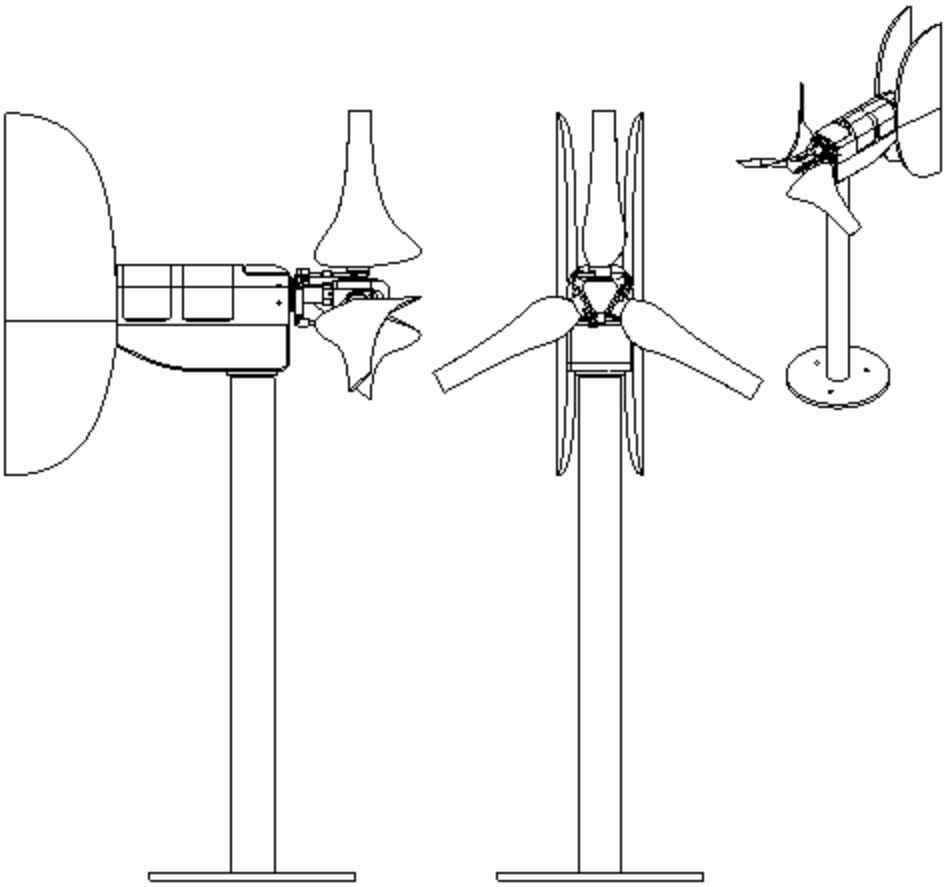
2021 CWC CAD and BOM Package

Barry Benson, Tore Cadman, Bryce Conner,

Joseph Conroy, Stan Kennedy, Aaron Zeek



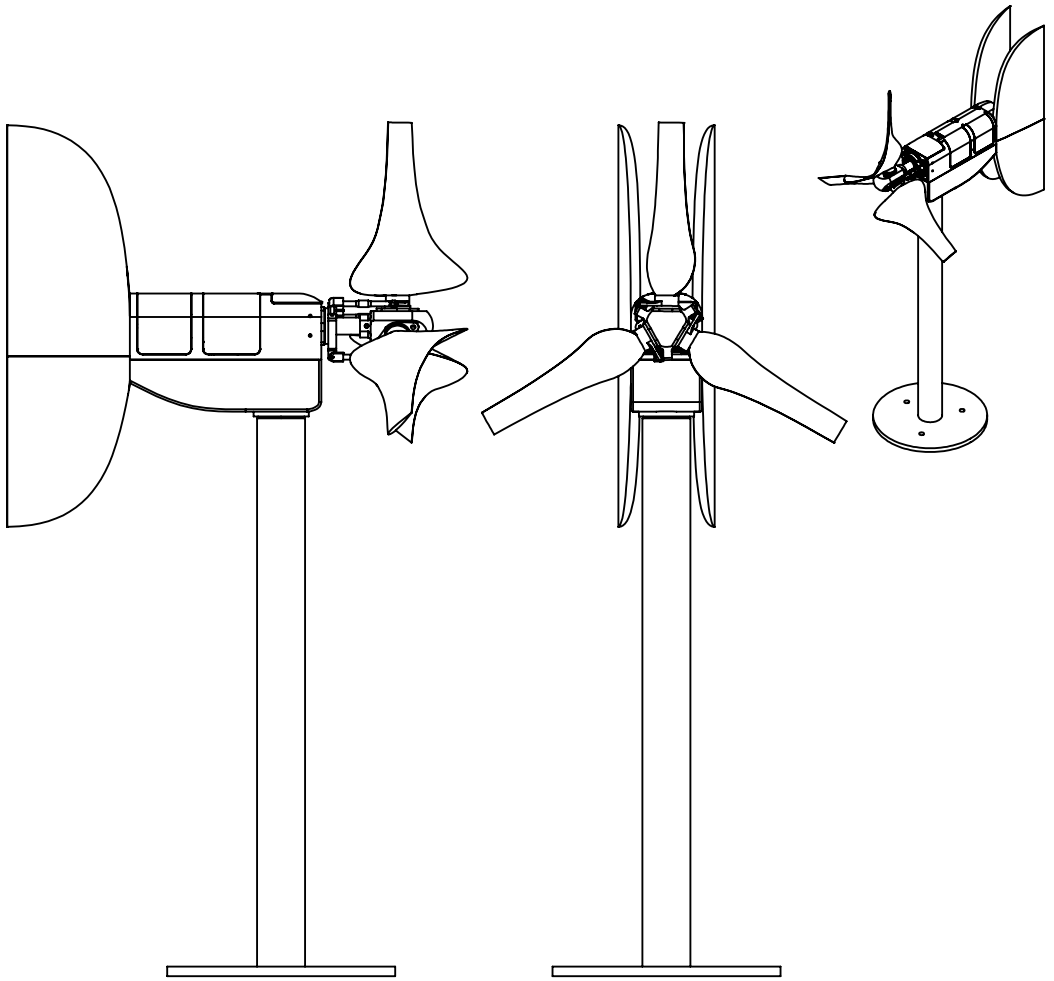
	Part ID	Item Name	Qty.	Cost (per item)	Outsourced Part Name (If applicable)	Vendor
Major Components	1	Mechanical Bracket	1	$5.72		
	2	Electrical Housing	1	$4.40		
	3	Upper Fin	1	$3.76		
	4	Lower Fin	1	$2.98		
	5	Tower	1	$89.50		
	6	Blade	3	$2.40		
	7	Linear Pitch Bearing	1	$12.60		
	8	Shaft	1	$43.50		
	9	Motor	1	$83.00	MAD 5010 110 kV Motor	Amazon
	10	Hub	1	$1.96		
	11	Cover	1	$1.12		
Minor Components	12	Mounted Bearing	3	$5.55	KFL08 Flange Bearing	VXB Bearings
	13	Heim Joint	3	$14.69	TOYANDONA M4 Threaded Heim Joint	Amazon
	14	Linear Bearing Coupler	3	$0.59		
	15	Wall Gear	2	$0.85		
	16	Floor Gear	1	$0.74		
	17	Stepper Gear	1	$0.84		
	18	Rack Gear	2	$1.06		
	19	Stepper Motor	1	$11.99	28BYJ-48 Stepper Motor	Amazon
	20	Stepper Driver			ULN2003 Driver Board	
	21	Circuit Board	1	$4.00		
	22	Shaft Coupler	1	$2.06		
	23	Hall Sensor	1	$5.99	KY-003 Hall Effect Magnetic Sensor	Amazon
	24	Linear Actuator	1	$64.99	PQ12-S Micro Linear Actuator	Amazon
	25	Brake Disk	1	$27.50		
	26	Brake Pad	1	$1.56		
	27	Slip Ring	1	$49.72	Taidacent 12 Way 10 A Slip Ring	Amazon
	28	1 3/4" Retaining Ring	1	$4.06		Homco
	29	25x47x12 mm Bearing	1	$5.55		VXB Bearings
	30	7x14x5 mm Bearing	2	$4.79		VXB Bearings
	31	45x58x7 mm Bearing	2	$19.49		VXB Bearings
			Total	$549.61		
Electrical Components	32	3' 18 Gauge Wire	12		Refer to NAU CWC 2021 Electrical Captsone for further Detail on Electrical Components	
	33	Rectifier	1			
	34	Boost Converter	1			
	35	MCU	1			
	36	Test Load	1			

The Bill of Materials is representative of the Turbine's printed, machined, and outsourced parts. In order for the turbine to be operational, several electrical components are also required. For further information on these parts, refer to the NAU CWC 2021 Electrical Capstone documentation.

Printed and machined parts are not only reflections of their material cost, but as well as the amount of post processing to the part required in terms of labor. For example, the required welding of the tower to a base is reflected in its listed price. On the other hand, some components such as the gearing require little to no post processing, also reflected in the listed price. All printed and machined parts will be shown in the drawings, but outsourced materials are only shown through publicly available drawings. Also, outsourced parts with clearly defined parameters are not included in the drawing (such as dimensioned bearings).

It is of note that all dimensions shown in the following CAD drawings are in **millimeters**. Some of the drawings contain comments important to the understanding of the part and its annotations.

ITEM NO.	PART NUMBER	QTY.
1	Tower	1
2	Bracket (Electrical)	1
3	Mechanical Bracket	1
4	45x58x7	2
5	Retaining Ring	1
6	Hub	1
7	Slip Ring	1
8	25x47x12	1
9	Shaft	1
10	Shaft Coupler	1
11	Motor	1
12	Stepper Gear	1
13	Stepper Motor	1
14	Wall Gear	2
15	Floor Gear	1
16	7x14x5	2
17	2662N55	2
18	Mounted Bearing	3
19	Brake Disk	1
20	Fin	1
21	Blade	3
22	LA Housing	1
23	LA Shaft	1
24	Linear Bearing Coupler	3
25	Linear Bearing	1
26	Heim Joint	3
27	Cover	1



