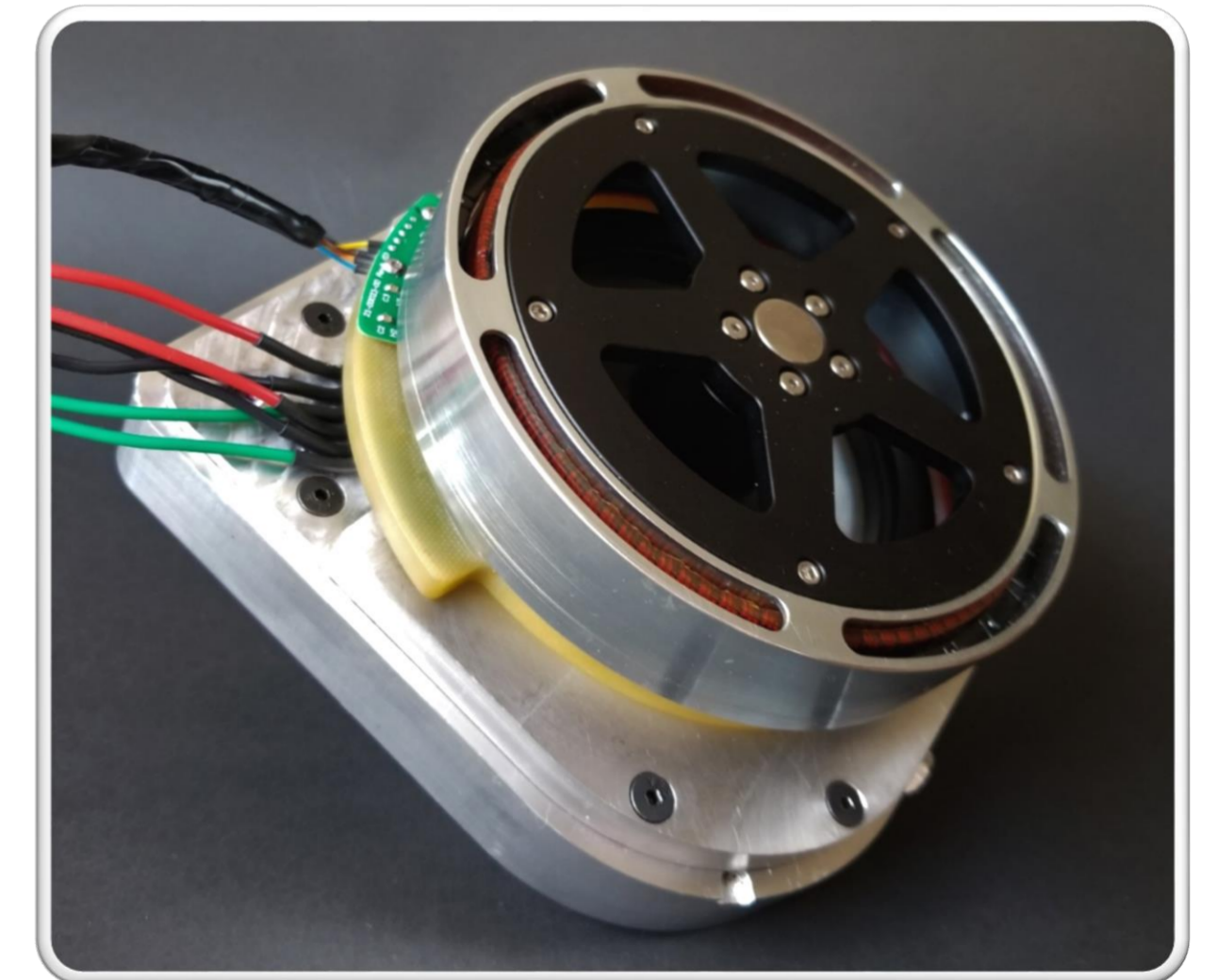
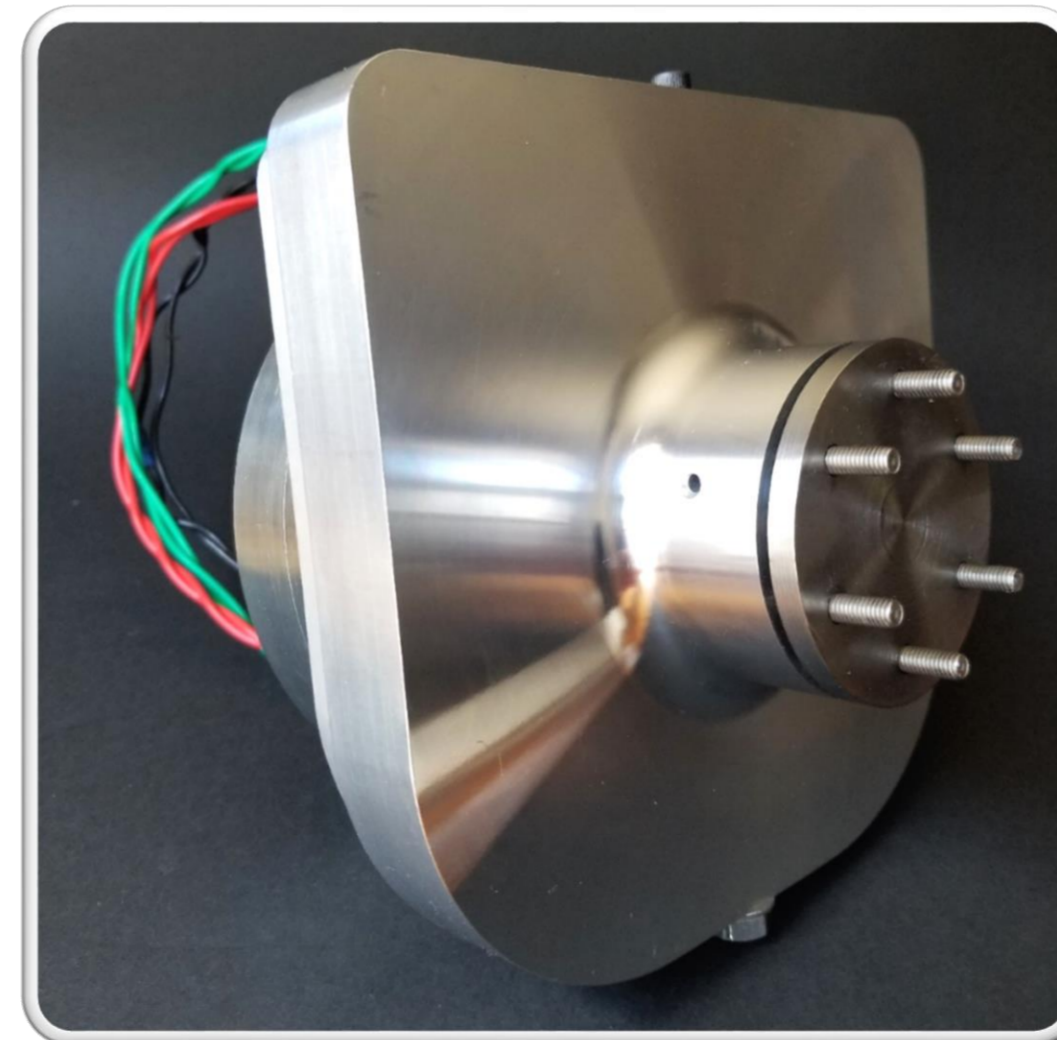


