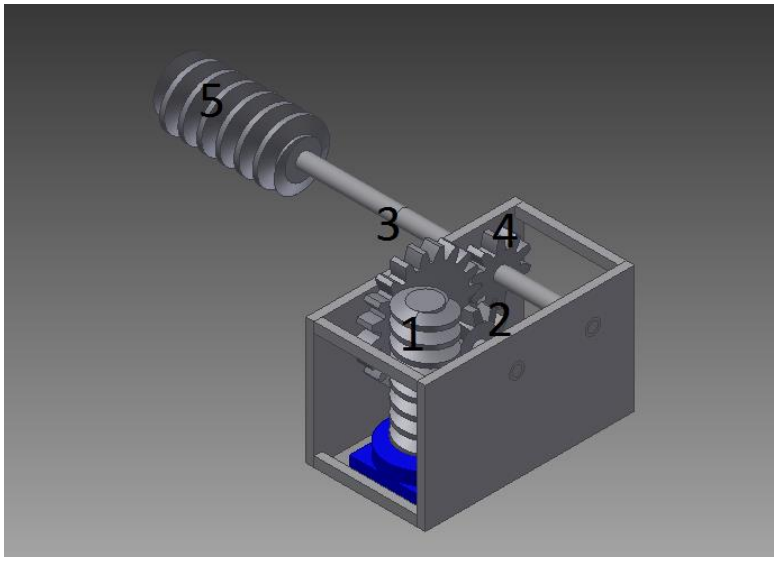


Figure:1

The mechanism relies on a worm drive, [1, 2] to reduce the output speed of the motor. The worm [1] is driven at the motor's operating speed, and the worm gear [2] decreases this speed by a factor equal to its number of teeth. The worm gear [2] is axially connected to spur gear [3], and spur is driven at the cut speed. Spur gear [3] is meshed to spur [4]. Spur [4], with half the number of teeth of [3], doubles the speed, and drives the final worm [5] at this angular velocity. As the final worm [5] rotates, the read head moves in a linear direction along its length.

Material Volume Summary

Mechanism volume: 6242.669 mm^3

Volume with mounting: 9902.753 mm^3

Gear [refer to figure 1]	**Volume (mm^3)**
Worm 1 [1]	1217.008 mm^3
Worm gear [2]	194.689 mm^3
Spur Gear 1 [3]	913.720 mm^3
Spur Gear 2 [4]	214.672 mm^3
Final worm gear [5]	1970.052 mm^3

Calculations

Gear	Diameter (mm)	Module	# of Teeth	W (rev/s)	ACP	Linear Velocity (mm/s)
Worm 1	10	1	1	143.5	3.14	N/A
Worm Gear	10	1	10	14.35	N/A	N/A
Spur 1	20	1	20	14.35	N/A	N/A
Spur 2	10	1	10	28.7	N/A	N/A
Worm 2	12.34	3.66/Pi	1	28.7	3.66	105.04

Target Output: 105 mm/s

Input $210 \times 41 = 8610$ rev/min
$= 143.5$ rev/s

- Final rotational output
  $\frac{105 \text{ mm/s}}{ACP}$ → ACP constrained between 1 and 4
  -ACP = 3.67

So, $\frac{105 \text{ mm/s}}{3.67 \text{ mm/rev}} = 28.61$ rev/s

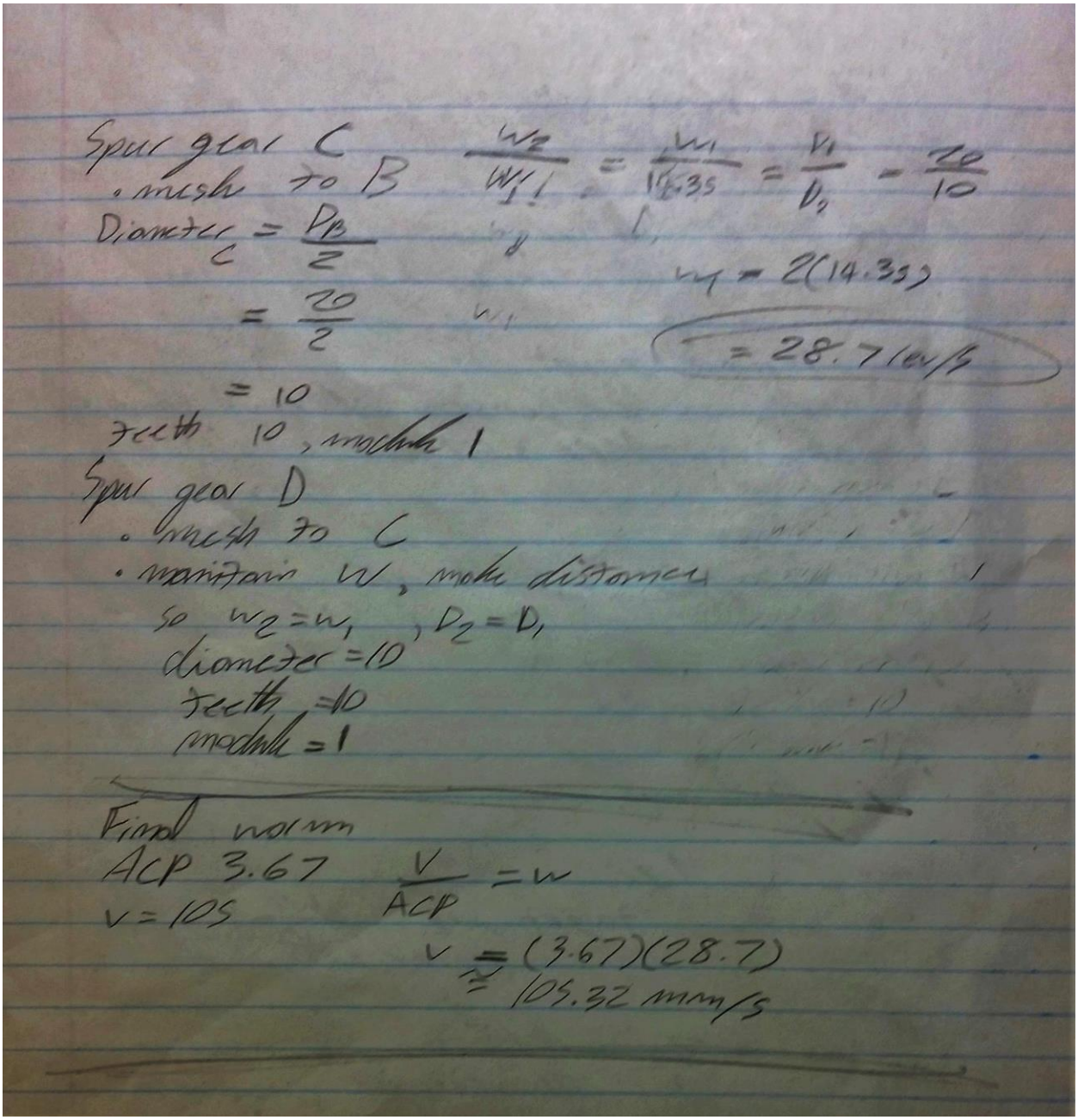
Stage One: Reduction
Worm Drive A.1.
- Diameter 6 mm
- $w = 143.5$ rev/s

