

# A.I.R.W.U.S.

DIY MANUAL

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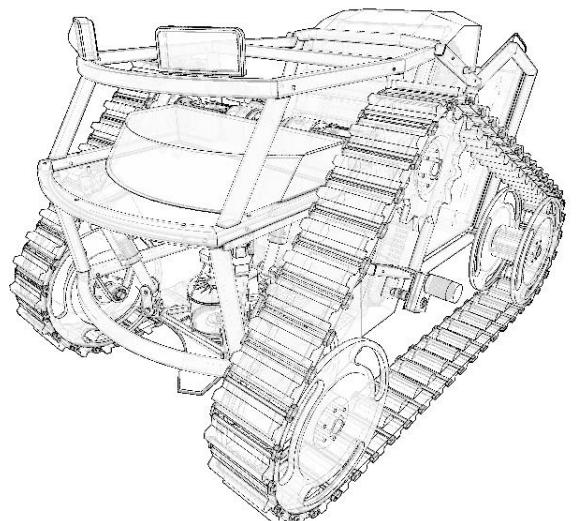
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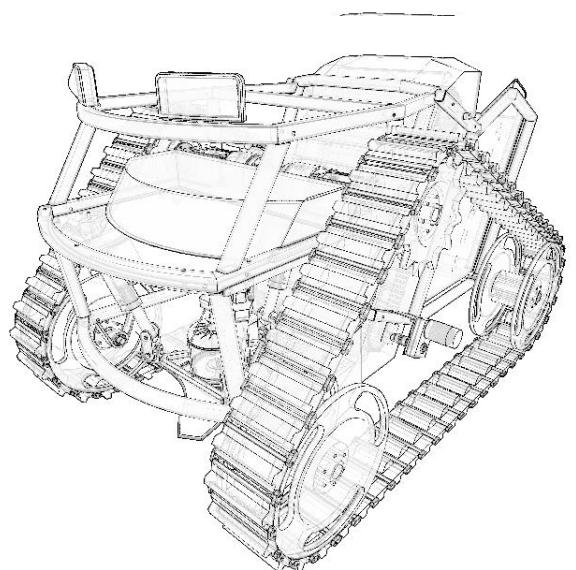
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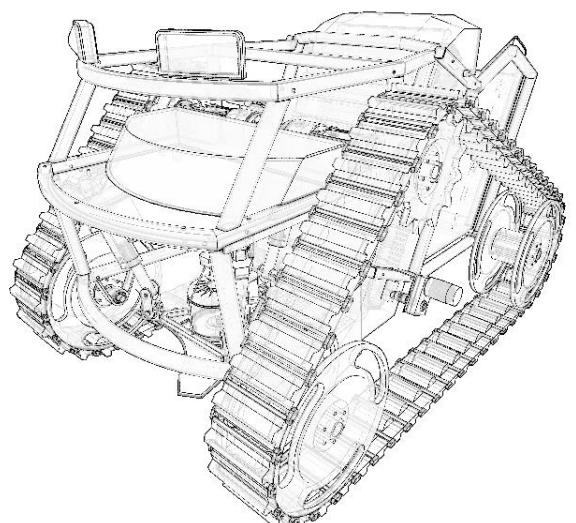


## Problem Statement

Availability of unskilled labor, willing to work in the agricultural industry is decreasing day-by-day. Nevertheless, demand for laborers in agriculture remains, as it was earlier. As a result, farmers must pay more for laborers. However, there are systems or machines been developed in India which perform a few of the agricultural tasks (harvester, thresher etc.), but many activities still require human interaction or are not automated. Weed (unwanted crops) cutting is one of the tasks done by laborers by hand pulling or by weed removal tool operated by the labourer. Automating the process of weed removal and collection in the agricultural sector will be beneficial for farmer directly or indirectly in a long term manner.

## Objective

A systematic design of an **Autonomous Intra Row Weed Uprooting system** is being provided as a solution to the problem addressed. The objective of system is to remove weeds and carry the same with it, equipped with some additional features that will help farmers in optimizing the process. The design aims to eliminate the need of unskilled labor for the task of weed removal, and perform the task autonomously, also the farmer can control the system remotely, by manual override.

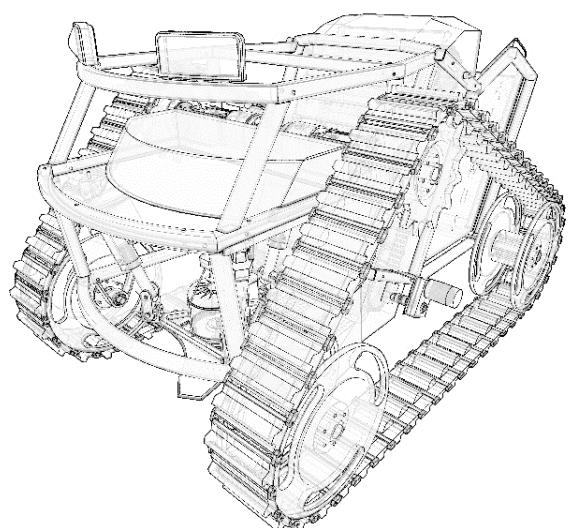


## Bill of Material

Item No.	Assembly	Part	Description	Quantity
1	Cutting Blade Stewart Platform Sub-Assembly			1
1.1		Linear Actuator	5 cm actuation; Linear Actuation (12v DC)	3
1.2		Universal Joint 1		6
1.3		Universal Joint 2		3
1.4		Universal Joint 3		3
1.5		BLDC Motor Frame		1
1.6		BNO	Orientation Gyroscope Sensor	1
1.7		BNO Mount	Mounting for Sensor	1
1.8		BLDC Motor (Segway Motor)	24V DC Motor With 2650 RPM	1
1.9		BLDC Coupler	To Couple Blade and BLDC Motor Shaft	1
1.10		Cutting Blade		1
1.11		Stewart Platform Table		1
2	Chassis Sub-Assembly	Chassis Frame	Welded chassis Frame	1
2.1		Tube, Square	20.00 X 20.00 X 2.00	11055.7
2.2		L angle	25x25x3	1507.4
2.3		Drive Motor Mount	L angle 50x30x4	175.5
2.4		Bearing Mount		4
2.5		Conveyer Motor Mount	Standard L Mount provided with motor	2
2.6		Acrylic or Glass shield	To enclose front module of chassis, especially the cutting blade Stewart platform and electronics	To be mounted as per convenience and requirement of end user (if required)
3	Conveyer Sub-Assembly			1
3.1		Conveyer Enclosure	Sheet	1

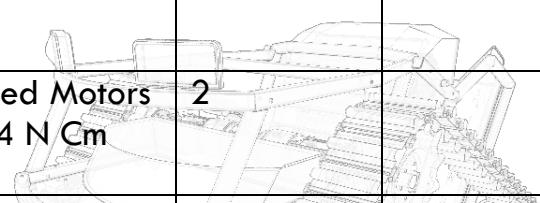
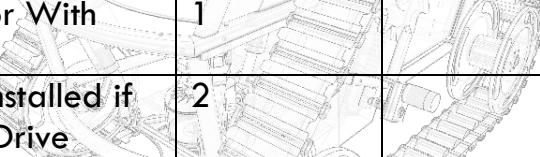
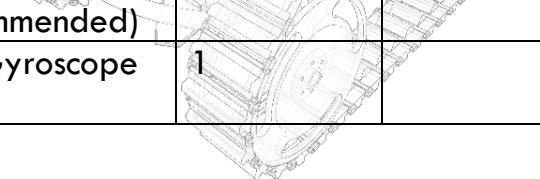
3.2		ISO - Spur gear	ISO - Spur gear 3M 25T 14.5PA 25.4FW --- S25B30H35L12.0S1	4
3.3		Conveyer Shaft	With key	2
3.4			Without key	2
3.5		Conveyer Belt	Single Sided Timing Belt	2
3.6		Scoop	Sheet	25
3.7		Connecting Rod	To attach scoop to Belt	25
3.8		Offset Shaft Geared DC Motor	12v DC Motor with 300RPM	2
3.9		Flexible Shaft Coupler	To Couple Motor with Shaft	2
4	Detachable Module Sub- Assembly			1
4.1		Detachable Module	Sheet	1
5	Drive Sub- Assembly			1
5.1		Idler Wheels/Pulley Wheel/Traction Wheel		4
5.2		Driving Wheel		2
5.3		Drive shaft		4
5.4		Angular Contact Ball Bearings	ISO 15 ABB - 3912 - 12, SI, NC,12_68	4
5.5		Drive Motors- Magnum DC Geared Motors	12v DC Geared Motors with torque 165.5 N Cm	2
5.7		Rotary Encoders	May not be installed if are inbuilt in Drive motors (Recommended)	2
5.6		Drive Couplers	To couple Drive Motors and drive Wheel, Idler wheels and shaft	6
5.7		Drive belts	Caterpillar drive belts	2
6	Electronics Sub- Assembly			1
6.1		Head Lights	Specifications - as per availability and need of end user	2
6.2		Back Light	(Red Light)	1

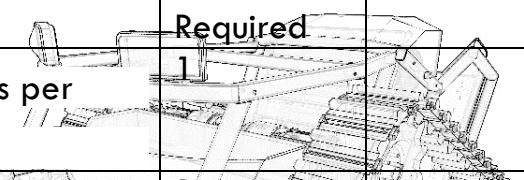
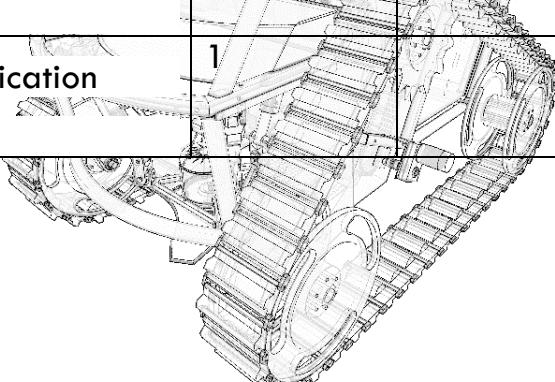
			Specifications - as per availability and need of end user	
6.3		Wires	As per requirement	
6.4		Load Cell	Round force sensitive resistor (FSR)- Interlink 402	1
6.5		Raspberry Pi 2	A Single On-board computer	1
6.6		Battery	Lead acid	2
6.7		Electronics enclosing chamber	To be made as per convenience	1
6.8		Battery management system	With fuse connectors	1
6.9		Motor Drivers	Central motor controller	1
6.10		Sim Shield 900	For Communication protocol	1

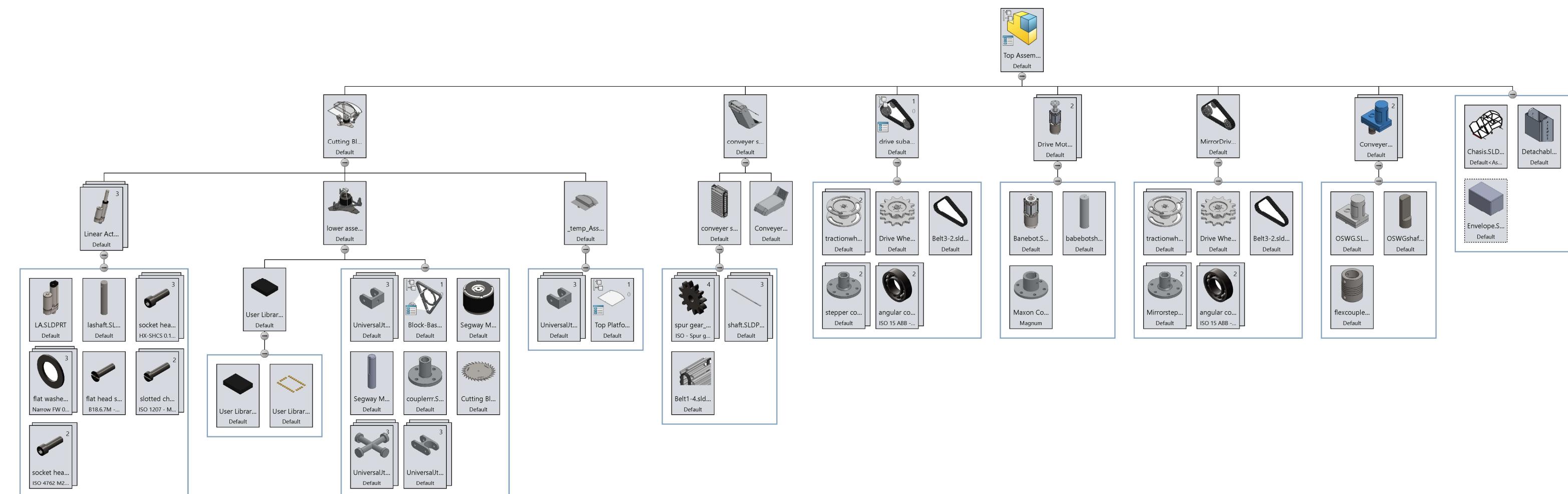


## Raw Materials Required

Item No.	Category	Part	Dimensions (mm) / Specifications	Quantity	Length (mm)
1	Parts Available in market		(Parts if not available in locality may be machined according to provided dimensions)		
1.1	Shafts				
A		Flexible Shaft Coupler	Inner Diameter-12.4 Outer Diameter-19	2	24.5
B		Shaft With key	Diameter- 12 Key length- 25.4	2	380
C		Shaft Without key	Diameter- 12	2	380
D		Drive shaft	Diameter- 12	4	130.11
1.2	Belts				
A		Caterpillar Drive belts	Double Sided	2	1940 (~2000)
B		Timing Belt (Conveyer)	Single Sided	2	920
1.3	ISO Standard Parts				
A		ISO - Spur gear	ISO - Spur gear 3M 25T 14.5PA 25.4FW --- S25B30H35L12.0S1	4	
B		Angular Contact Ball Bearings	ISO 15 ABB - 3912 - 12, SI, NC,12_68	4	
1.4	Miscellaneous Standard Parts				
A		Universal Joint 1	32x34	6	
B		Universal Joint 2	60x34	3	
C		Universal Joint 3	34x34	3	
D		Standard Cutting Blade	300 (3 Teeth)	1	
E		Standard L Mount for offset Shaft Motor	56x68x2	2	50
2	Parts To be welded	Chassis			
2.1		Tube, Square	20.00 X 20.00 X 2.00		11055.7

2.2		L angle	25x25x3		1507.4
2.3		Drive Motor Mount (L angle)	50x30x4		175.5
2.4		Bearing Mount	120x120x25	4	
3	Sheet Metal		Flattened Sheet Dimensions	1	
3.1		Detachable Module	1330x1145	1	
3.2		Conveyer Enclosure	865x945	1	
3.3		Scoop	285x55	25	
4	Parts To be Machined				
4.1		Idler Wheels/Pulley Wheel/Traction Wheel	240x100	4	
4.2		Driving Wheel	177x60	2	
4.3		BLDC Motor Frame	See Detailed Dimensions	1	
4.4		Stewart Platform Table	420x420	1	
4.5		Connecting Rod	4x2	25	300
4.6		BNO Mount	See Detailed Dimensions	1	
4.7		BLDC Coupler	See Detailed Dimensions	1	
4.8		Drive Couplers	See Detailed Dimensions	6	
6	Electronics			1	
6.1		Linear Actuator	5 cm actuation; Linear Actuation (12v DC)	3	
6.2		Offset Shaft Geared DC Motor	12v DC Motor with 300RPM	2	
6.3		Drive Motors- Magnum DC Geared Motors	12v DC Geared Motors with torque 34 N Cm	2	
6.4		BLDC Motor (Segway Motor)	24V DC Motor With 2650 RPM	1	
6.5		Rotary Encoders	May not be installed if are inbuilt in Drive motors (Recommended)	2	
6.6		BNO	Orientation Gyroscope Sensor	1	

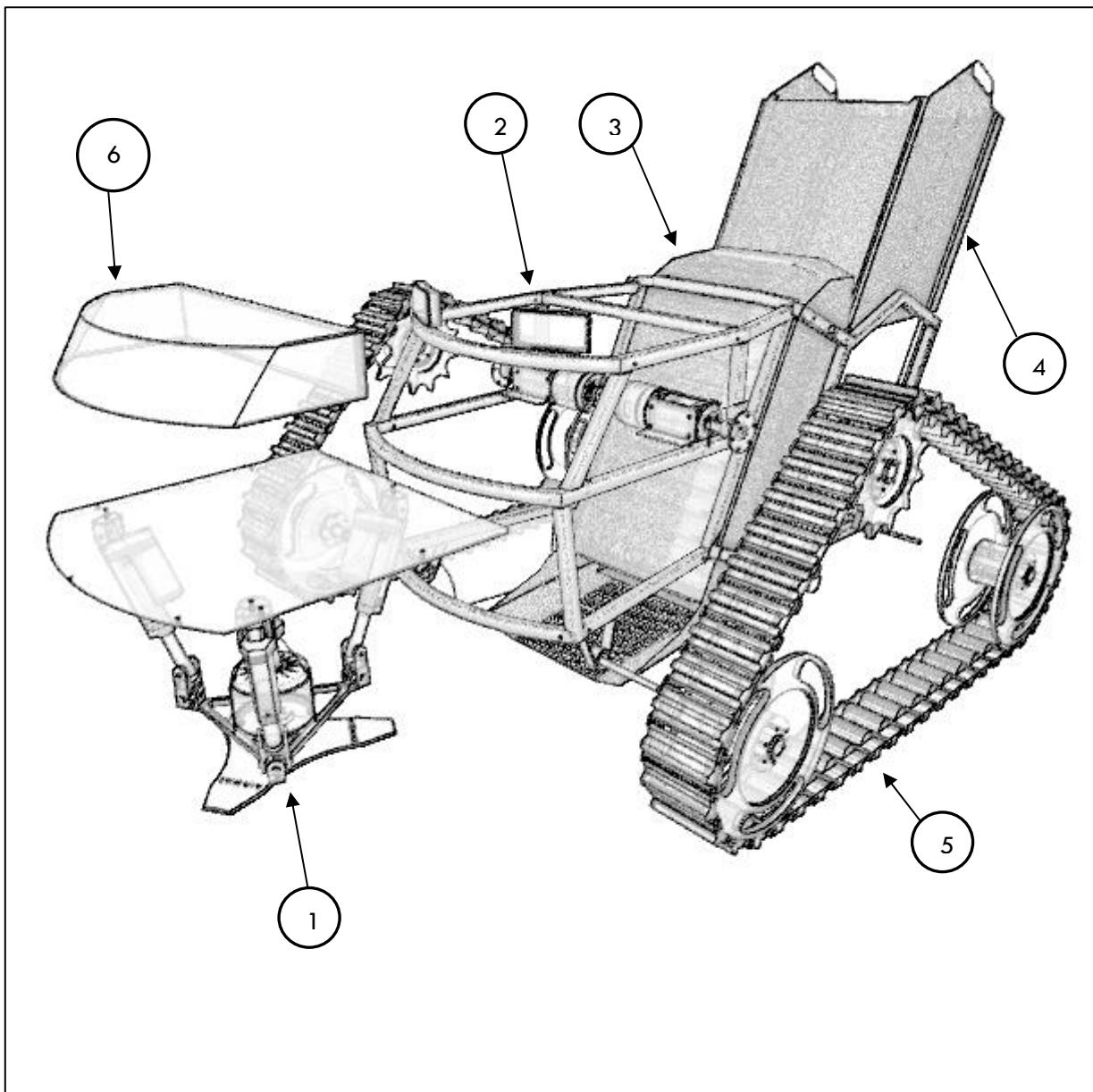
6.7		Load Cell	Round force sensitive resistor (FSR)- Interlink 402	1	
6.8		Raspberry Pi 2	A Single On-board computer	1	
6.9		Battery	Lead acid	2	
6.10		Battery management system	With fuse connectors	1	
6.11		Motor Drivers	Central motor controller.	1	
7	Parts as per end user convenience	Bought out items			
7.1		Acrylic or Glass shield	To enclose front module of chassis, especially the cutting blade Stewart platform and electronics	To be mounted as per convenience and requirement of end user (if required)	
7.2		Head Lights	Specifications - as per availability and need of end user	2	
7.3		Back Light	(Red Light)	1	
7.4		Wires		As Required	
7.5		Electronics enclosing chamber	To be made as per convenience		
7.6		Sim Shield 900	For Communication protocol		



## Assembly Details

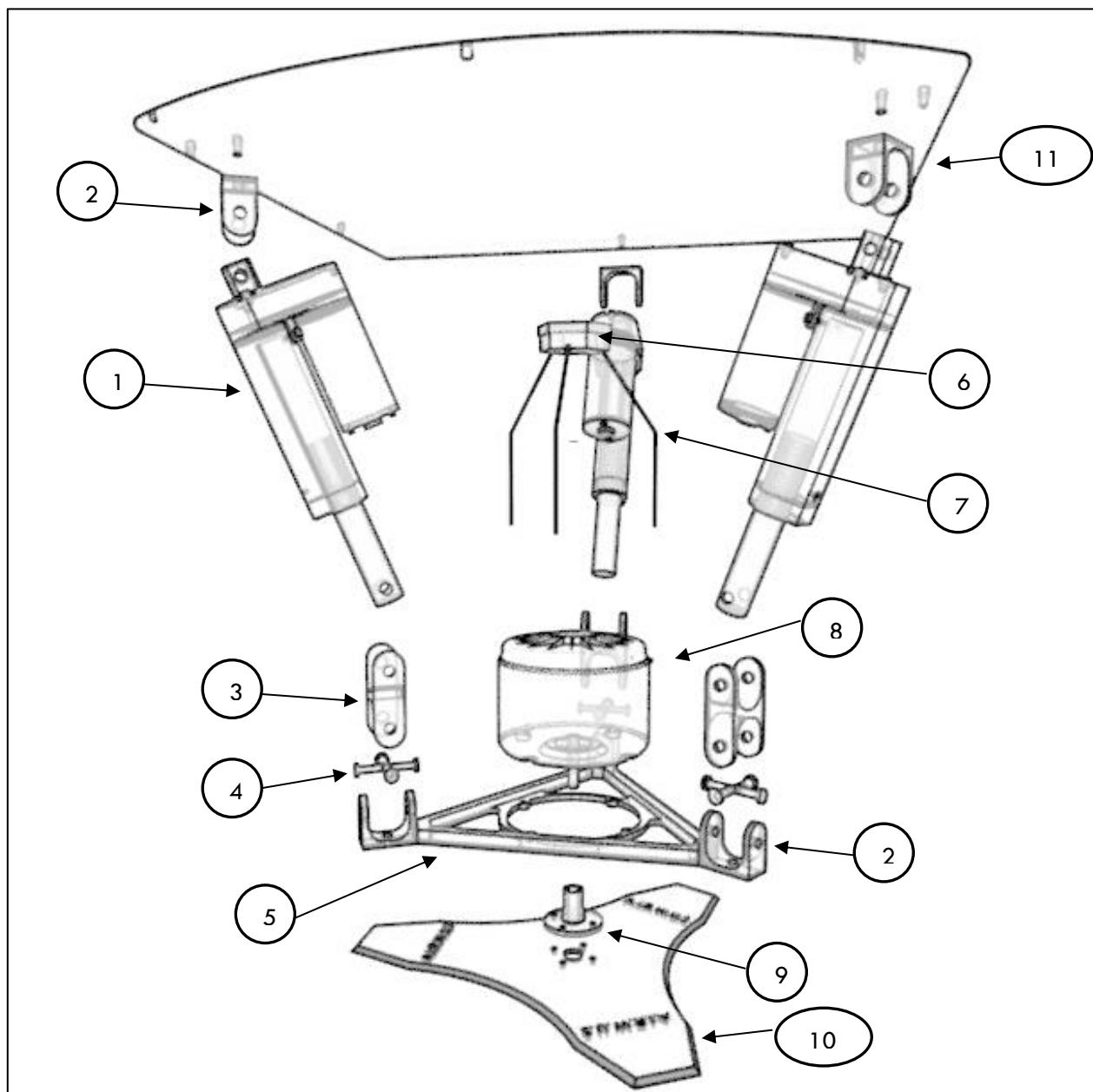
### 1) Top Assembly

Item No.	Part Name	Description	Quantity
1	Cutting Blade Stewart Platform Sub-Assembly	Connected to universal joint 1 and 2	1
2	Chassis Sub-Assembly	Mounted on table and on frame	1
3	Conveyer Sub-Assembly	Joins linear actuator shaft and universal joint 3	1
4	Detachable Module Sub-Assembly	Joins universal joint 2 and 1	1
5	Drive Sub-Assembly	Holds BLDC motor, universal joint 1 & BNO Mount	1
6	Electronics Sub-Assembly	Placed in BNO Box	1



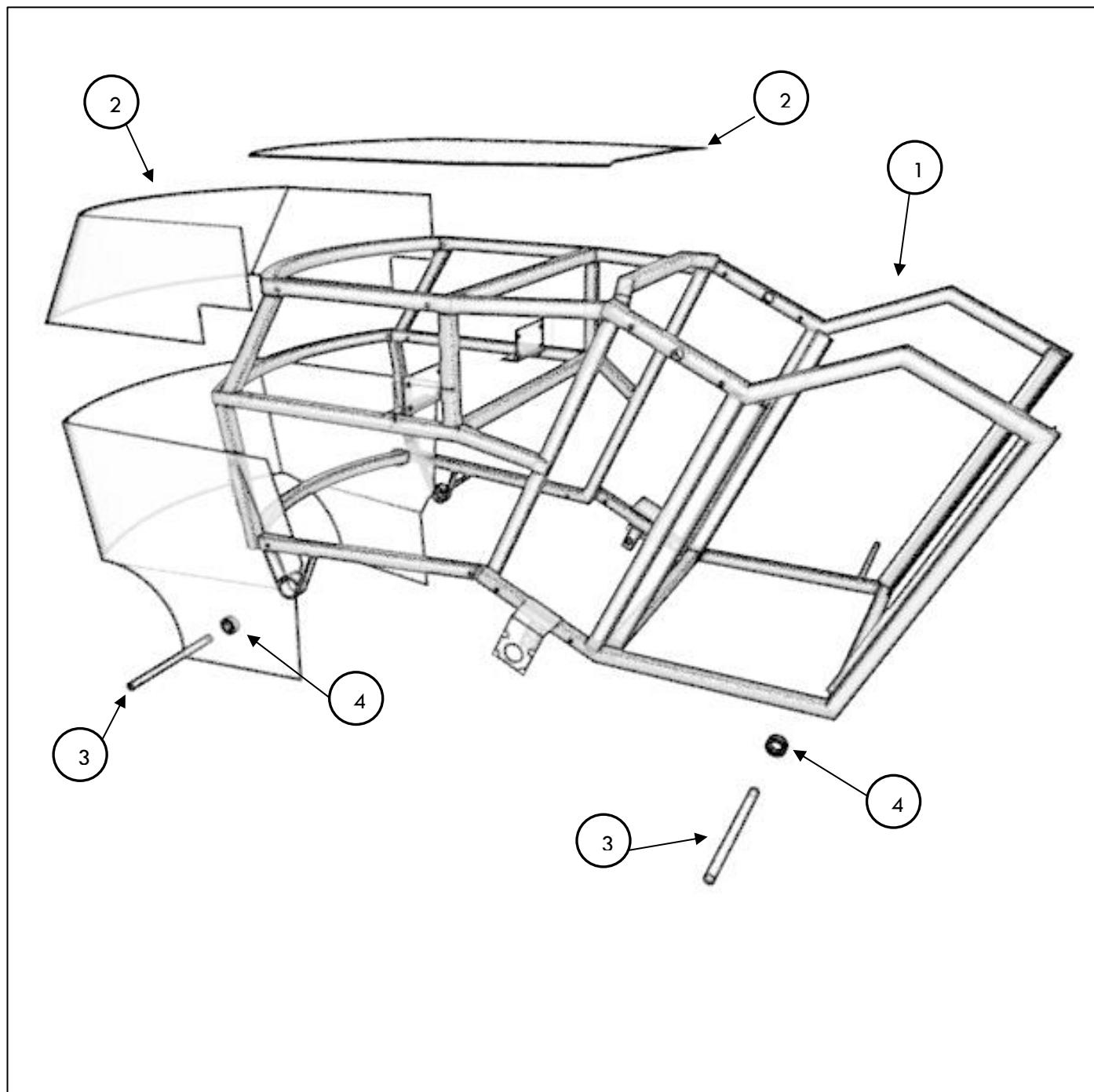
## 2) Cutting Blade Stewart Platform Sub-Assembly

Item No.	Part Name	Description	Quantity
1	Linear Actuator	Connected to universal joint 1 and 2	3
2	Universal Joint 1	Mounted on table and on frame	6
3	Universal Joint 2	Joins linear actuator shaft and universal joint 3	3
4	Universal Joint 3	Joins universal joint 2 and 1	3
5	BLDC Motor Frame	Holds BLDC motor, universal joint 1 & BNO Mount	1
6	BNO	Placed in BNO Box	1
7	BNO Mount	Placed on frame	1
8	BLDC Motor (Segway Motor)	Placed on Frame (fixed)	1
9	BLDC Coupler	Couples shaft and Blade	1
10	Cutting Blade	Joins to coupler	1
11	Stewart Platform Table	Holds Universal joint 1	1