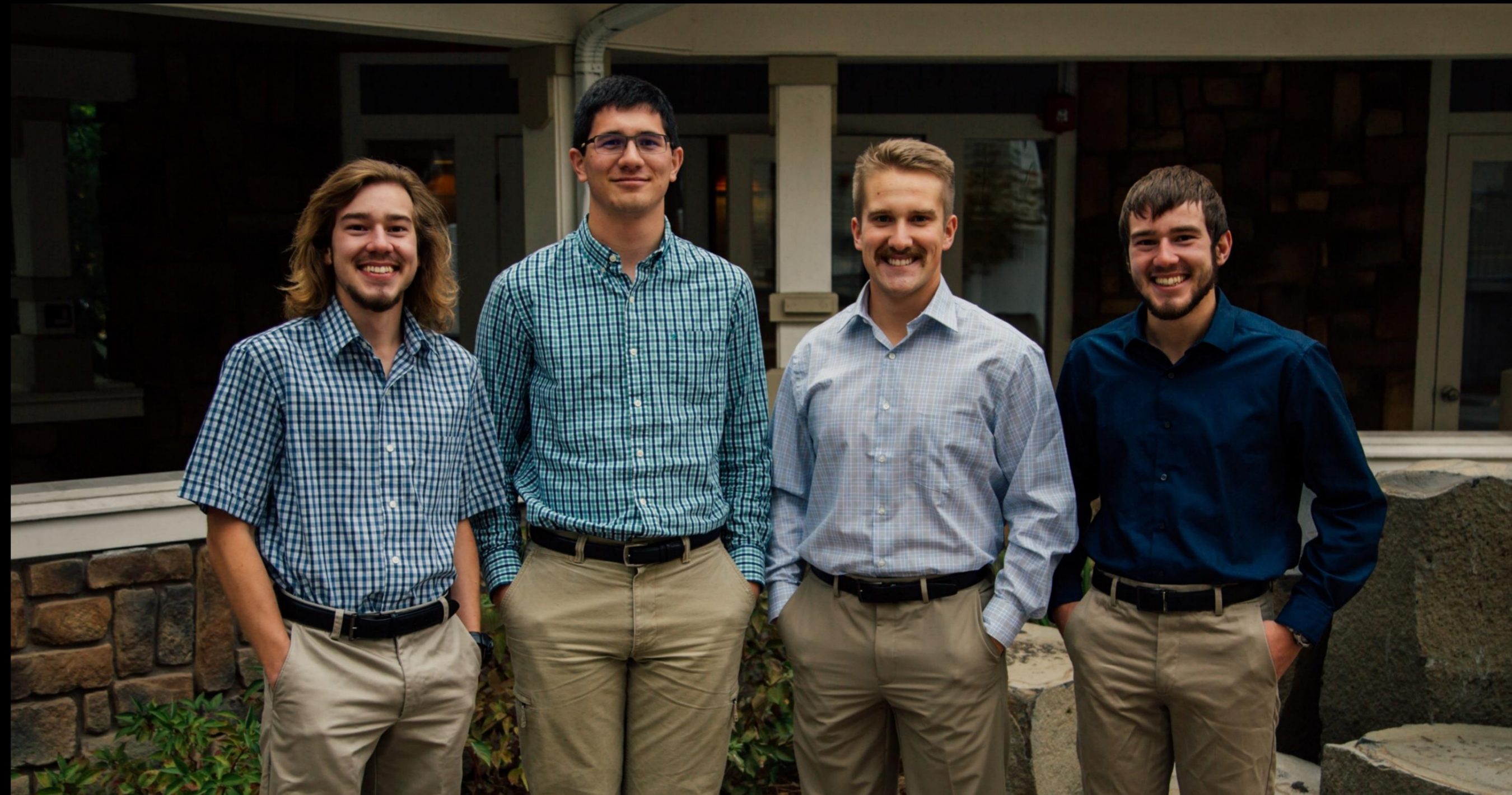


University
of Idaho

COMPACT ROBOTIC WHEEL DRIVE



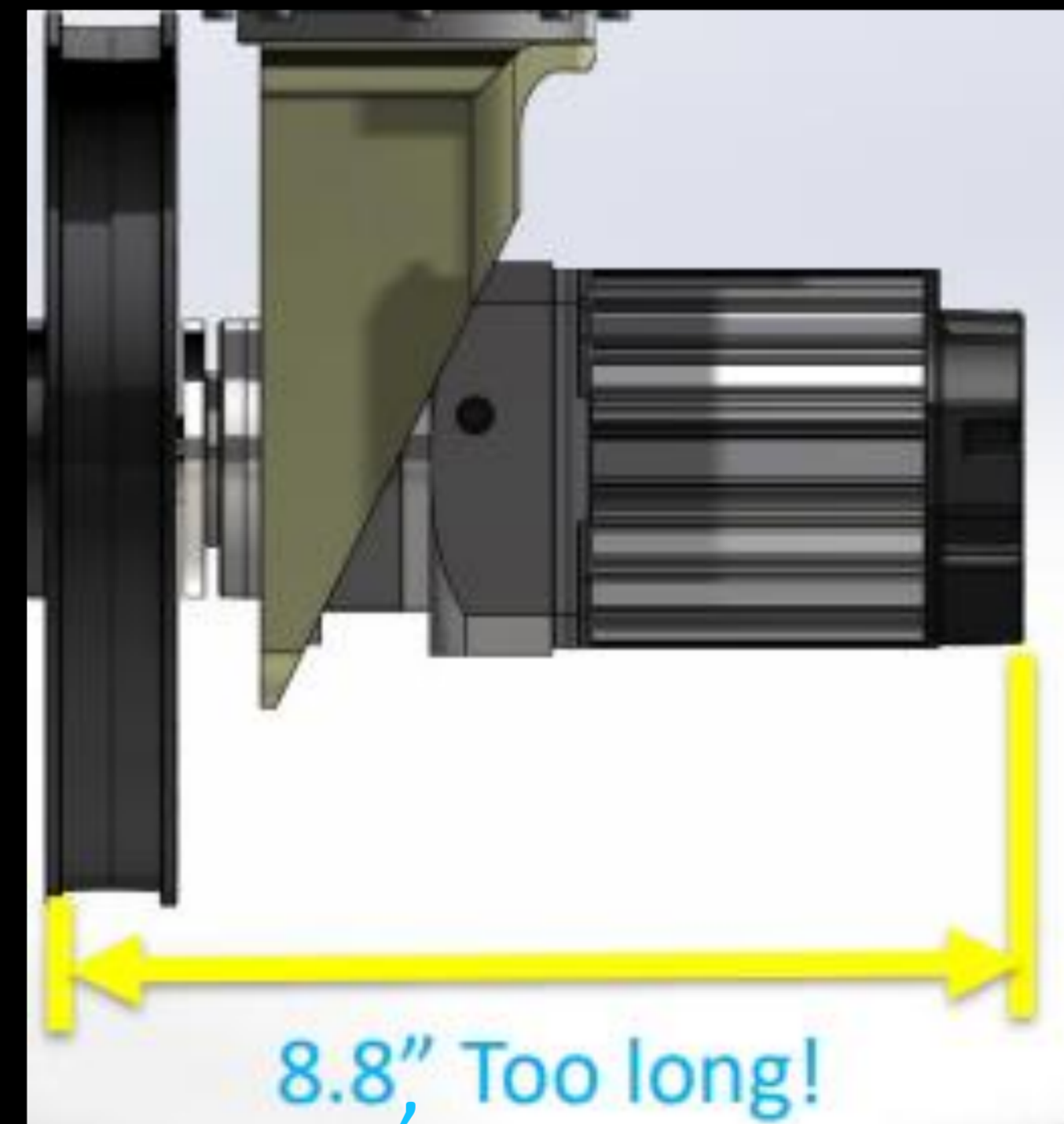
THE TEAM



Jake Riggs, Daniel Hein, Brad Morris, Gabe Riggs

PROBLEM STATEMENT

An industrial autonomous vehicle produced by Bastian Solutions has a bulky wheel drive assembly. To conserve onboard space, a shorter axial length of the drive assembly is desired.