Worm Gear A.2.
$\frac{w_1}{w_2} = \frac{z_2}{z_1}$ target w_2 is $\frac{w_1}{10}$;
14.35 rev/s

$\frac{143.5}{14.35} = \frac{z_2}{1}$ Module 1
diameter 10
teeth 10

$10 = z_2$

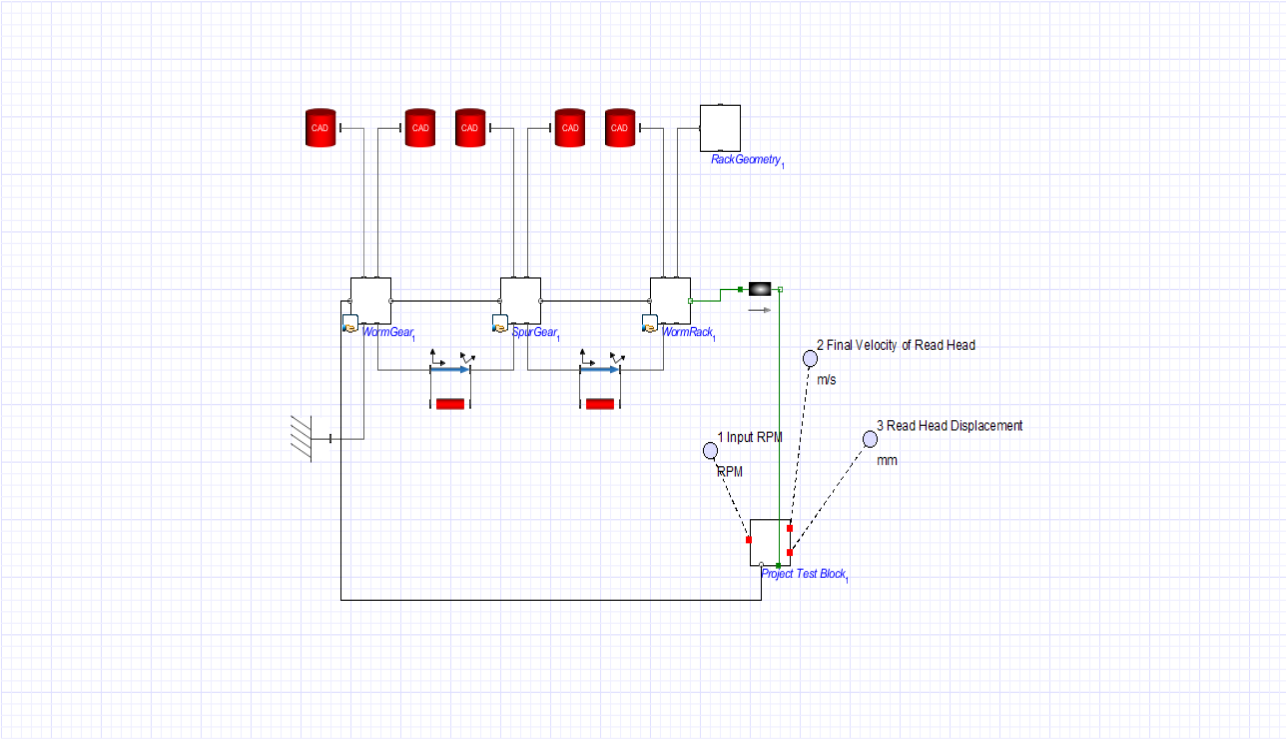
Spur Gear B
- Axial mount to A.2.
- diameter 20 to facilitate increase in next stage, so
- 20 teeth
- module 1
- 14.35 rev/s