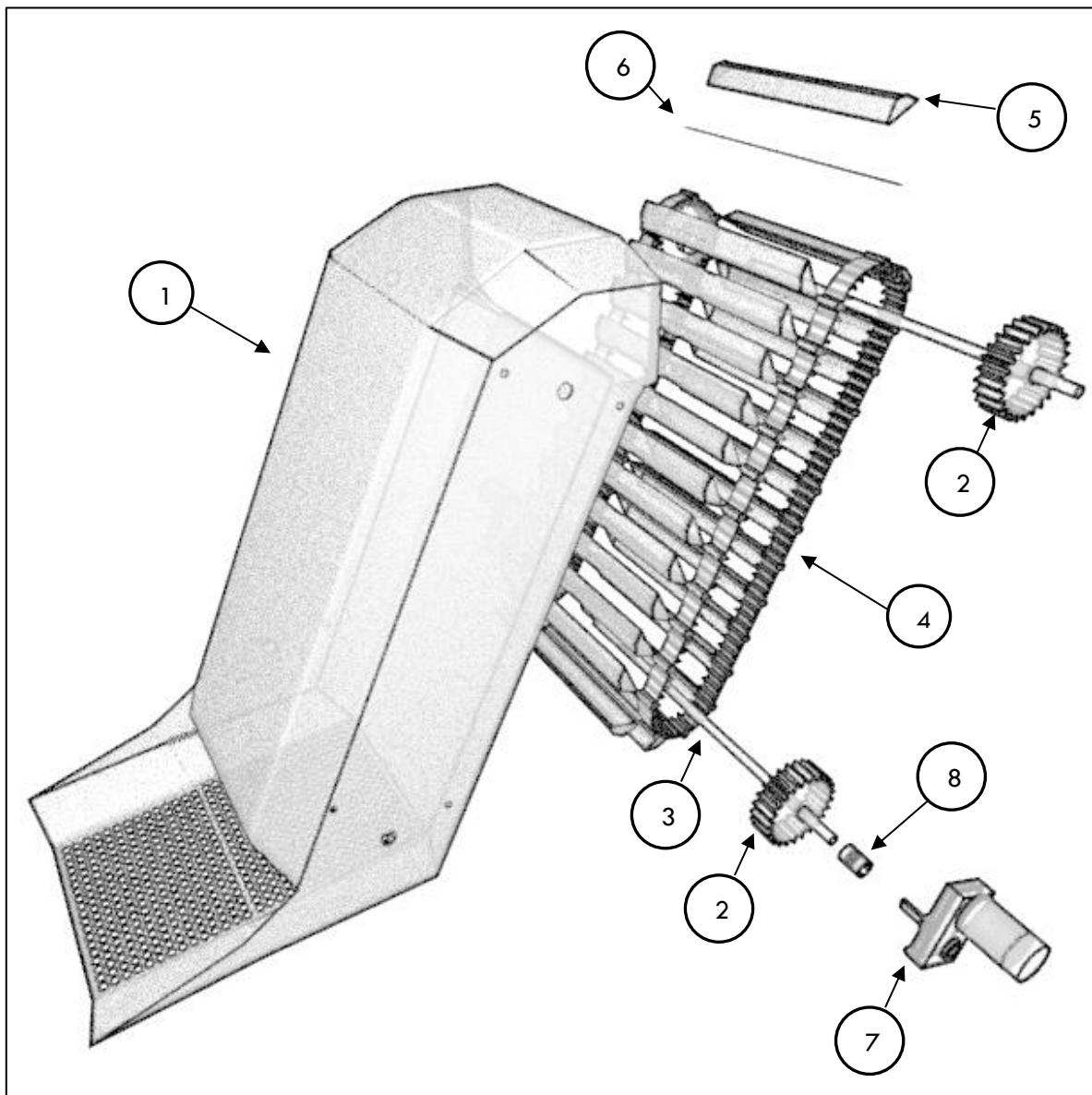
### 3) Chassis Sub-Assembly

Item No.	Part Name	Description	Quantity
1	Chassis	Welded Chassis	1
2	Acrylic or glass enclosure	Mounted on chassis if required by end user	7
3	Drive Shaft	Mounted on bearing	4
4	Bearings	Mounted on bearing mounts which are welded	4



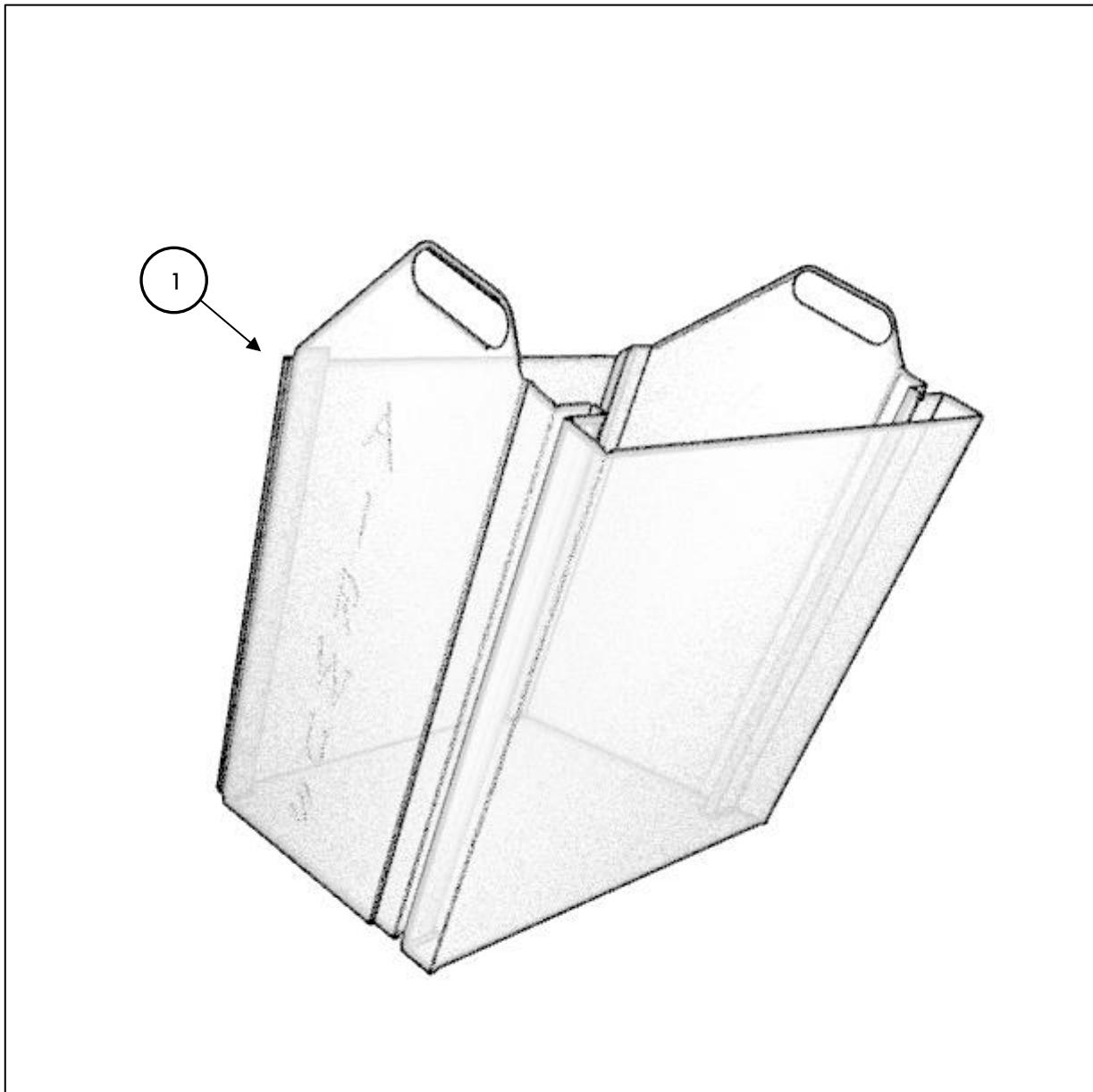
#### 4) Conveyer Sub-Assembly

Item No.	Part Name	Description	Quantity
1	Conveyer Enclosure	Wraps Conveyer, Mounted on chassis	1
2	ISO - Spur gear	Mounted on Shafts and chassis	4
3	Conveyer Shaft	Holds Spur gear	4
4	Conveyer Belt	Mounted on gears, holds connecting rod	2
5	Scoop	Mounted on connecting Rod	25
6	Connecting Rod	Joins Belt at its ends and holds scoop	25
7	Offset Shaft Geared DC Motor	Coupled with flex coupler	2
8	Flexible Shaft Coupler	Joins shaft with key and motor	2



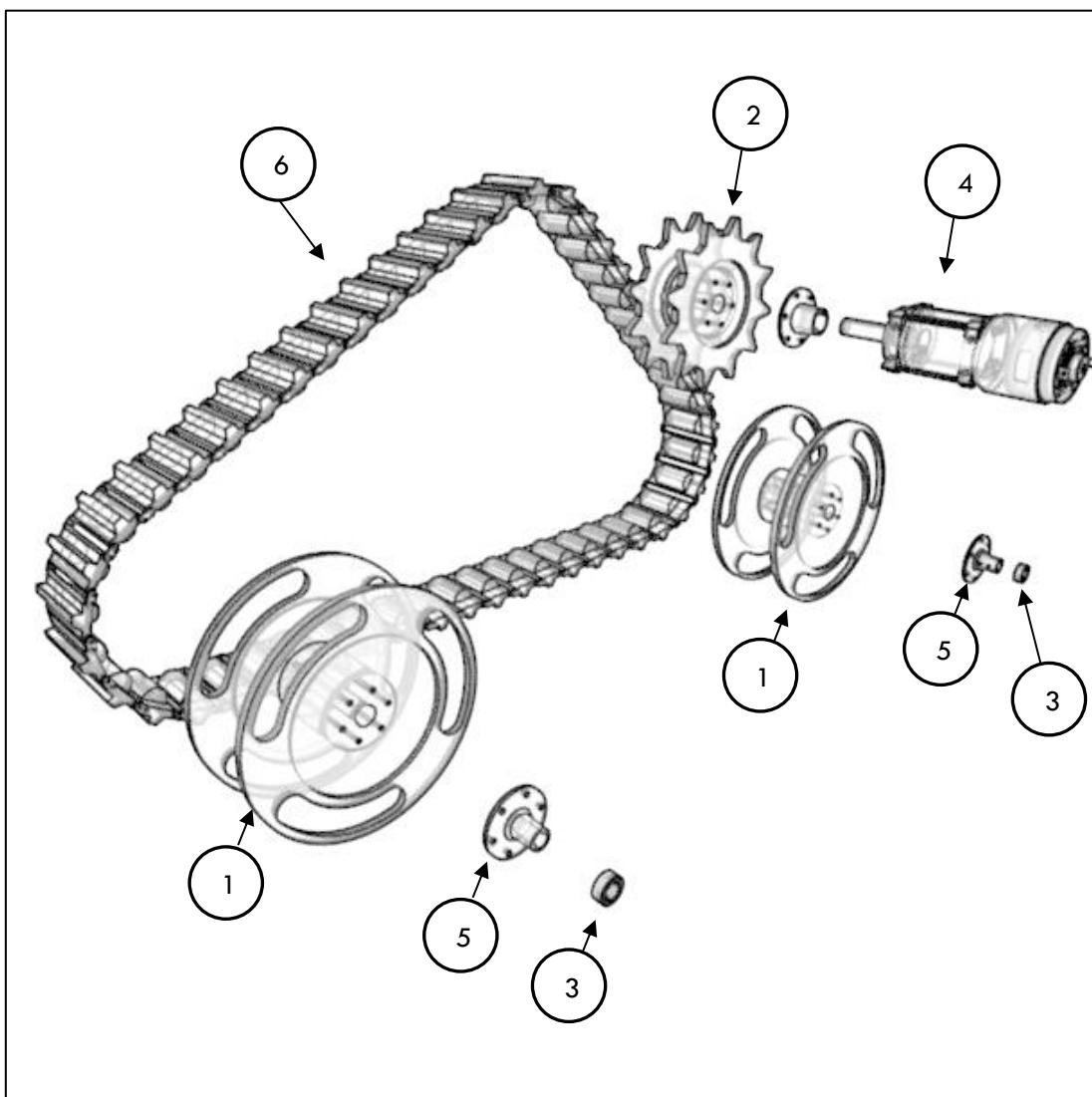
**5) Detachable Module Sub-Assembly**

Item No.	Part Name	Description	Quantity
1	Detachable Module	Placed at rear end of Chassis	1



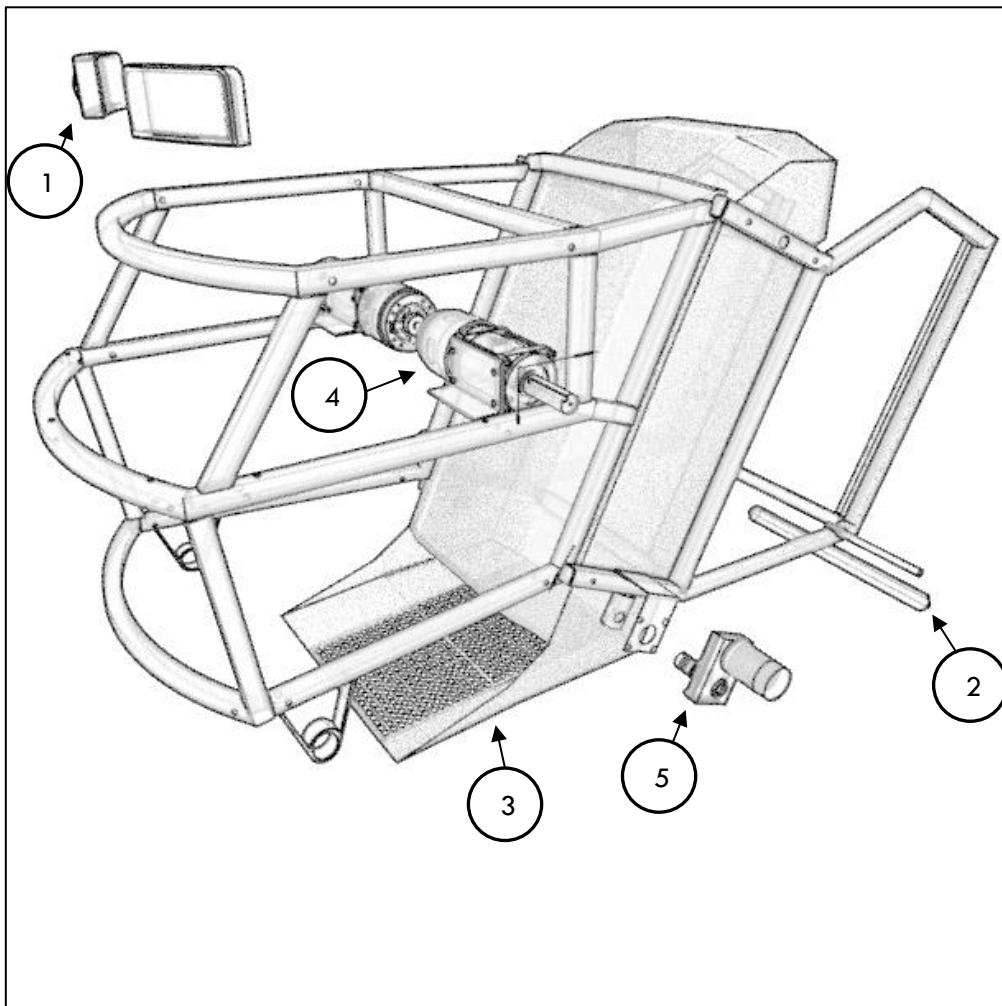
## 6) Drive Sub-Assembly

Item No.	Part Name	Description	Quantity
1	Idler Wheels/Pulley Wheel/Traction Wheel	Coupled with Drive Shaft	4
2	Driving Wheel	Coupled with Motor Coupler	2
3	Angular Contact Ball Bearings	Mounted on chassis using bearing mount	4
4	Drive Motors	Mounted on chassis and coupled with motor coupler	2
	Rotary Encoders	Inbuilt in motor	2
5	Drive Couplers (Motor Couplers)	Joins Motor and driving wheel	6
6	Drive belts	Connects 2 idle wheel and drive wheels	2



## 7) Motors & Electronics Sub-Assembly

Item No.	Part Name	Description	Quantity
1	Head Lights	Mounted at front upper end of Chassis	2
2	Back Light	Mounted at rear lower end of chassis	1
3	Load Cell	Mounted below conveyer enclosure scoop	1
4	Drive Motors	Mounted with chassis	2
5	Offset Shaft Geared Motor	Mounted with chassis	2

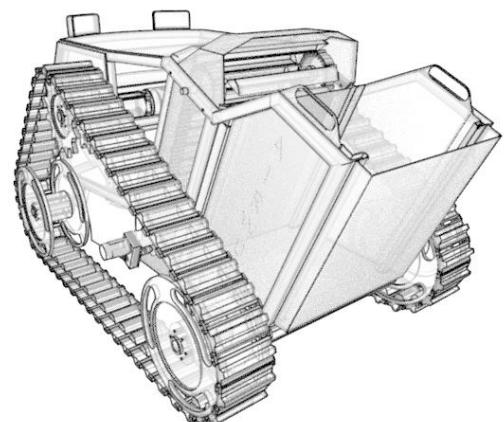


(Weight, Material, bend angles & other dimensions are given in Manufacturing details & drawings)

# Manufacturing Details & Drawings

## Order of Content-

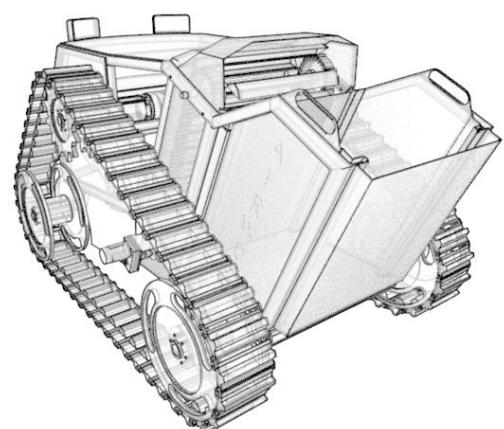
1. Conveyer Enclosure Bend Table
2. Detachable module Bend Table
3. Chassis Weldment Cut List
4. Stewart Platform Table
5. Universal Joint 1
6. Universal Joint 2
7. Universal Joint 3
8. BLDC Motor Frame
9. BNO Mount
10. Cutting Blade
11. Coupler
12. Conveyer Enclosure
13. Conveyer Belt
14. Connecting Rod
15. Conveyer Shaft (with Key & without key)
16. Conveyer Gear (ISO - Spur gear 3M 25T 14.5PA 25.4FW-S25B30H35L12.0S)
17. Scoop
18. Flexible Shaft Coupler
19. Detachable Module
20. Chassis
  - a. Conveyer Motor Mount
  - b. Bearing Mount
21. Driven Wheels (Traction Wheels)
22. Bearings (ISO 15 ABB - 3912 - 12, SI, NC,12\_68)
23. Drive Shaft
24. Driving Wheels
25. Drive Belts



(For Given data and drawings, **all dimensions are in mm**, unless specified)

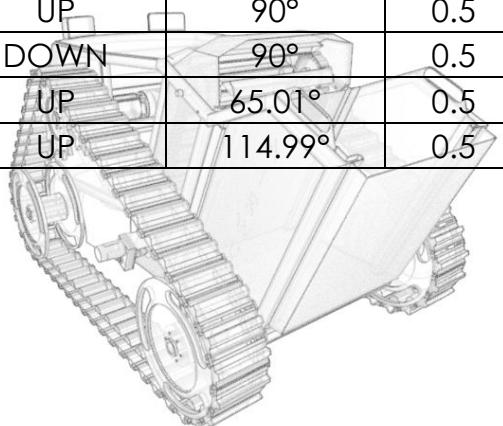
### 1) Conveyer Enclosure Bend Table

Tag	Direction	Angle	Inner Radius
A	DOWN	20°	0.5
B	DOWN	28.12°	0.5
C	DOWN	36.47°	0.5
D	DOWN	20°	0.5
E	DOWN	70.95°	0.5
F	DOWN	70.95°	0.5
G	DOWN	70.86°	0.5
H	DOWN	70.63°	0.5
J	DOWN	70.86°	0.5
K	DOWN	70.63°	0.5
L	DOWN	70°	0.5
M	DOWN	70°	0.5
N	DOWN	20°	0.5
P	DOWN	70°	0.5
R	DOWN	70°	0.5
T	DOWN	20°	0.5



## 2) Detachable module Bend Table

Tag	Direction	Angle	Inner Radius	Tag	Direction	Angle	Inner Radius
A	DOWN	180°	0.05	AL	UP	90°	0.5
B	DOWN	180°	0.05	AM	UP	90°	0.5
C	DOWN	180°	0.05	AN	UP	90°	0.5
D	DOWN	180°	0.05	AP	UP	90°	0.5
E	UP	90°	0.5	AR	UP	90°	0.5
F	UP	90°	0.5	AT	UP	90°	0.5
G	UP	180°	0.06	AU	UP	90°	0.5
H	UP	180°	0.06	AV	UP	90°	0.5
J	UP	180°	0.06	AW	UP	90°	0.5
K	UP	180°	0.06	AY	UP	89.21°	0.5
L	UP	180°	0.06	BA	UP	0.79°	0.5
M	UP	180°	0.06	BB	DOWN	90°	0.5
N	UP	180°	0.06	BC	DOWN	90.79°	0.5
P	UP	180°	0.06	BD	UP	90.85°	0.5
R	UP	180°	0.06	BE	UP	90°	0.5
T	UP	180°	0.06	BF	DOWN	90°	0.5
U	UP	180°	0.06	BG	DOWN	90°	0.5
V	UP	180°	0.06	BH	UP	90°	0.5
W	UP	180°	0.06	BJ	DOWN	90°	0.5
Y	UP	65°	0.5	BK	UP	89.21°	0.5
AA	UP	115°	0.5	BL	UP	0.79°	0.5
AB	UP	115°	0.5	BM	DOWN	90°	0.5
AC	UP	115°	0.5	BN	DOWN	90.79°	0.5
AD	UP	90°	0.5	BP	UP	90.85°	0.5
AE	UP	90°	0.5	BR	UP	90°	0.5
AF	UP	89.94°	0.5	BT	DOWN	90°	0.5
AG	UP	89.94°	0.5	BU	DOWN	90°	0.5
AH	UP	65°	0.5	BV	UP	90°	0.5
AJ	UP	115°	0.5	BW	DOWN	90°	0.5
AK	UP	90°	0.5	BY	UP	65.01°	0.5
				CA	UP	114.99°	0.5



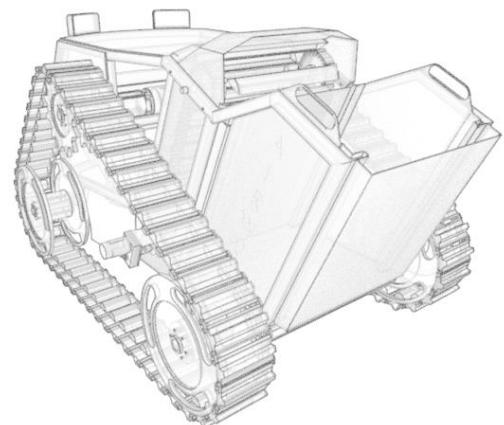
### 3) Chassis Weldment Cut List

ITEM NO.	QTY.	DESCRIPTION	LENGTH	ANGLE1	ANGLE2	MATERIAL
1	1	TUBE, SQUARE 20.00 X 20.00 X 2.00	370.44	28.7°	17.93°	6061-T6 (SS)
2	1	TUBE, SQUARE 20.00 X 20.00 X 2.00	432.17	0°	0°	6061-T6 (SS)
3	1	TUBE, SQUARE 20.00 X 20.00 X 2.00	379.99	-	-	6061-T6 (SS)
4	1	TUBE, SQUARE 20.00 X 20.00 X 2.00	266.15	23.66°	7.76°	6061-T6 (SS)
5	1	TUBE, SQUARE 20.00 X 20.00 X 2.00	446.63	0°	0°	6061-T6 (SS)
6	1	TUBE, SQUARE 20.00 X 20.00 X 2.00	170.11	33.86°	33.86°	6061-T6 (SS)
7	2	TUBE, SQUARE 20.00 X 20.00 X 2.00	130	0°	0°	6061-T6 (SS)
8	1	TUBE, SQUARE 20.00 X 20.00 X 2.00	170.01	33.86°	33.86°	6061-T6 (SS)
9	1	20 x 20 x 2.0	417.3	45°	32.63°	6061-T6 (SS)
10	1	20 x 20 x 2.0	65.86	10°	45°	6061-T6 (SS)
11	1	20 x 20 x 2.0	206.25	10°	10°	6061-T6 (SS)
12	1	20 x 20 x 2.0	65.86	45°	10°	6061-T6 (SS)
13	1	20 x 20 x 2.0	417.3	32.63°	45°	6061-T6 (SS)
14	1	20 x 20 x 2.0	351.08	-	32.63°	6061-T6 (SS)
15	1	20 x 20 x 2.0	433.69	-	-	6061-T6 (SS)
16	1	20 x 20 x 2.0	350.99	32.63°	-	6061-T6 (SS)
17	1	TUBE, SQUARE 20.00 X 20.00 X 2.00	370.44	17.93°	28.7°	6061-T6 (SS)
18	1	TUBE, SQUARE 20.00 X 20.00 X 2.00	115.3	17.93°	-	6061-T6 (SS)
19	1	TUBE, SQUARE 20.00 X 20.00 X 2.00	115.3	-	17.93°	6061-T6 (SS)
20	1	TUBE, SQUARE 20.00 X 20.00 X 2.00	379.98	-	-	6061-T6 (SS)
21	1	20 x 20 x 2.0	201.71	0°	0°	6061-T6 (SS)
22	4					6061-T6 (SS)
23	1	20 x 20 x 2.0	182.48	0°	22.85°	6061-T6 (SS)
24	1	20 x 20 x 2.0	182.31	0°	22.85°	6061-T6 (SS)
25	1	20 x 20 x 2.0	180.51	12.5°	0°	6061-T6 (SS)
26	1	20 x 20 x 2.0	320.97	-	2.23°	6061-T6 (SS)
27	1	20 x 20 x 2.0	180.18	12.5°	0°	6061-T6 (SS)
28	1	20 x 20 x 2.0	296.85	32.5°	12.5°	6061-T6 (SS)
29	1	20 x 20 x 2.0	396.64	45°	32.5°	6061-T6 (SS)
30	1	20 x 20 x 2.0	165.09	22.85°	45°	6061-T6 (SS)
31	2	20 x 20 x 2.0	167.25	22.85°	22.85°	6061-T6 (SS)
32	1	20 x 20 x 2.0	296.19	32.5°	12.5°	6061-T6 (SS)
33	1	20 x 20 x 2.0	395.36	45°	32.5°	6061-T6 (SS)

34	1	20 x 20 x 2.0	163.99	22.85°	45°	6061-T6 (SS)
35	1	20 x 20 x 2.0	2.16	87.76°	0°	6061-T6 (SS)
36	1	20 x 20 x 2.0	385.45	-	-	6061-T6 (SS)
37	1	20 x 20 x 2.0	2.18	0°	87.78°	6061-T6 (SS)
38	1	20 x 20 x 2.0	320.19	0°	0°	6061-T6 (SS)
39	1	20 x 20 x 2.0	384.51	-	-	6061-T6 (SS)
40	1	20 x 20 x 2.0	5.21	0°	87.76°	6061-T6 (SS)
41	1	25x25x3	375.07	0°	0°	6061-T6 (SS)
42	1	25x25x3	375.41	0°	0°	6061-T6 (SS)
43	1	25x25x3	372.44	-	0°	6061-T6 (SS)
44	1	25x25x3	384.49	0°	-	6061-T6 (SS)
45	1	TUBE, SQUARE 20.00 X 20.00 X 2.00	186.92	7.76°	-	6061-T6 (SS)
46	1	20 x 20 x 2.0	40	0°	0°	6061-T6 (SS)
47	1	TUBE, SQUARE 20.00 X 20.00 X 2.00	186.92	-	7.76°	6061-T6 (SS)
48	1	50x30x4	87.75	0°	0°	6061-T6 (SS)
49	1	50x30x4	87.75	0°	0°	6061-T6 (SS)
50	1	20 x 20 x 2.0	201.71	0°	0°	6061-T6 (SS)
51	1	TUBE, SQUARE 20.00 X 20.00 X 2.00	266.15	7.76°	23.66°	6061-T6 (SS)

### Materials Required

Type	Dimension	Quantity	Total Length
Tube, Square	20.00 X 20.00 X 2.00	-	11055.7
L angle	25x25x3	-	1507.4
Drive Motor Mount (L angle)	50x30x4	-	175.5
Bearing Mount	120x120x25	4	



# Design Calculations

## 1. Motor Calculations

### i) Drive Motors –

Mass of Subassembly	Radius of wheel	Required Torque
18.805 kg	8.80 cm	165.5 kg-cm

### ii) Conveyer Motors –

The sub assembly is held by 2 motors. Hence the required torque is half of the calculated value for each motor.