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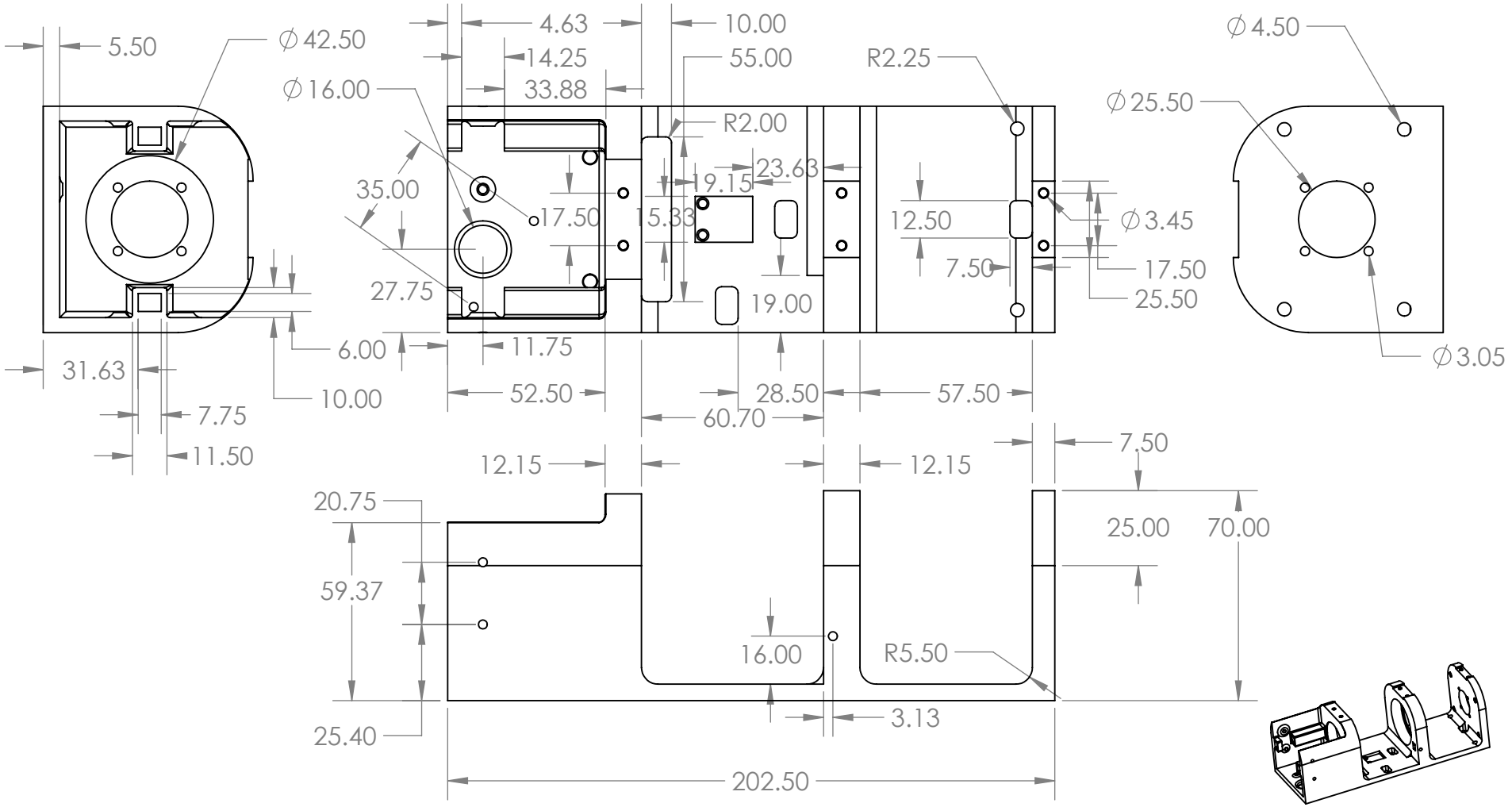
			CHECKED		
			ENG APPR.		
			MFG APPR.		
		INTERPRET GEOMETRIC TOLERANCING PER:	Q.A.		
		MATERIAL	COMMENTS: Due to the methodology of assembling the turbine digitally, the CAD BOM does not line up with the BOM separate from the drawing files. When referring to Part IID's, please utilize the separate BOM.		
NEXT ASSY	USED ON	FINISH			
APPLICATION		DO NOT SCALE DRAWING			

TITLE:

Full Turbine Assembly

SIZE	DWG. NO.	REV
A		
SCALE: 1:20	WEIGHT:	SHEET 0 OF 17



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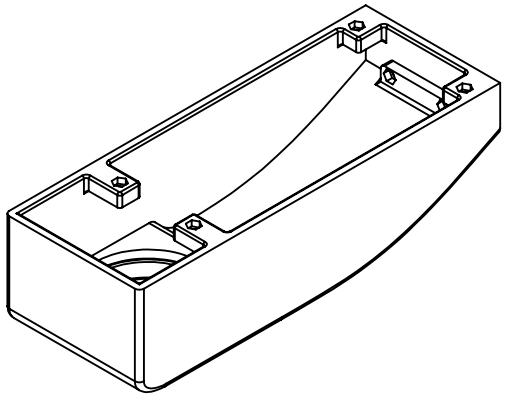
		INTERPRET GEOMETRIC TOLERANCING PER:	Q.A.		
		MATERIAL: PLA	COMMENTS: Due to the large number of components associated with this part, there is a large number of dimensions that cannot be easily captured in the drawing, please refer to the associated part for more clear dimensioning		
NEXT ASSY	USED ON	FINISH			
APPLICATION		DO NOT SCALE DRAWING			

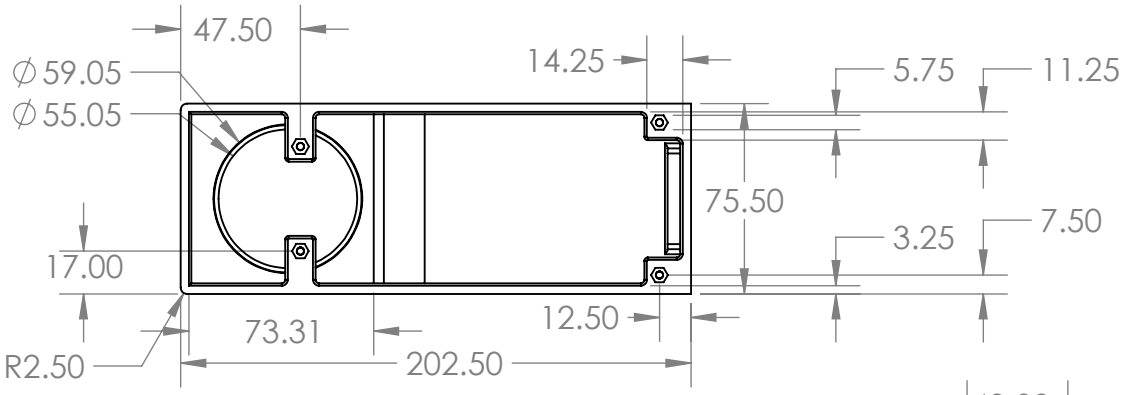
TITLE:

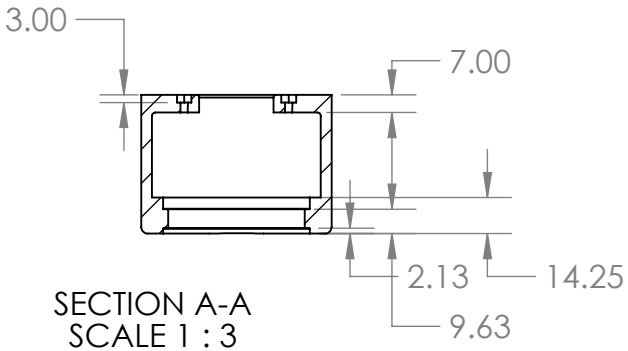
Mechanical Bracket
Part ID: 1

SIZE	DWG. NO.	REV
A		

SCALE: 1:2	WEIGHT:	SHEET 1 OF 17







SECTION A-A
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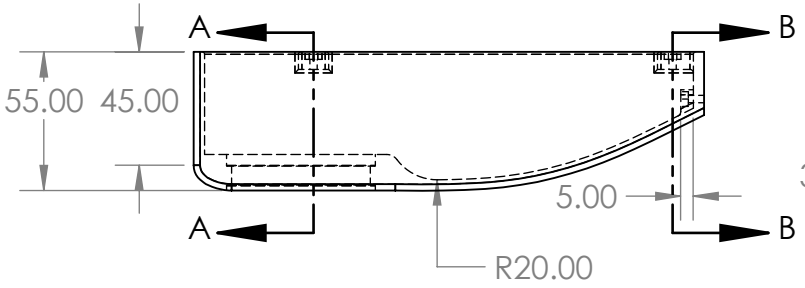

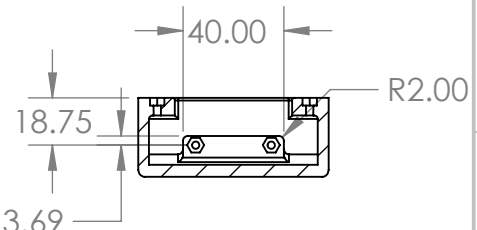

SECTION B-B
SCALE 1 : 3

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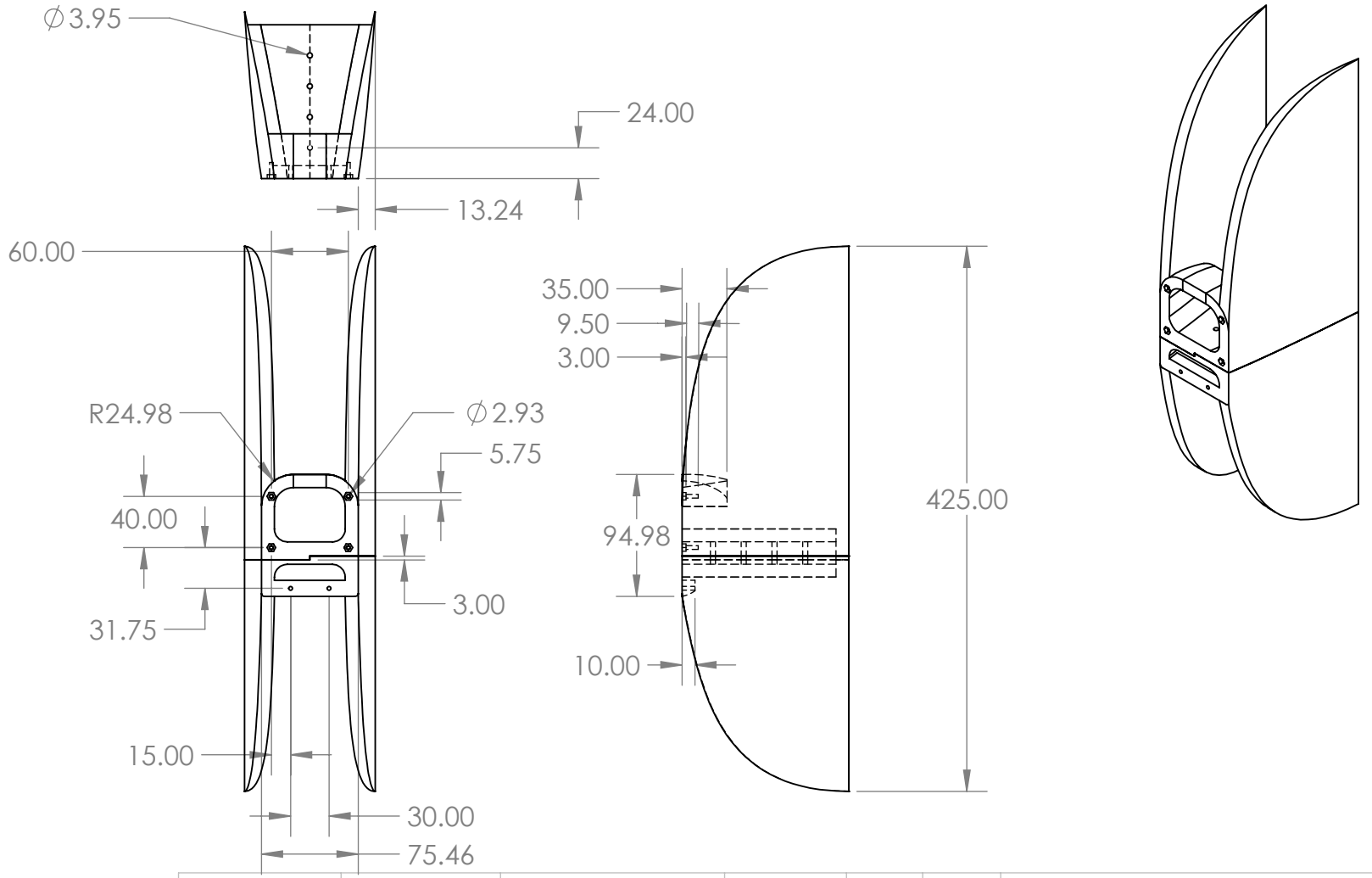
		MATERIAL: PLA	COMMENTS:		
NEXT ASSY	USED ON	FINISH			
APPLICATION		DO NOT SCALE DRAWING			

TITLE:
Bracket (Electrical)
Part ID 2

SIZE	DWG. NO.	REV
A		

SCALE: 1:2 | WEIGHT: | SHEET 2 OF 17



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			ENG APPR.		
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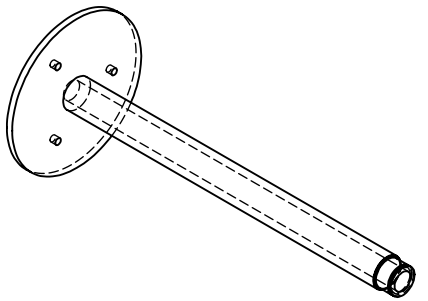
		INTERPRET GEOMETRIC TOLERANCING PER:	Q.A.		
		MATERIAL: PLA	COMMENTS:		
NEXT ASSY	USED ON	FINISH			
APPLICATION		DO NOT SCALE DRAWING			