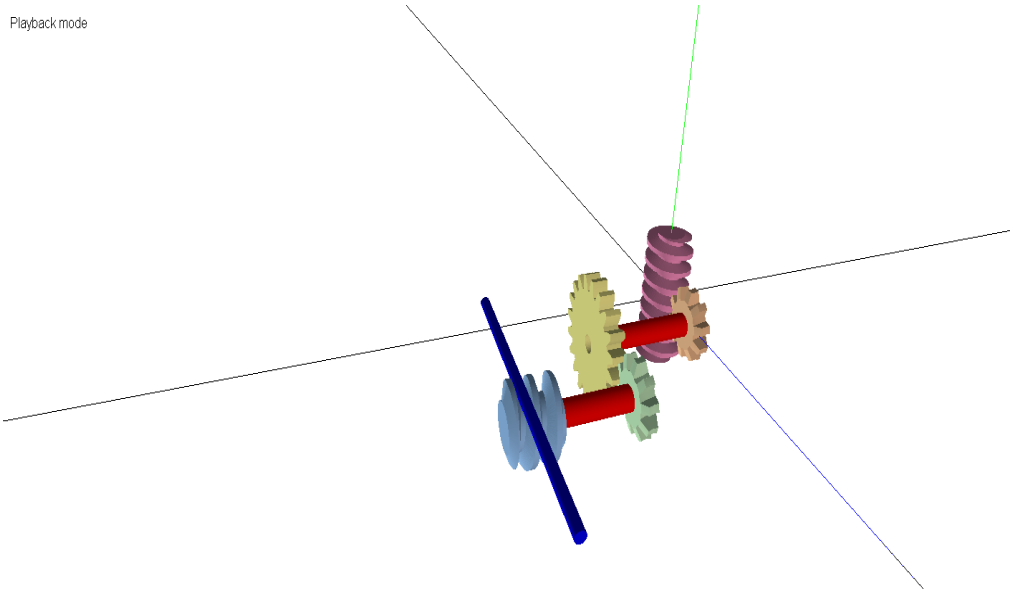


Note: ACP was later modified to 3.66, to give a predicted linear velocity of 105.042mm/s. This was the value used for simulation and physical model. “Spur Gear D” was omitted.