Current wheel drive system

DESIGN REQUIREMENTS

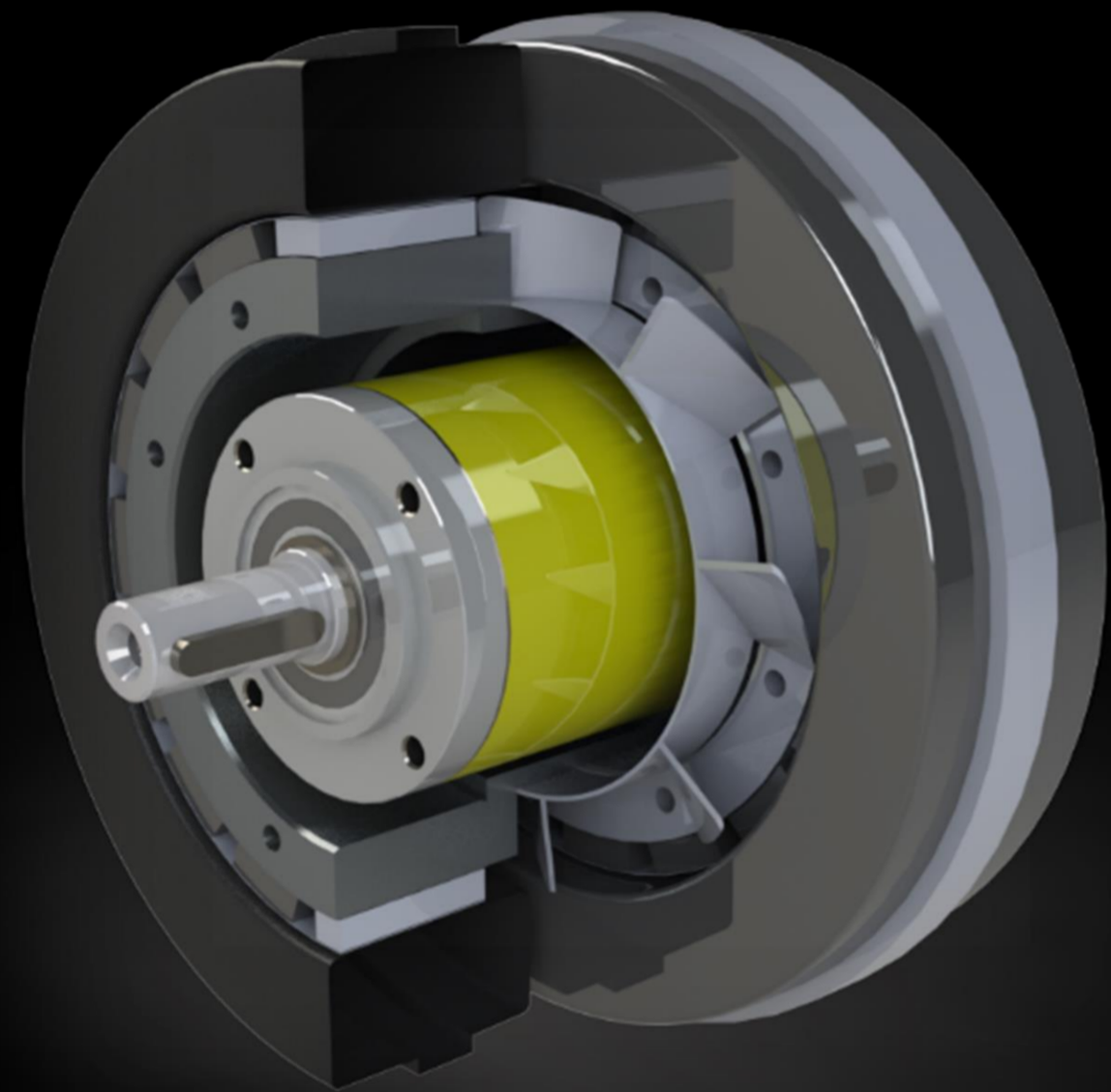
Condition	A	B
Torque (lb-in)	146	25
Speed (rpm)	275	750
Acceleration (ft/s ²)	4	8
Duration of Load (s)	10	t > 10