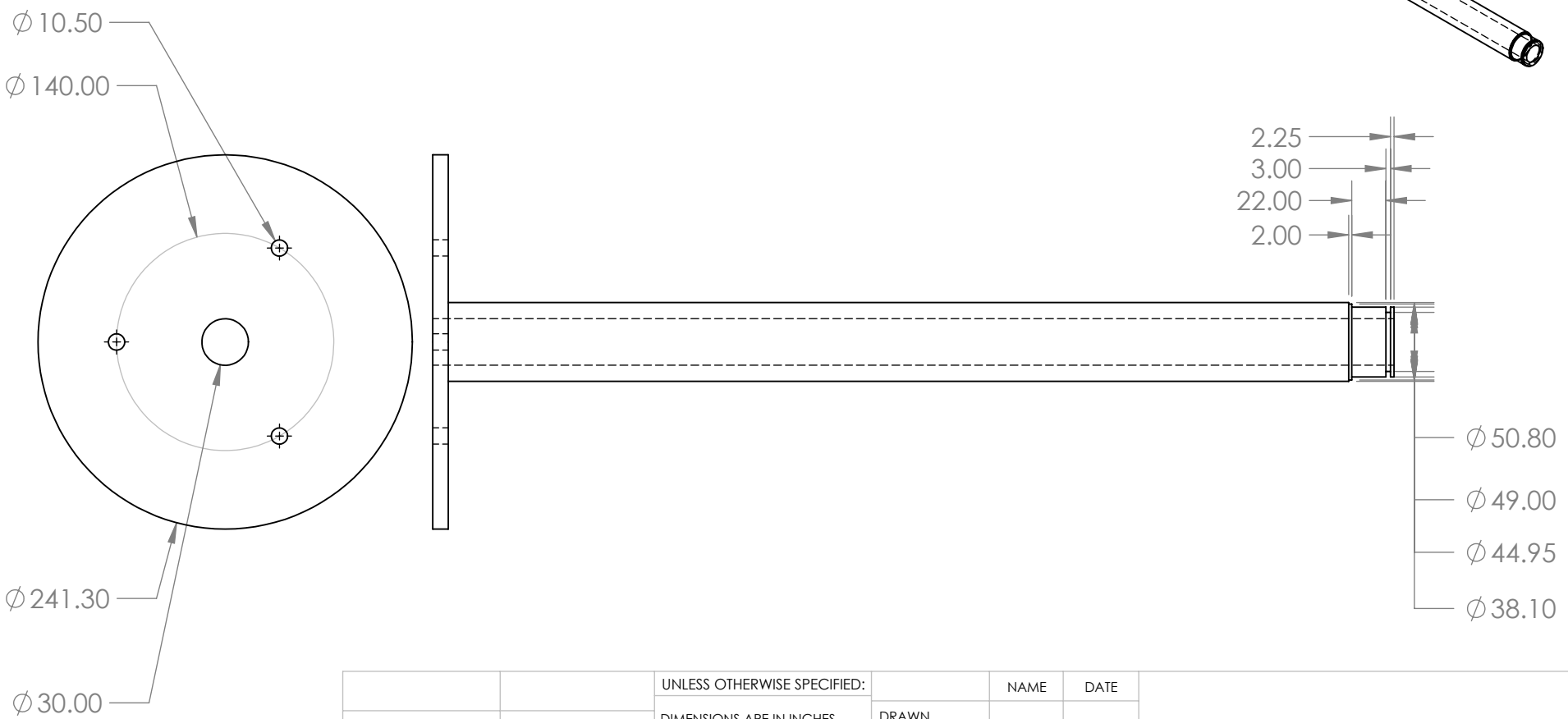
TITLE:

Fin
Part ID: 3-4

SIZE	DWG. NO.	REV
A		

SCALE: 1:10 | WEIGHT: | SHEET 3 OF 17





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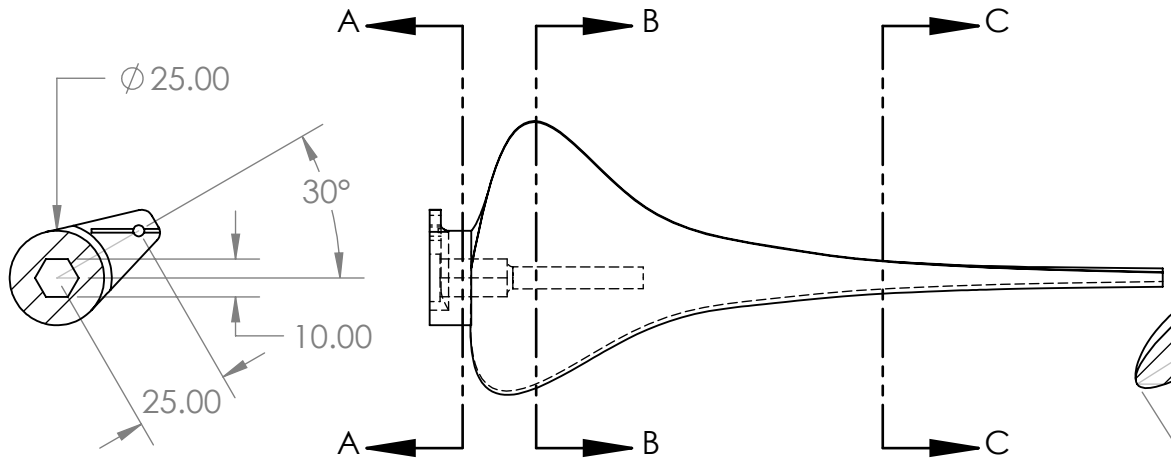
		INTERPRET GEOMETRIC TOLERANCING PER:	Q.A.		
		MATERIAL: Aluminum	COMMENTS:		
NEXT ASSY	USED ON	FINISH			
APPLICATION		DO NOT SCALE DRAWING			

TITLE:

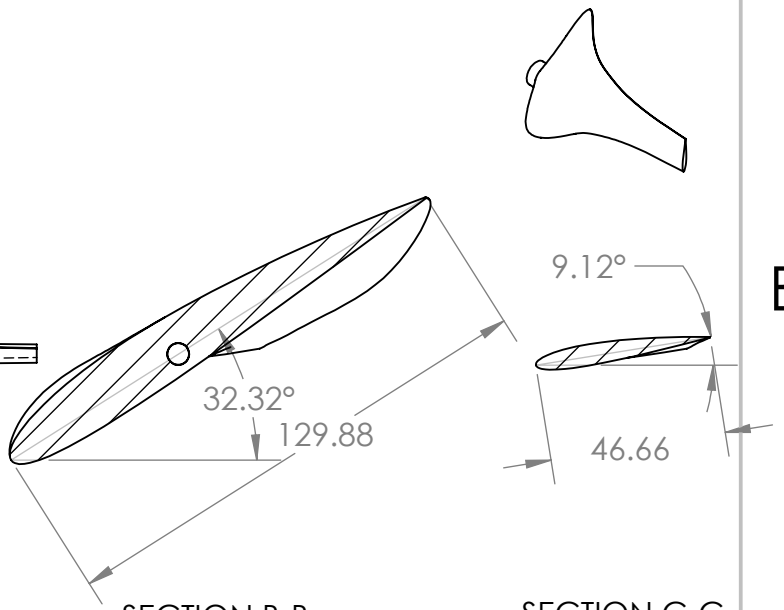
Tower
Part ID 5

SIZE	DWG. NO.	REV
A		

SCALE: 1:10 | WEIGHT: | SHEET 4 OF 17

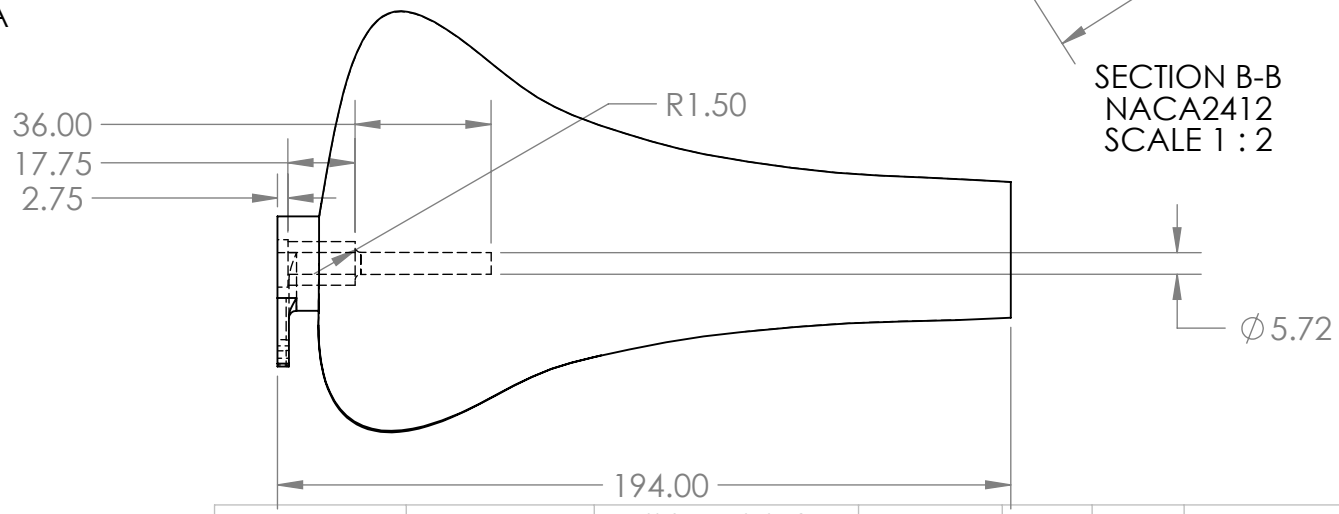


SECTION A-A
SCALE 1 : 2



SECTION B-B
NACA2412
SCALE 1 : 2

SECTION C-C
NACA1412
SCALE 1 : 2



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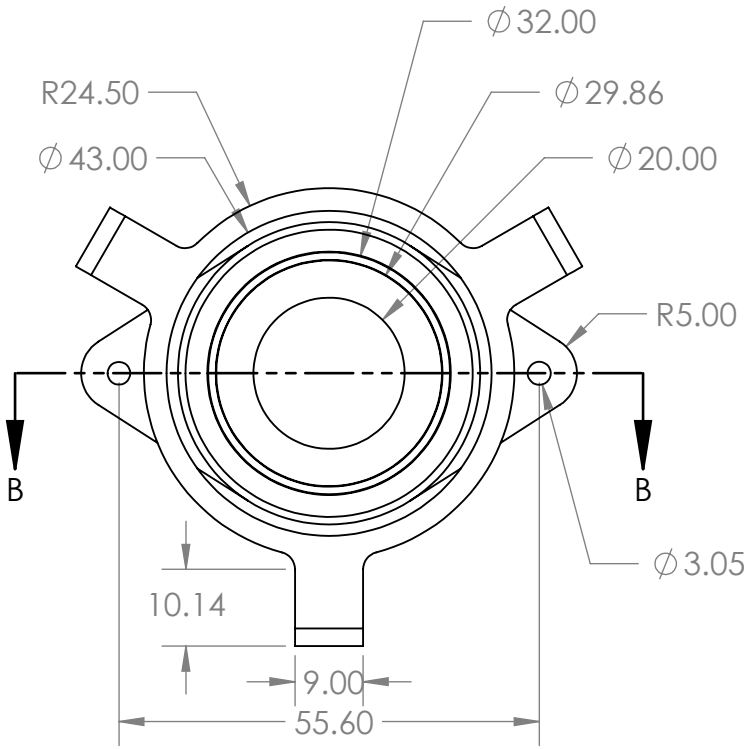
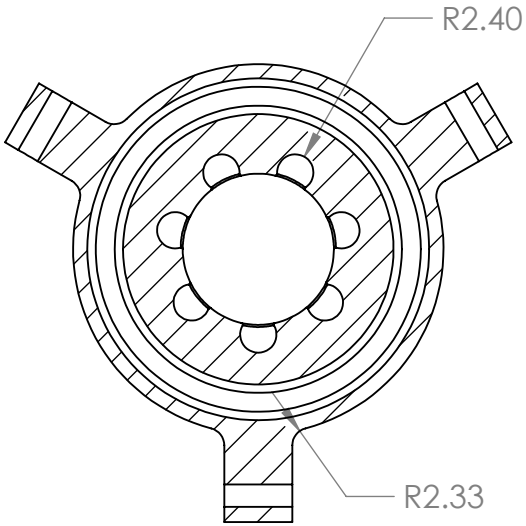
		MATERIAL: PLA	COMMENTS:		
NEXT ASSY	USED ON	FINISH			
APPLICATION		DO NOT SCALE DRAWING			