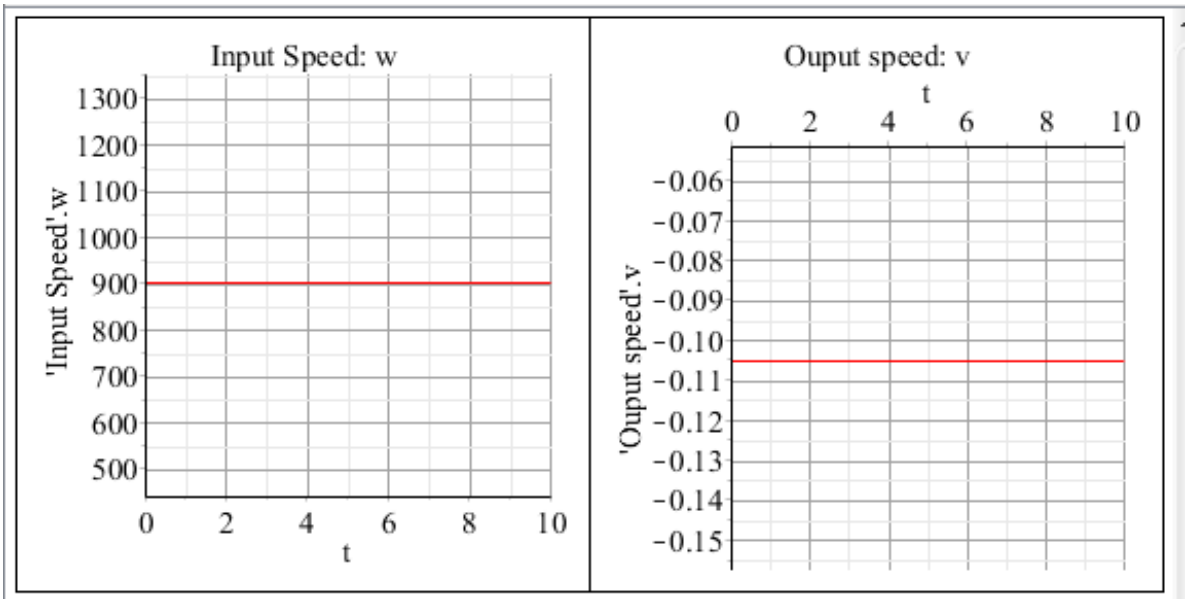
Simulation & Testing

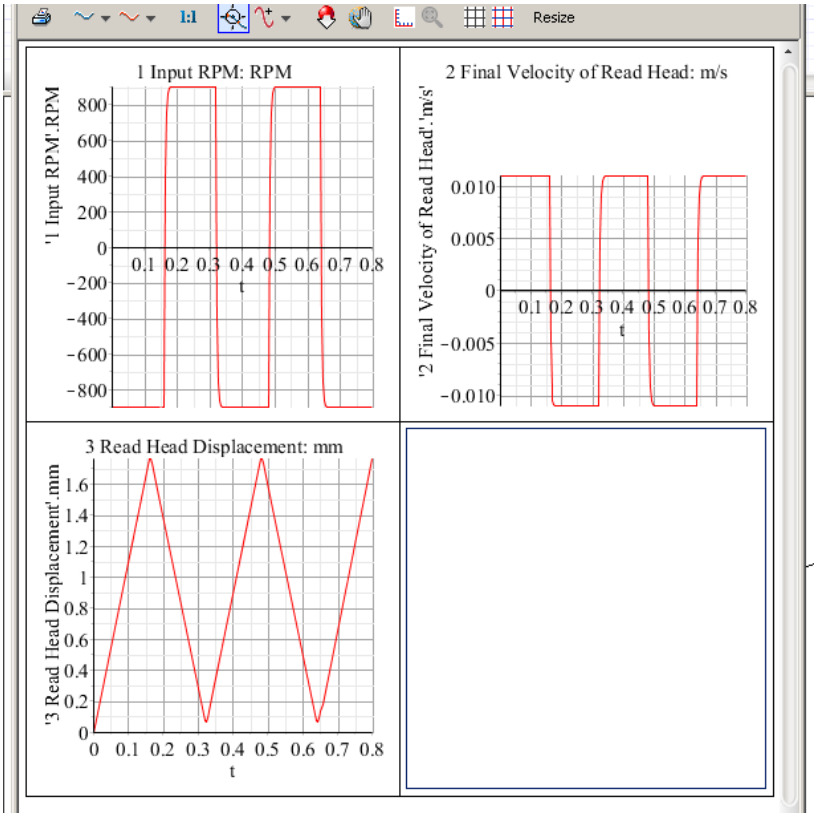
Schematic & Graphical View





Testing Data

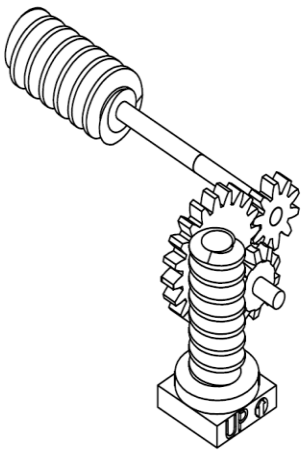




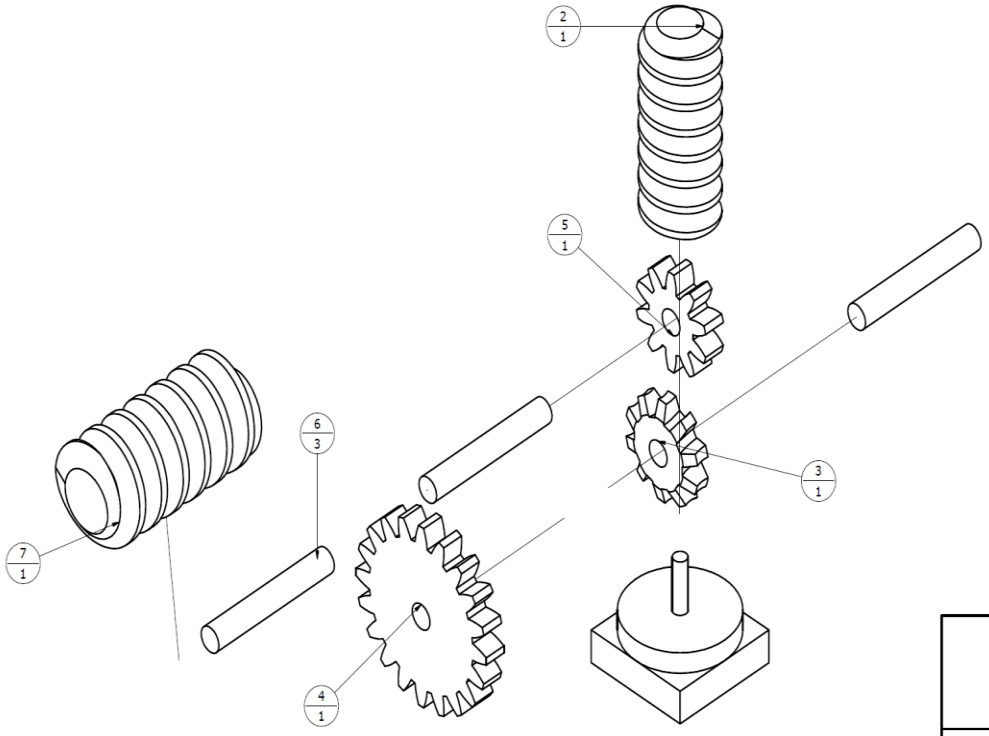
Index of Drawings

Drawing Gear Train

PARTS LIST		
ITEM	PART NUMBER	QTY
1	Motor	1
2	Moter Worm	1
3	Worm Gear	1
4	Spur Gear1	1
5	Spur Gear2	1
6	axle model	3
7	Final Worm	1