Power Constraints	
Max 48 volts	Max 80 Amps

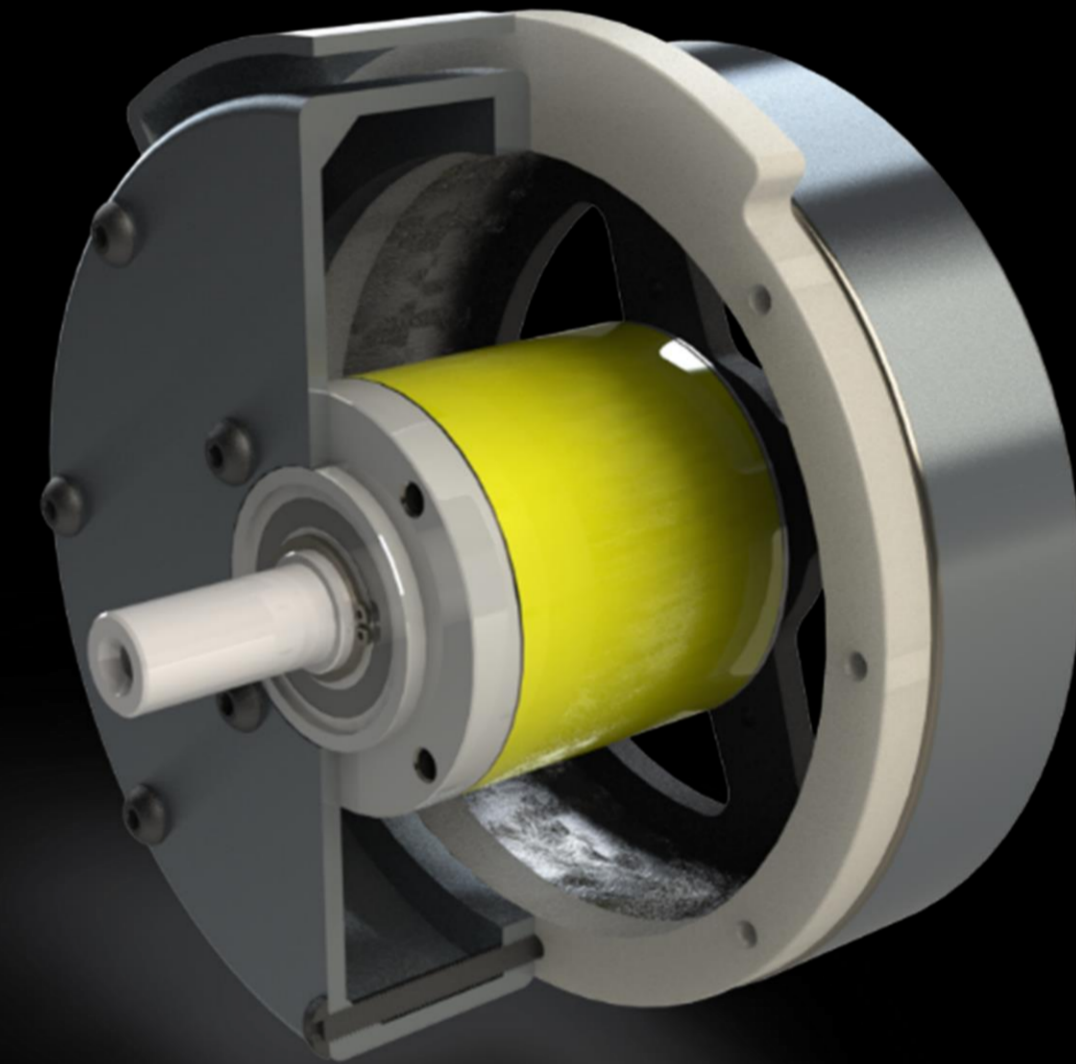
Gearbox Life	
30,000 hr	5 year service life