TITLE:

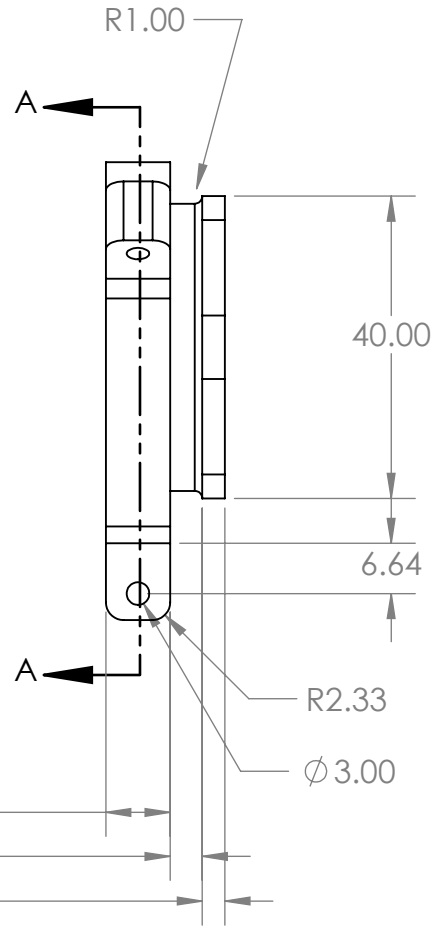
7 Blade
Part ID 6

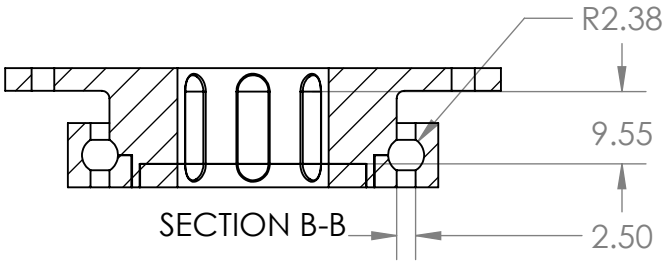
SIZE	DWG. NO.	REV
A		
SCALE: 1:5	WEIGHT:	SHEET 5 OF 17



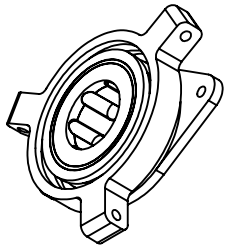


SECTION A-A





SECTION B-B



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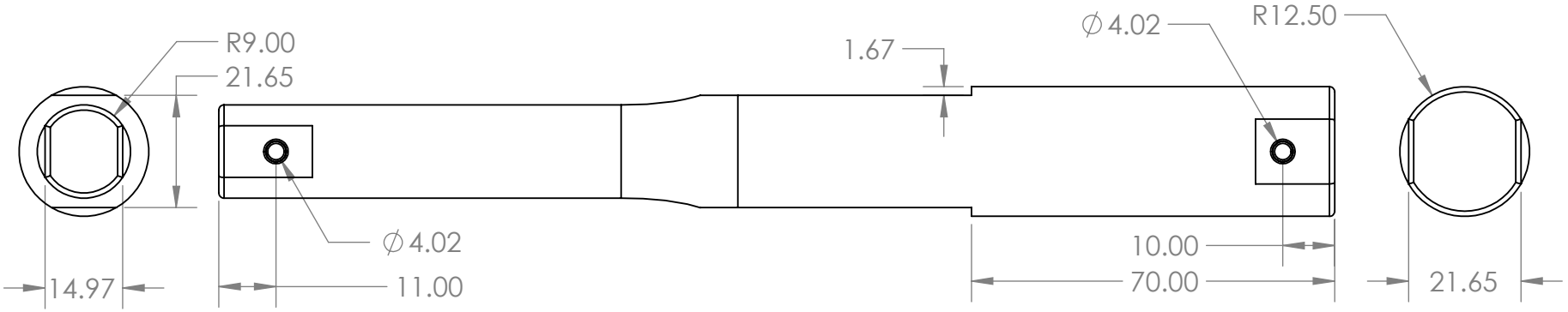
		INTERPRET GEOMETRIC TOLERANCING PER:	Q.A.		
		MATERIAL: PLA	COMMENTS:		
NEXT ASSY	USED ON	FINISH			
APPLICATION		DO NOT SCALE DRAWING			

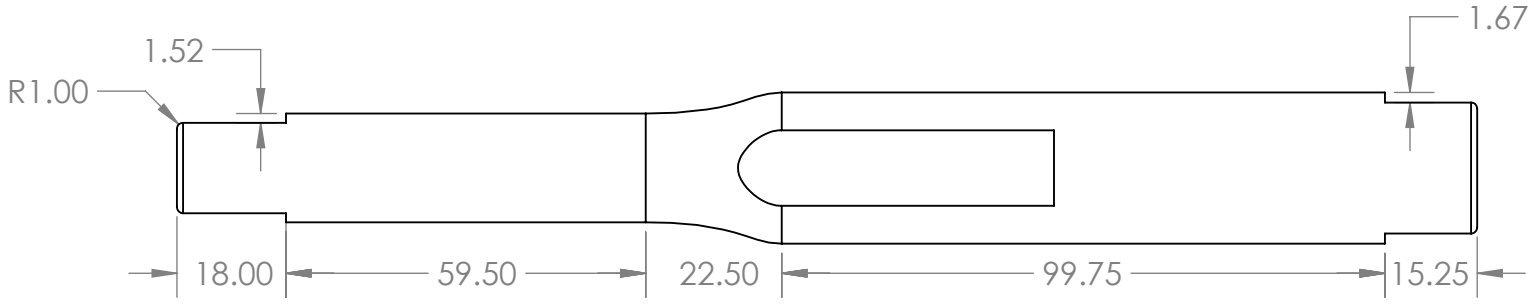
TITLE:

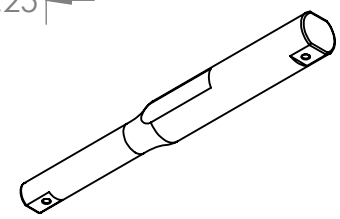
Linear Bearing
Part ID 7

SIZE	DWG. NO.	REV
A		

SCALE: 1:1 | WEIGHT: | SHEET 6 OF 17







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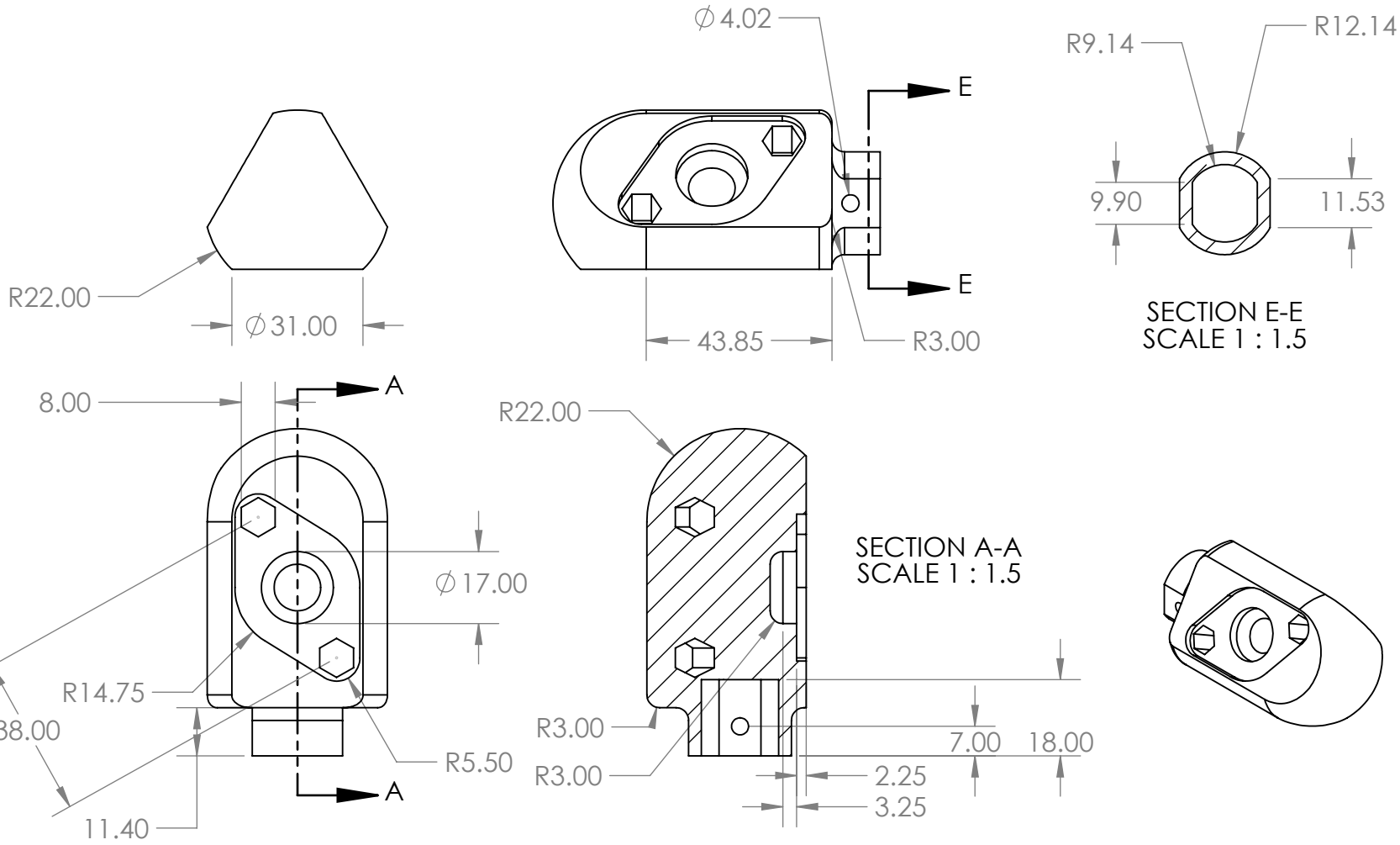
		INTERPRET GEOMETRIC TOLERANCING PER:	Q.A.		
		MATERIAL: Aluminum	COMMENTS:		
NEXT ASSY	USED ON	FINISH			
APPLICATION		DO NOT SCALE DRAWING			

TITLE:
Shaft
Part ID 8

SIZE	DWG. NO.	REV
A		

SCALE: 1:5 | WEIGHT: | SHEET 7 OF 17



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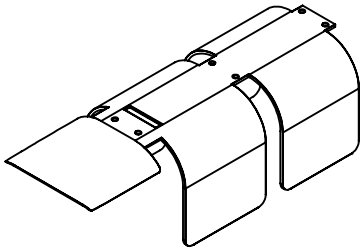
		INTERPRET GEOMETRIC TOLERANCING PER:	Q.A.		
		MATERIAL: PLA	COMMENTS:		
NEXT ASSY	USED ON	FINISH			
APPLICATION		DO NOT SCALE DRAWING			