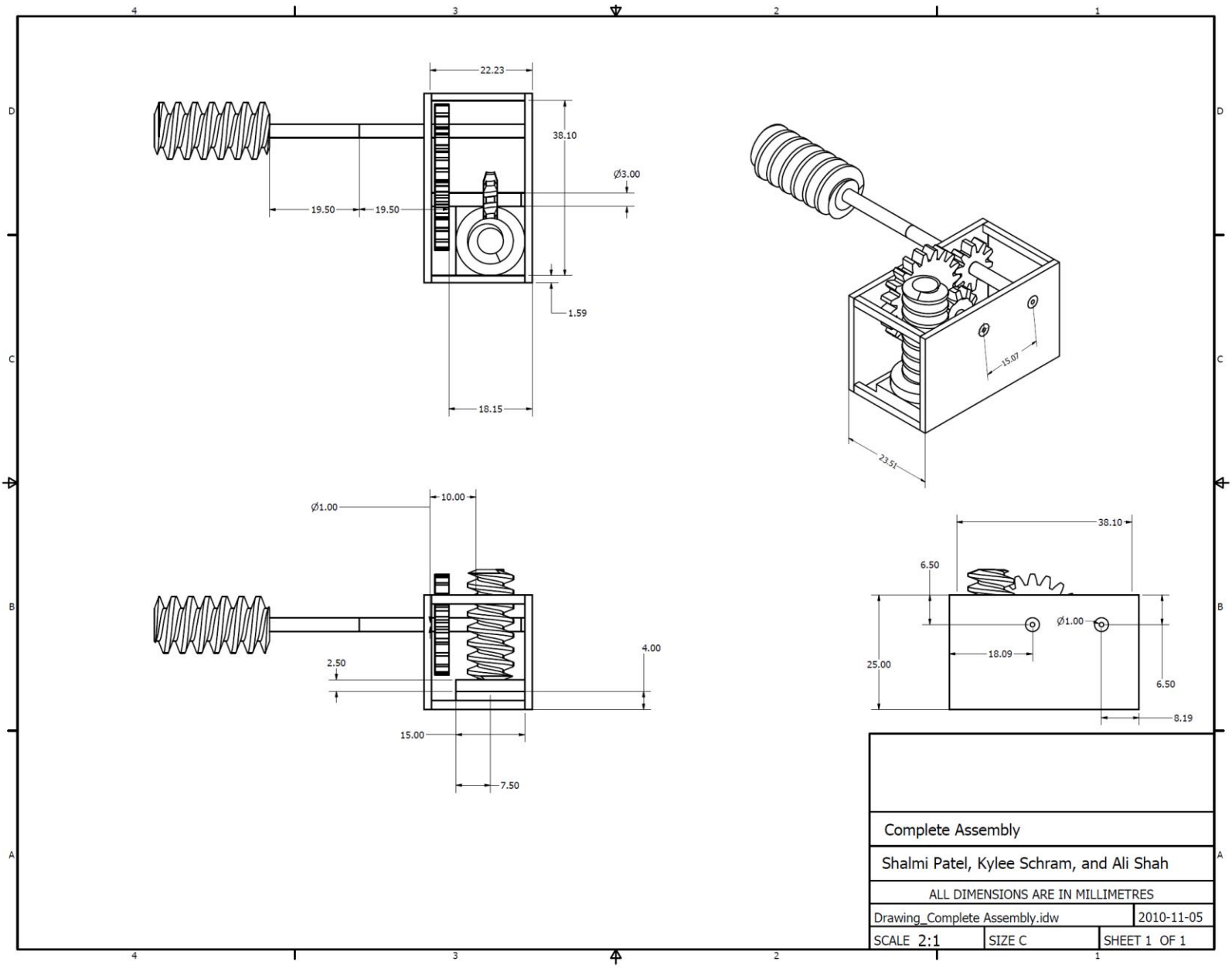


Isometric
Scale 2:1

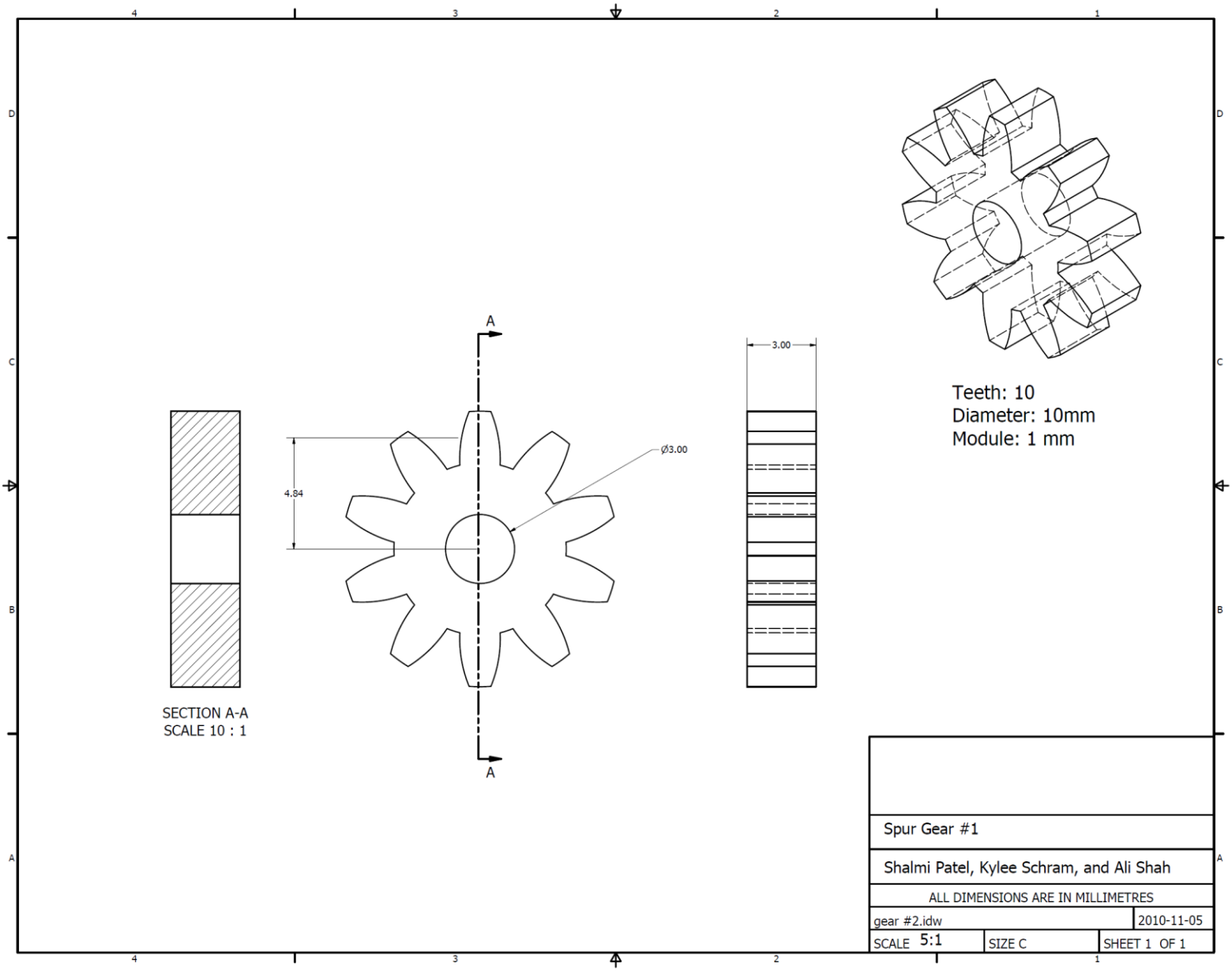


Motor Assembly		
Shalmi Patel, Kylee Schram, and Ali Shah		
ALL DIMENSIONS ARE IN MILLIMETRES		
Drawing_ Gear Train.idw		2010-11-05
SCALE 3:1	SIZE C	SHEET 1 OF 1

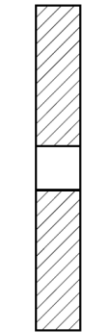
Drawing Complete Assembly