BOM Cost
\$2,000 Max

INITIAL CONCEPTS

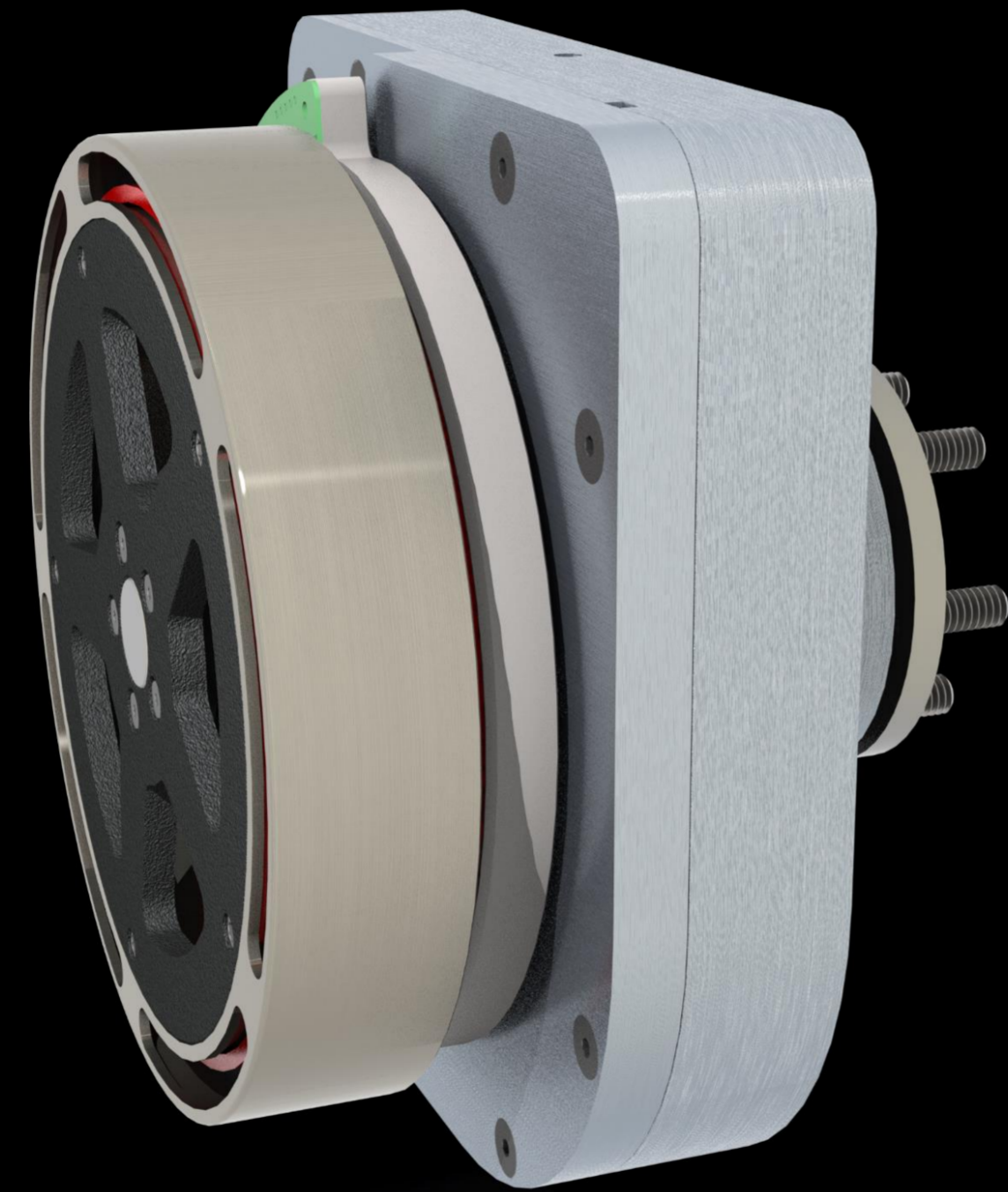


- Dual Koll-Morgen Motors
- 6:1 Framo-Morat Gearbox