Mass of Subassembly	Radius of wheel	Required Torque	Required Torque for each motor
3.338 kg	4.05 cm	13.59 kg-cm	6.795 kg-cm

## 2. Weed collection calculations

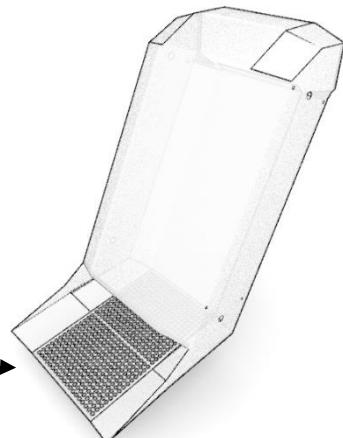
Volume of primary scoop = 9780 cubic.cm

Volume of secondary scoop = 754 cubic.cm

Number of secondary scoops = 26

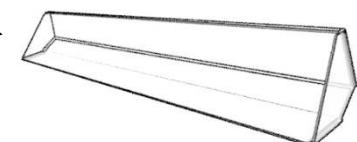
Volume of detachable module = 66580 cubic.cm

Weight of weed required in primary scoop to trigger conveyer Subassembly = 500g



weight of weed carried by secondary scoop -

$$(754 \times 500) / 9780 = 38.5 \text{ g}$$



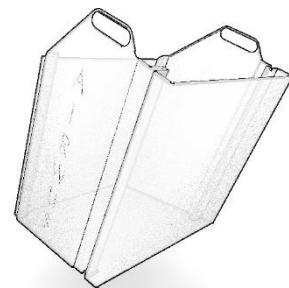
weight of weed carried by detachable module -

$$(66580 \times 500) / 9780 = 3.403 \text{ kg}$$



Number of secondary scoops required to fill detachable module -

$$3403 / 38.5 = 88.4 \text{ (88 scoops)}$$



Number of cycles required to fill detachable module –

$$88.4/26 = 3.4 \text{ cycles}$$

### 3. Field area covered by system to completely fill the detachable module

If a Y sq. m area grows X grams weed, then the area covered by system (A) is –

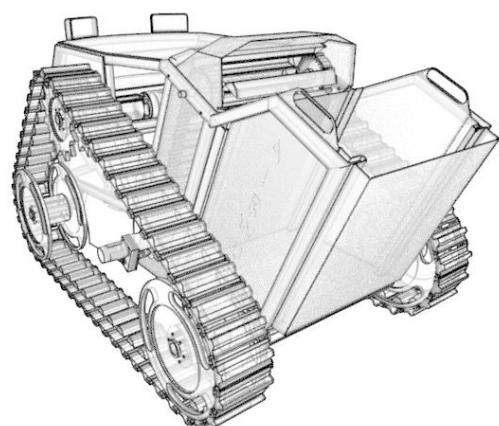
$$A = (Y*3403)/X$$

e.g.  $y = 100 \text{ sq.m}$

$x = 250 \text{ g}$

$$A = (100*3403)/250 = 1361 \text{ sq.m}$$

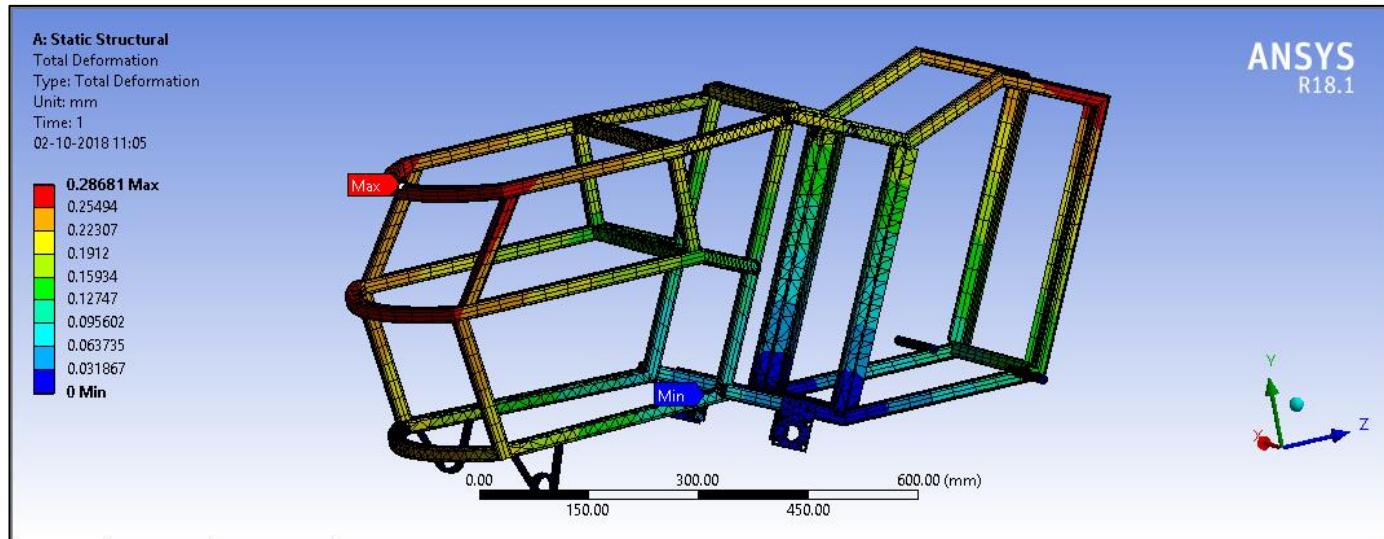
Once the area A is covered. The detachable module gets filled. Hence, the system goes to nearest docking point. The farmer evacuates the module manually.



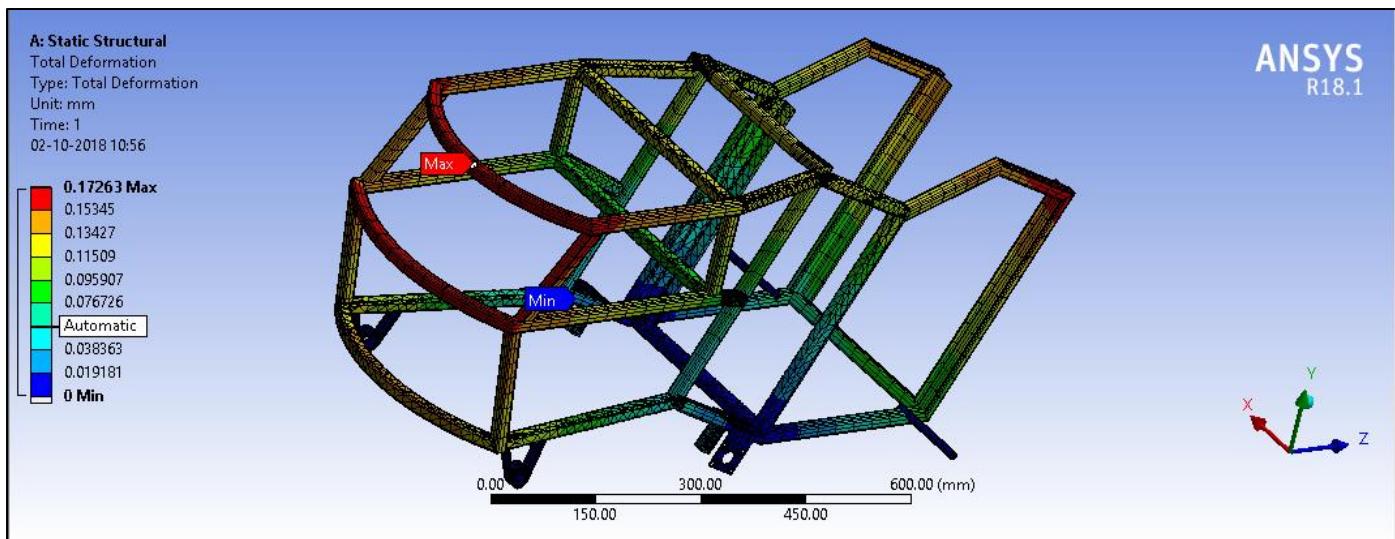
# Simulation Report

## STATIC ANALYSIS OF THE CHASSIS

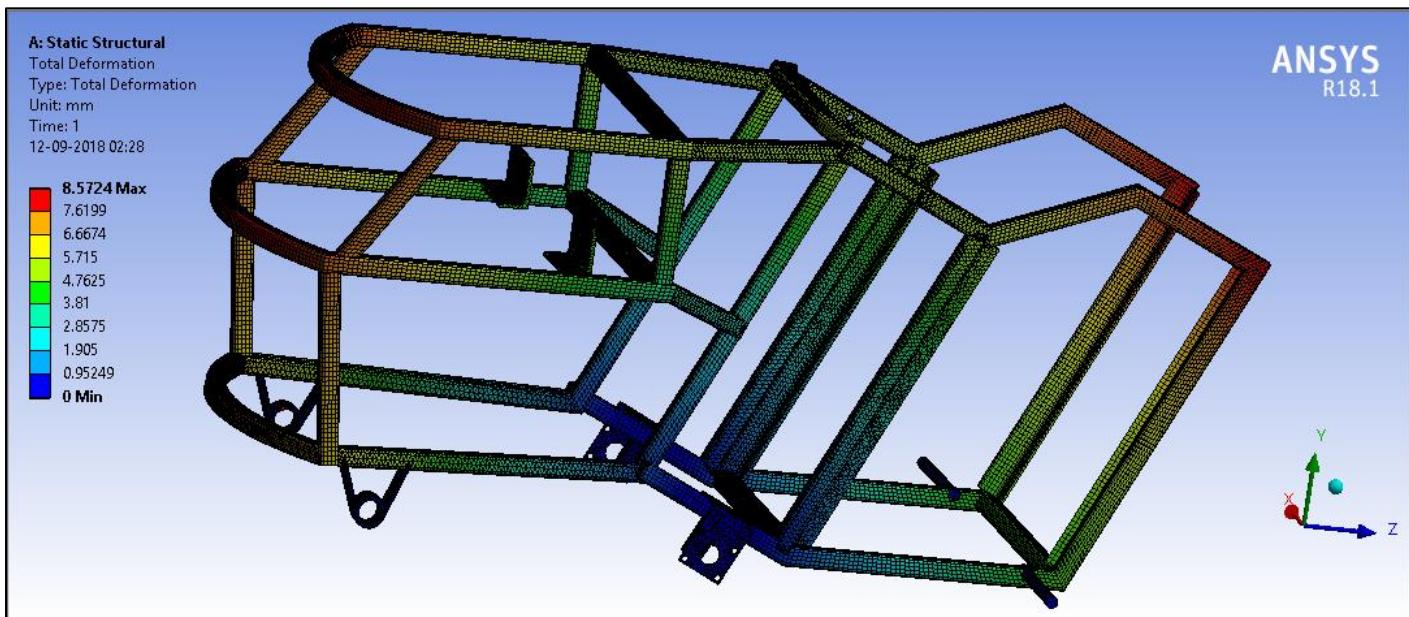
- Several Finite Element Analysis(FEA) were done on the chassis to decide the final material of the chassis.
- The approach used was by comparison.



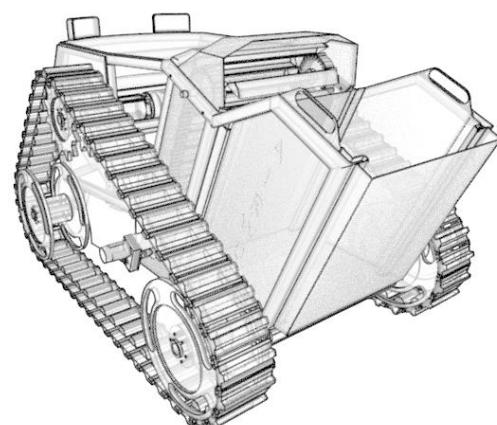
- The first material chosen was Galvanised Cast Iron and the deformation noted was based on self-weight.
- The maximum deformation noted was of 0.29mm.
- This was considered and kept for comparison with other materials.



- Next analysis was done on Structural steel and Aluminium 6061 Alloy. The deformations were similar in the range of 0.17mm
- Hence, cast iron was discarded due to greater deformation. The final deduction came down to the selection of structural steel and aluminium.
- Aluminium was chosen as it has a comparatively cheaper cost when compared to steel.



- This was an overtime deformation plot due to the weight of the components. Causing us to re-buy the chassis after around 8 years.



# Costing Report

(generated using Solidworks Costing tool)

**Estimated Cost per System – RS. 2,67,120**

## Cost Breakdown:

### 1) Parts to be bought-

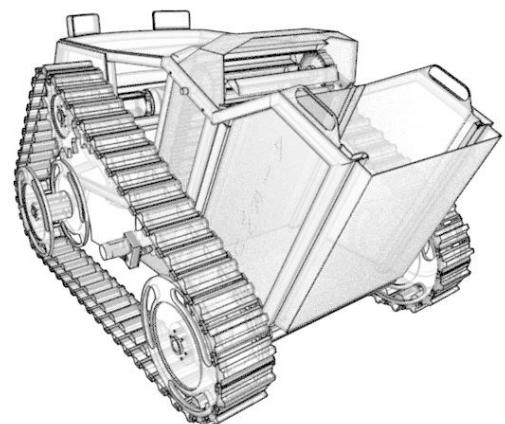
S.No.	Part	Quantity	Price per unit (Rs.)	Total Cost (Rs.)
1	Flexible Shaft Coupler	2	400	800
2	Shaft With key	2	200	400
3	Shaft Without key	2	200	400
4	Drive shaft	4	800	3200
5	Caterpillar Drive belts	2	25000	50000
6	Timing Belt (Conveyer)	2	4000	8000
7	ISO - Spur gear	4	2000	8000
8	Angular Contact Ball Bearings	4	500	2000
9	Universal Joint 1	6	300	1800
10	Universal Joint 2	3	300	900
11	Universal Joint 3	3	300	900
12	Standard Cutting Blade	1	3000	3000
13	Standard L Mount for offset Shaft Motor	2	500	1000
14	Linear Actuator	3	3000	9000
15	Offset Shaft Geared DC Motor	2	2000	4000
16	Drive Motors- Magnum DC Geared Motors with encoder	2	40000	80000
17	BLDC Motor (Segway Motor)	1	4000	4000
18	Motor Drivers	1	3000	3000
19	BNO	1	4000	4000
20	Load Cell	1	700	700
21	Raspberry Pi 2	1	2500	2500
22	Battery	2	3000	6000
23	Battery management system	1	800	800
24	Wires	As required	1000	1000

## 2) Parts to be machined-

S.No.	Part	Material Cost	Manufacturing cost	Total Cost (Rs.)
1	Chassis	42120	6000	48120
2	Detachable Module	4000	800	4800
3	Conveyer Enclosure	3000	800	3800
4	Scoop (26)	2000	800	2800
5	Idler Wheels/Pulley Wheel/Traction Wheel	2000	900	2900
6	Driving Wheel	1000	800	1800
7	BLDC Motor Frame	1000	2000	3000
8	Stewart Platform Table	500	1000	1500
9	Connecting Rod	500	300	800
10	BNO Mount	300	300	600
11	BLDC Coupler	500	300	800
12	Drive Couplers	500	300	800

## 3) Total Cost-

S.No.	Part	Total Cost (Rs.)
1	Parts to be bought	195400
2	Parts to be machined	71720
3	<b>Total</b>	<b>267120</b>



# Sustainability Report

(generated using Solidworks Sustainability tool)

## Environmental Impact (calculated using CML impact assessment methodology)

### Carbon Footprint



5800 kg CO<sub>2</sub>e

### Total Energy Consumed



7.1E+4 MJ

<span style="color: blue;">█</span> Material:	5300 kg CO <sub>2</sub> e
<span style="color: yellow;">█</span> Manufacturing:	390 kg CO <sub>2</sub> e
<span style="color: orange;">█</span> Use:	0.00 kg CO <sub>2</sub> e
<span style="color: purple;">█</span> Transportation:	57 kg CO <sub>2</sub> e
<span style="color: cyan;">█</span> End of Life:	53 kg CO <sub>2</sub> e

<span style="color: blue;">█</span> Material:	6.6E+4 MJ
<span style="color: yellow;">█</span> Manufacturing:	3900 MJ
<span style="color: orange;">█</span> Use:	0.00 MJ
<span style="color: purple;">█</span> Transportation:	760 MJ
<span style="color: cyan;">█</span> End of Life:	39 MJ

### Air Acidification



42 kg SO<sub>2</sub>e

<span style="color: blue;">█</span> Material:	35 kg SO <sub>2</sub> e
<span style="color: yellow;">█</span> Manufacturing:	5.5 kg SO <sub>2</sub> e
<span style="color: orange;">█</span> Use:	0.00 kg SO <sub>2</sub> e
<span style="color: purple;">█</span> Transportation:	0.524 kg SO <sub>2</sub> e
<span style="color: cyan;">█</span> End of Life:	0.027 kg SO <sub>2</sub> e

### Water Eutrophication



1.8 kg PO<sub>4</sub>e

<span style="color: blue;">█</span> Material:	1.4 kg PO <sub>4</sub> e
<span style="color: yellow;">█</span> Manufacturing:	0.211 kg PO <sub>4</sub> e
<span style="color: orange;">█</span> Use:	0.00 kg PO <sub>4</sub> e
<span style="color: purple;">█</span> Transportation:	0.076 kg PO <sub>4</sub> e
<span style="color: cyan;">█</span> End of Life:	0.064 kg PO <sub>4</sub> e

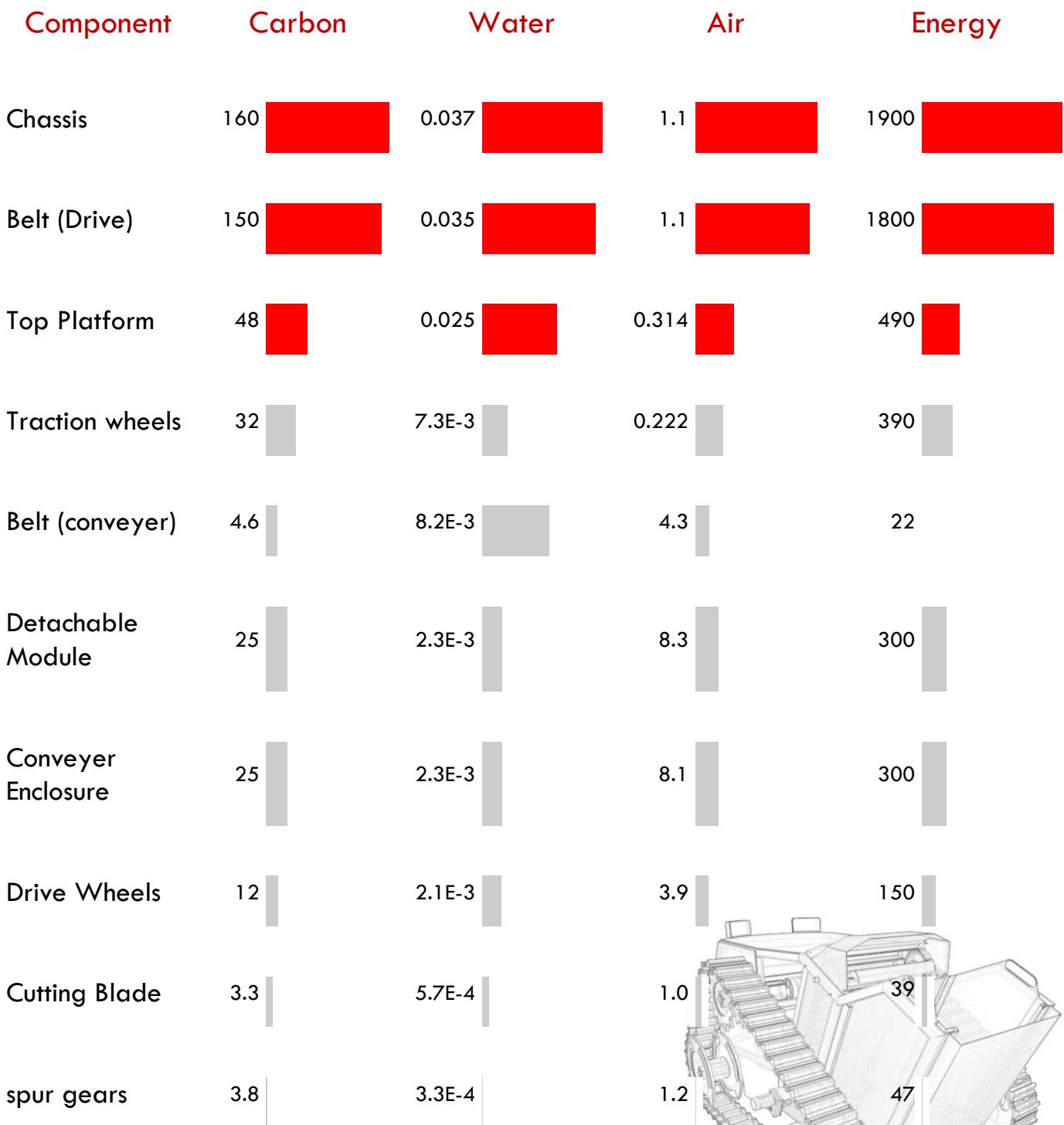
### Material Financial Impact

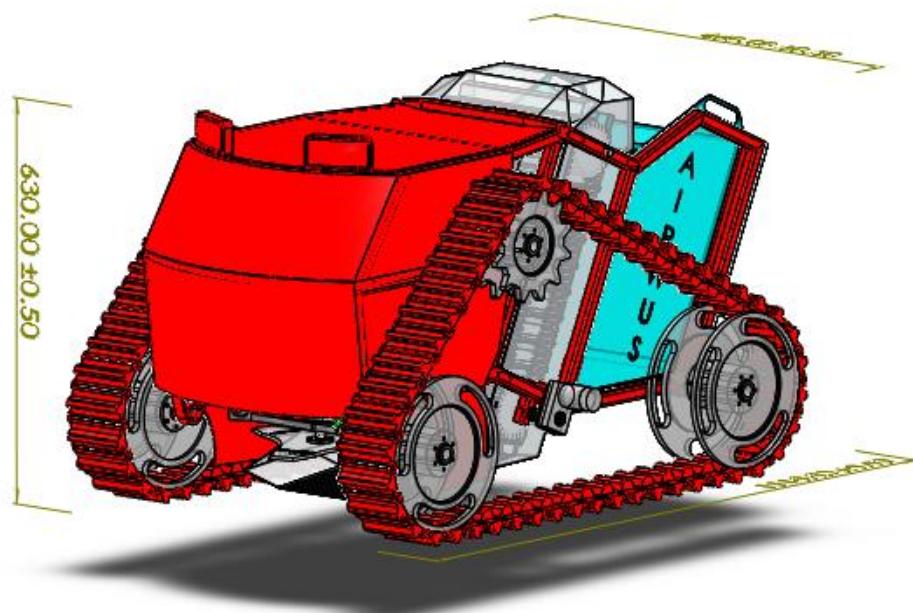
878.80 USD

System Weight	69.058 Kg
Built to last	8 years
Duration of use	8 years
Assembly process	Region: India
Use	Region: India
End of Life	Recycled: 8% Incinerated: 20% Landfill: 73%

## Component Environmental Impact

Top Ten Components Contributing Most to the Four Areas of Environmental Impact:





## Glossary

**Air Acidification** - Sulphur dioxide, nitrous oxides other acidic emissions to air cause an increase in the acidity of rainwater, which in turn acidifies lakes and soil. These acids can make the land and water toxic for plants and aquatic life. Acid rain can also slowly dissolve manmade building materials such as concrete. This impact is typically measured in units of either kg **sulphur dioxide equivalent (SO<sub>2</sub>)**, or **moles H<sup>+</sup> equivalent**.

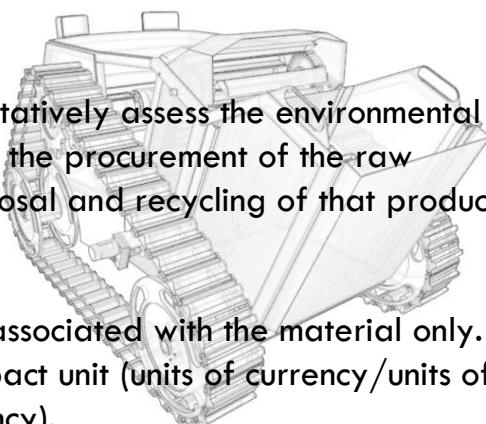
**Carbon Footprint** - Carbon-dioxide and other gasses which result from the burning of fossil fuels accumulate in the atmosphere which in turn increases the earth's average temperature. Carbon footprint acts as a proxy for the larger impact factor referred to as Global Warming Potential (GWP). Global warming is blamed for problems like loss of glaciers, extinction of species, and more extreme weather, among others.

**Total Energy Consumed** - A measure of the non-renewable energy sources associated with the part's lifecycle in units of megajoules (**MJ**). This impact includes not only the electricity or fuels used during the product's lifecycle, but also the upstream energy required to obtain and process these fuels, and the embodied energy of materials which would be released if burned. PED is expressed as the net calorific value of energy demand from non-renewable resources (e.g. petroleum, natural gas, etc.). Efficiencies in energy conversion (e.g. power, heat, steam, etc.) are considered.

**Water Eutrophication** - When an overabundance of nutrients is added to a water ecosystem, eutrophication occurs. Nitrogen and phosphorous from waste water and agricultural fertilizers causes an overabundance of algae to bloom, which then depletes the water of oxygen and results in the death of both plant and animal life. This impact is typically measured in either kg **phosphate equivalent (PO<sub>4</sub>)** or **kg nitrogen (N) equivalent**.

**Life Cycle Assessment (LCA)** - This is a method to quantitatively assess the environmental impact of a product throughout its entire lifecycle, from the procurement of the raw materials, through the production, distribution, use, disposal and recycling of that product.

**Material Financial Impact** - This is the financial impact associated with the material only. The mass of the model is multiplied by the financial impact unit (units of currency/units of mass) to calculate the financial impact (in units of currency).



8

7

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F

F

ITEM NO.

PART NUMBER

DESCRIPTION

QTY.

Mass

Material

1

Top Platform

Top Platform @ Cutting Blade  
sub-assembly

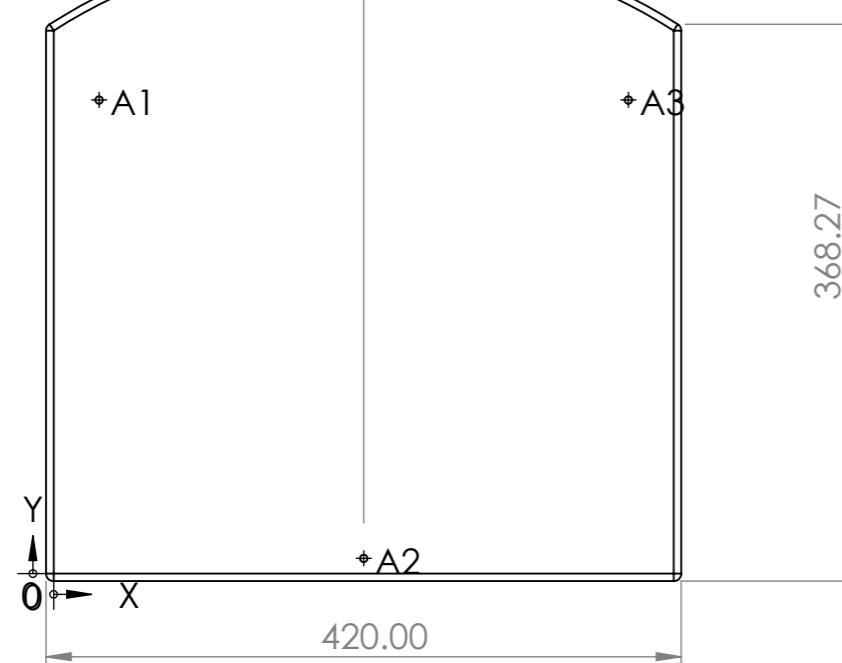
1

4172.20

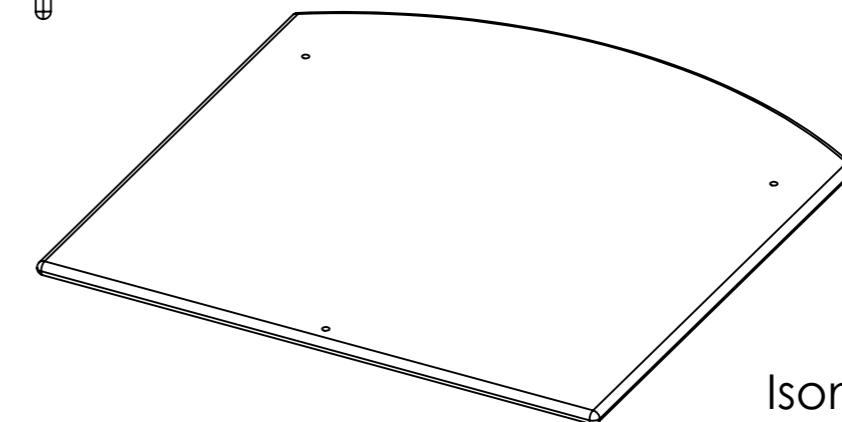
Glass

## Hole Table

TAG	X LOC	Y LOC	SIZE
A1	30	313.11	$\odot 5.00$ THRU
A2	205	10	$\odot 5.00$ THRU
A3	380	313.11	$\odot 5.00$ THRU



Right View



UNLESS OTHERWISE SPECIFIED: DIMENSIONS ARE IN MILLIMETERS SURFACE FINISH: TOLERANCES: LINEAR: ANGULAR:	FINISH:	DEBURR AND BREAK SHARP EDGES	DO NOT SCALE DRAWING	REVISION
DRAWN	NAME	SIGNATURE	DATE	
CHK'D				
APP'D				
MFG				
QA				
	MATERIAL:	Title: Top Platform @ Cutting Blade sub-assembly		
	Glass	DWG NO. A3		
	WEIGHT:	SCALE: 1:5		
		SHEET 1 OF 1		

Top Platform

A3

8

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2

1

F

F

ITEM NO.

PART NUMBER

DESCRIPTION

QTY.