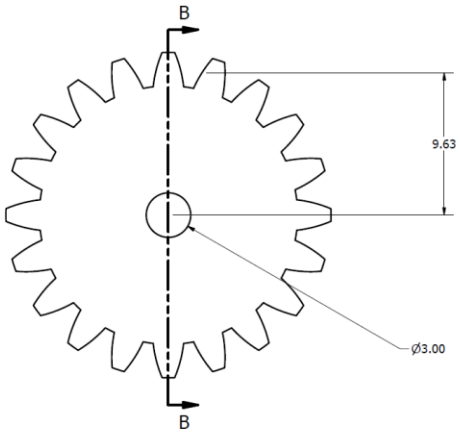
Spur Gear #1

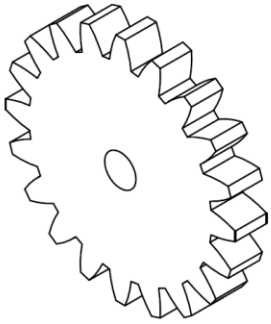

A
A
3.00
4.84
ø3.00
SECTION A-A
SCALE 10 : 1
Teeth: 10
Diameter: 10mm
Module: 1 mm
Spur Gear #1
Shalmi Patel, Kylee Schram, and Ali Shah
ALL DIMENSIONS ARE IN MILLIMETRES
gear #2.idw
2010-11-05
SCALE 5:1
SIZE C
SHEET 1 OF 1