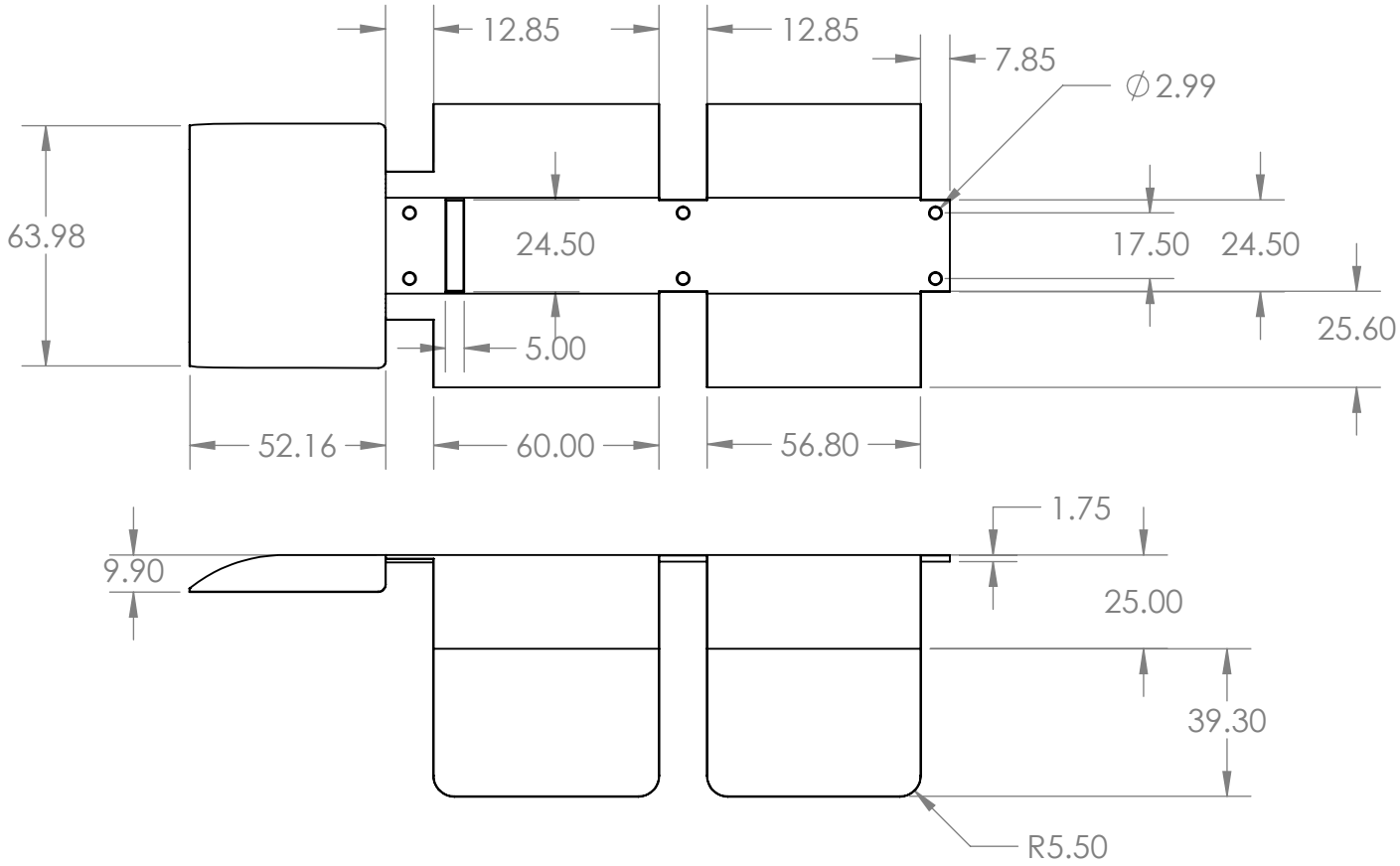
TITLE:

Hub
Part ID 10

SIZE	DWG. NO.	REV
A		

SCALE: 1:1	WEIGHT:	SHEET 8 OF 17





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		MATERIAL: PLA	COMMENTS:		
NEXT ASSY	USED ON	FINISH			
APPLICATION		DO NOT SCALE DRAWING			

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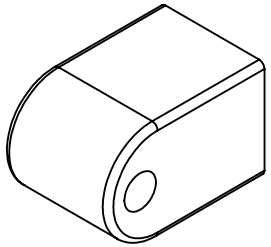
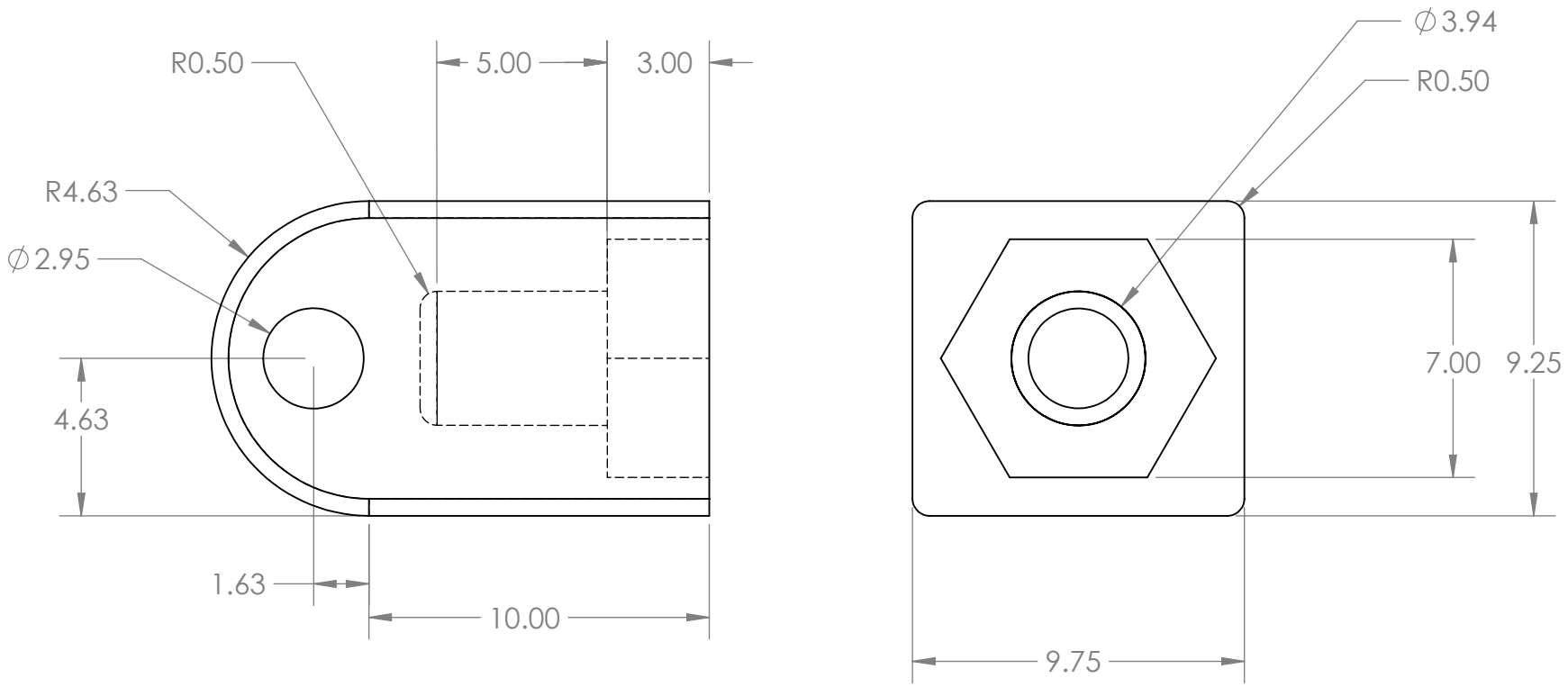
TITLE:

Cover
Part ID 11

SIZE	DWG. NO.	REV
A		

SCALE: 1:5	WEIGHT:	SHEET 9 OF 17





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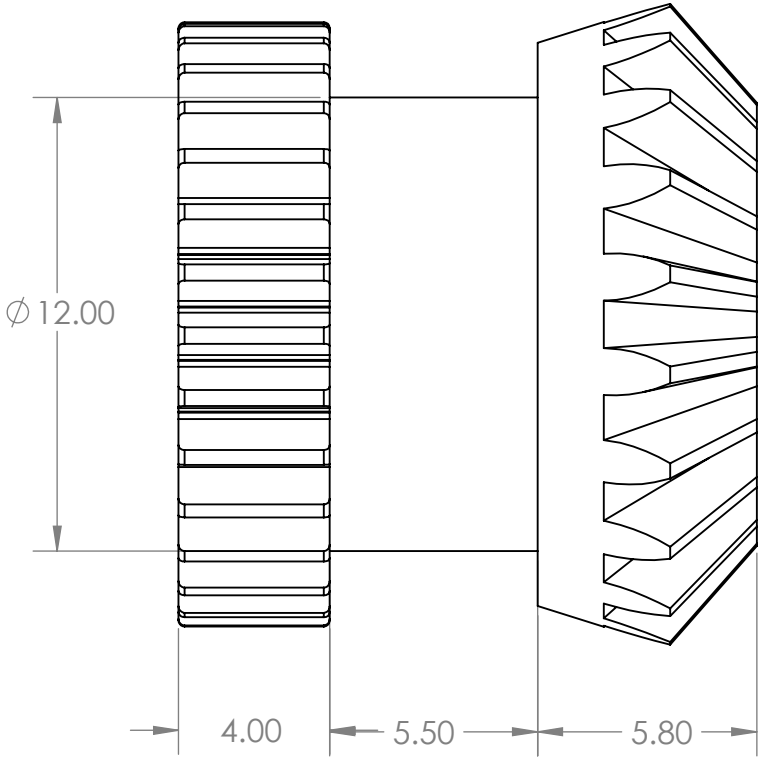
		INTERPRET GEOMETRIC TOLERANCING PER:	Q.A.		
		MATERIAL: PLA	COMMENTS:		
NEXT ASSY	USED ON	FINISH			
APPLICATION		DO NOT SCALE DRAWING			

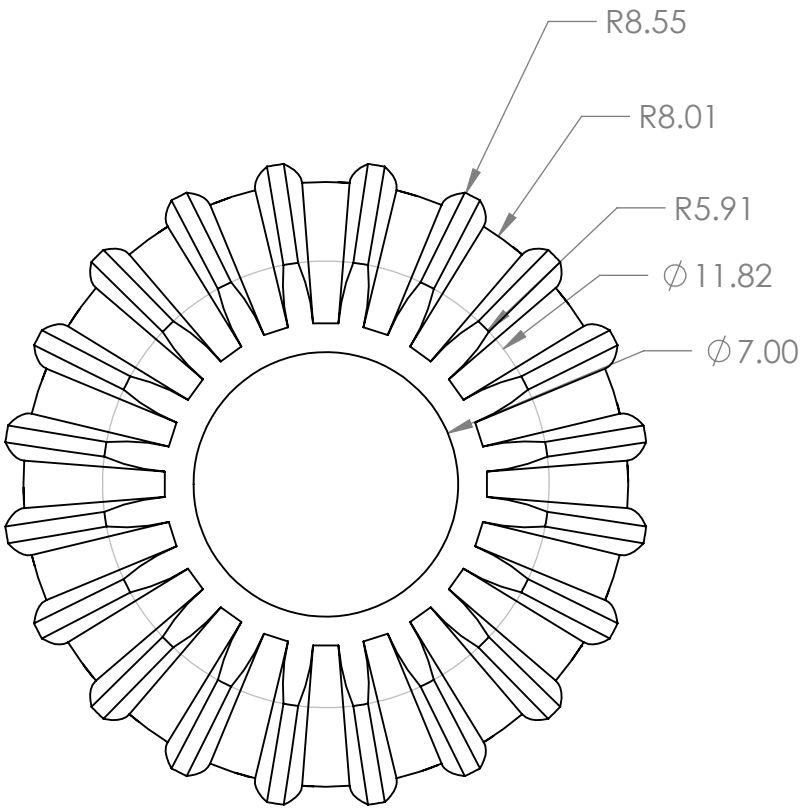
TITLE:

Linear Bearing Coupler
Part ID 14

SIZE	DWG. NO.	REV
A		

SCALE: 5:1 | WEIGHT: | SHEET 10 OF 17





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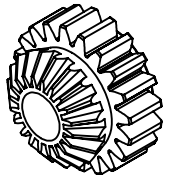
		INTERPRET GEOMETRIC TOLERANCING PER:	Q.A.		
		MATERIAL PLA	COMMENTS:		
NEXT ASSY	USED ON	FINISH			
APPLICATION		DO NOT SCALE DRAWING			

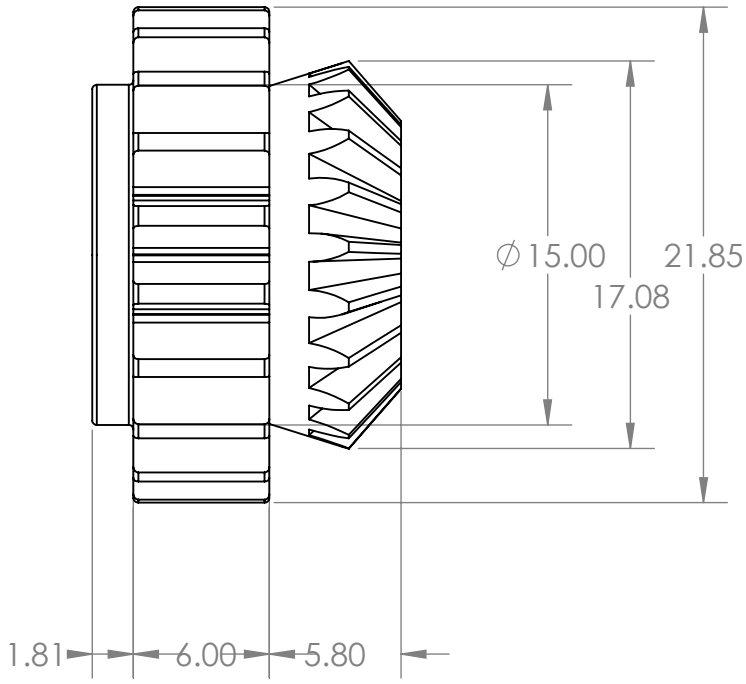
TITLE:

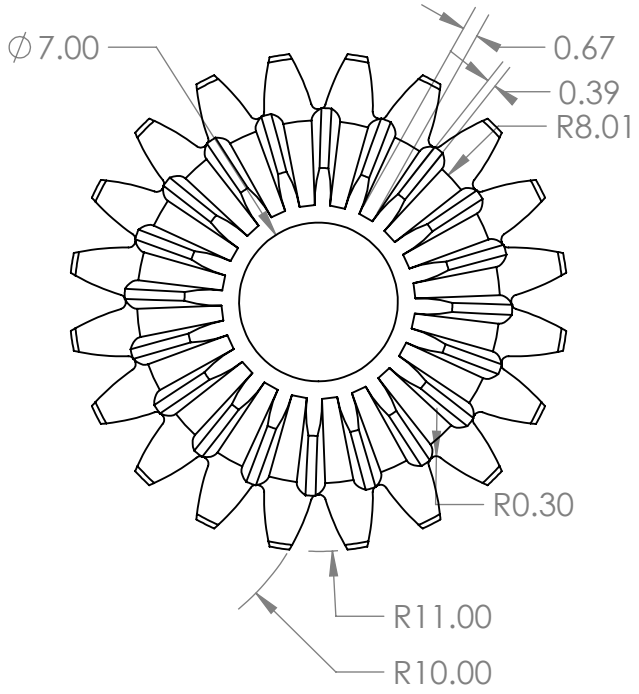
Wall Gear
Part ID 15

SIZE	DWG. NO.	REV
A		

SCALE: 2:1	WEIGHT:	SHEET 11 OF 17







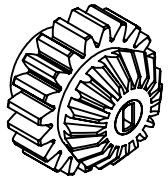
		UNLESS OTHERWISE SPECIFIED:		NAME	DATE
		DIMENSIONS ARE IN INCHES TOLERANCES: FRACTIONAL ± ANGULAR: MACH ± BEND ± TWO PLACE DECIMAL ± THREE PLACE DECIMAL ±	DRAWN		
			CHECKED		
			ENG APPR.		
			MFG APPR.		
		INTERPRET GEOMETRIC TOLERANCING PER:	Q.A.		
		MATERIAL: PLA	COMMENTS:		
NEXT ASSY	USED ON	FINISH			
APPLICATION		DO NOT SCALE DRAWING			

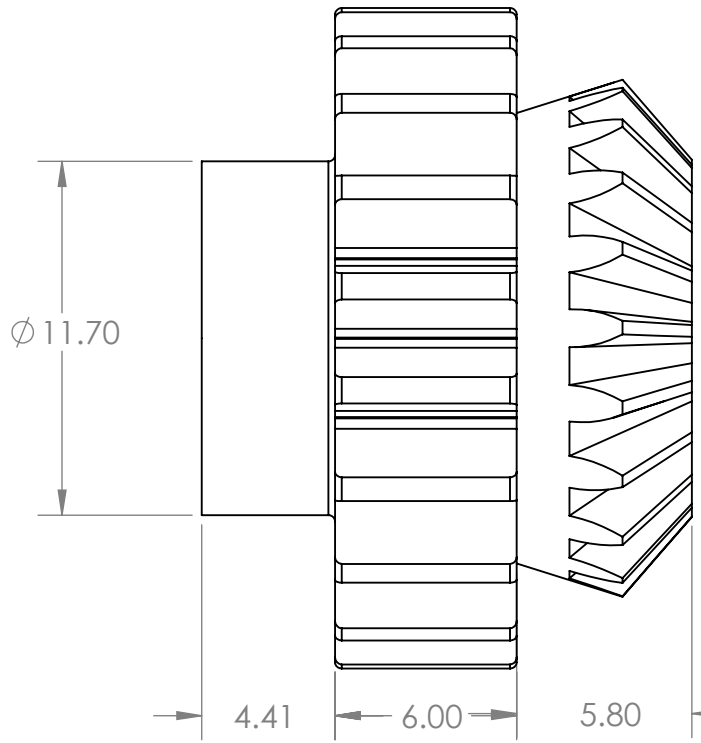
TITLE:

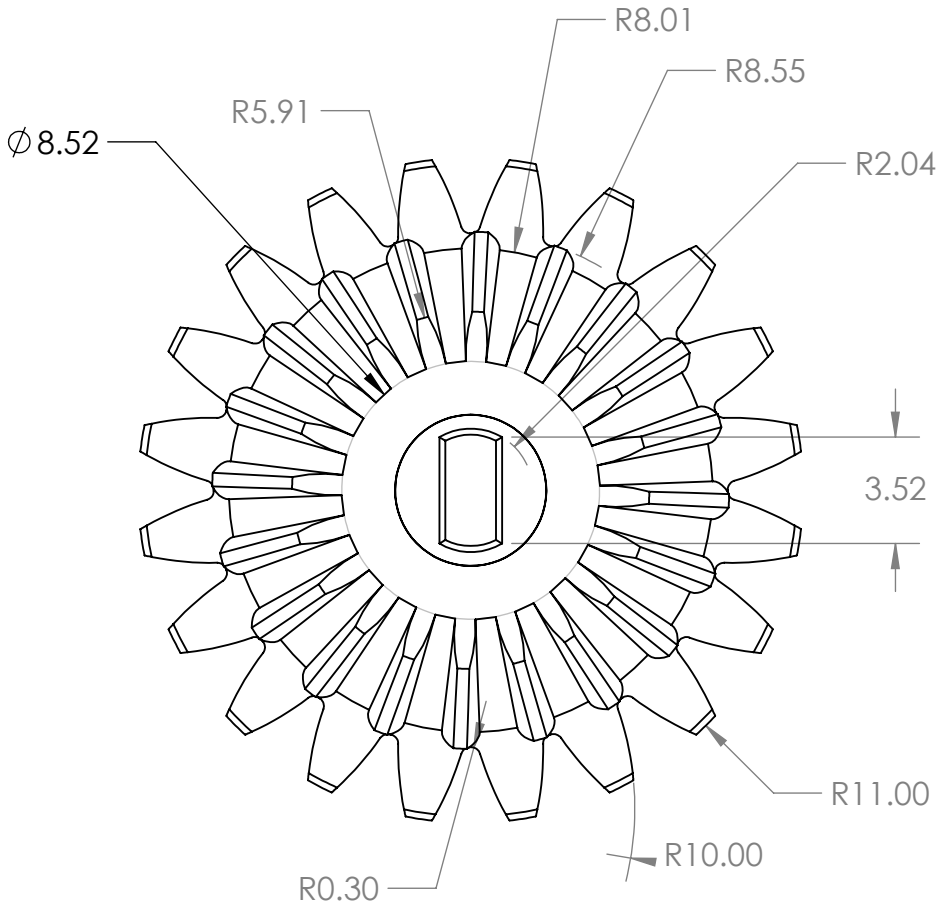
Floor Gear
Part ID 16

SIZE	DWG. NO.	REV
A		

SCALE: 2:1	WEIGHT:	SHEET 12 OF 17







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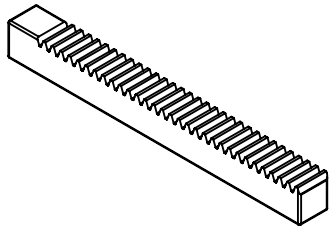
			CHECKED		
			ENG APPR.		
			MFG APPR.		
		INTERPRET GEOMETRIC TOLERANCING PER:	Q.A.		
		MATERIAL: PLA	COMMENTS:		
NEXT ASSY	USED ON	FINISH			
APPLICATION		DO NOT SCALE DRAWING			

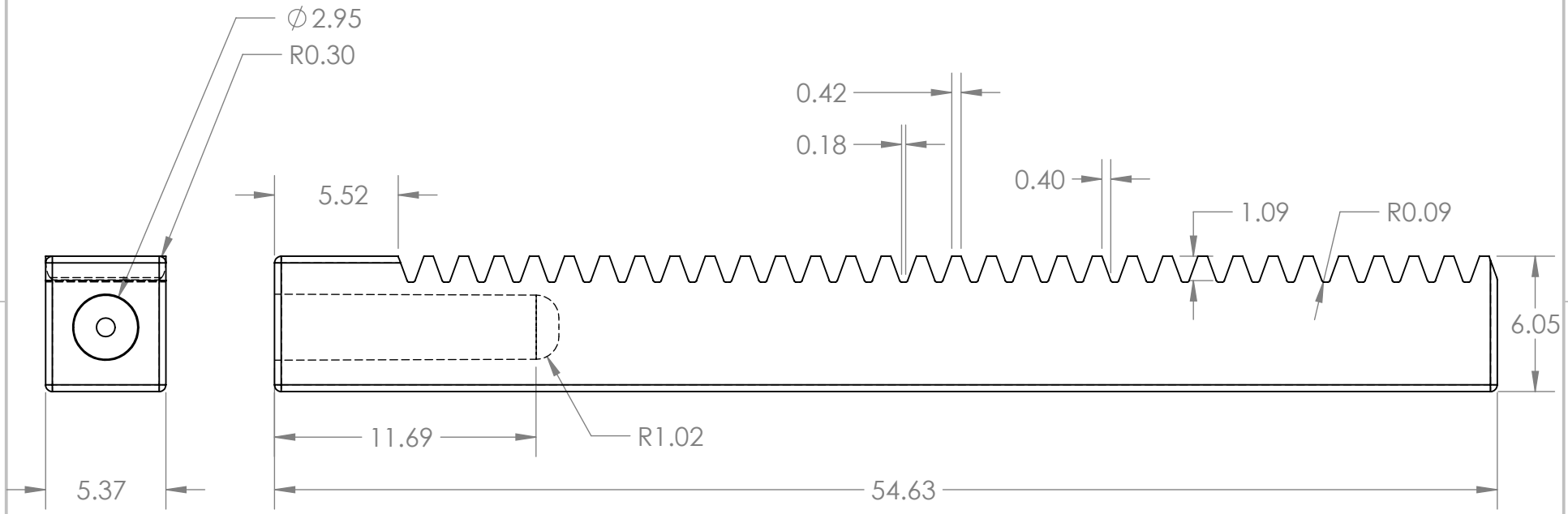
TITLE:

Stepper Gear
Part ID 17

SIZE	DWG. NO.	REV
A		

SCALE: 2:1 | WEIGHT: | SHEET 13 OF 17





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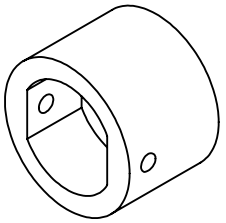
			CHECKED		
			ENG APPR.		
			MFG APPR.		
		INTERPRET GEOMETRIC TOLERANCING PER:	Q.A.		
		MATERIAL: PLA	COMMENTS:		
NEXT ASSY	USED ON	FINISH			
APPLICATION		DO NOT SCALE DRAWING			

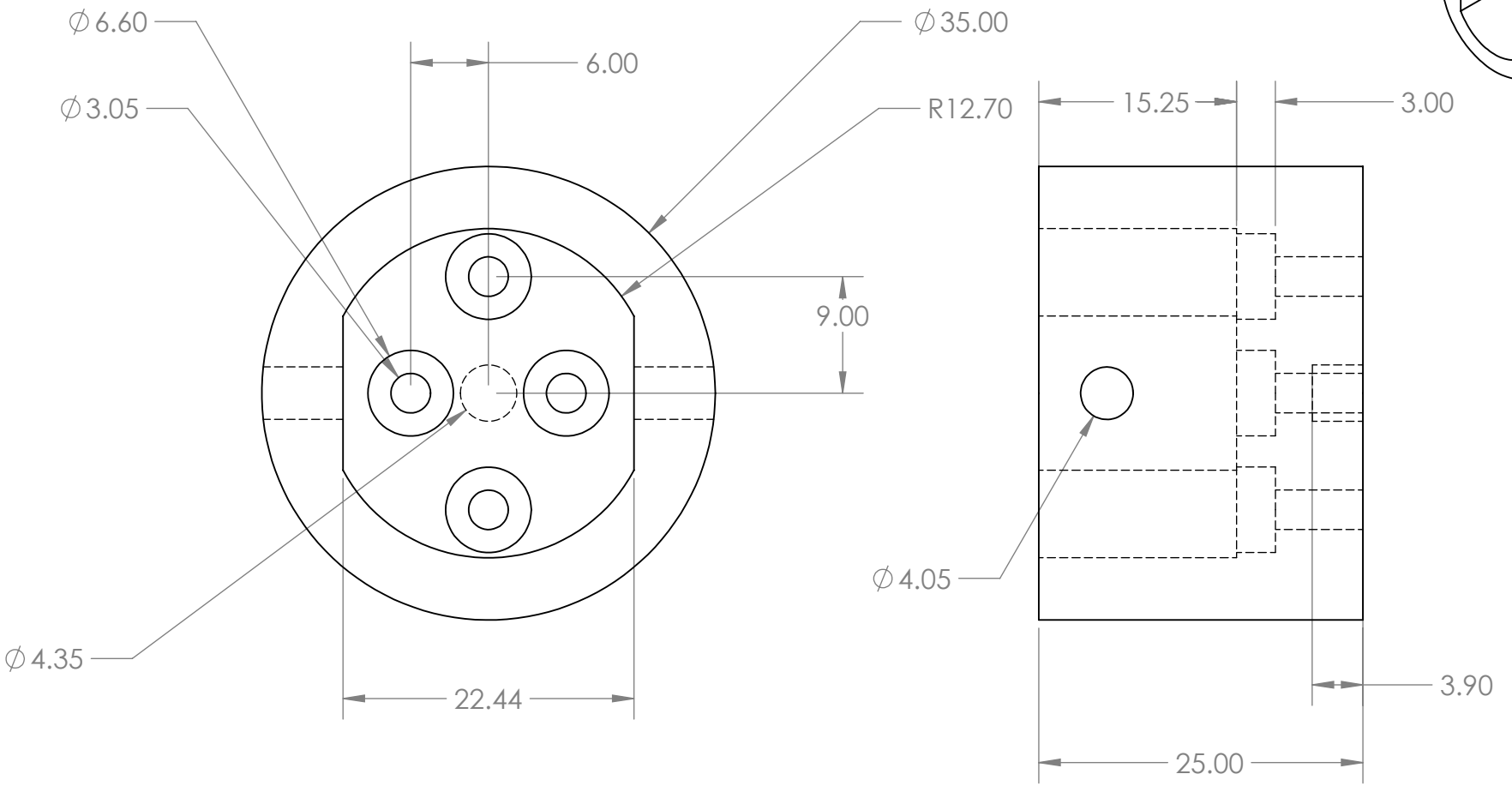
TITLE:

Gear (R)
Part ID 18

SIZE	DWG. NO.	REV
A		

SCALE: 2:1 | WEIGHT: | SHEET 14 OF 17





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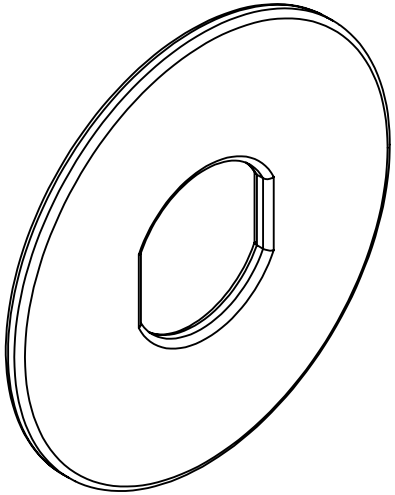
			CHECKED		
			ENG APPR.		
			MFG APPR.		
		INTERPRET GEOMETRIC TOLERANCING PER:	Q.A.		
		MATERIAL: PLA	COMMENTS:		
NEXT ASSY	USED ON	FINISH			
APPLICATION		DO NOT SCALE DRAWING			

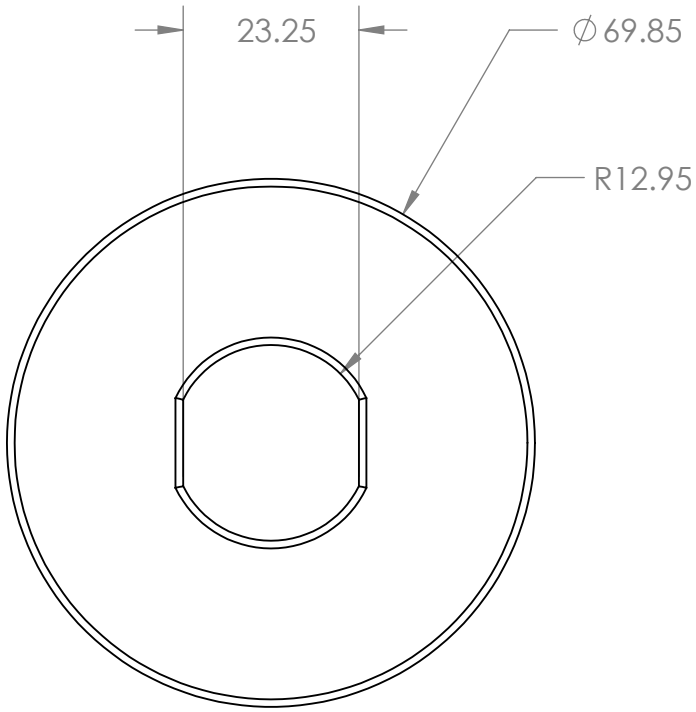
TITLE:

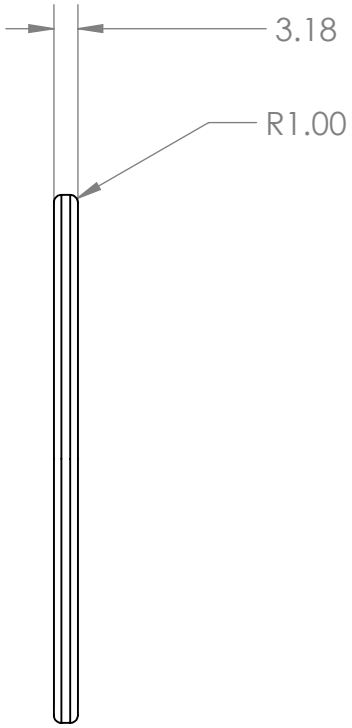
Shaft Coupler
Part ID 22

SIZE	DWG. NO.	REV
A		

SCALE: 1:1 | WEIGHT: | SHEET 15 OF 17







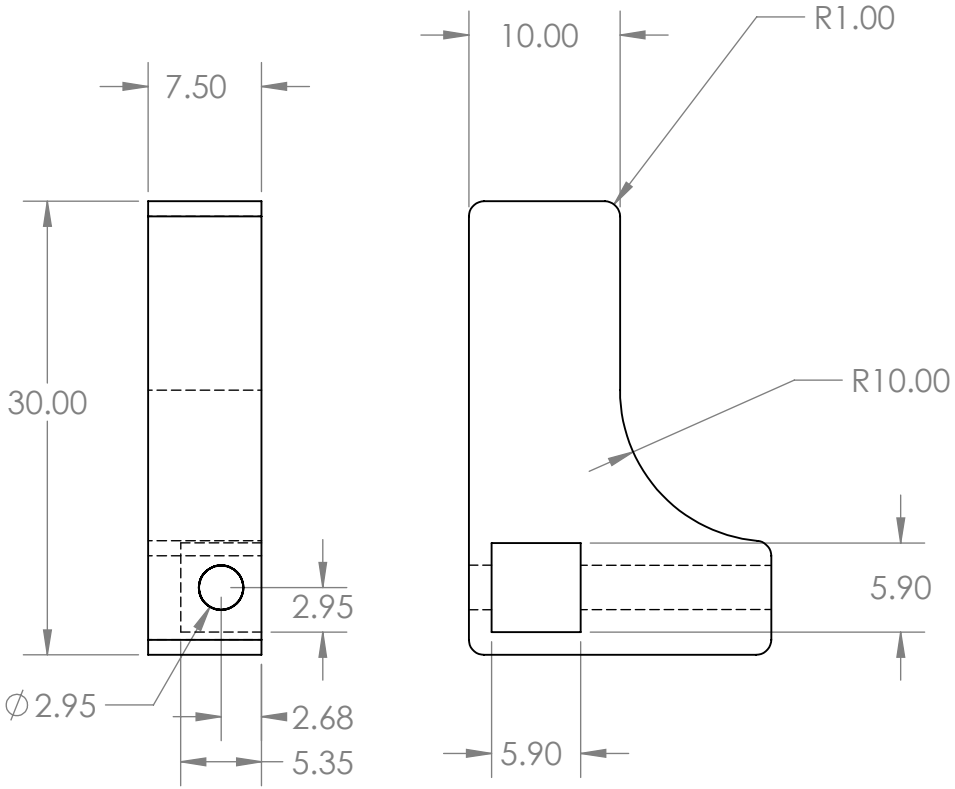
		UNLESS OTHERWISE SPECIFIED:		NAME	DATE
		DIMENSIONS ARE IN INCHES TOLERANCES: FRACTIONAL ± ANGULAR: MACH ± BEND ± TWO PLACE DECIMAL ± THREE PLACE DECIMAL ±	DRAWN		
			CHECKED		
			ENG APPR.		
			MFG APPR.		
		INTERPRET GEOMETRIC TOLERANCING PER:	Q.A.		
		MATERIAL: Steel	COMMENTS:		
NEXT ASSY	USED ON	FINISH			
APPLICATION		DO NOT SCALE DRAWING			