Mass

Material

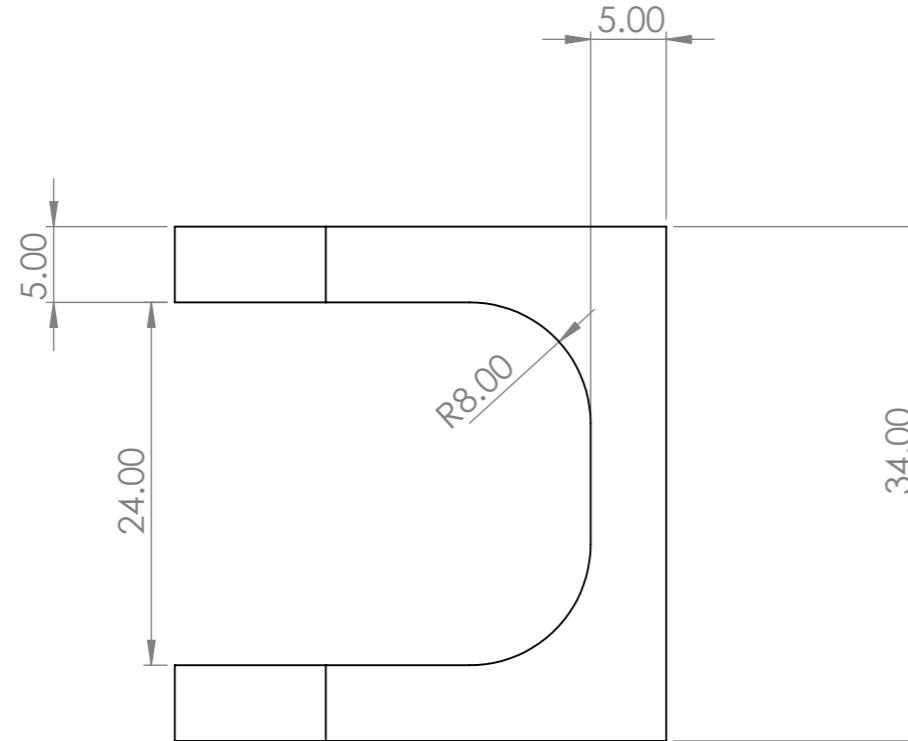
1 Universal Joint 1

Universal Joint @ Stewart Platform

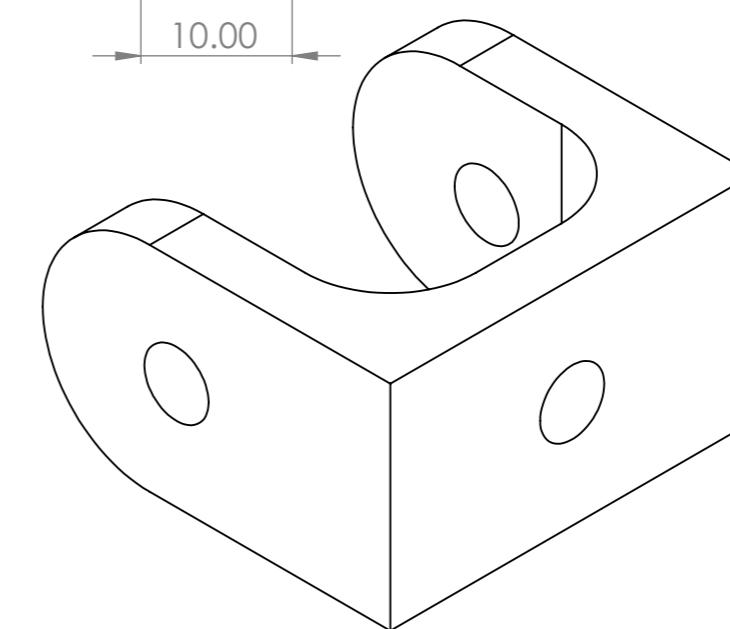
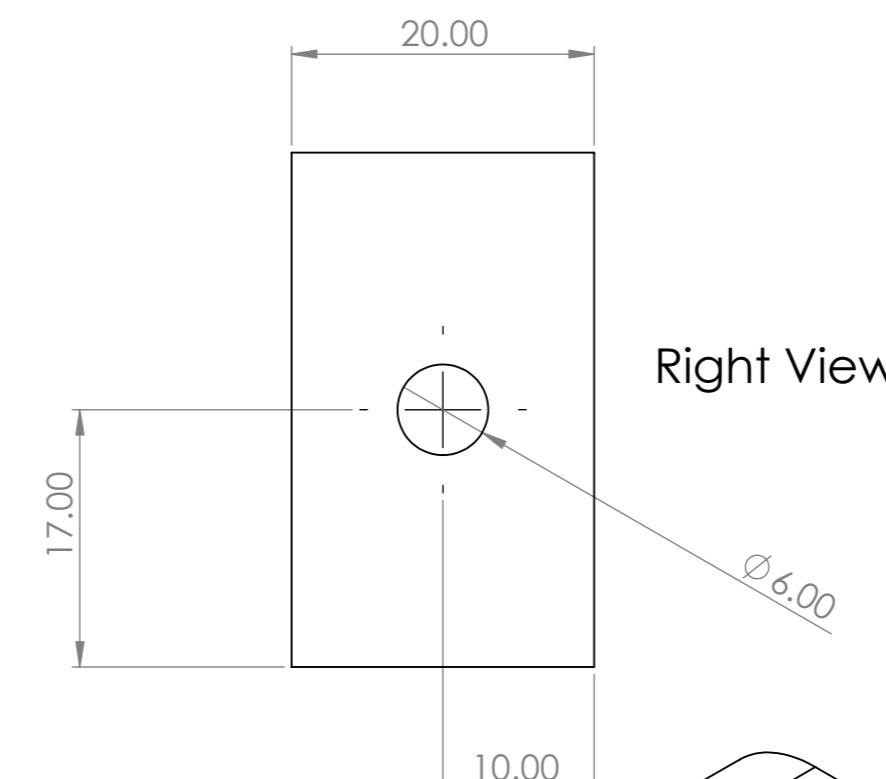
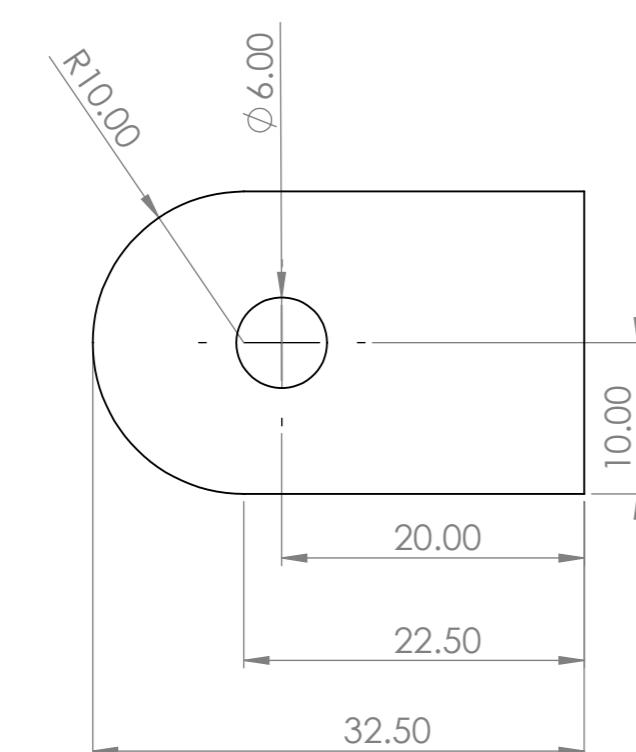
6

67.05

Plain Carbon Steel



Front View



UNLESS OTHERWISE SPECIFIED:  
DIMENSIONS ARE IN MILLIMETERS  
SURFACE FINISH:  
TOLERANCES:  
LINEAR:  
ANGULAR:

FINISH:  
DEBURR AND  
BREAK SHARP  
EDGES

DO NOT SCALE DRAWING

REVISION

DRAWN  
CHK'D  
APP'D  
MFG  
Q.A.

NAME  
SIGNATURE  
DATE

MATERIAL:  
Plain Carbon Steel

WEIGHT:  
SCALE:2:1

TITLE:  
Universal Joint @  
Stewart Platform  
DWG NO.  
Universal Joint 1

A3  
A3

SHEET 1 OF 1

8

7

6

5

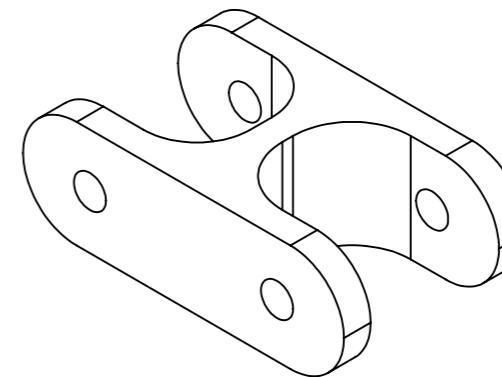
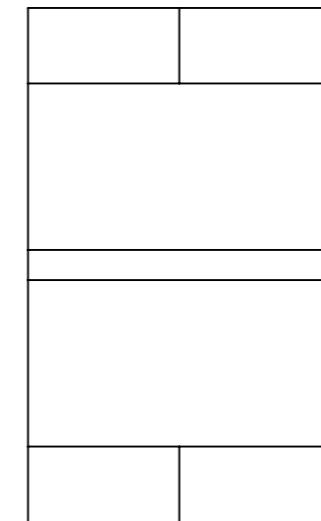
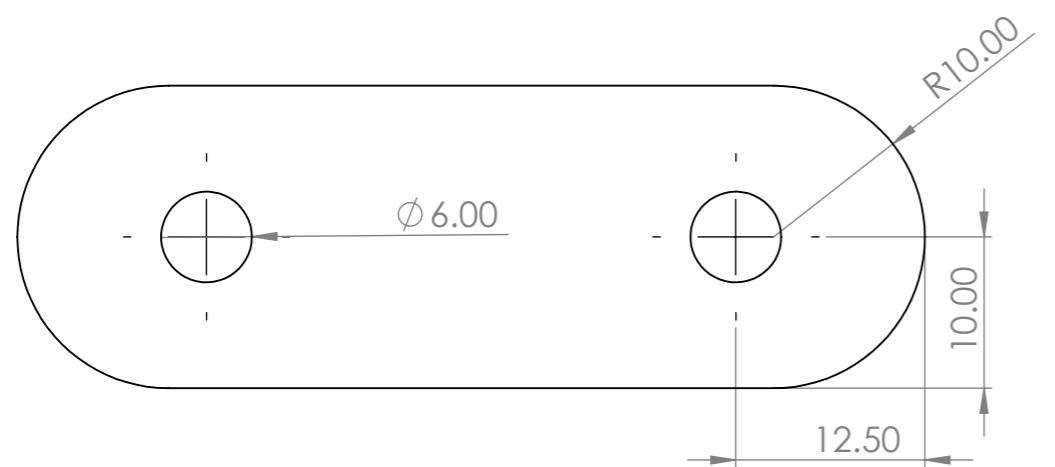
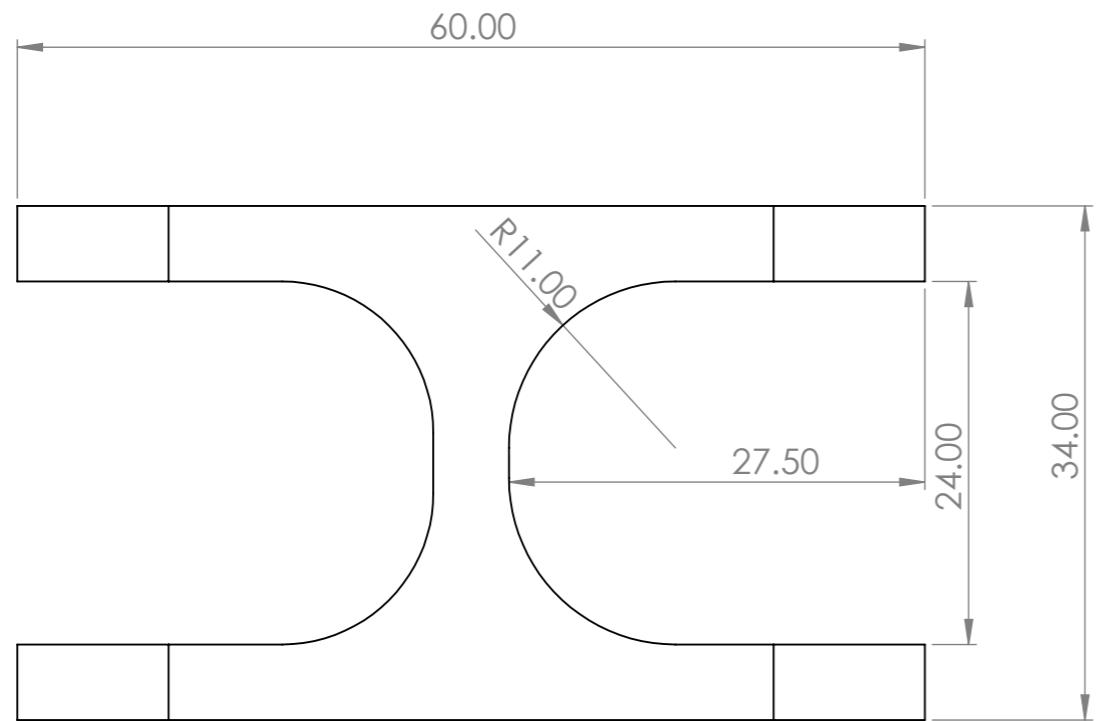
4

3

2

1

8	7	6	5	4	3	2	1	
F			ITEM NO.	PART NUMBER	DESCRIPTION	QTY.	Mass	Material
			1	Universal Joint 2	Universal Joint @Stewart Platform	3	116.01	Plain Carbon Steel



UNLESS OTHERWISE SPECIFIED: DIMENSIONS ARE IN MILLIMETERS SURFACE FINISH: TOLERANCES: LINEAR: ANGULAR:	FINISH:	DEBURR AND BREAK SHARP EDGES	DO NOT SCALE DRAWING	REVISION
DRAWN	NAME	SIGNATURE	DATE	
CHK'D				
APP'D				
MFG				
Q.A				
	MATERIAL:			
	Plain Carbon Steel			
	WEIGHT:			
	SCALE:2:1			
				SHEET 1 OF 1
				A3

Universal Joint  
@Stewart Platform

Universal Joint 2

8

7

6

5

4

3

2

1

ITEM NO.

PART NUMBER

DESCRIPTION

QTY.

Mass

Material

1

Universal Joint 3

Universal joint @Stewart Platform

3

22.35

Plain  
Carbon  
Steel

F

F

E

E

D

D

C

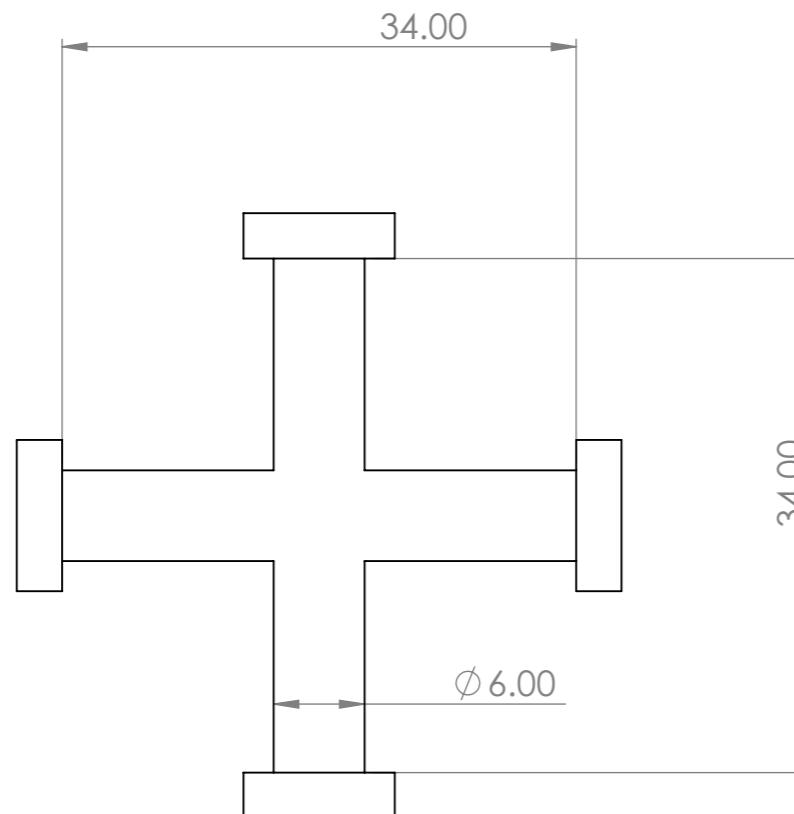
C

B

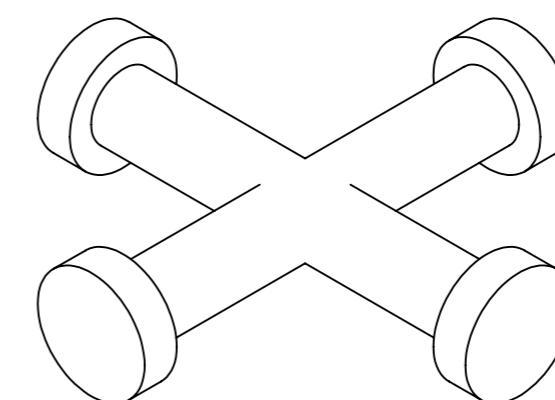
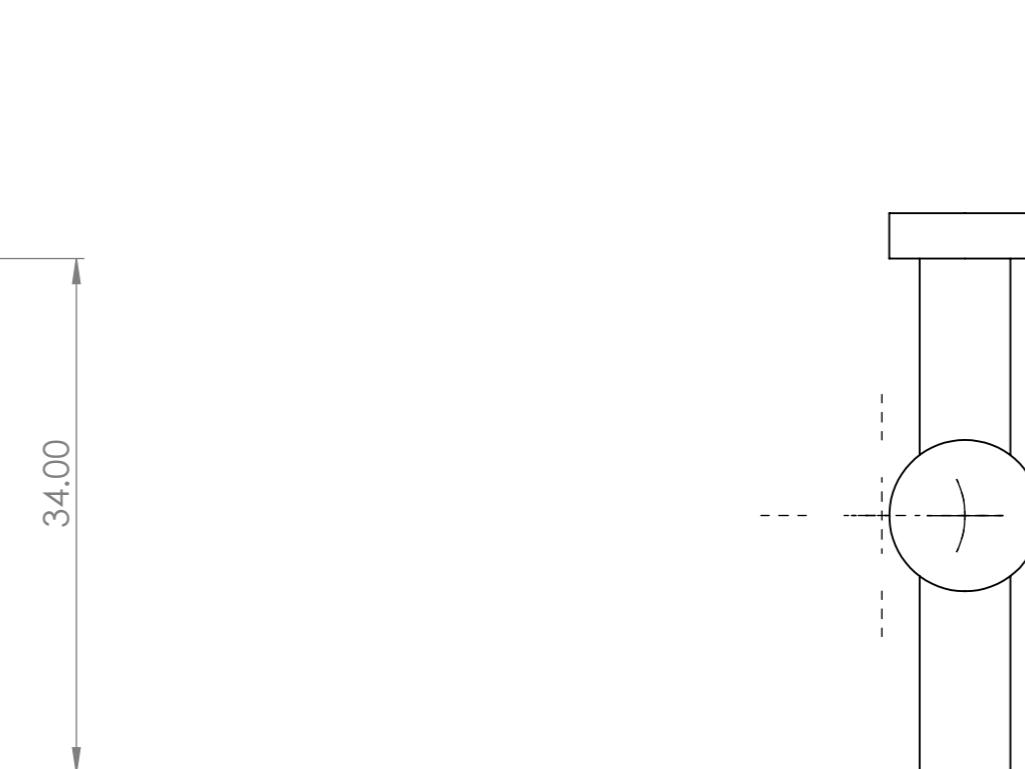
B

A

A



Front View



UNLESS OTHERWISE SPECIFIED: DIMENSIONS ARE IN MILLIMETERS SURFACE FINISH: TOLERANCES: LINEAR: ANGULAR:	FINISH:	DEBURR AND BREAK SHARP EDGES	DO NOT SCALE DRAWING	REVISION
DRAWN	NAME	SIGNATURE	DATE	
CHK'D				
APP'D				
MFG				
QA				
	MATERIAL:	Plain Carbon Steel	DWG NO.	A3
	WEIGHT:		SCALE:2:1	SHEET 1 OF 1

Universal joint  
@Stewart Platform  
Universal Joint 3

8

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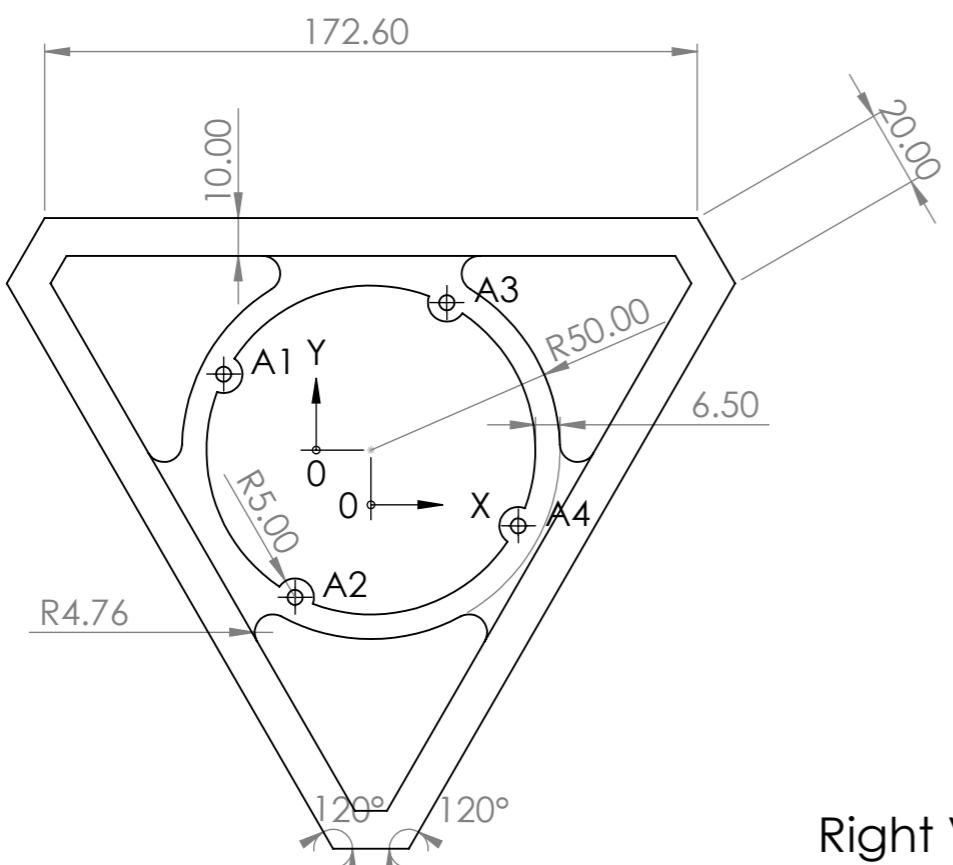
2

1

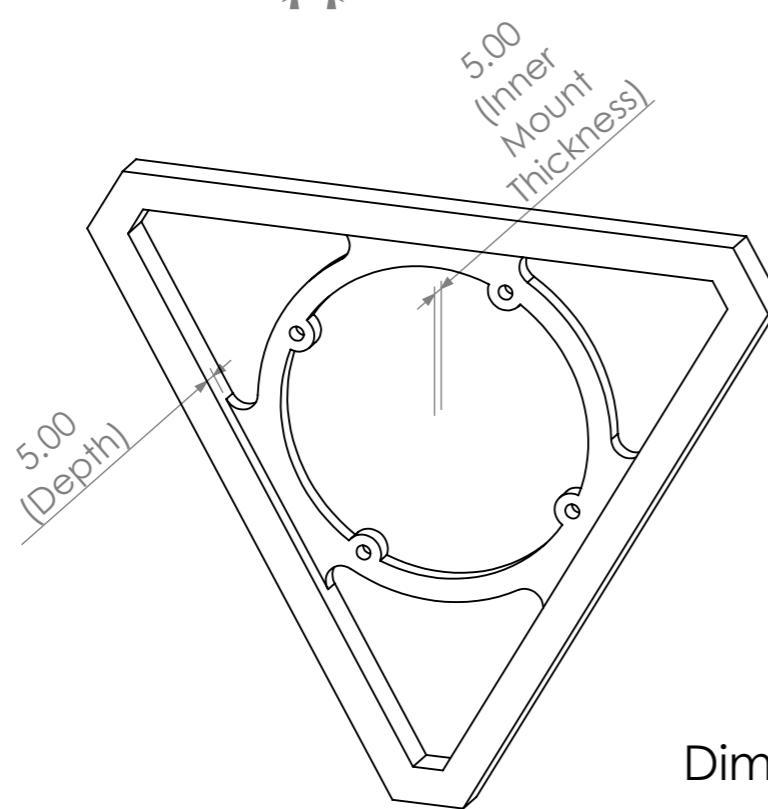
F

F

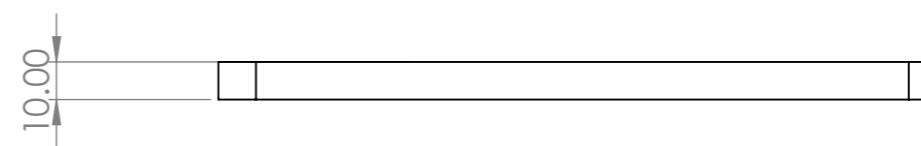
ITEM NO.	PART NUMBER	DESCRIPTION	QTY.	Material	Mass
1	BLDC Motor Frame	BLDC Motor Frame @Stewart Platform Sub-Assembly	1	Plain Carbon Steel	521.91



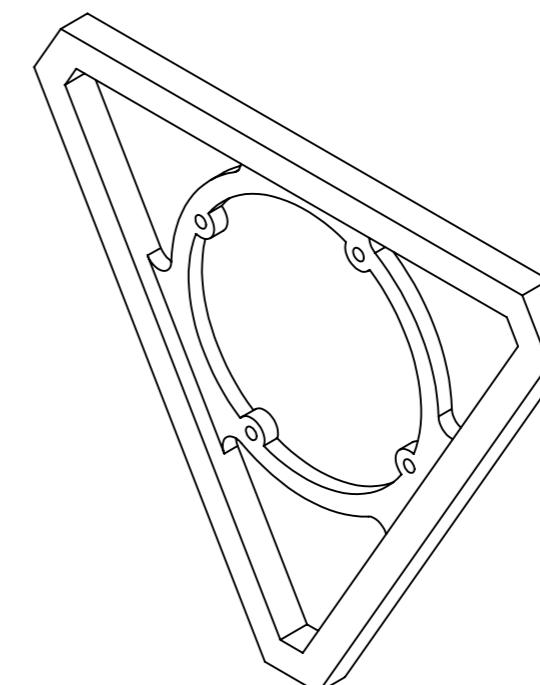
Right View



Dimetric View



Front View



Isometric View

## Hole Table

TAG	X LOC	Y LOC	SIZE
A1	-38.97	20.07	Ø 4.00 THRU
A2	-20.07	-38.97	Ø 4.00 THRU
A3	20.07	38.97	Ø 4.00 THRU
A4	38.97	-20.07	Ø 4.00 THRU

UNLESS OTHERWISE SPECIFIED: DIMENSIONS ARE IN MILLIMETERS SURFACE FINISH: TOLERANCES: LINEAR: ANGULAR:	FINISH:	DEBURR AND BREAK SHARP EDGES	DO NOT SCALE DRAWING	REVISION
DRAWN	NAME	SIGNATURE	DATE	
CHK'D				
APP'D				
MFG				
QA				
	MATERIAL:		TITLE:	
	Plain Carbon Steel		BLDC Motor Frame @Stewart Platform Sub-Assembly	
	DWG NO.		A3	
	BLDC Motor Frame			
	WEIGHT:		SCALE:1:2	
			SHEET 1 OF 1	

8

7

6

5

4

3

2

1

8

7

6

5

4

3

2

1

ITEM NO.	PART NUMBER	DESCRIPTION	QTY.	Material
1	BNO Mount	BNO Mount	1	Plastic

F

F

E

E

D

D

C

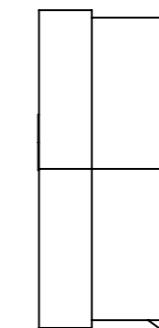
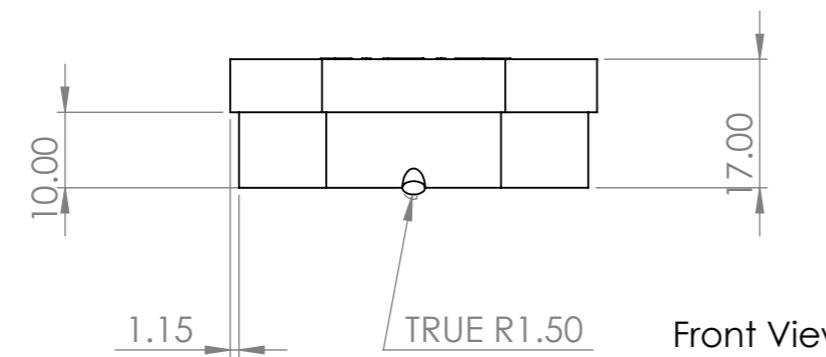
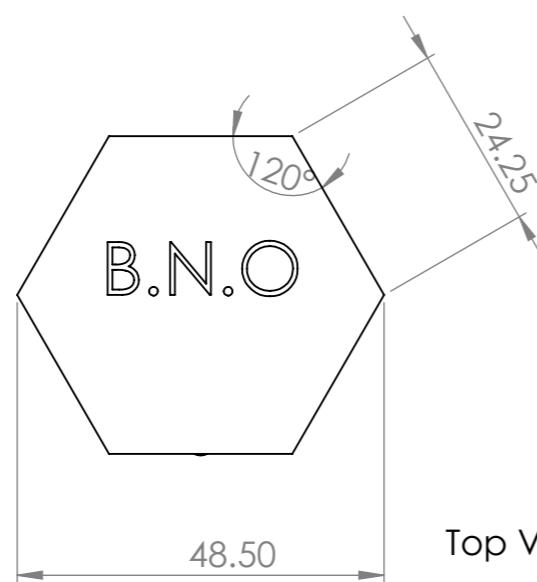
C

B

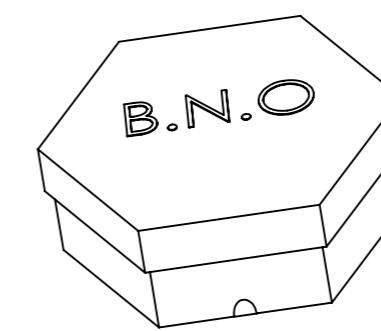
B

A

A



Right View



Isometric View

UNLESS OTHERWISE SPECIFIED: DIMENSIONS ARE IN MILLIMETERS SURFACE FINISH: TOLERANCES: LINEAR: ANGULAR:		FINISH:	DEBURR AND BREAK SHARP EDGES	DO NOT SCALE DRAWING	REVISION
DRAWN	NAME	SIGNATURE	DATE		
CHK'D					
APP'D					
MFG					
QA				MATERIAL:	
				DWG NO.:	
				SCALE:1:2	
				SHEET 1 OF 1	
				A3	

**BNO Mount**

**BNO Mount**

8

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1

Item No.

Part

Description

Material

Weight

Qty.