Spur Gear #1



SECTION B-B
SCALE 5 : 1

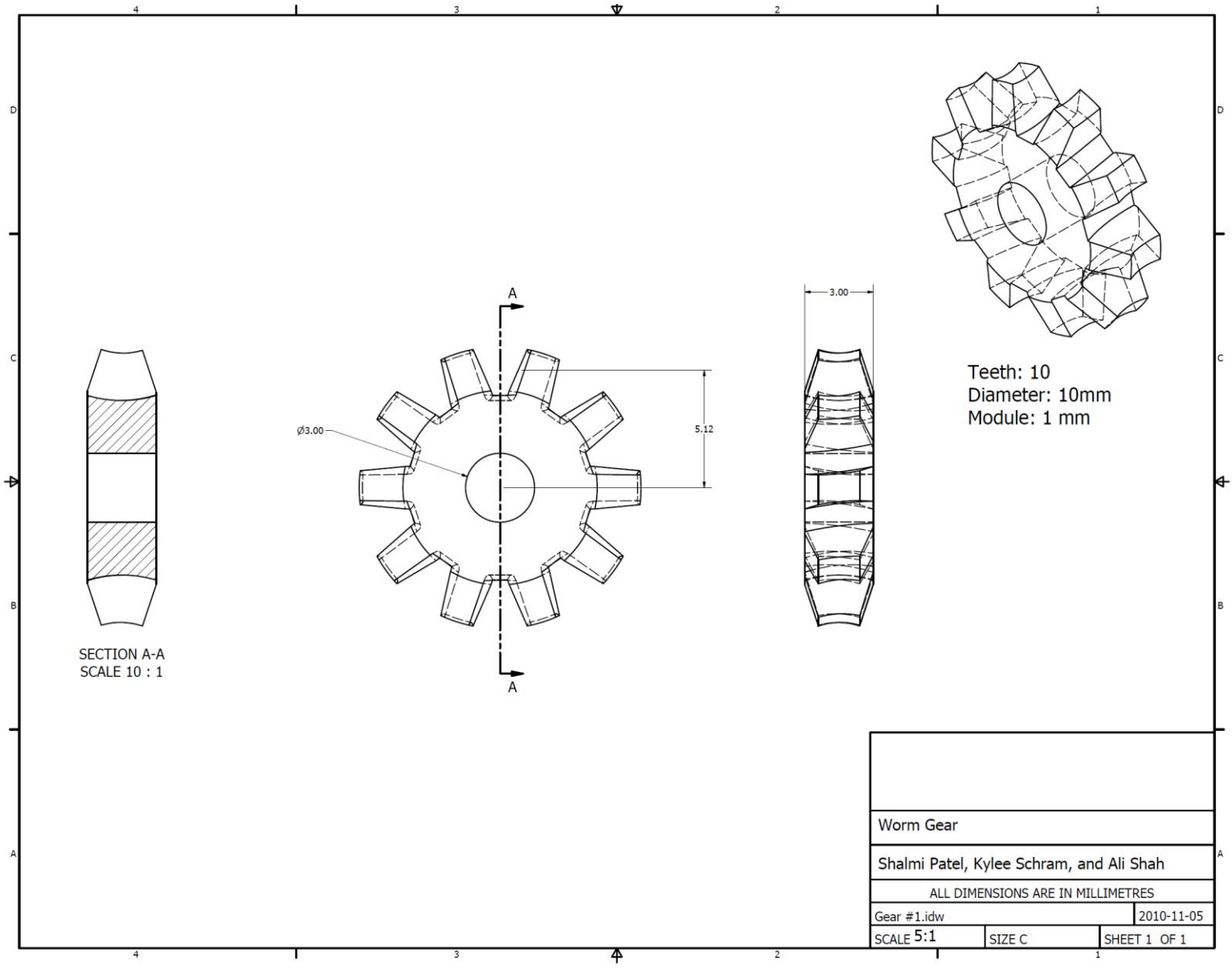




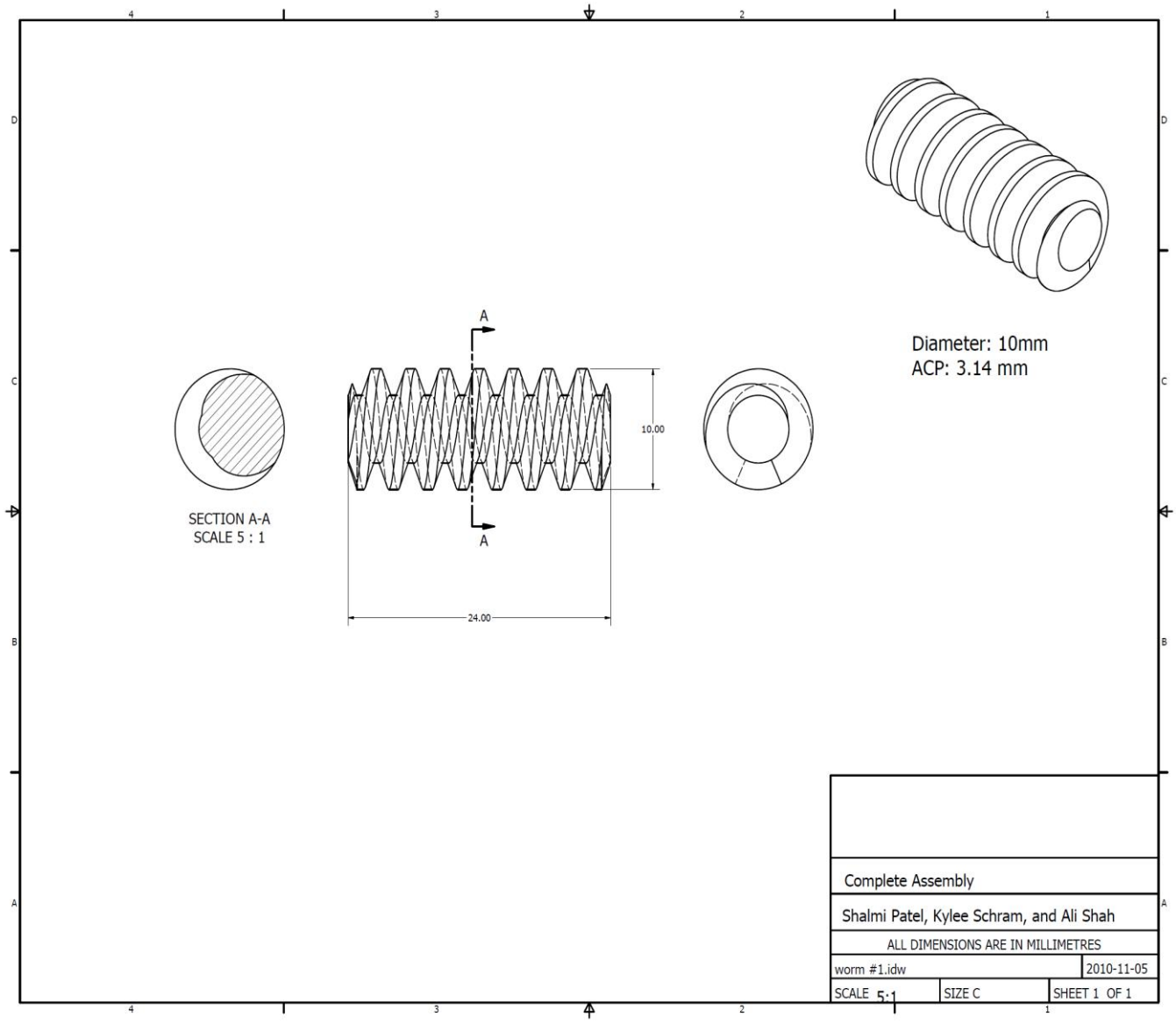
Teeth: 20
Diameter: 20mm
Module: 1 mm

Spur Gear #2		
Shalmi Patel, Kylee Schram, and Ali Shah		
ALL DIMENSIONS ARE IN MILLIMETRES		
Gear #3.idw		2010-11-05
SCALE 5:1	SIZE C	SHEET 1 OF 1