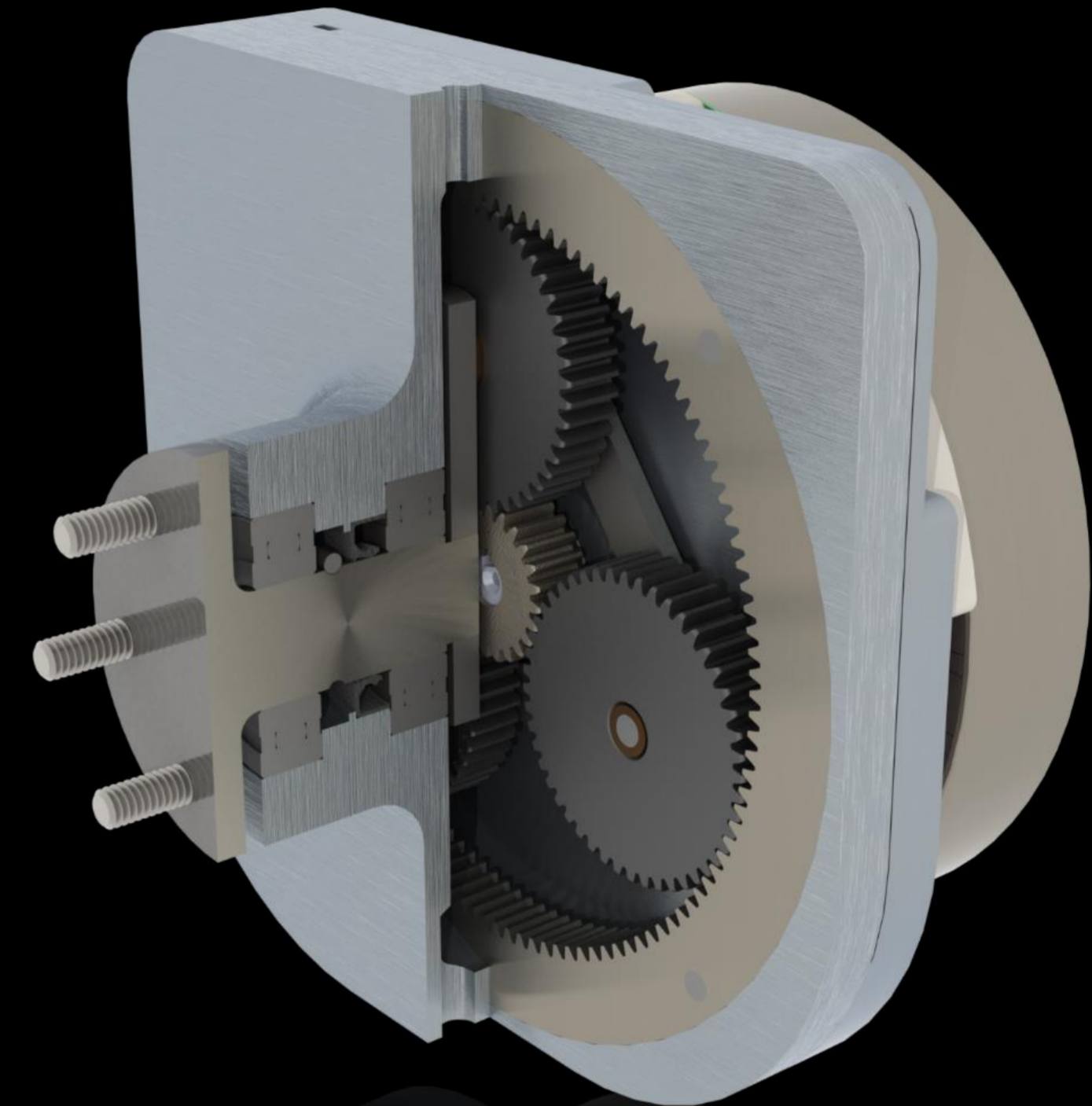


- Thin Gap Motor
- 6:1 Framo-Morat Gearbox

SOLUTION



- Thin Gap Motor

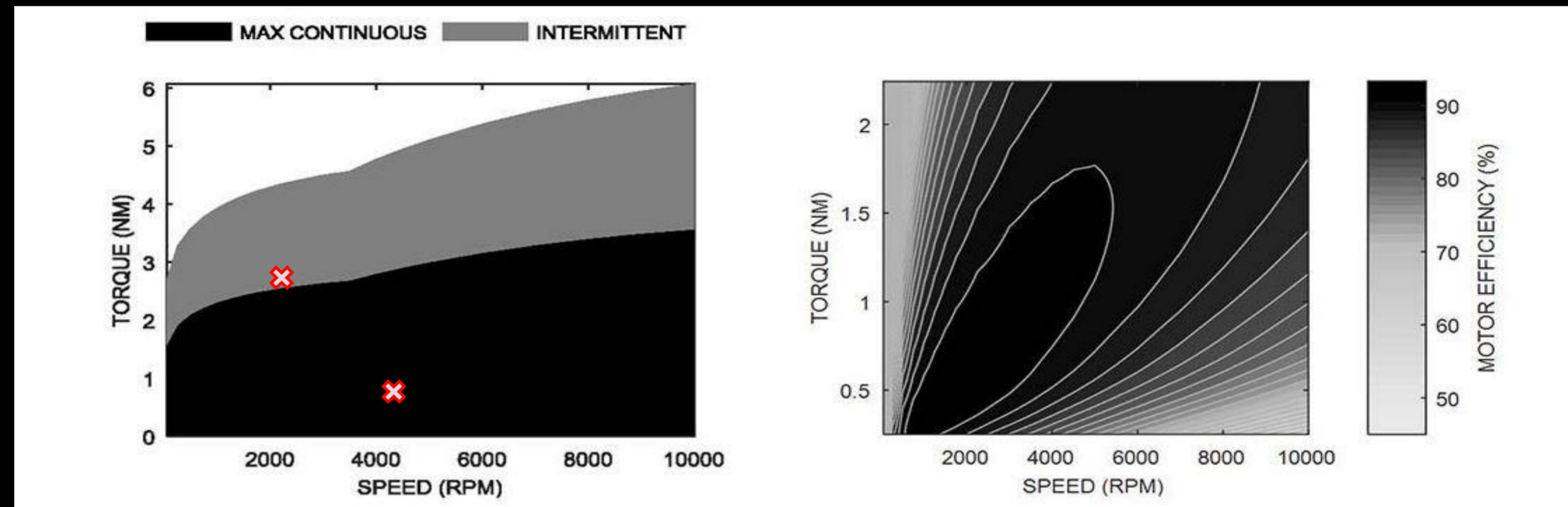