1

Blade

Cutting Blade

AISI 1020

936.53

1

F

F

E

E

D

D

C

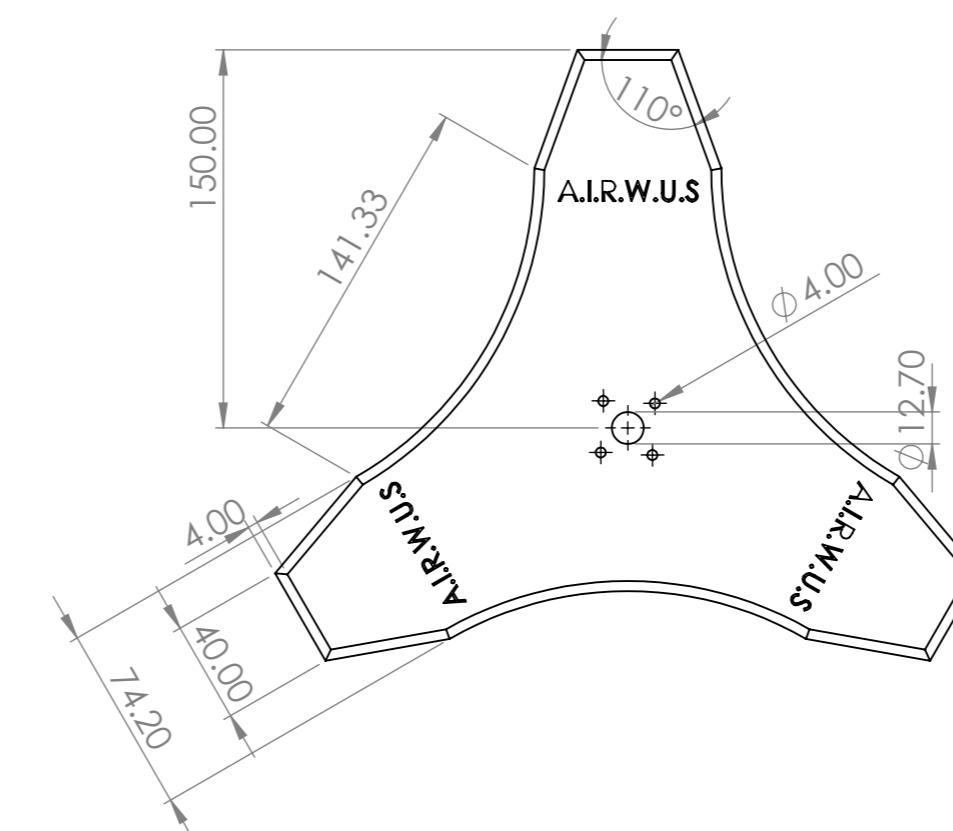
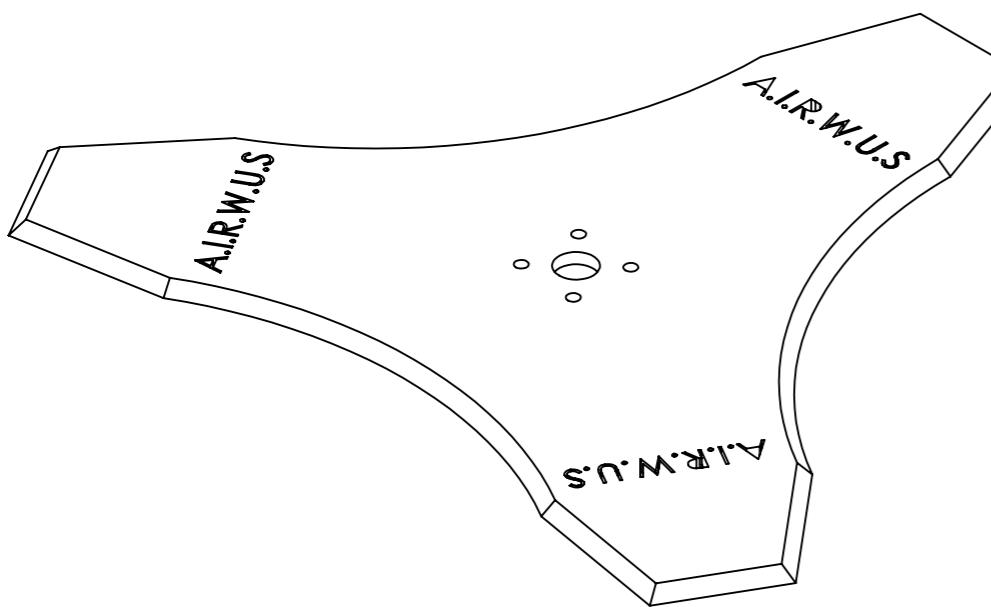
C

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B

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A



UNLESS OTHERWISE SPECIFIED: DIMENSIONS ARE IN MILLIMETERS SURFACE FINISH: TOLERANCES: LINEAR: ANGULAR:			FINISH:	DEBURR AND BREAK SHARP EDGES	DO NOT SCALE DRAWING	REVISION
DRAWN	NAME	SIGNATURE	DATE			
CHK'D						
APP'D						
MFG						
Q.A						
			MATERIAL: AISI 1020		DWG NO. <b>Cutting Blade</b>	
			WEIGHT: 936.53		SCALE: 1:3	
					SHEET 1 OF 1	

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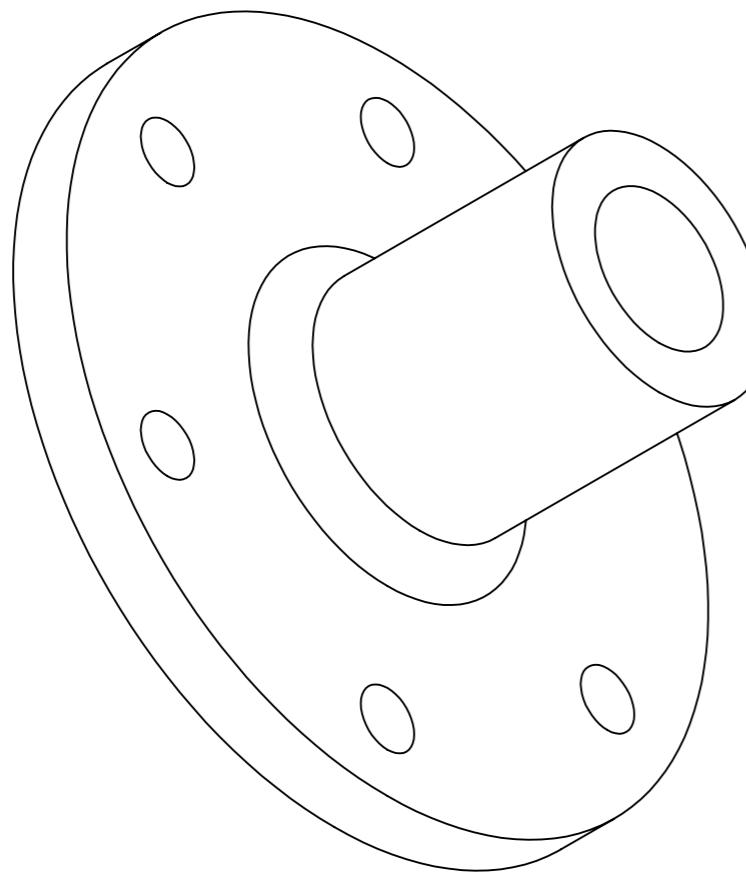
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3

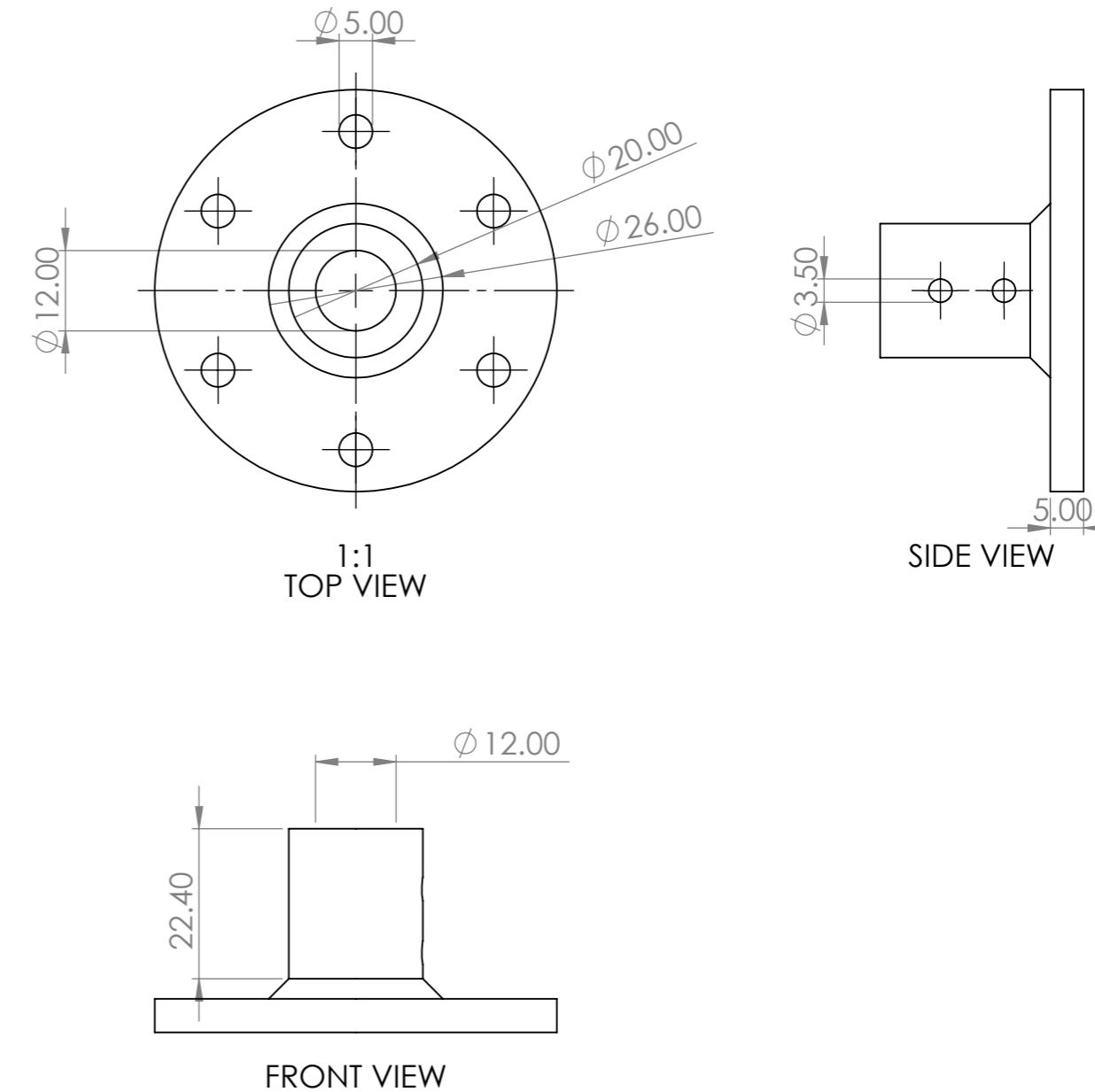
2

1

ITEM NO.	PART NO	DESCRIPTION	MATERIAL	WEIGHT	QTY
1.	COUPLER	COUPLER	Plain Carbon Steel	142.92	7.0

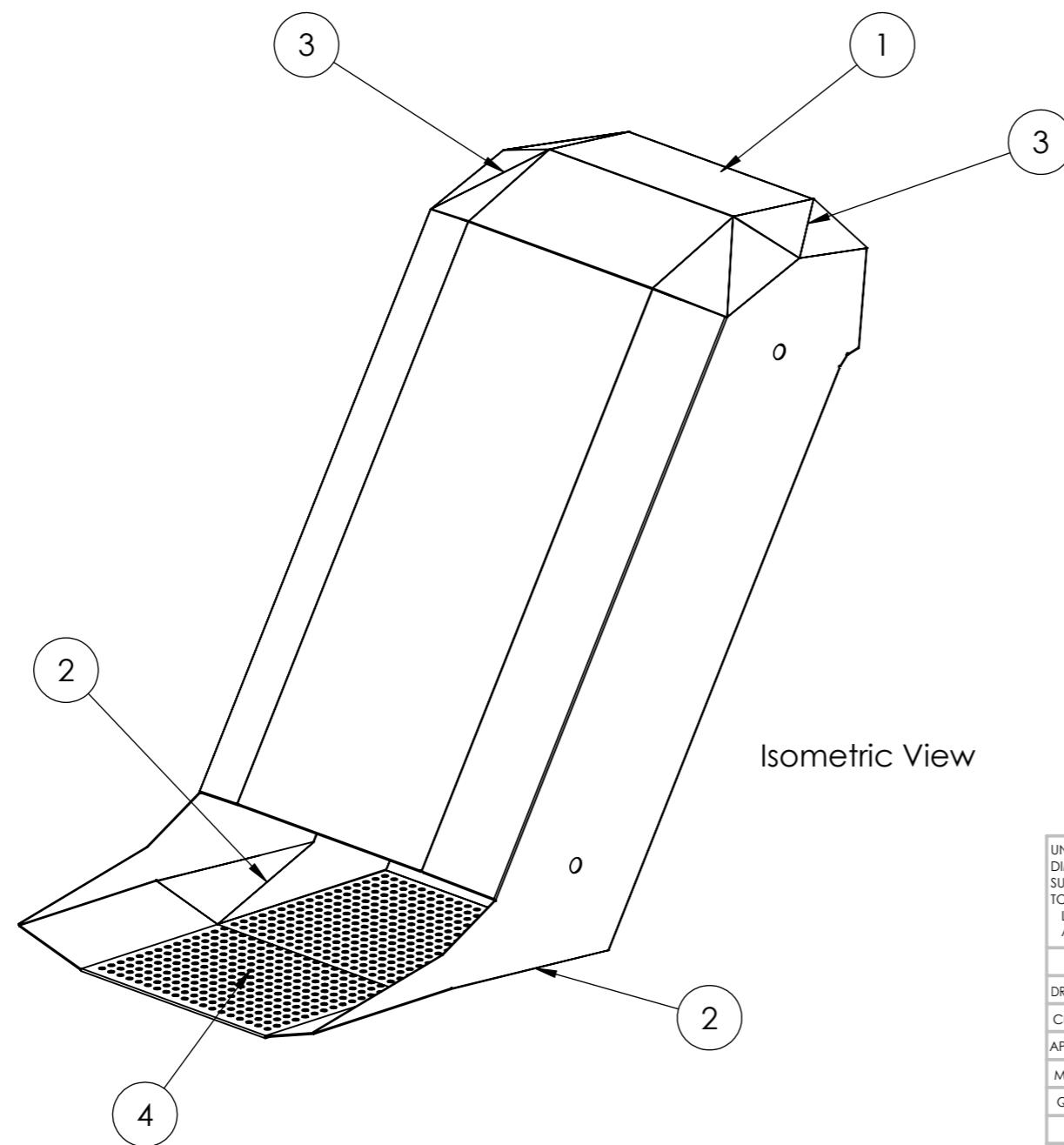


SCALE 2 : 1  
ISOMETRIC VIEW



UNLESS OTHERWISE SPECIFIED: DIMENSIONS ARE IN MILLIMETERS SURFACE FINISH: TOLERANCES: LINEAR: ANGULAR:		FINISH:			DEBURR AND BREAK SHARP EDGES	DO NOT SCALE DRAWING	REVISION
DRAWN	NAME	SIGNATURE	DATE			TITLE:	
CHK'D							
APPV'D							
MFG							
Q.A	MATERIAL: Plain Carbon Steel			DWG NO.	stepper coupler		A3
				SCALE:1:1			
	WEIGHT: 142.92			SHEET 1 OF 1			

No.	PART NUMBER	DESCRIPTION	QTY.	Bend Radius	Cut Outs	Mass	Material	Sheet Metal Thickness	Bends
1	Conveyer Enclosure 1	Sheet	1	0.5	4	1488.45	6061-T6 (SS)	1	23
2	Conveyer Enclosure 2	Sheet	2	0.5	0	30.50	6061-T6 (SS)	1	1
3	Conveyer Enclosure 3	Sheet	1	0.5	0	28.86	6061-T6 (SS)	1	2
4	Conveyer Enclosure 4	Sheet	2	0.5	0	35.21	6061-T6 (SS)	1	1



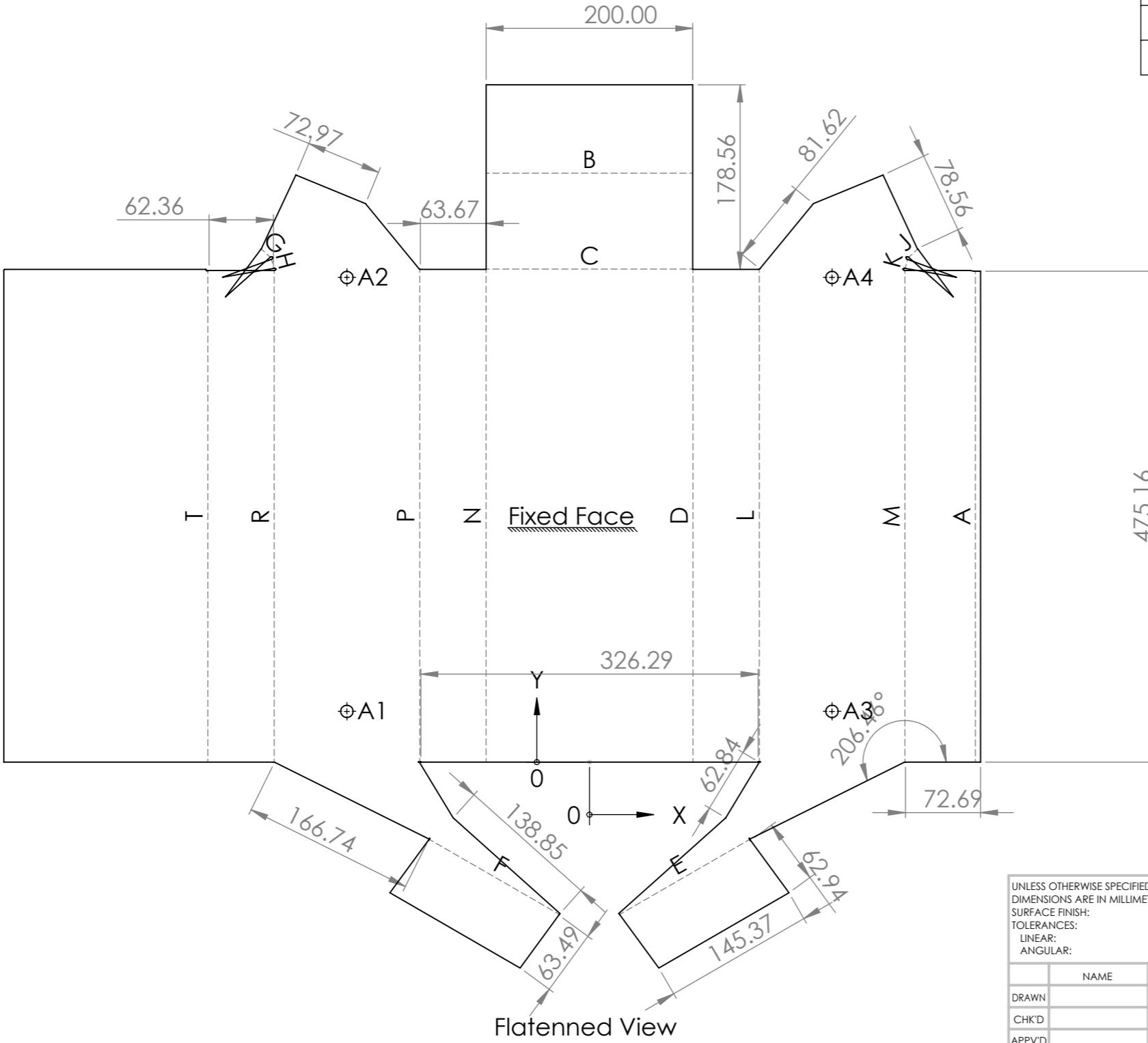
## Isometric View

UNLESS OTHERWISE SPECIFIED: DIMENSIONS ARE IN MILLIMETERS SURFACE FINISH: TOLERANCES: LINEAR: ANGULAR:		FINISH:			DEBURR AND BREAK SHARP EDGES	DO NOT SCALE DRAWING	REVISION
DRAWN	NAME	SIGNATURE	DATE			TITLE: Sheet	
CHK'D							
APP'D							
MFG							
Q.A			MATERIAL:		DWG NO.	Conveyer Enclosure Assembly <sup>A3</sup>	
			WEIGHT:		SCALE:1:10	SHEET 1 OF 1	

8	7	6	5	4	3	2	1				
PART NUMBER			DESCRIPTION			QTY.	Bend Radius	Bends	Cut Outs	Mass	MATERIAL
			Conveyer Enclosure 1		Sheet	1	0.5	16	4	1456.75	6061-T6 (SS)

Hole Table

TAG	X LOC	Y LOC	SIZE
A1	-234.73	49.09	Ø 12.00 THRU
A2	-234.73	469.09	Ø 12.00 THRU
A3	234.68	49.09	Ø 12.00 THRU
A4	234.68	469.09	Ø 12.00 THRU



UNLESS OTHERWISE SPECIFIED: DIMENSIONS ARE IN MILLIMETERS SURFACE FINISH: TOLERANCES: LINEAR: ANGULAR:	FINISH:	DEBURR AND BREAK SHARP EDGES	DO NOT SCALE DRAWING	REVISION
DRAWN	NAME _____	SIGNATURE _____	DATE _____	TITLE: _____
CHK'D				DWG NO. _____
APP'D				Conveyer Enclosure.1SLDDRW1
MFG				SCALE: 1:10
QA				WEIGHT: _____
				SCALE: 1:10
				SHEET 1 OF 1

Description	Quantity
Conveyer Enclosure 2	1

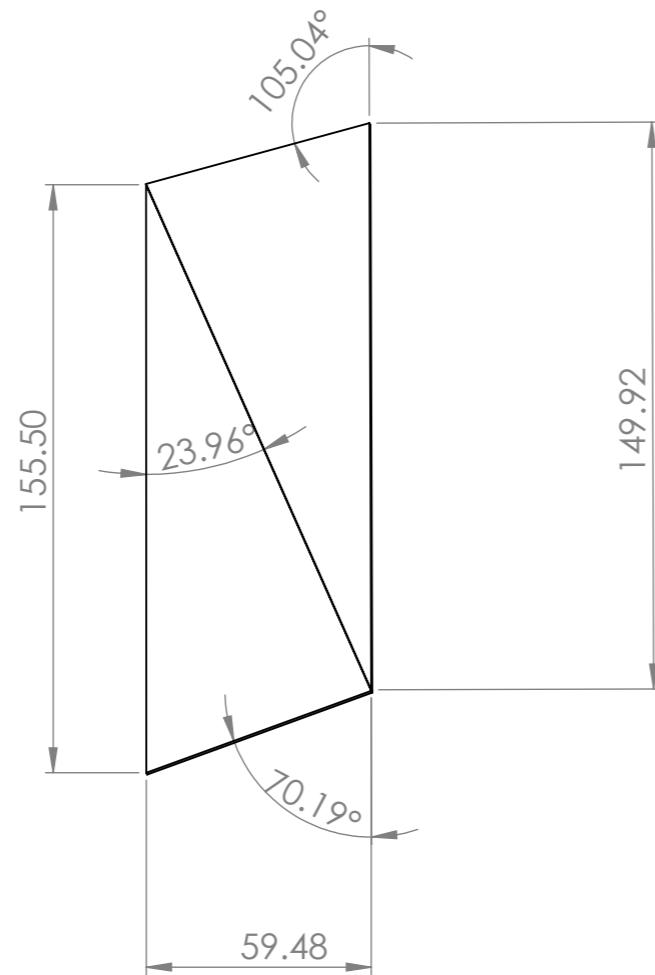
R2.50 x 532

200.00

280.33

UNLESS OTHERWISE SPECIFIED: DIMENSIONS ARE IN MILLIMETERS SURFACE FINISH: TOLERANCES: LINEAR: ANGULAR:		FINISH:		DEBURR AND BREAK SHARP EDGES	DO NOT SCALE DRAWING	REVISION
DRAWN		SIGNATURE	DATE		TITLE:	
CHK'D						
APP'D						
MFG						
Q.A		MATERIAL:			DWG NO.	
						A3
		WEIGHT:			SCALE:1:10	SHEET 1 OF 1
4	2	9			1	

Description	Quantity
Conveyer Enclosure 3	2



UNLESS OTHERWISE SPECIFIED: DIMENSIONS ARE IN MILLIMETERS SURFACE FINISH: TOLERANCES: LINEAR: ANGULAR:		FINISH:	DEBURR AND BREAK SHARP EDGES	DO NOT SCALE DRAWING	REVISION
DRAWN	NAME	SIGNATURE	DATE	TITLE:	
CHK'D					
APP'D					
MFG					
Q.A.				MATERIAL:	
				DWG NO.	
				Conveyer Enclosure3 3 A3	
				SCALE:1:10	SHEET 1 OF 1

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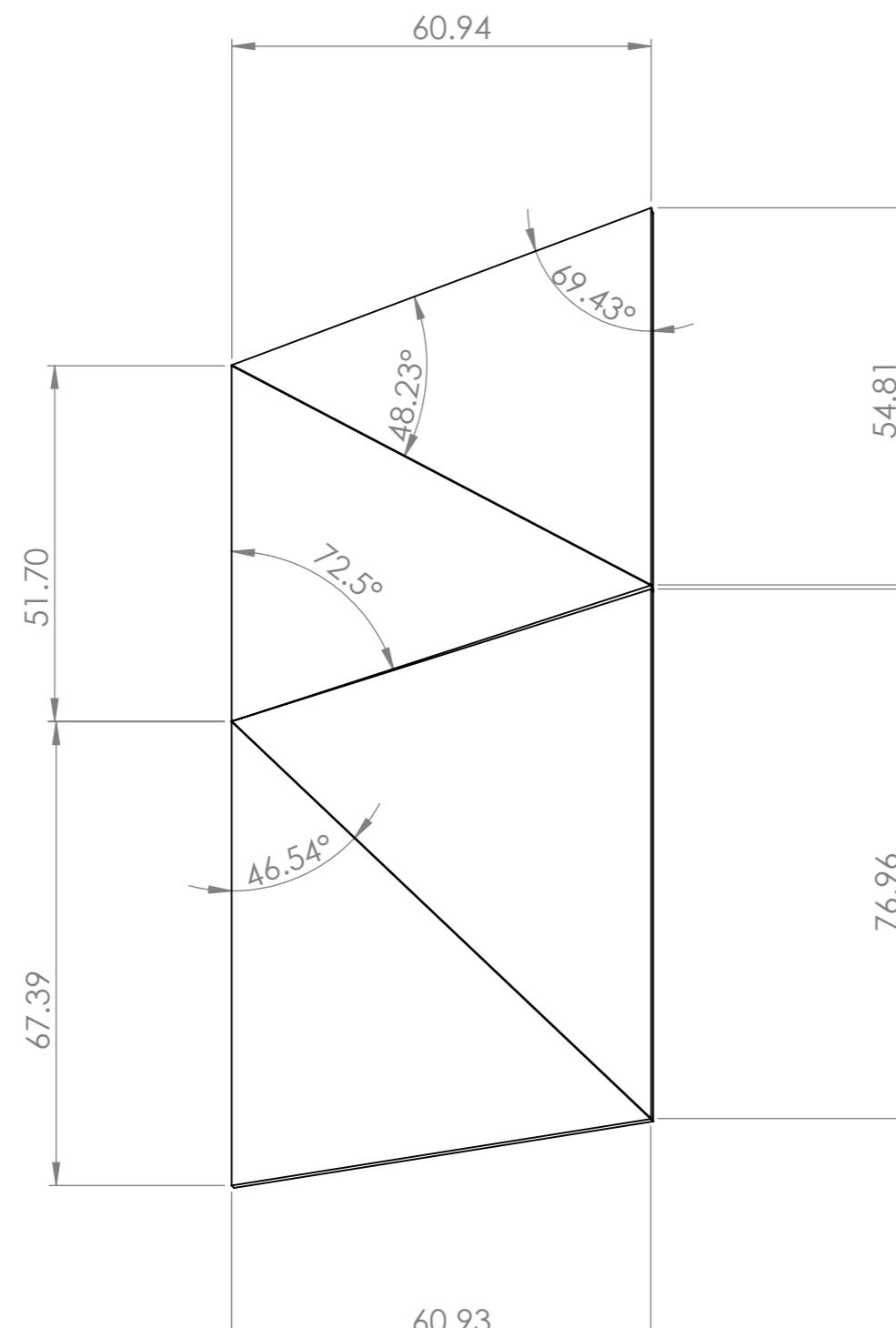
C

B

B

A

A



## Description

## Quantity

Conveyer Enclosure 4

2

UNLESS OTHERWISE SPECIFIED:  
DIMENSIONS ARE IN MILLIMETERS  
SURFACE FINISH:  
TOLERANCES:  
LINEAR:  
ANGULAR:

FINISH:  
DEBURR AND  
BREAK SHARP  
EDGES

NAME SIGNATURE DATE

MATERIAL

WEIGHT:

DO NOT SCALE DRAWING

REVISION

TITLE:

DWG NO.