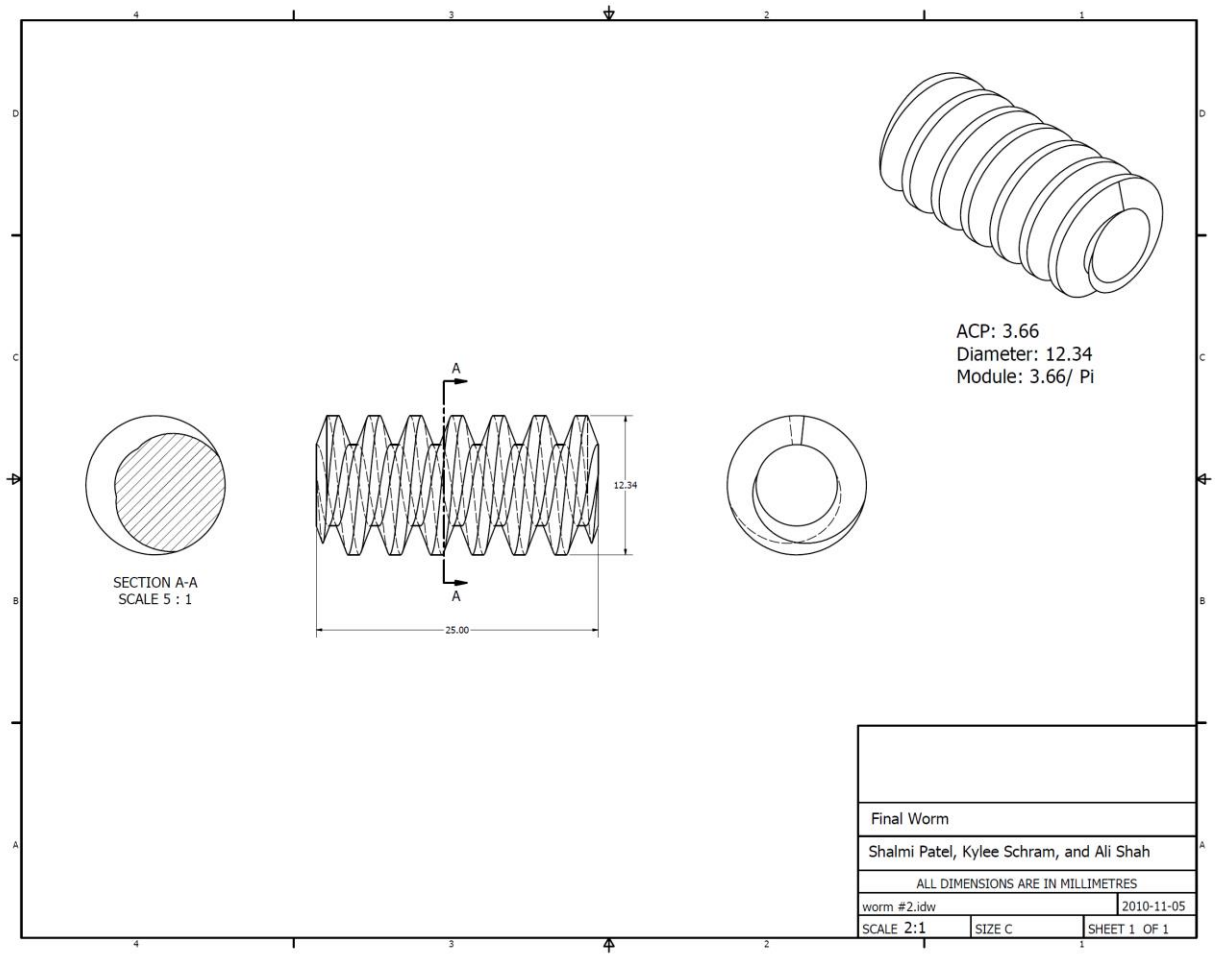
Worm Gear


A
A
Ø3.00
5.12
3.00
SECTION A-A
SCALE 10 : 1
Teeth: 10
Diameter: 10mm
Module: 1 mm
Worm Gear
Shalmi Patel, Kylee Schram, and Ali Shah
ALL DIMENSIONS ARE IN MILLIMETRES
Gear #1.idw
2010-11-05
SCALE 5:1
SIZE C
SHEET 1 OF 1

Worm #1


A
A
10.00
24.00
SECTION A-A
SCALE 5 : 1
Diameter: 10mm
ACP: 3.14 mm
Complete Assembly
Shalmi Patel, Kylee Schram, and Ali Shah
ALL DIMENSIONS ARE IN MILLIMETRES
worm #1.idw
2010-11-05
SCALE 5:1
SIZE C
SHEET 1 OF 1

Worm #2


ACP: 3.66
Diameter: 12.34
Module: 3.66/ Pi
SECTION A-A
SCALE 5 : 1
A
A
12.34
25.00
Final Worm
Shalmi Patel, Kylee Schram, and Ali Shah
ALL DIMENSIONS ARE IN MILLIMETRES
worm #2.idw
2010-11-05
SCALE 2:1
SIZE C
SHEET 1 OF 1