- Custom Gear Box

THE MOTOR

TG5153 by thin gap

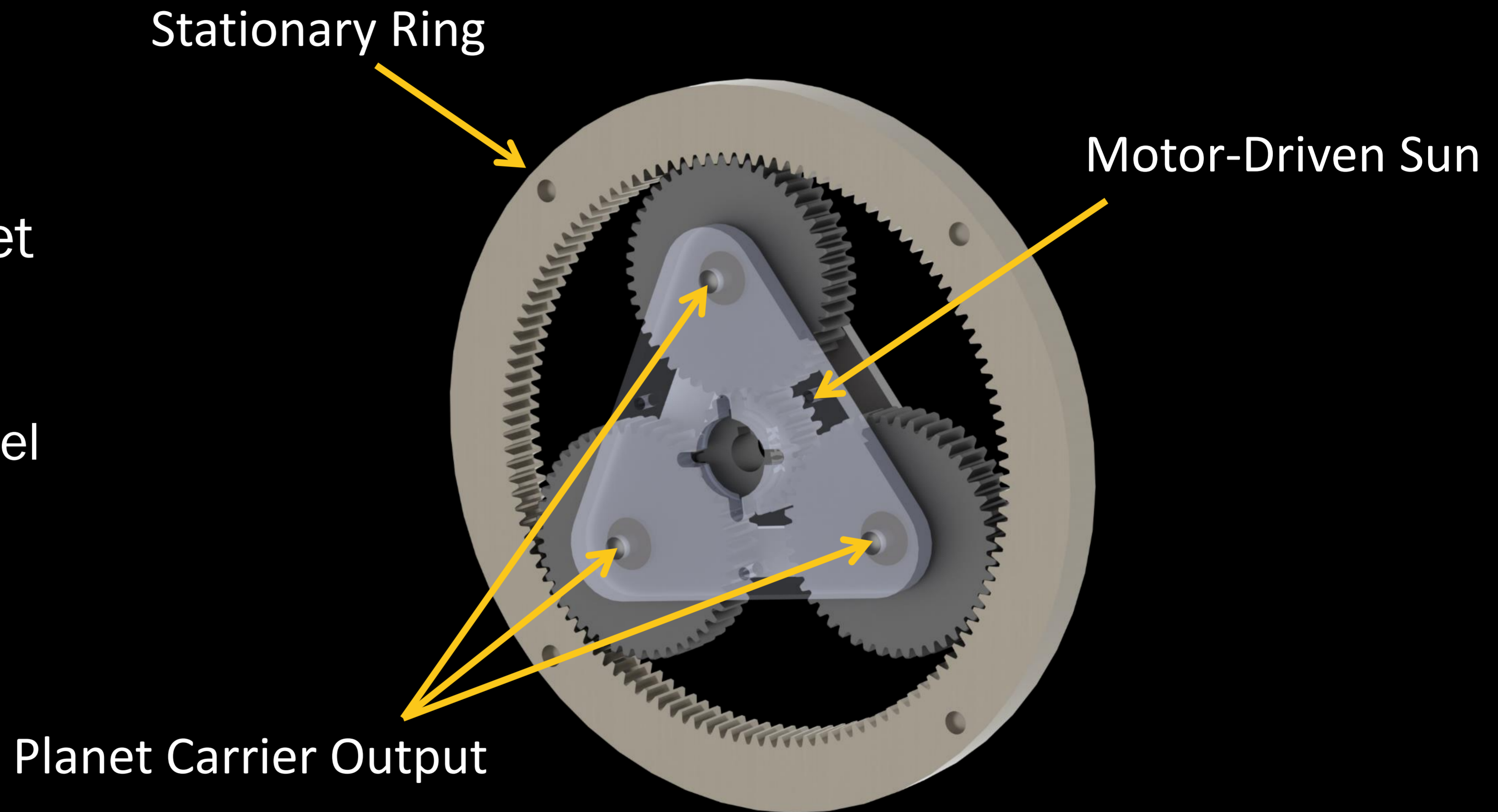
- 4 hp
- 31 in-lb
- 10,000 RPM
- 93% efficient