Conveyer Enclosure 4 A3

SCALE:1:10

SHEET 1 OF 1

8

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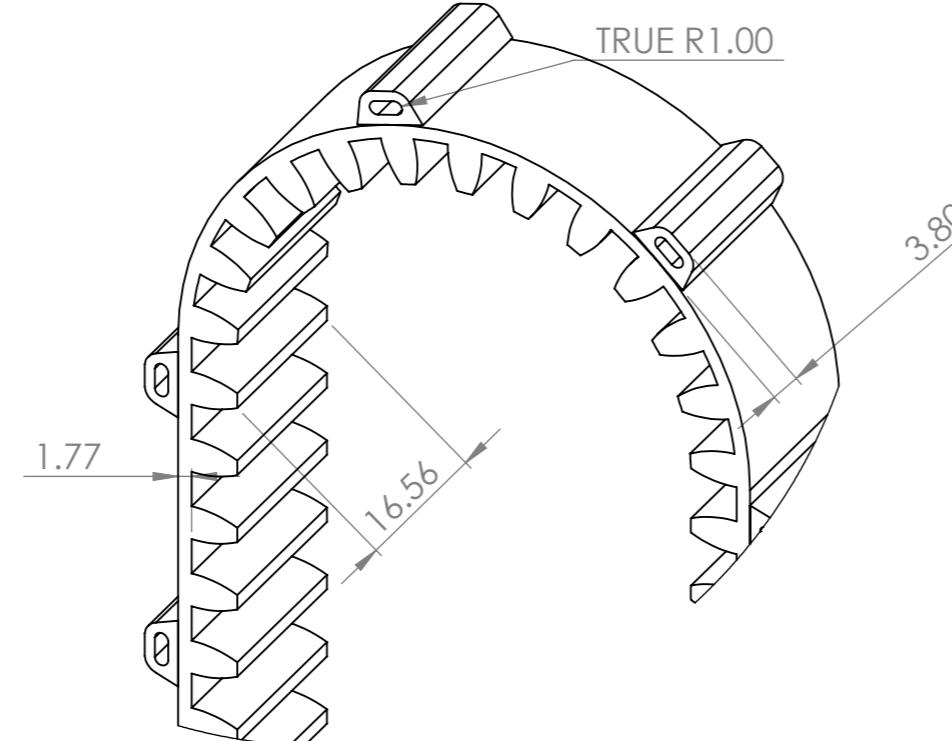
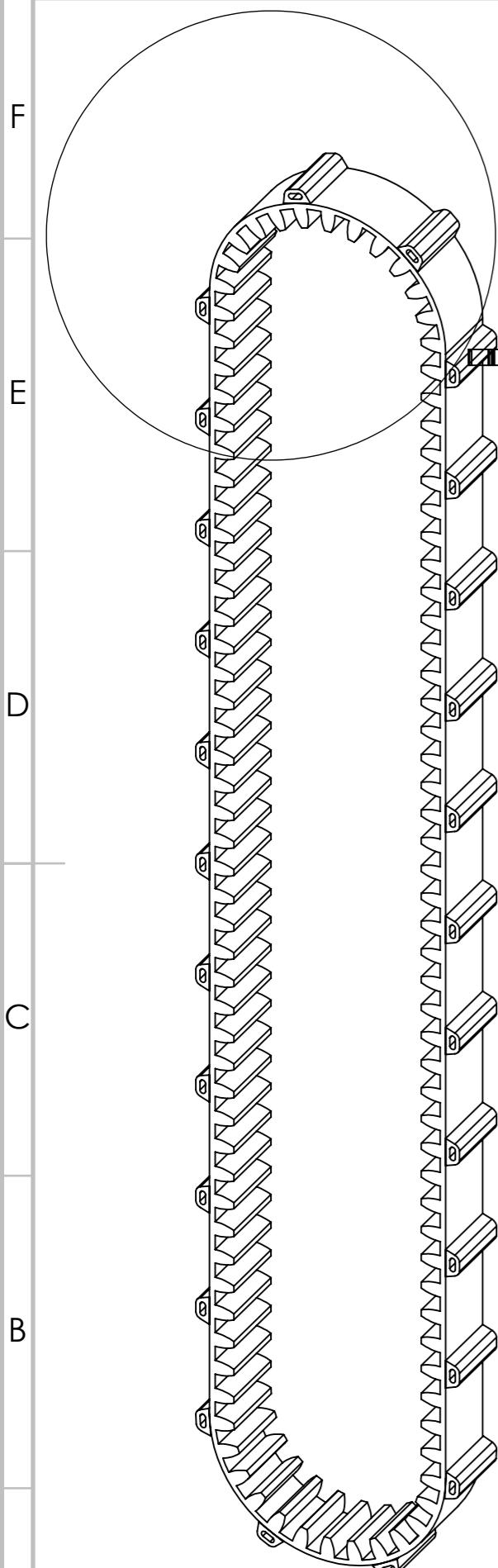
4

3

2

1

ITEM NO.	PART	DESCRIPTION	MATERIAL	WEIGHT	QTY.
1.	BELT	BELT	BUTYL	178.84	2



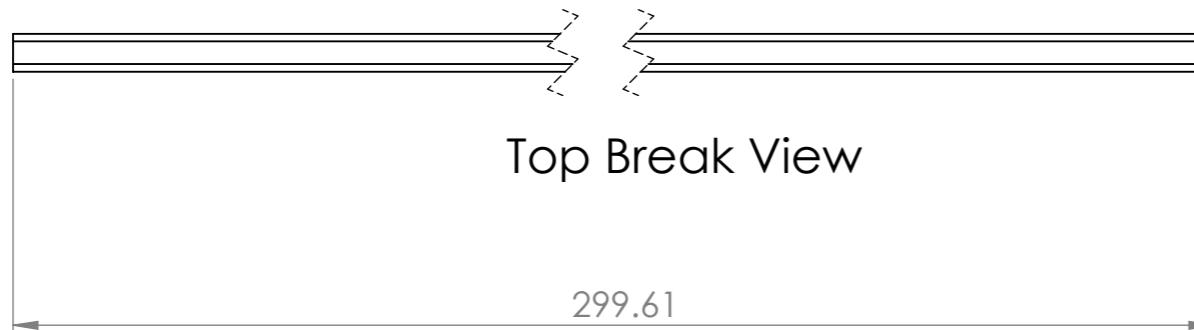
DETAIL A

SCALE 1:1

SCALE 1 : 2  
ISOMETRIC VIEW

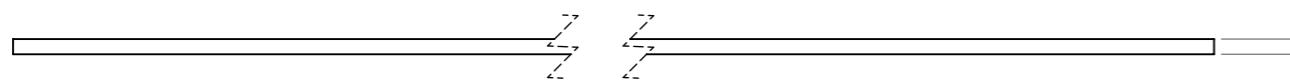
UNLESS OTHERWISE SPECIFIED: DIMENSIONS ARE IN MILLIMETERS SURFACE FINISH: TOLERANCES: LINEAR: ANGULAR:	FINISH:	DEBURR AND BREAK SHARP EDGES	DO NOT SCALE DRAWING	REVISION
DRAWN	NAME	SIGNATURE	DATE	
CHK'D				
APP'D				
MFG				
Q.A				
	MATERIAL:		DWG NO.	
	BUTYL		A3	
	WEIGHT: 178.84		SCALE:1:5	
	SHEET 1 OF 1			

ITEM NO.	PART NUMBER	DESCRIPTION	Mass	Material	QTY.
1	Connecting Rod	Connecting Rod @Conveyer Belt	21.36	Plain Carbon Steel	26



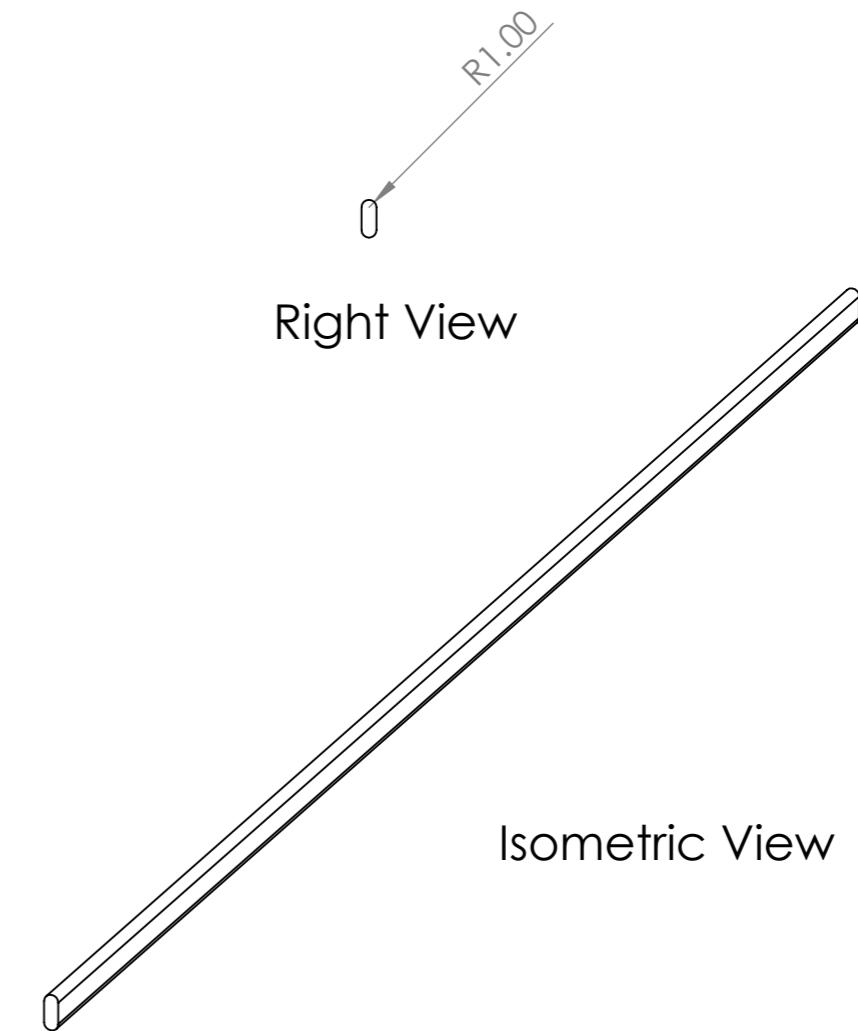
## Top Break View

299.61



## Front Break View

∅ 2.00

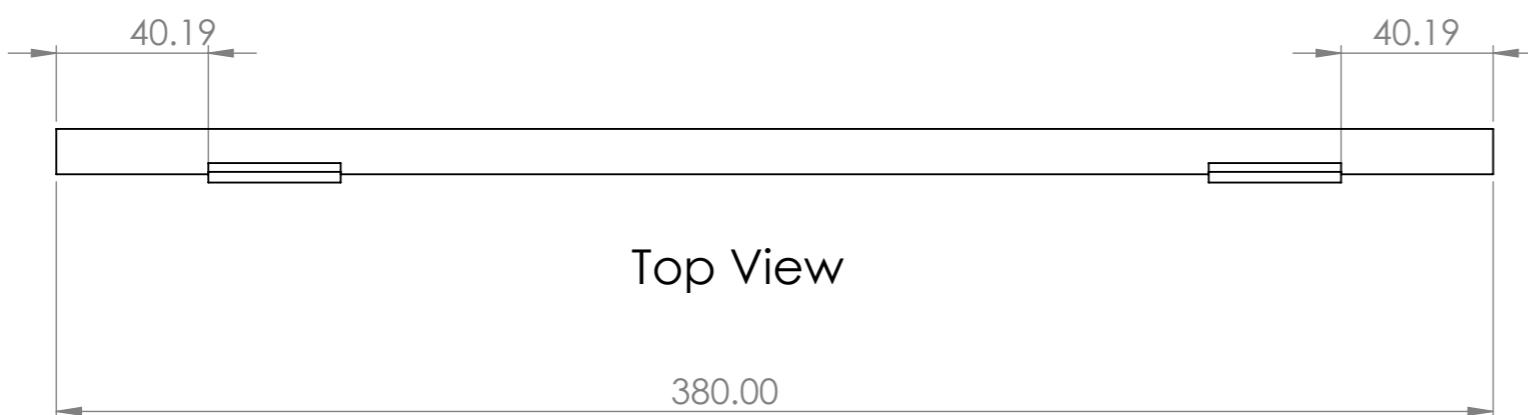


Right View

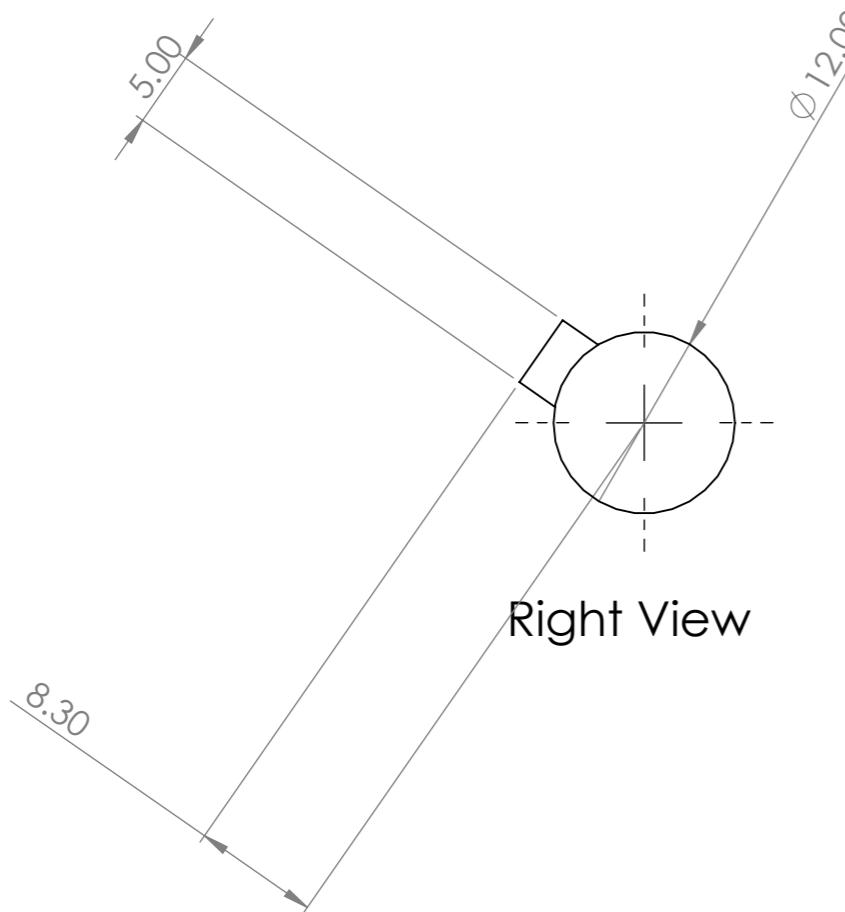
## Isometric View

UNLESS OTHERWISE SPECIFIED: DIMENSIONS ARE IN MILLIMETERS SURFACE FINISH: TOLERANCES: LINEAR: ANGULAR:		FINISH:			DEBURR AND BREAK SHARP EDGES	DO NOT SCALE DRAWING	REVISION
DRAWN	NAME	SIGNATURE	DATE			<p>TITLE: <b>Connecting Rod @Conveyer Belt</b></p>	
CHK'D							
APPV'D							
MFG							
Q.A			MATERIAL:	Plain Carbon Steel		DWG NO.	A3
			WEIGHT:			SCALE:1:2	SHEET 1 OF 1

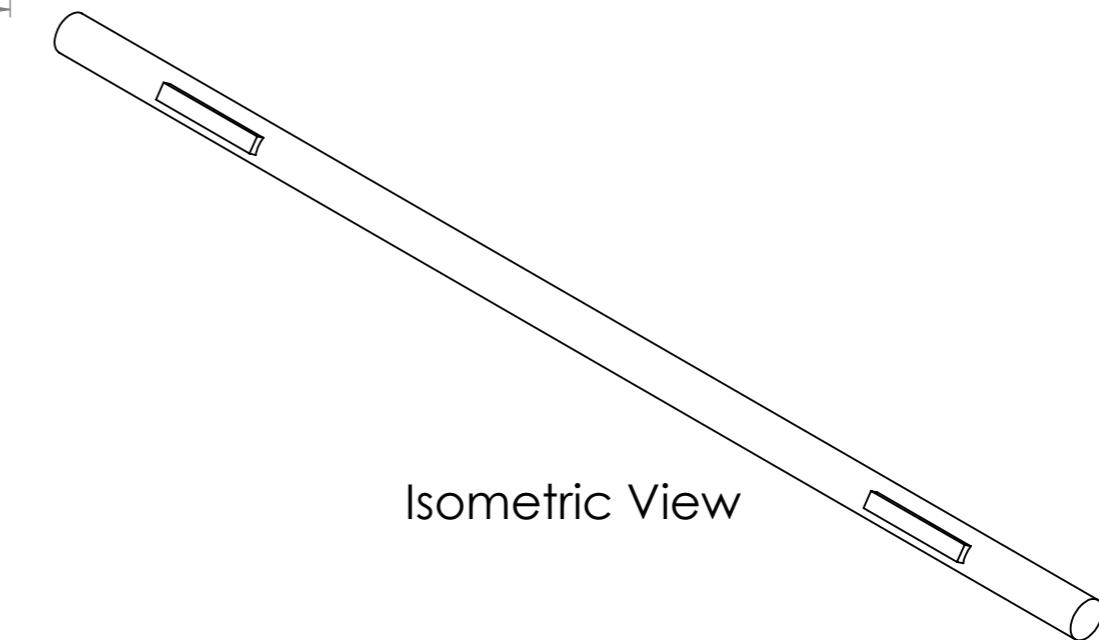
ITEM NO.	PART NUMBER	DESCRIPTION	Configuration	QTY.	Mass	Material
1	shaft	Convryer shaft	Without Key	1	335.22	Plain Carbon Steel



## Top View



# Right View



## Isometric View

UNLESS OTHERWISE SPECIFIED: DIMENSIONS ARE IN MILLIMETERS SURFACE FINISH: TOLERANCES: LINEAR: ANGULAR:		FINISH:		DEBURR AND BREAK SHARP EDGES	DO NOT SCALE DRAWING	REVISION
DRAWN	NAME	SIGNATURE	DATE		TITLE:	
CHK'D						
APPV'D						
MFG						
Q.A			MATERIAL:	Plain Carbon Steel	DWG NO.	Shaft with key
			WEIGHT:		SCALE:1:2	SHEET 1 OF 1
						A3

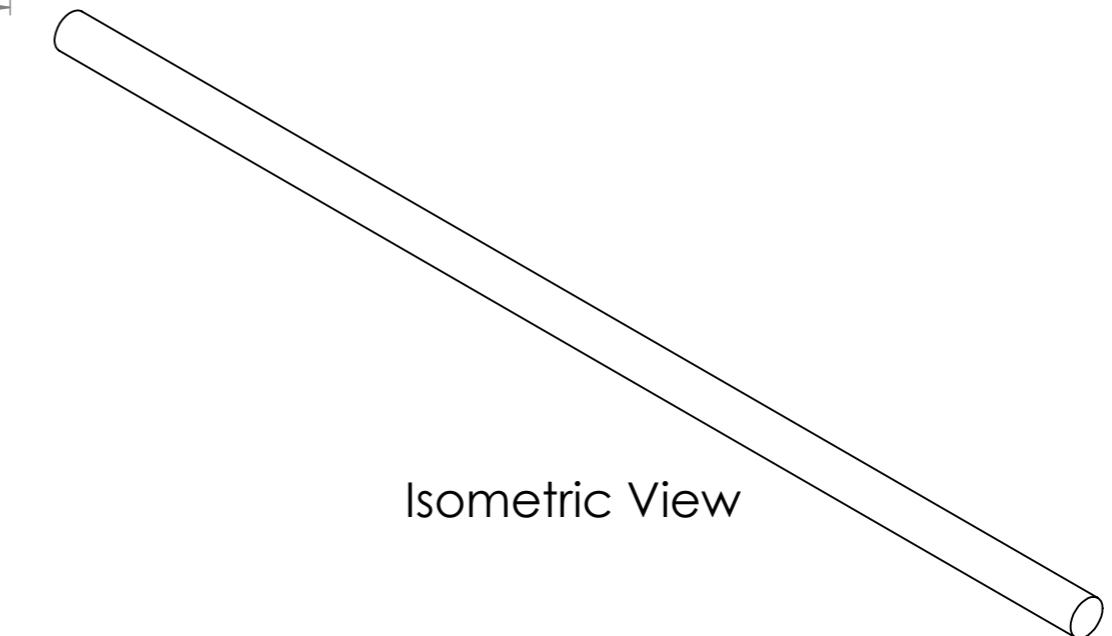
ITEM NO.	PART NUMBER	DESCRIPTION	Configuration	QTY.	Mass	Material
1	shaft	Convryer shaft	Without Key	1	335.22	Plain Carbon Steel

## Top View

380.00

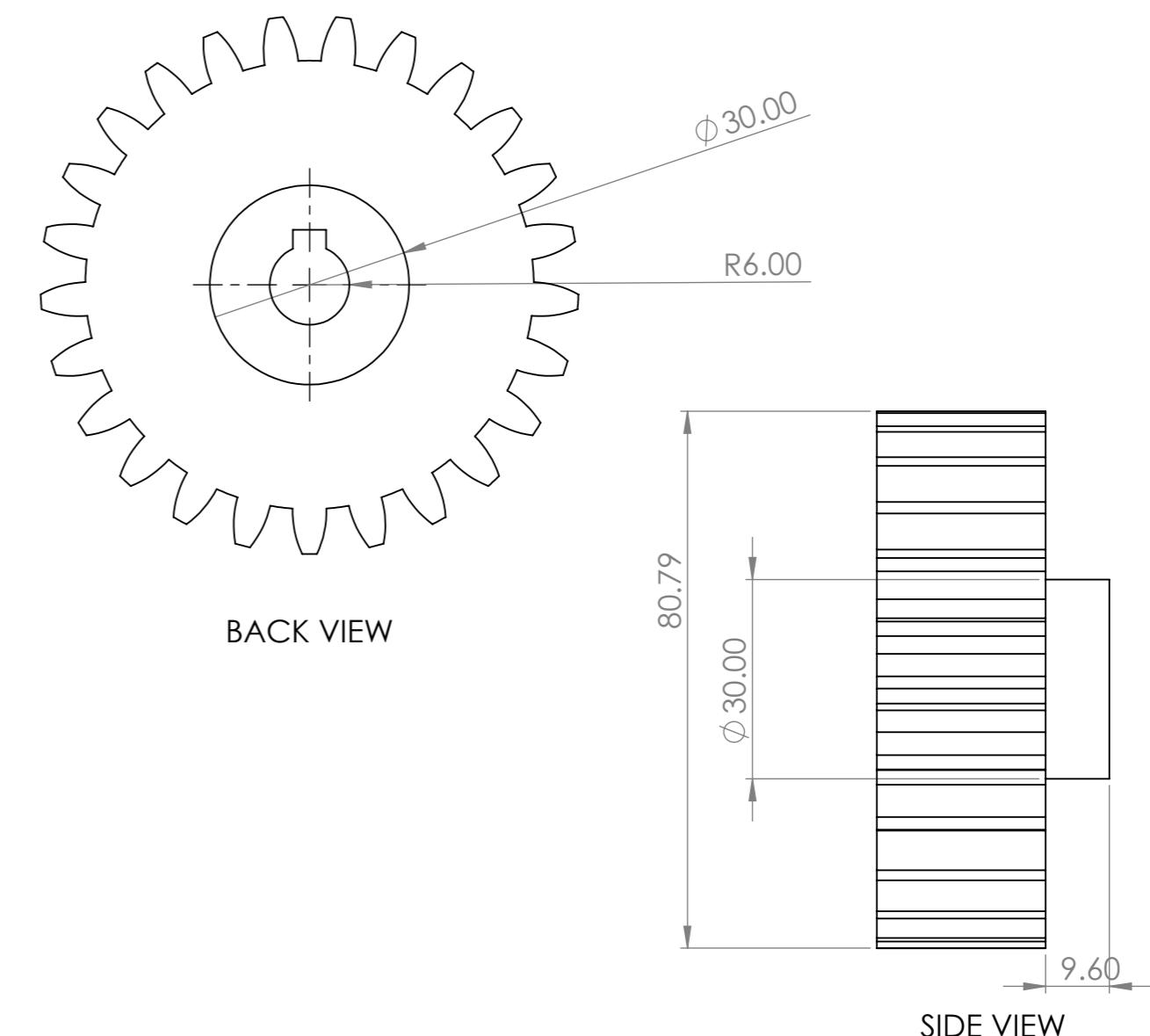
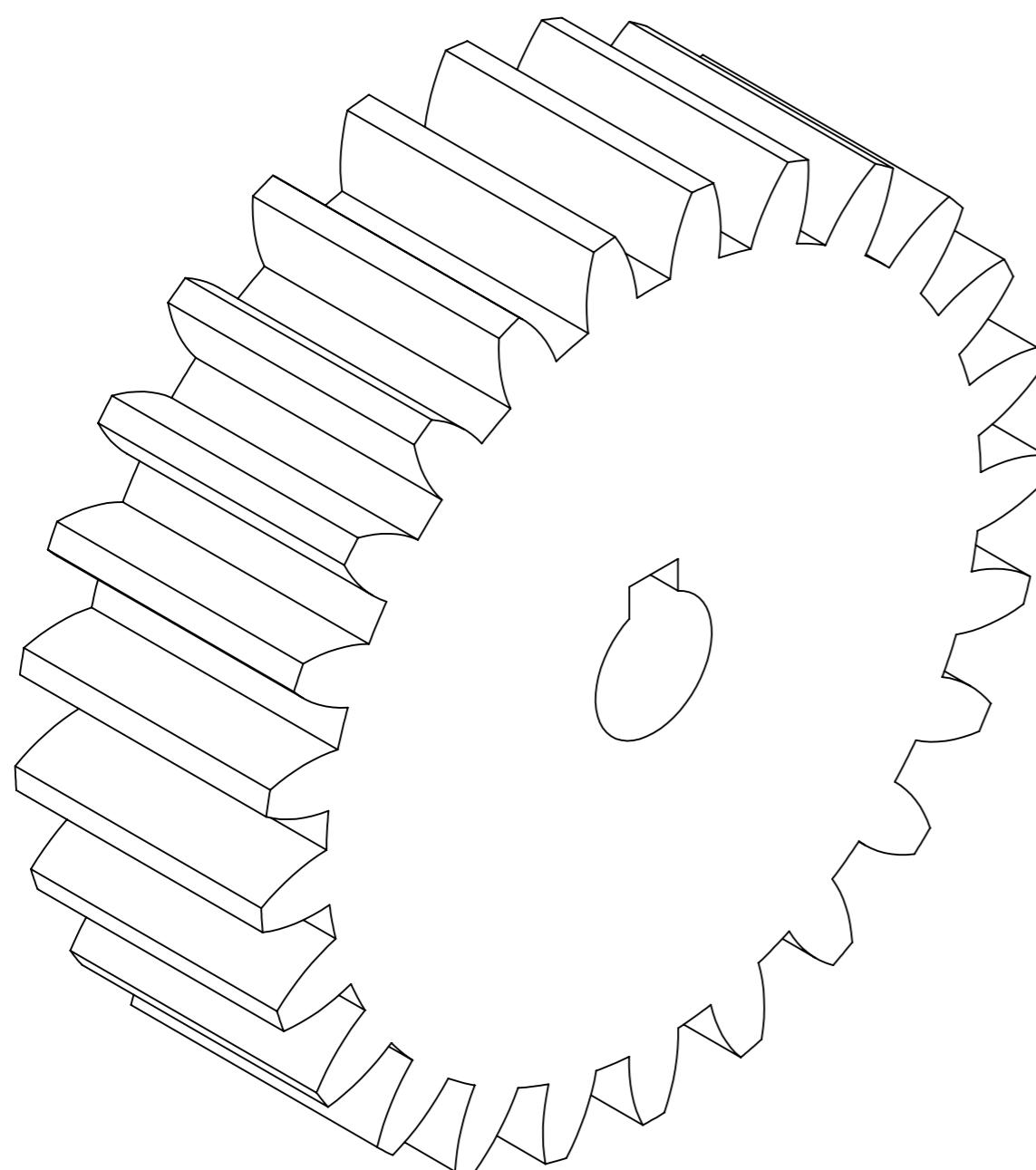
## Right View

## Isometric View



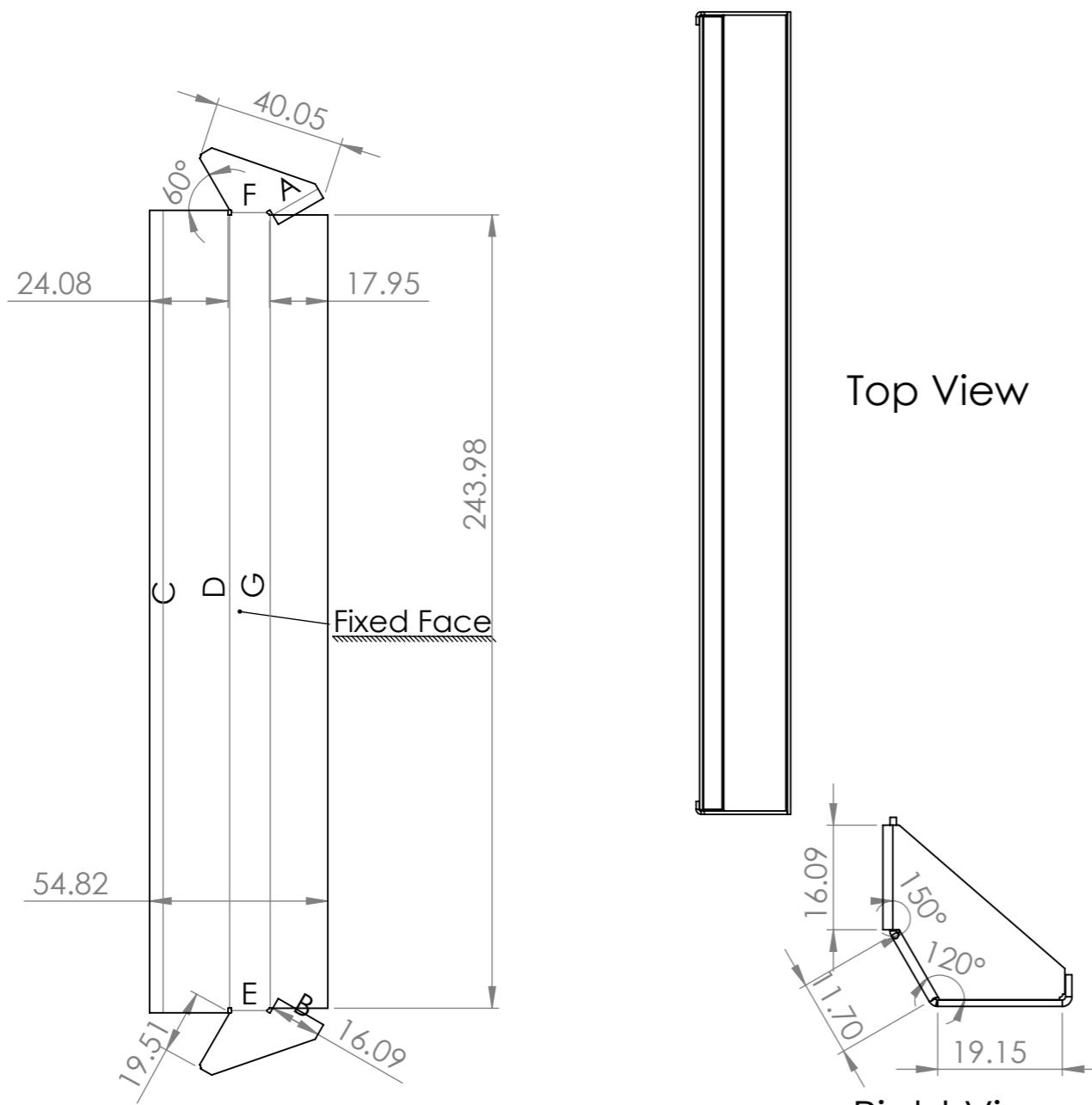
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DRAWN	NAME	SIGNATURE	DATE			TITLE:	Convryer shaft
CHK'D							
APPV'D							
MFG							
Q.A				MATERIAL:	Plain Carbon Steel	DWG NO.	Shaft without key A3
				WEIGHT:		SCALE:1:2	SHEET 1 OF 1

8	7	6	5	4	3	2	1
ITEM NO.	PART NO	DESCRIPTION	MATERIAL	WEIGHT	QTY		
1.	SPUR GEAR	SPUR GEAR	1060 Alloy	300.712	4.0		



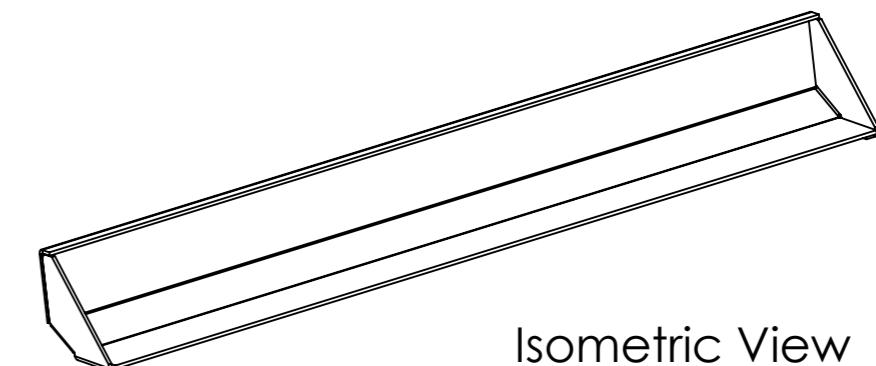
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DRAWN	NAME	SIGNATURE	DATE	
CHK'D				
APP'D				
MFG				
Q.A				
	MATERIAL:			DWG NO.
	1060 Alloy			spur gear_iso
	WEIGHT: 300.712			SCALE:1:1
				SHEET 1 OF 1
				A3