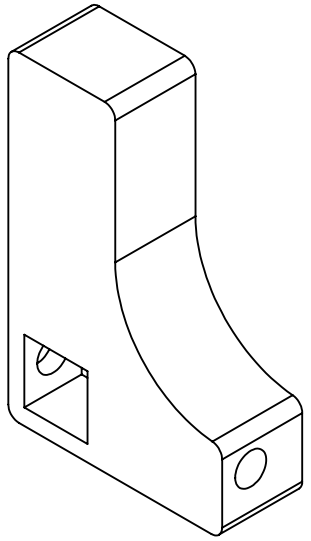
TITLE:

Brake Disk
Part ID 25

SIZE	DWG. NO.	REV
A		

SCALE: 1:1 | WEIGHT: | SHEET 16 OF 17





		UNLESS OTHERWISE SPECIFIED:		NAME	DATE
		DIMENSIONS ARE IN INCHES TOLERANCES: FRACTIONAL ± ANGULAR: MACH ± BEND ± TWO PLACE DECIMAL ± THREE PLACE DECIMAL ±	DRAWN		
			CHECKED		
			ENG APPR.		
			MFG APPR.		
		INTERPRET GEOMETRIC TOLERANCING PER:	Q.A.		
		MATERIAL PLA	COMMENTS:		
NEXT ASSY	USED ON	FINISH			
APPLICATION		DO NOT SCALE DRAWING			

TITLE:

Brake Pad
Part ID 26

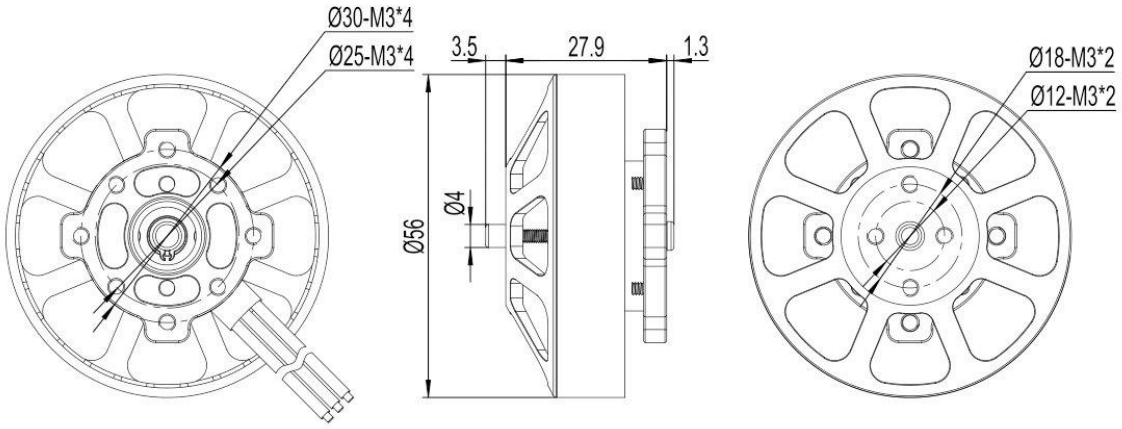
SIZE	DWG. NO.	REV
A		

SCALE: 2:1	WEIGHT:	SHEET 17 OF 17

Commercially Available Drawings

MAD 5010 110 kV Motor – Part ID 9

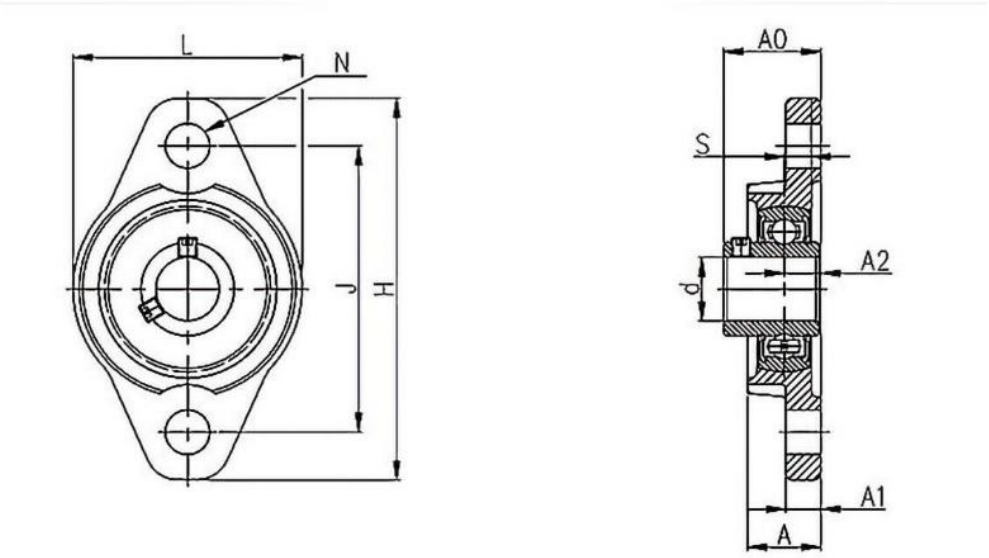
PRODUCT DRAWING



MOTOR MOUNTING HOLES

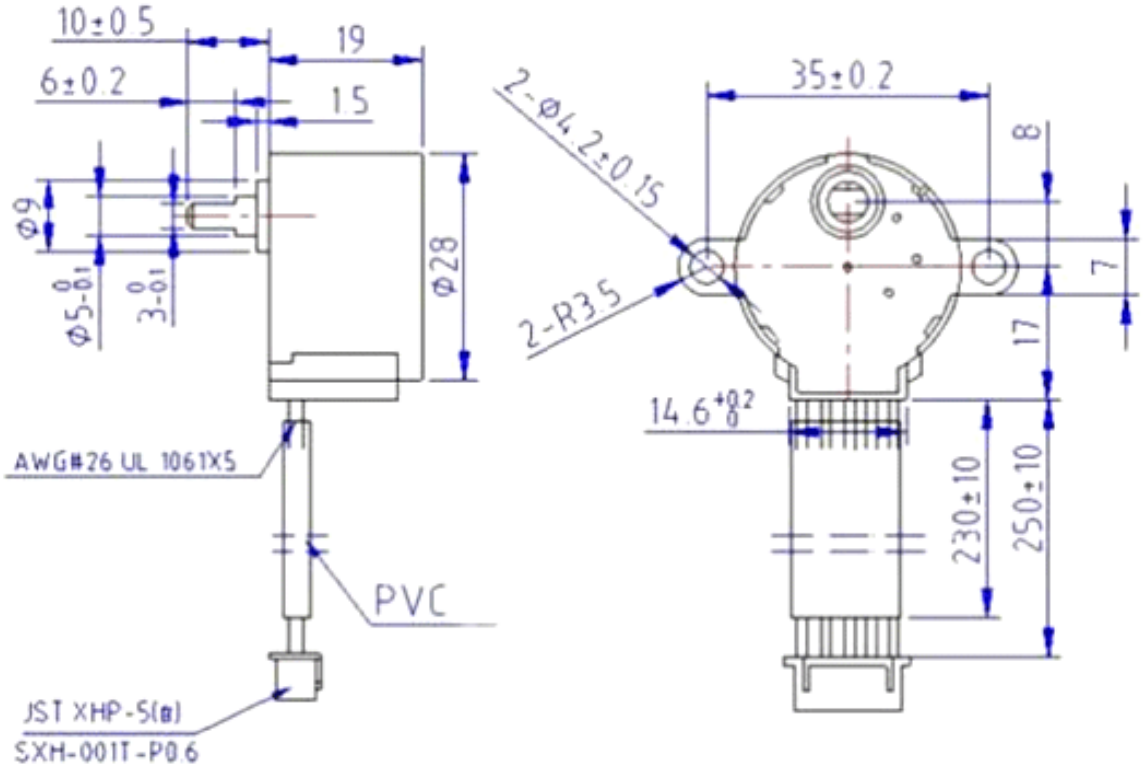
PROP MOUNTING HOLES

KFL08 Mounted Bearings – Part ID 12

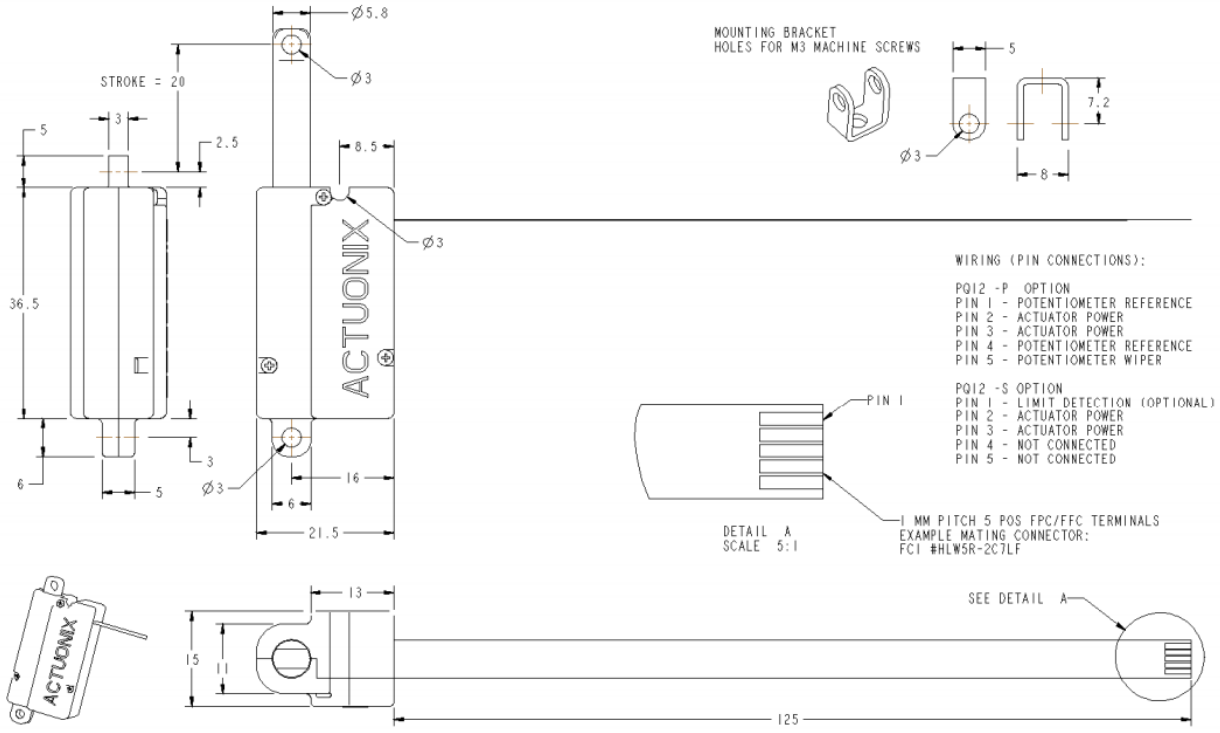


		Dimensions (mm)									
	d	H	L	A	J	N	A1	A2	A0	S	KG
KFL08	8	48	27	8.5	36	5	4	4	12	3	0.022
KFL000	10	60	36	11.5	45	7	5.5	5.5	15.5	4	0.0358
KFL001	12	63	38	11.5	48	7	5.5	5.5	16	4	0.0415
KFL002	15	67	42	13	53	7	6.5	6.5	18.5	4.5	0.0552
KFL003	17	71	46	14	56	7	7	7	19.5	5	0.0715
KFL004	20	90	55	16	71	10	8	8	23	6	0.1217
KFL005	25	95	60	16	75	10	8	8	24.5	6	0.145
KFL006	30	112	70	18	85	13	9	9	27	6.5	0.22

28BYJ-48 Stepper Motor – Part ID 19



Actuonix PQ12 Actuator – Part ID 24



Taidacent 12 Wire 10 Amp Slip Ring – Part ID 27