8	7	6	5	4	3	2	1			
PART NUMBER	DESCRIPTION	QTY.	Mass	MATERIAL	Bend Allowance	Thickness	Bend Radius	Volume	Flattened Mass	
F	Scoop	Sheet Metal Part	25	38.82	6061-T6 (SS)	0.5	1	0.5	14377.86	38.82



Bend Table

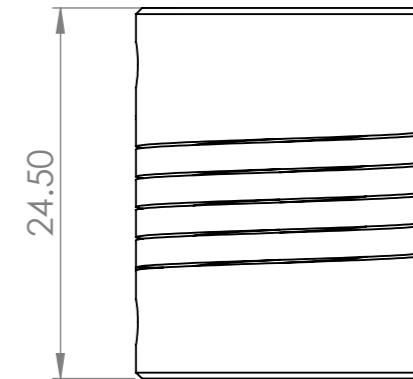
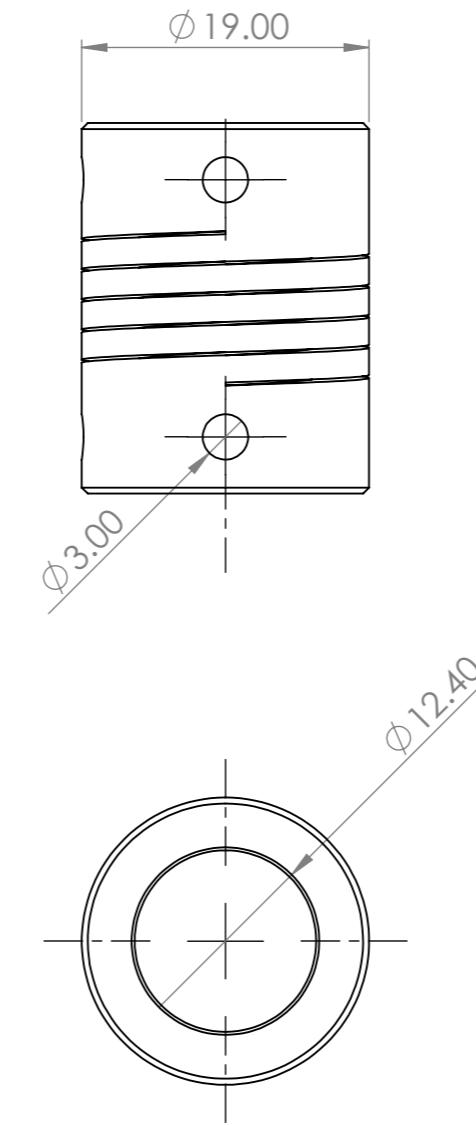
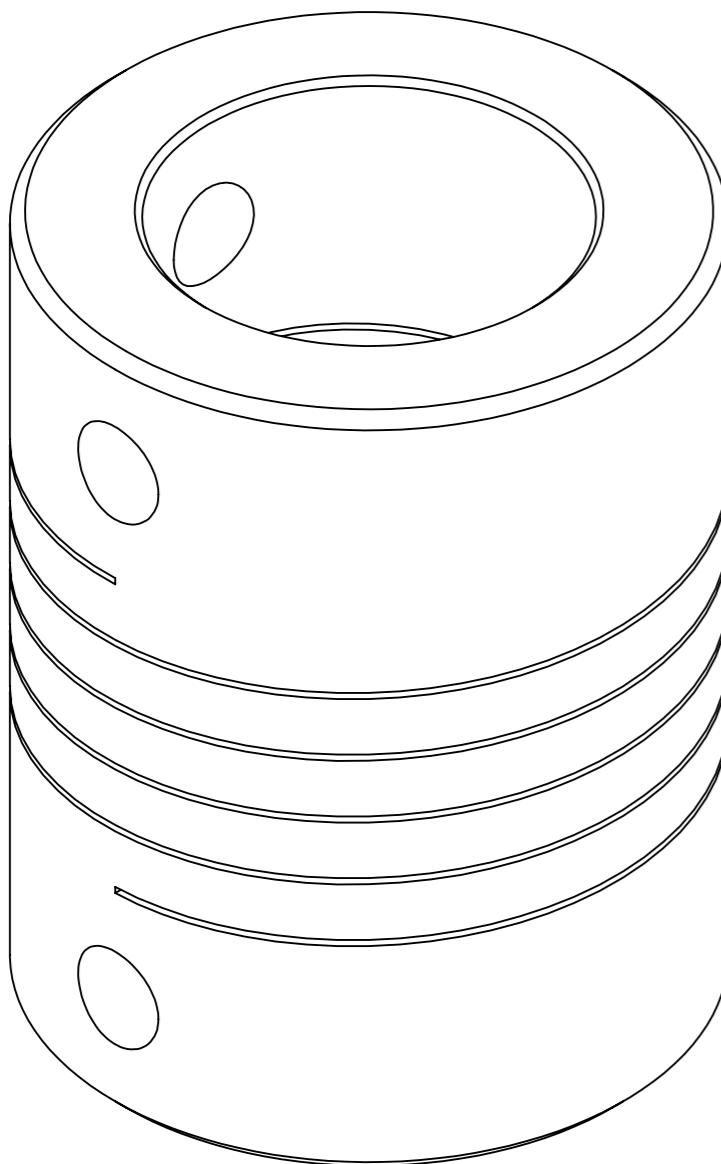
Tag	Direction	Angle	Inner Radius
A	UP	90°	0.5
B	UP	90°	0.5
C	UP	90°	0.5
D	UP	60°	0.5
E	UP	90°	0.5
F	UP	90°	0.5
G	UP	30°	0.5



UNLESS OTHERWISE SPECIFIED: DIMENSIONS ARE IN MILLIMETERS SURFACE FINISH: TOLERANCES: LINEAR: ANGULAR:	FINISH:	DEBURR AND BREAK SHARP EDGES	DO NOT SCALE DRAWING	REVISION
DRAWN	NAME	SIGNATURE	DATE	
CHK'D				
APP'D				
MFG				
Q.A				
	MATERIAL:			DWG NO.
				SHEET 1 OF 1
				SCALE:1:10
				A3

Scoop

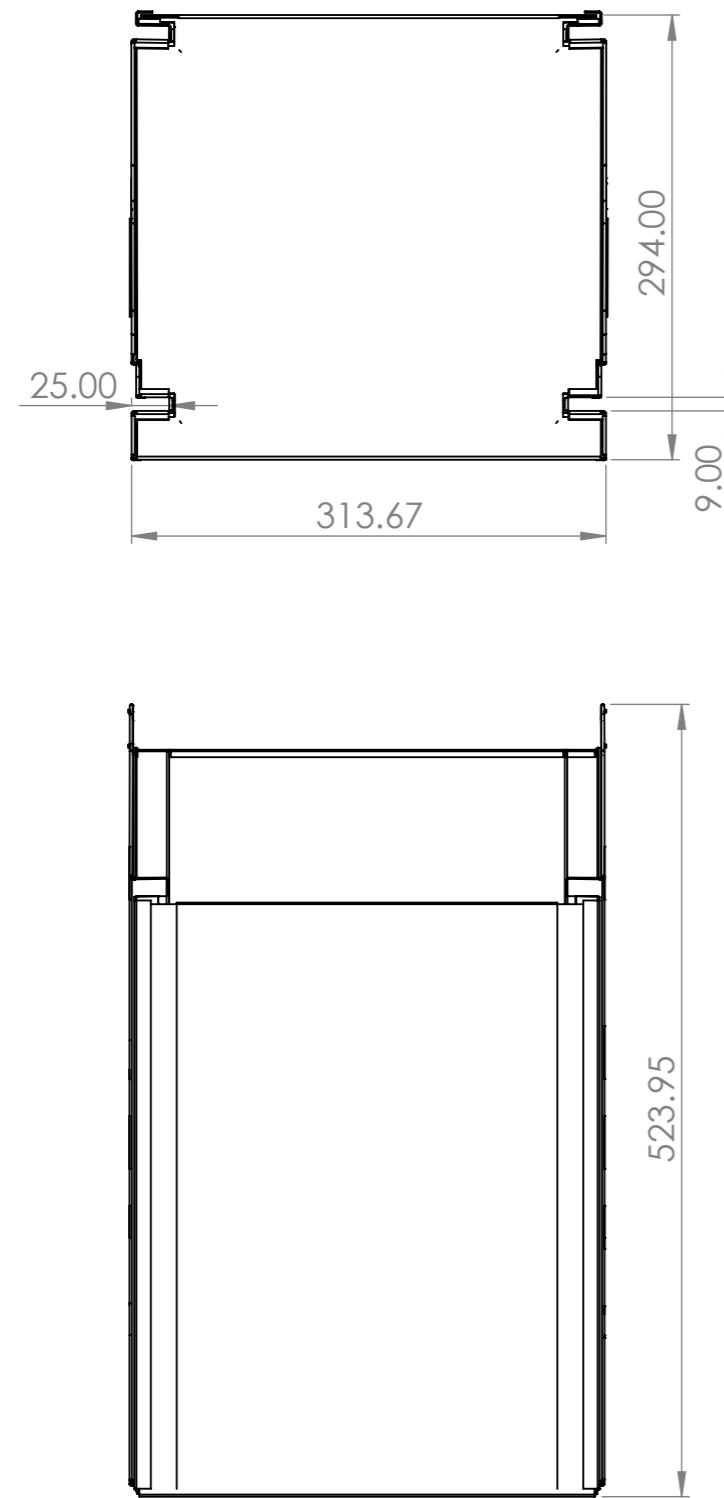
ITEM NO.	PART NO	DESCRIPTION	MATERIAL	WEIGHT	QTY
1.	Flex shaft coupler	Flex shaft coupler	AISI 1020	30.77	1



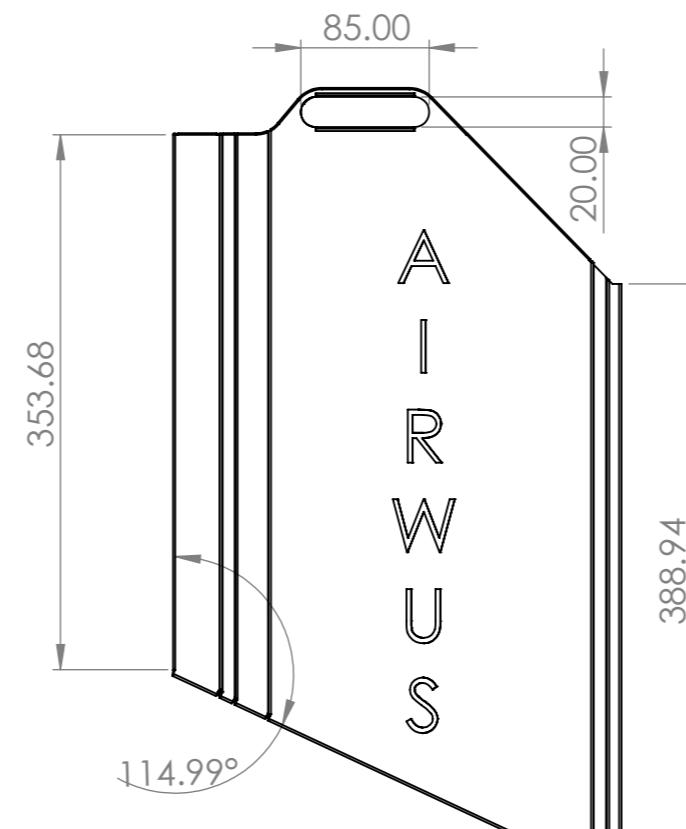
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	NAME	SIGNATURE	DATE			TITLE:	
DRAWN							
CHK'D							
APP'VD							
MFG							
Q.A			MATERIAL:	AISI 1020	DWG NO.	flexcoupler	A3
			WEIGHT: 30.77		SCALE:2:1		SHEET 1 OF 1
4	3	2	1				

ITEM NO.	PART NUMBER	DESCRIPTION	QTY.	Mass	Material	Thickness	Volume	Bend Radius
1	Detachable Module	Sheet Metal Part	1	2088.15	6061-T6 (SS)	1	773387.66	0.5

## Top View



## Front View

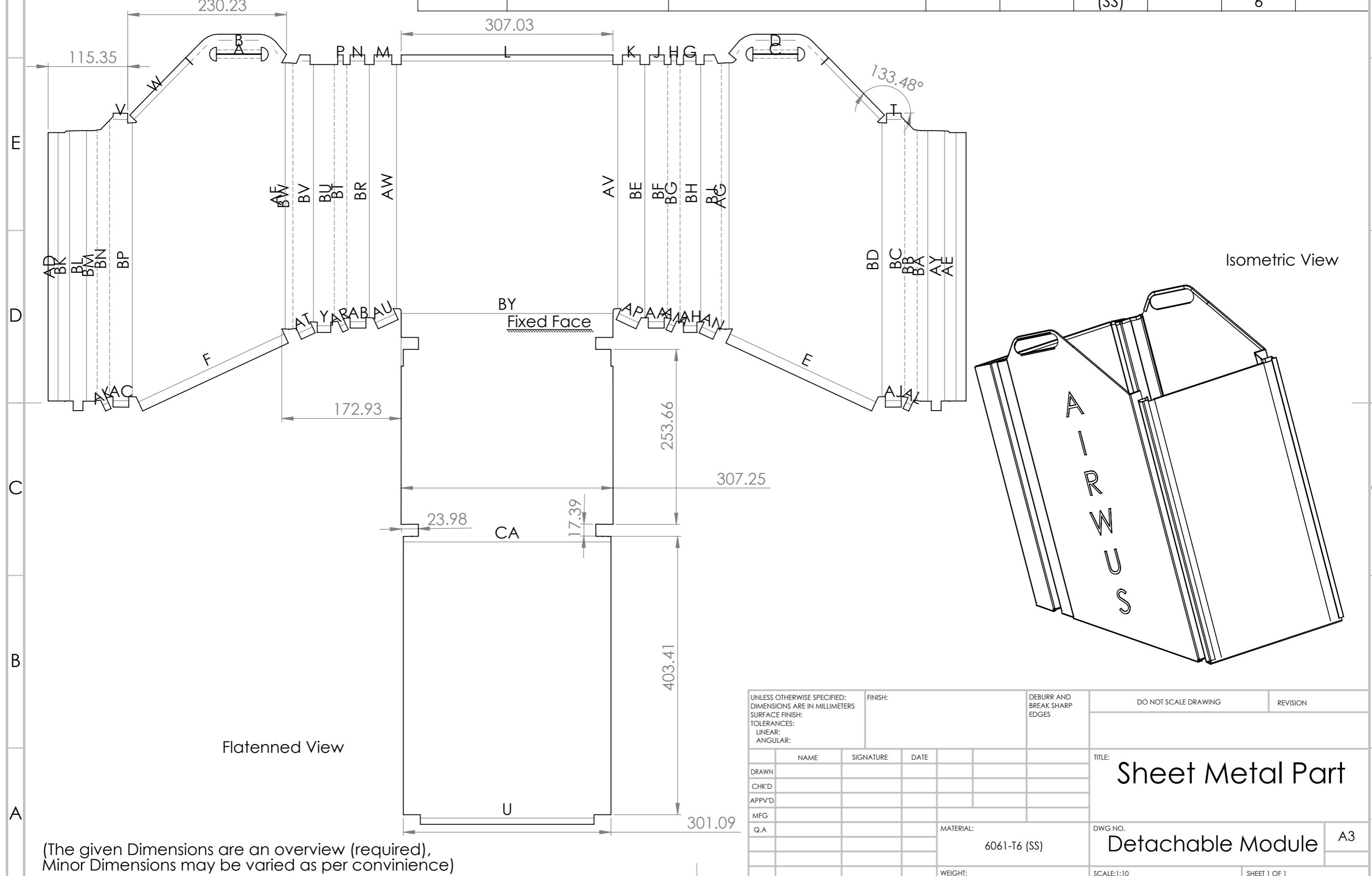


## Right View

## Isometric View

UNLESS OTHERWISE SPECIFIED: DIMENSIONS ARE IN MILLIMETERS SURFACE FINISH: TOLERANCES: LINEAR: ANGULAR:		FINISH:			DEBURR AND BREAK SHARP EDGES	DO NOT SCALE DRAWING	REVISION
DRAWN		SIGNATURE	DATE			TITLE:	
CHK'D							
APPV'D							
MFG							
Q.A.		MATERIAL: 6061-T6 (SS)			DWG NO. <b>Detachable Module Views</b>	A3	
		WEIGHT:			SCALE:1:10	SHEET 1 OF 1	

ITEM NO.	PART NUMBER	DESCRIPTION	QTY.	Mass	Material	Thickness	Volume	Bend Radius
1	Detachable Module	Sheet Metal Part	1	2088.15	6061-T6 (SS)	1	773387.6	0.5



Item No.	Description	Mass	Material
1	Chassis	4557.38	6061-T6 (SS)

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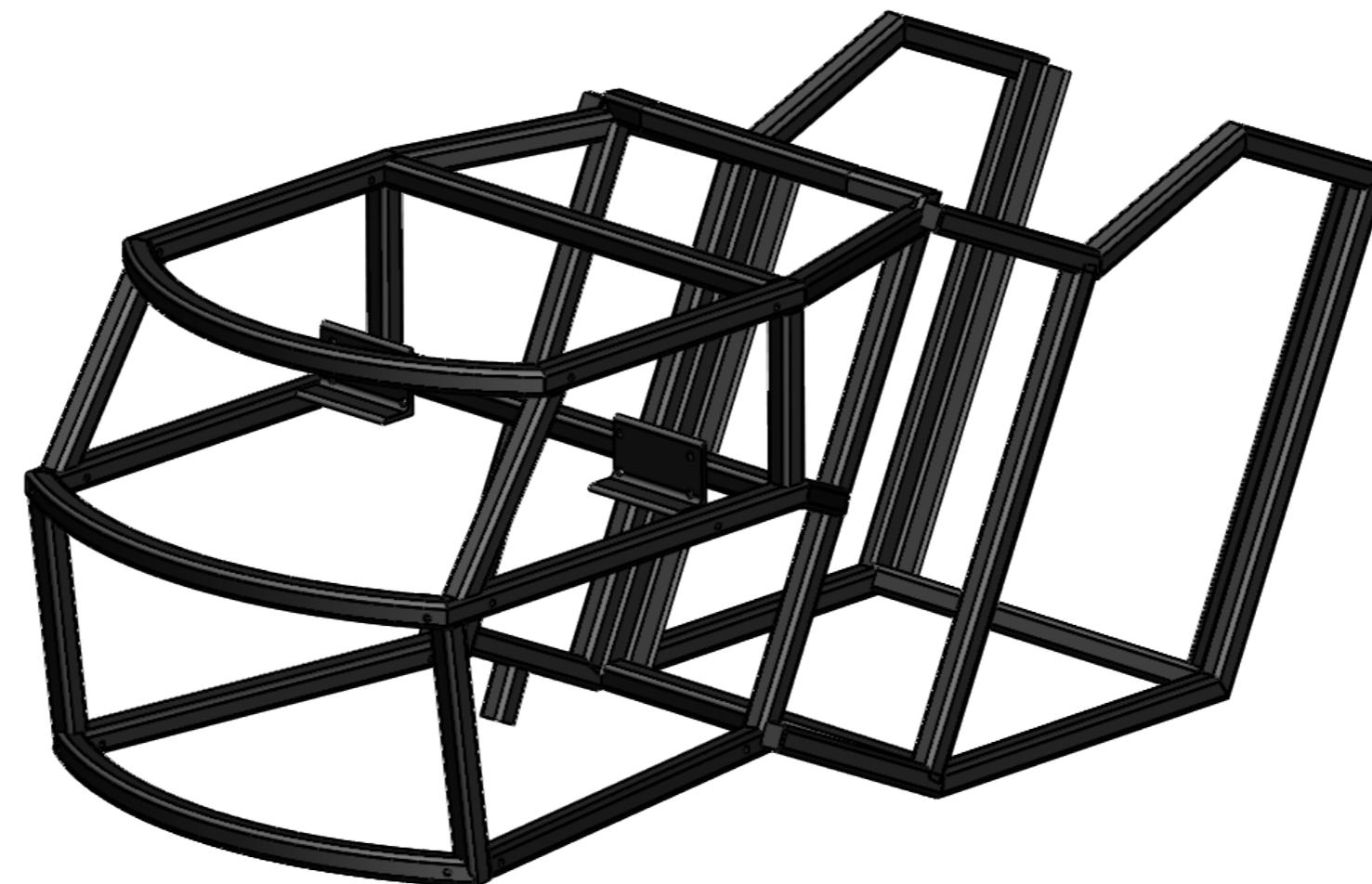
E

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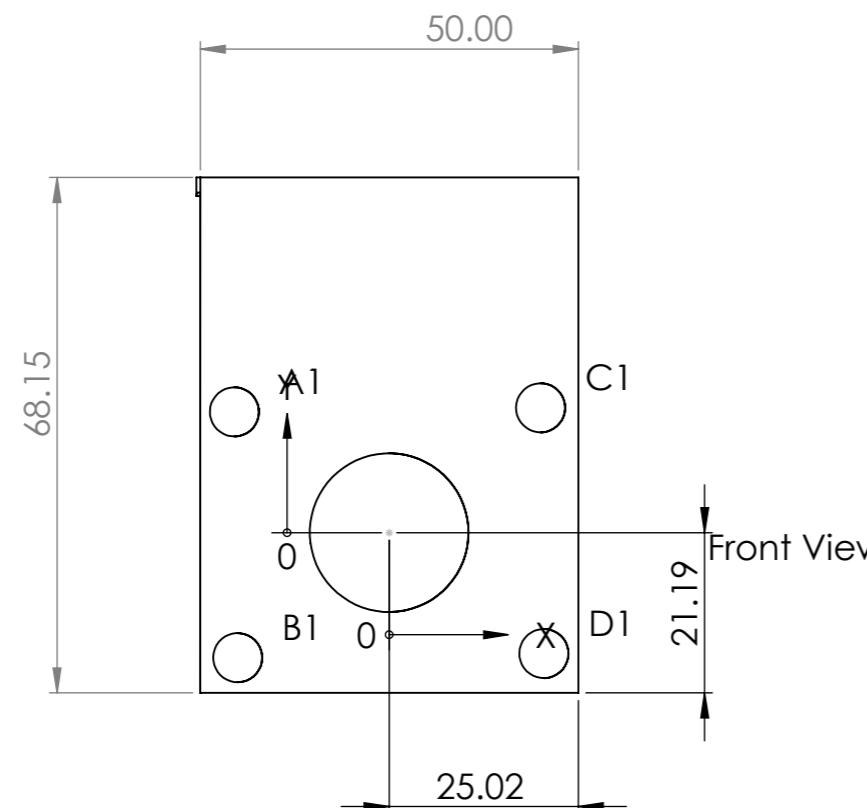


## Isometric View

(See Table in manual for detailed dimensions)

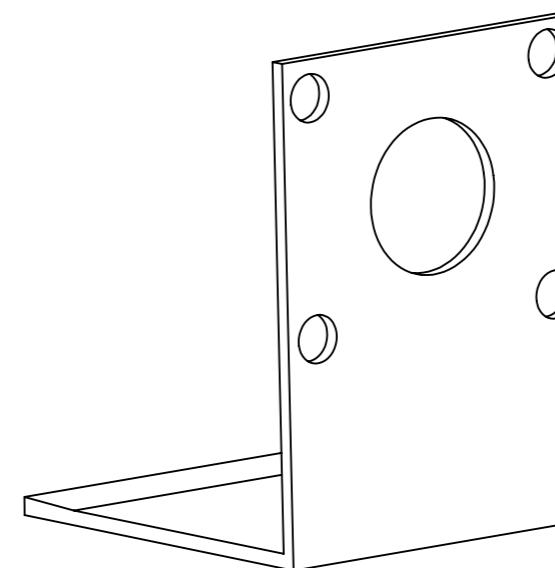
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DRAWN	NAME	SIGNATURE	DATE			TITLE:	
CHK'D							
APPVD							
MFG							
Q.A.			MATERIAL:	6061-T6 (SS)	DWG NO.	Chassis	
			WEIGHT:		SCALE:1:10		
						SHEET 1 OF 1	A3

ITEM NO.	PART NUMBER	DESCRIPTION	QTY.	Mass	Material
1	Conveyer Motor Mount	Conveyer Motor Mount	2	30.83	6061-T6 (SS)



## Hole Table

TAG	X LOC	Y LOC	SIZE
A1	-20.46	15.97	M5
B1	-20.03	-16.53	M5
C1	20.03	16.51	M5
D1	20.47	-15.99	M5

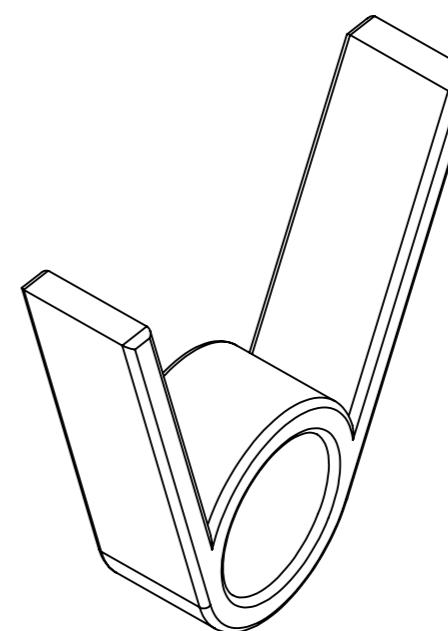
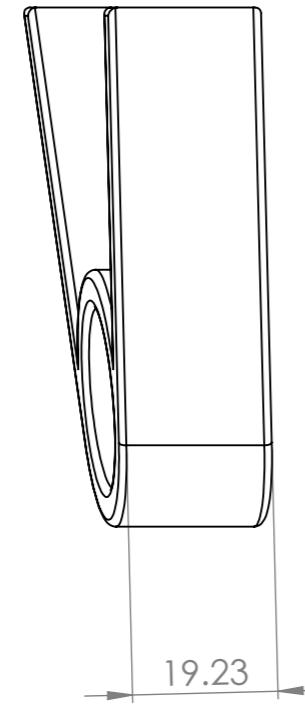
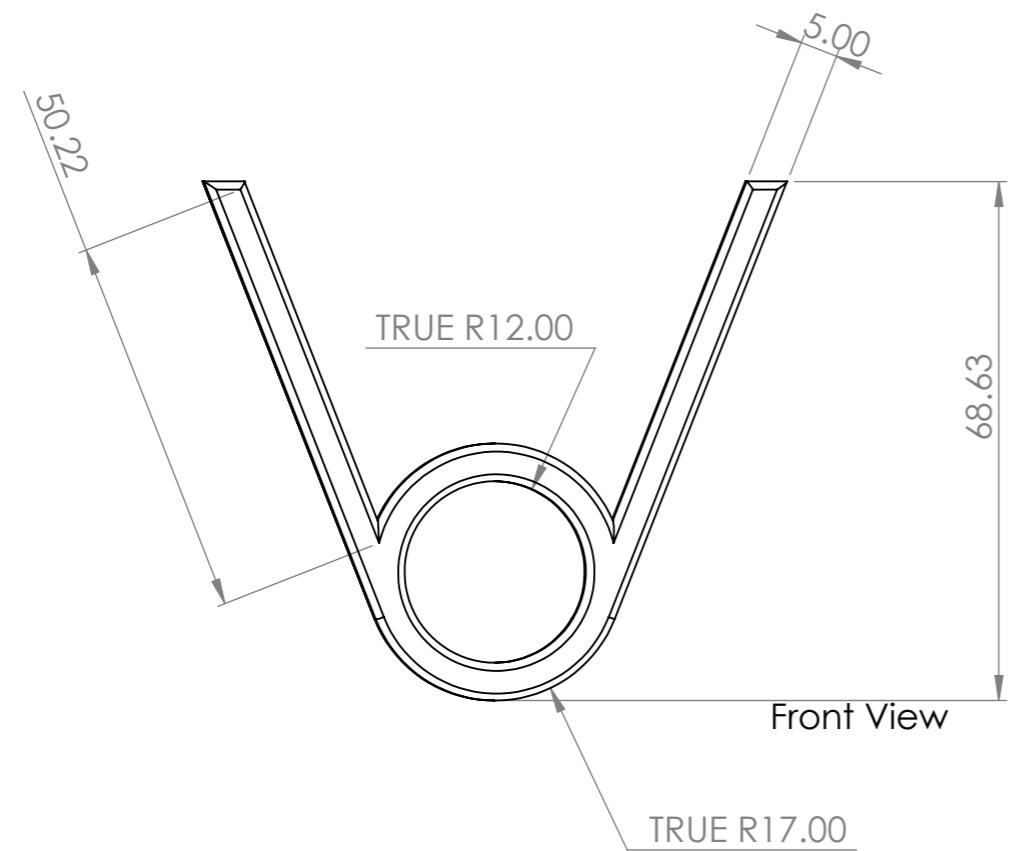


## Isometric View

Right View

UNLESS OTHERWISE SPECIFIED: DIMENSIONS ARE IN MILLIMETERS SURFACE FINISH: TOLERANCES: LINEAR: ANGULAR:		FINISH:		DEBURR AND BREAK SHARP EDGES	DO NOT SCALE DRAWING	REVISION
DRAWN					TITLE:  <h1>Conveyer Motor Mount</h1>	
CHK'D						
APP'D						
MFG						
Q.A		MATERIAL: 6061-T6 (SS)		DWG NO. Conveyer Motor Mount	A3	
		WEIGHT:		SCALE:1:1		
					SHEET 1 OF 1	

8	7	6	5	4	3	2	1
F						F	
				ITEM NO.	PART NUMBER	DESCRIPTION	QTY.
				1	Bearing Mount	Mount holding bearing for drive shaft	4
							Mass
							6061-T6 (SS)



UNLESS OTHERWISE SPECIFIED: DIMENSIONS ARE IN MILLIMETERS SURFACE FINISH: TOLERANCES: LINEAR: ANGULAR:	FINISH:	DEBURR AND BREAK SHARP EDGES	DO NOT SCALE DRAWING	REVISION
DRAWN	NAME	SIGNATURE	DATE	
CHK'D				
APP'D				
MFG				
Q.A				
	MATERIAL:			DWG NO.
	6061-T6 (SS)			Mount holding bearing for drive shaft
	WEIGHT:			SCALE:1:1
				A3
				SHEET 1 OF 1

8 7 6 5 4 3 2 1

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D

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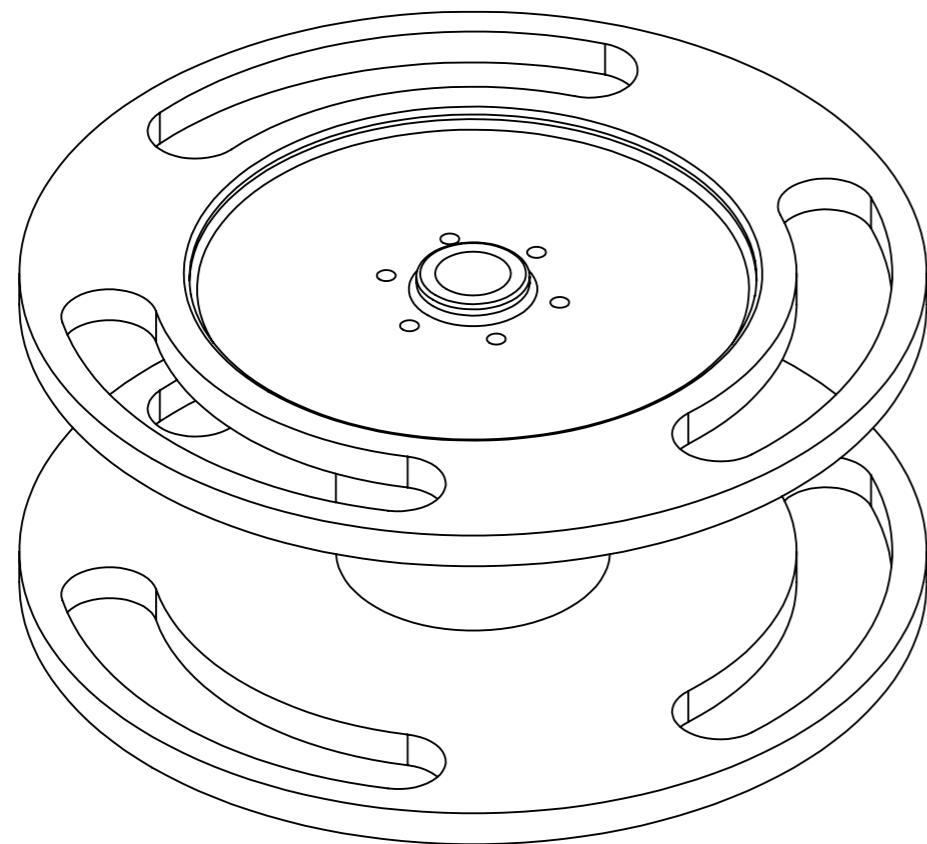
C

B

B

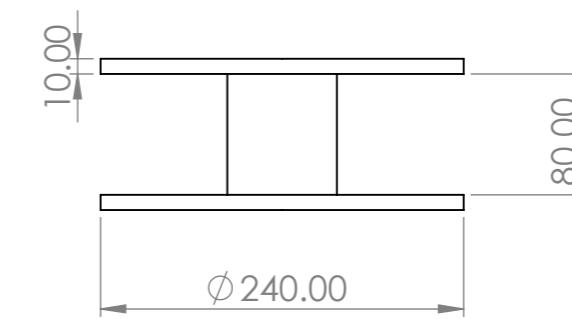
A

A

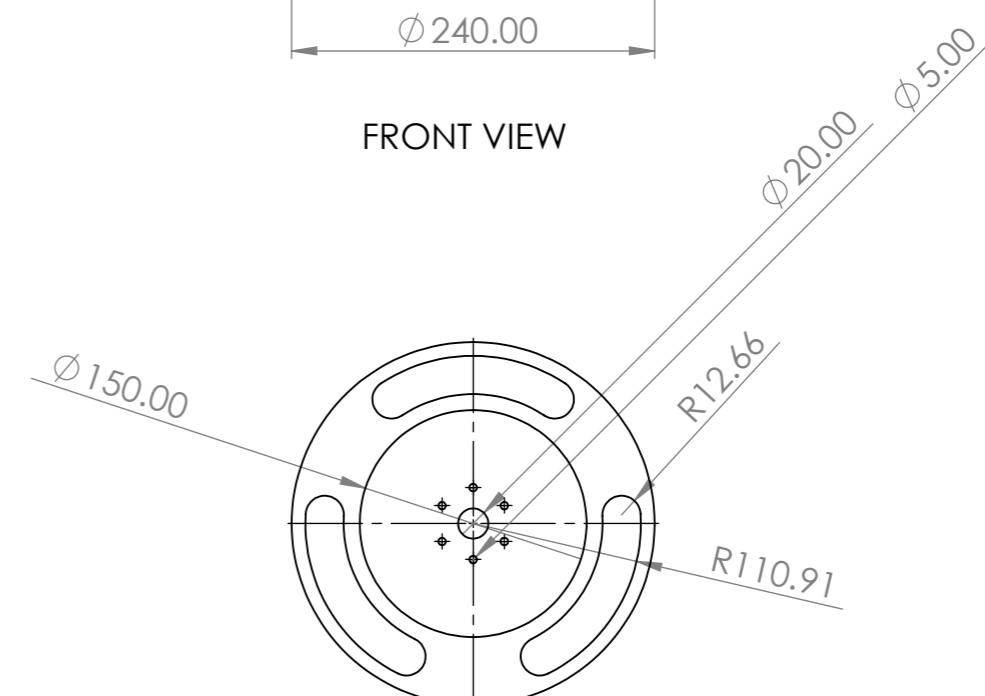


SCALE 1:2  
ISOMETRIC VIEW

ITEM NO	PART	DESCRIPTION	MATERIAL	WEIGHT	QTY.
1.	TRACTION WHEEL	TRACTION WHEEL	1060 Alloy	2207.98	4



FRONT VIEW



TOP VIEW

UNLESS OTHERWISE SPECIFIED: DIMENSIONS ARE IN MILLIMETERS SURFACE FINISH: TOLERANCES: LINEAR: ANGULAR:			FINISH:	DEBURR AND BREAK SHARP EDGES	DO NOT SCALE DRAWING	REVISION
DRAWN	NAME	SIGNATURE	DATE		TITLE:	
CHK'D						
APP'D						
MFG						
Q.A					DWG NO.	
					tractionwheel	
					A3	
					SCALE:1:5	
					SHEET 1 OF 1	
					8	

8

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6

5

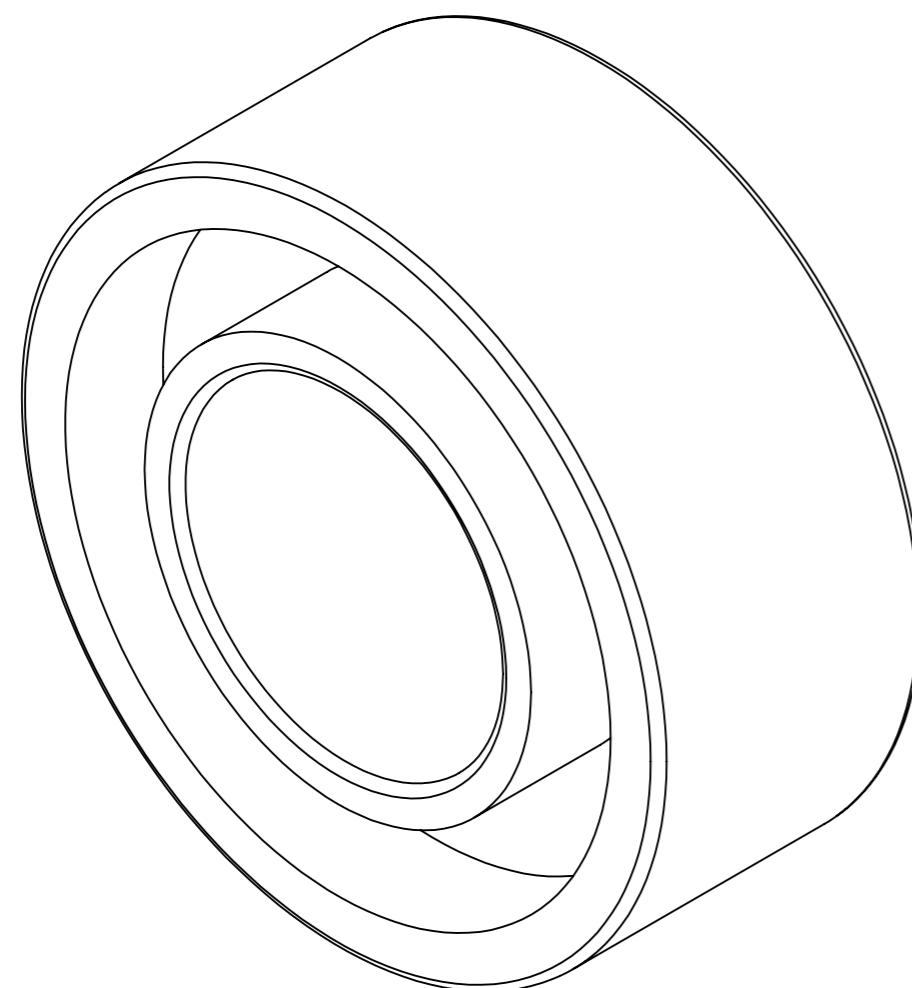
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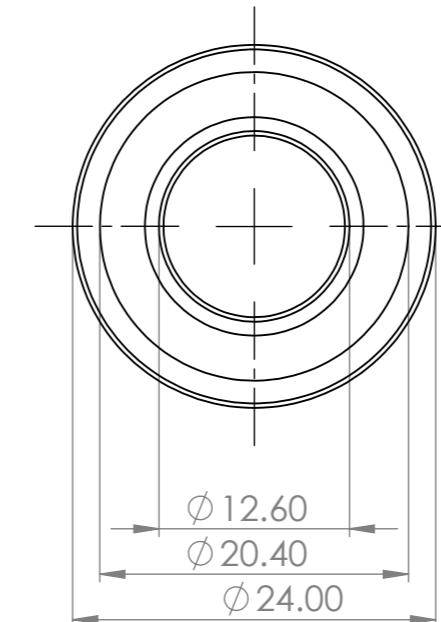
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1

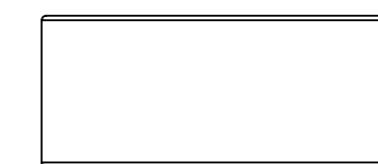
ITEM NO	PART	DESCRIPTION	MATERIAL	WEIGHT	QTY.
1	BEARING	BEARING	Malleable Cast Iron	16.193	2



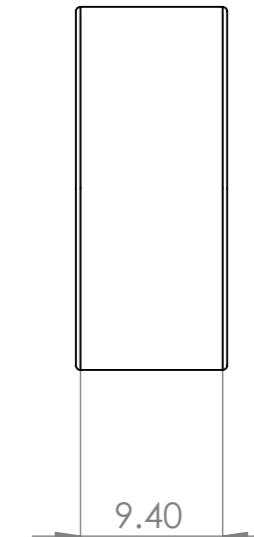
SCALE 5 : 1  
ISOMETRIC VIEW



FRONT VIEW



TOP VIEW



SIDE VIEW

UNLESS OTHERWISE SPECIFIED: DIMENSIONS ARE IN MILLIMETERS SURFACE FINISH: TOLERANCES: LINEAR: ANGULAR:		FINISH:	DEBURR AND BREAK SHARP EDGES	DO NOT SCALE DRAWING	REVISION
DRAWN	NAME	SIGNATURE	DATE	TITLE:	
CHK'D					
APP'D					
MFG				DWG NO.	
Q.A				A3	
				angular contact ball bearing_68	
				Malleable Cast Iron	
				WEIGHT: 16.193	
				SCALE: 2:1	
				SHEET 1 OF 1	

8

7

6

5

4

3

2

1

8

7

6

5

4

3

2

1

ITEM NO.	PART NUMBER	DESCRIPTION	QTY.	Material	Mass
1	Drive Shaft	Drive Shaft	4	6061-T6 (SS)	39.69

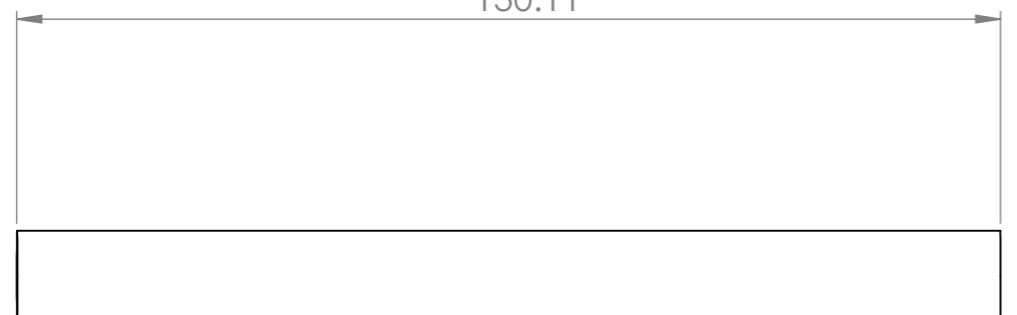
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F

E

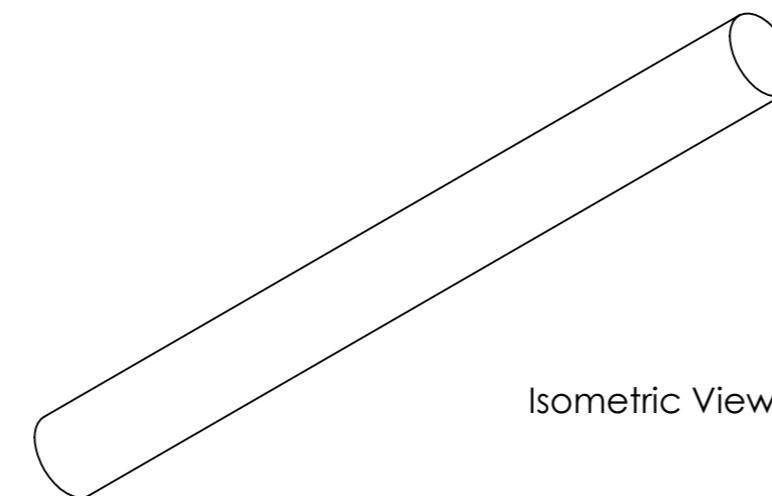
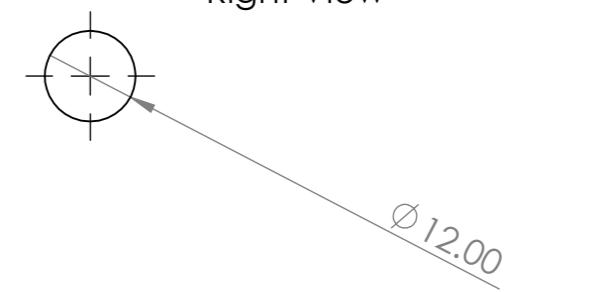
E

130.11



Front View

Right View



Isometric View

D

D

C

C

B

B

A

A

UNLESS OTHERWISE SPECIFIED:  
DIMENSIONS ARE IN MILLIMETERS  
SURFACE FINISH:  
TOLERANCES:  
LINEAR:  
ANGULAR:

	NAME	SIGNATURE	DATE	
DRAWN				
CHK'D				
APPVD				
MFG				
Q.A				

FINISH:

DEBURR AND  
BREAK SHARP  
EDGES

DO NOT SCALE DRAWING  
TITLE:  
**Drive Shaft**

DRWG NO.  
**Drive Shaft**  
A3

MATERIAL:  
6061-T6 (SS)

WEIGHT:

SCALE:1:1

SHEET 1 OF 1

8

7

6

5

4

3

2

1

8

7

6

5

4

3

2

1

ITEM NO.

PART NUMBER

DESCRIPTION

QTY.

Mass

Material

1 Drive Wheels

Drive Wheels

2

3493.20

AISI 1020

F

F

E

E

D

D

C

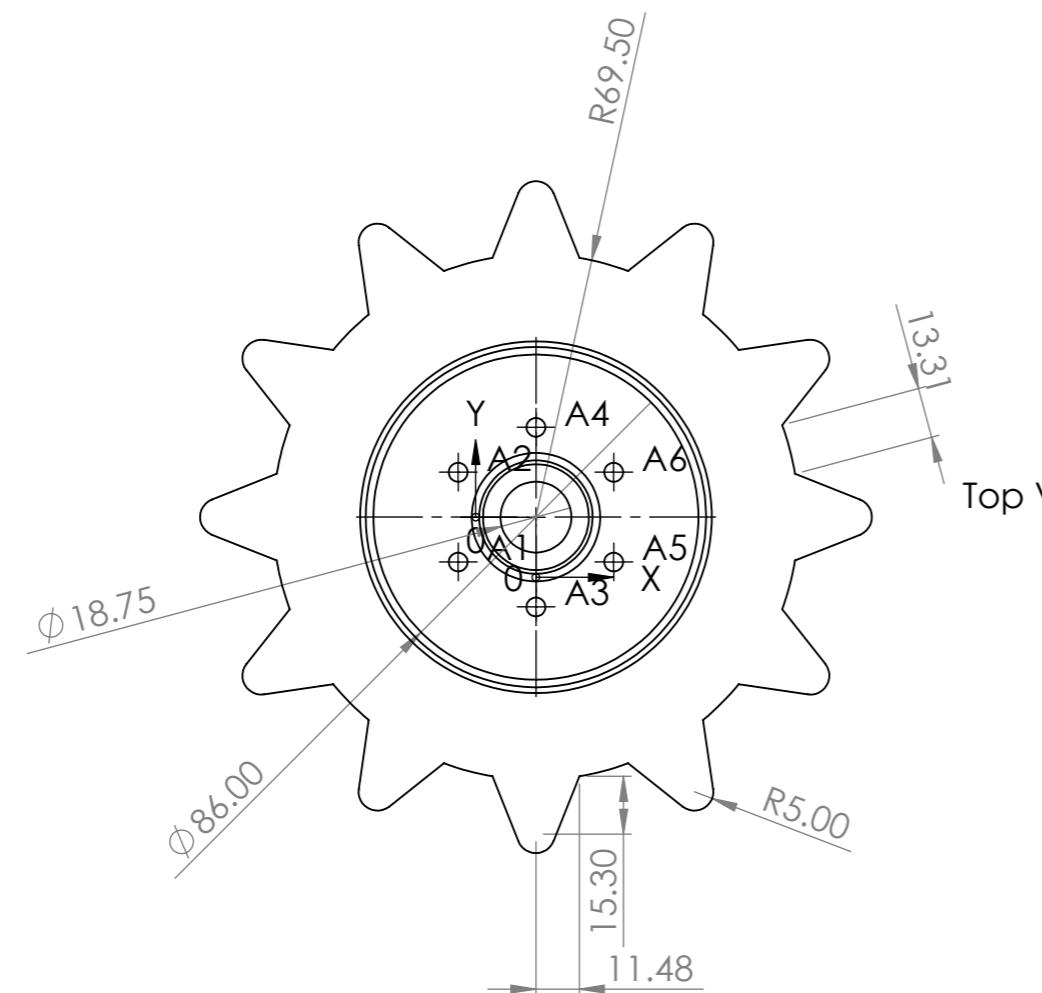
C

B

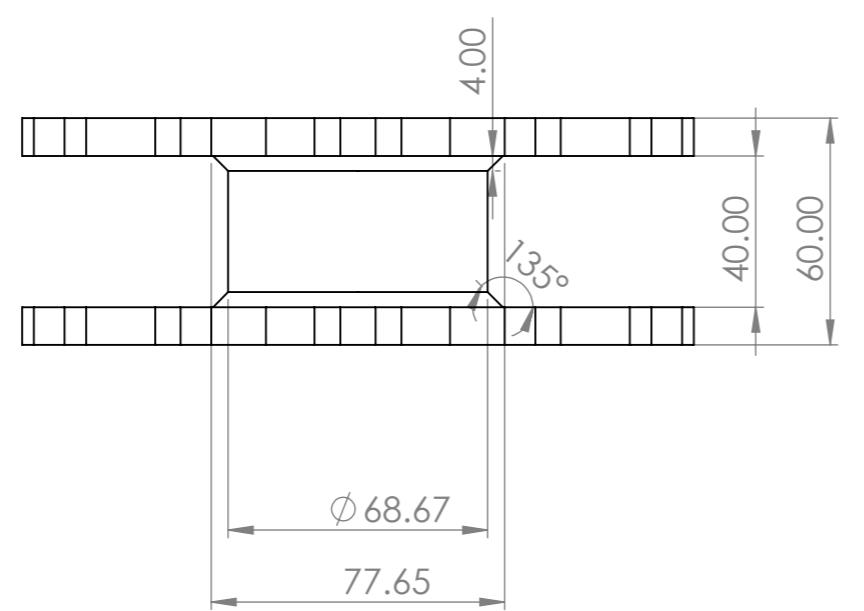
B

A

A



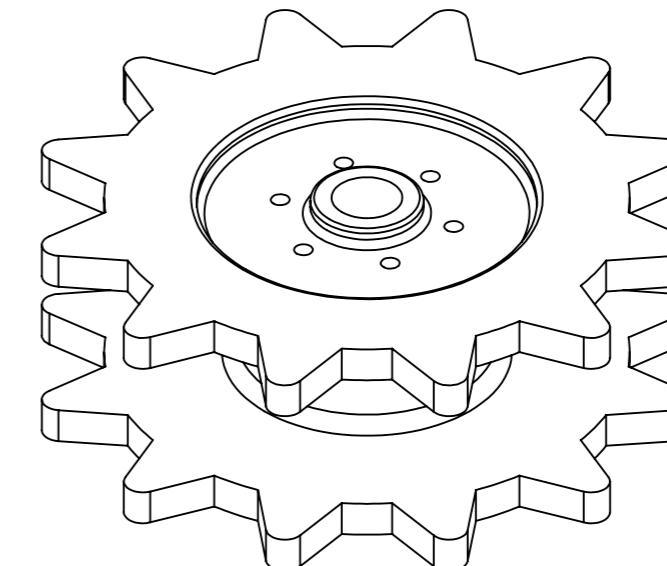
Top View



Front View

## Hole table

TAG	X LOC	Y LOC	SIZE
A1	-20.57	-11.88	Ø 5.00 THRU
A2	-20.57	11.88	Ø 5.00 THRU
A3	0	-23.75	Ø 5.00 THRU
A4	0	23.75	Ø 5.00 THRU
A5	20.57	-11.88	Ø 5.00 THRU
A6	20.57	11.88	Ø 5.00 THRU



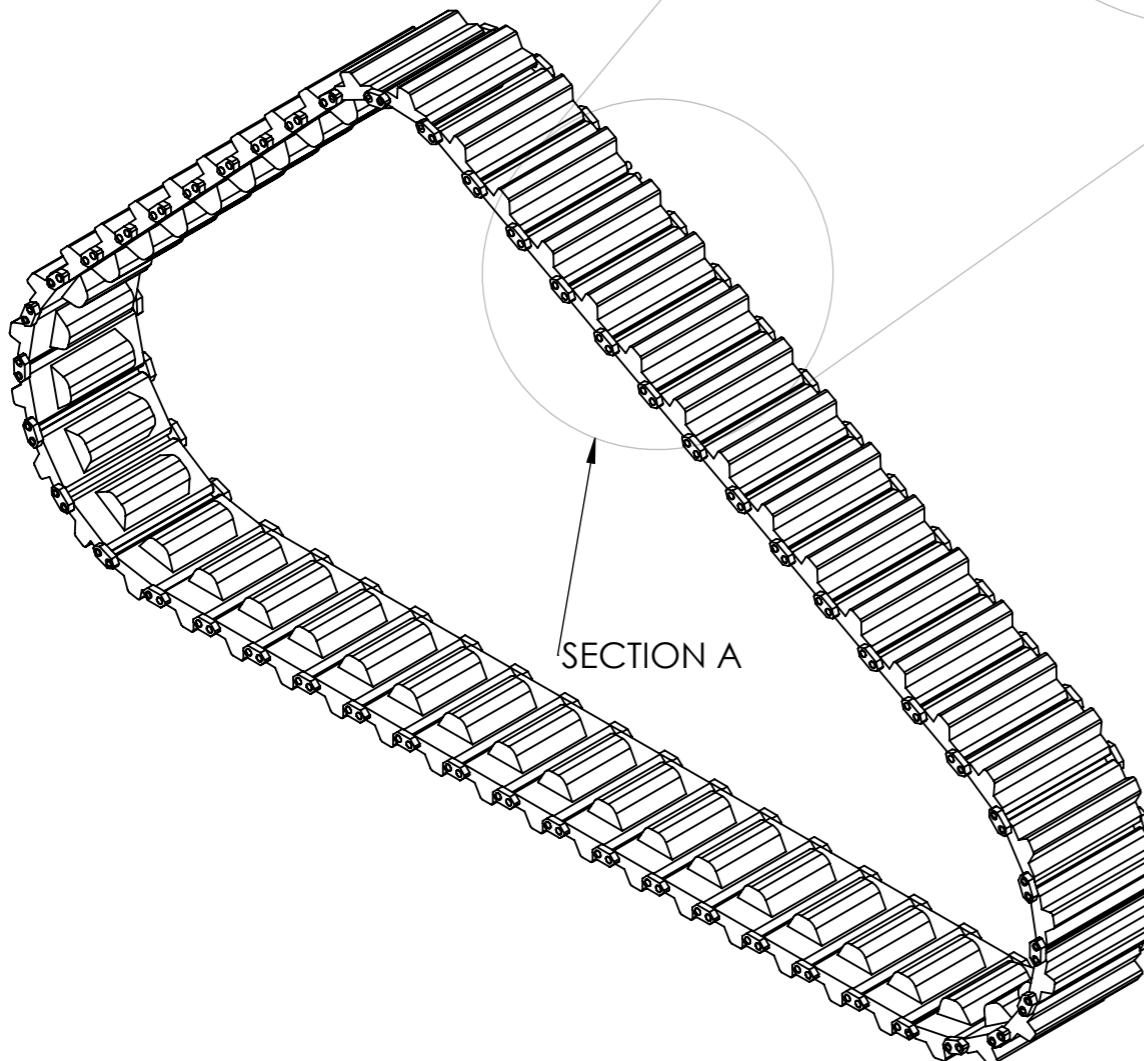
Isometric View

UNLESS OTHERWISE SPECIFIED: DIMENSIONS ARE IN MILLIMETERS SURFACE FINISH: TOLERANCES: LINEAR: ANGULAR:			FINISH:			DEBURR AND BREAK SHARP EDGES	DO NOT SCALE DRAWING		REVISION
DRAWN	NAME	SIGNATURE	DATE						
CHK'D									
APP'D									
MFG									
QA									
MATERIAL: AISI 1020						TITLE: Drive Wheels		DWG NO. A3	
						SCALE:1:2		SHEET 1 OF 1	

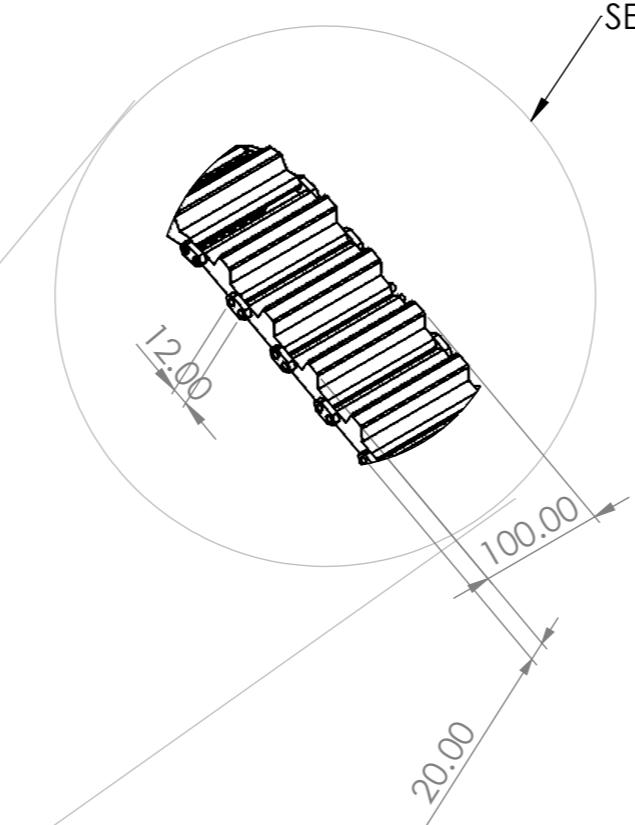
ITEM NO.	PART	DESCRIPTION	MATERIAL	WEIGHT	QTY.
1.	DRIVE BELT	DRIVE BELT	6061-T6(SS)	10961.1	2

F  
E  
D  
C  
B  
A

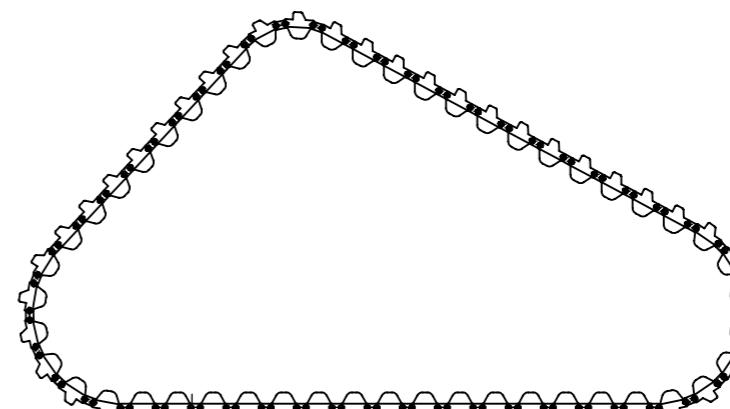
F  
E  
D  
C  
B  
A



SCALE 1 : 5  
ISOMETRIC VIEW



FRONT VIEW



## SIDE VIEW



TOP VIEW

## Notes