THE GEARS

6:1 Planetary gear set

- Driving Sun
- Driven Carrier
- Untreated Carbon Steel
 - 24 hr life $\eta = 3$
- Cheap and Available



THE OUTPUT SHAFT

Shaft:

- $\frac{3}{4}$ " 1018CD Steel
- Infinite Life

Bearings:

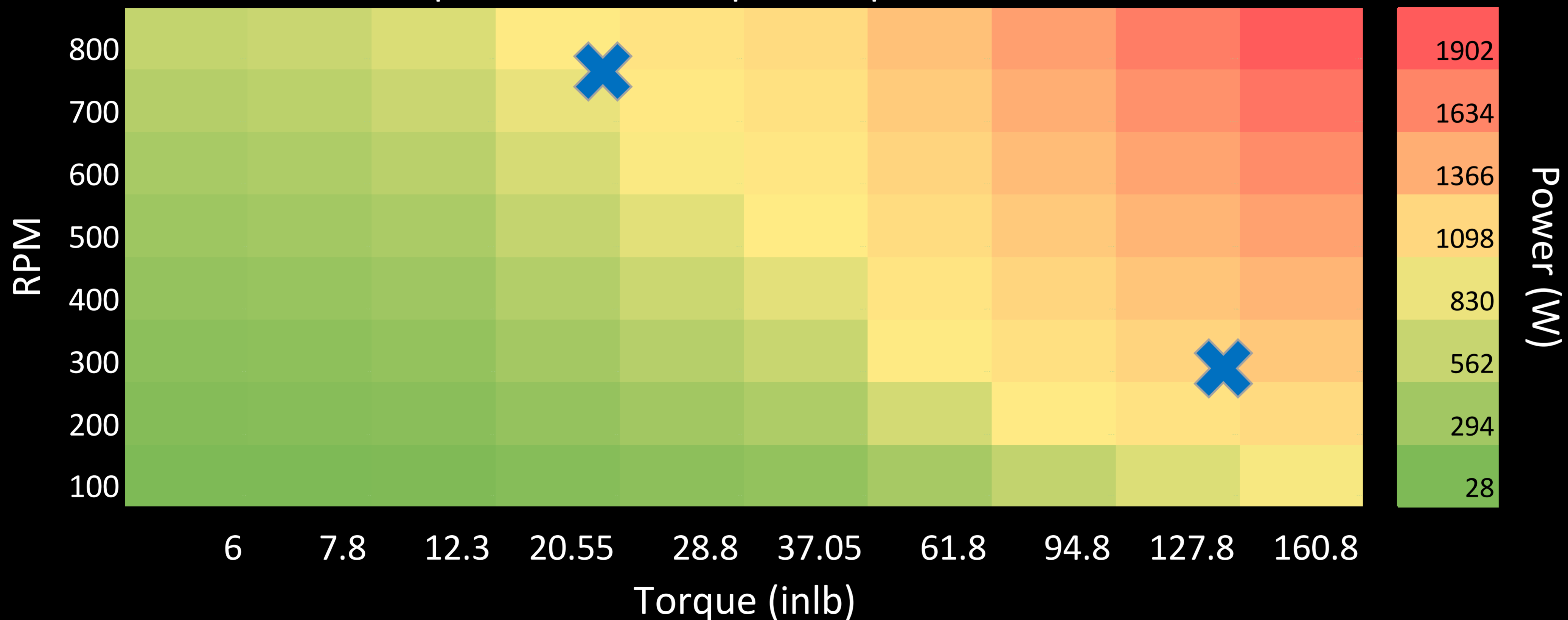
- Roller ball bearings
- $\eta_s = 2.4$
- $\eta_d = 4.2$





PERFORMANCE RESULTS

Input Power vs Output Torque and RPM



OIL VALIDATION

Factors:

- Webbing
- Foaming
- Efficiency
- Gear noise

Results:

- Weight: **85W-190**
- Volume: **50mL**
- $\eta \approx 80\%$



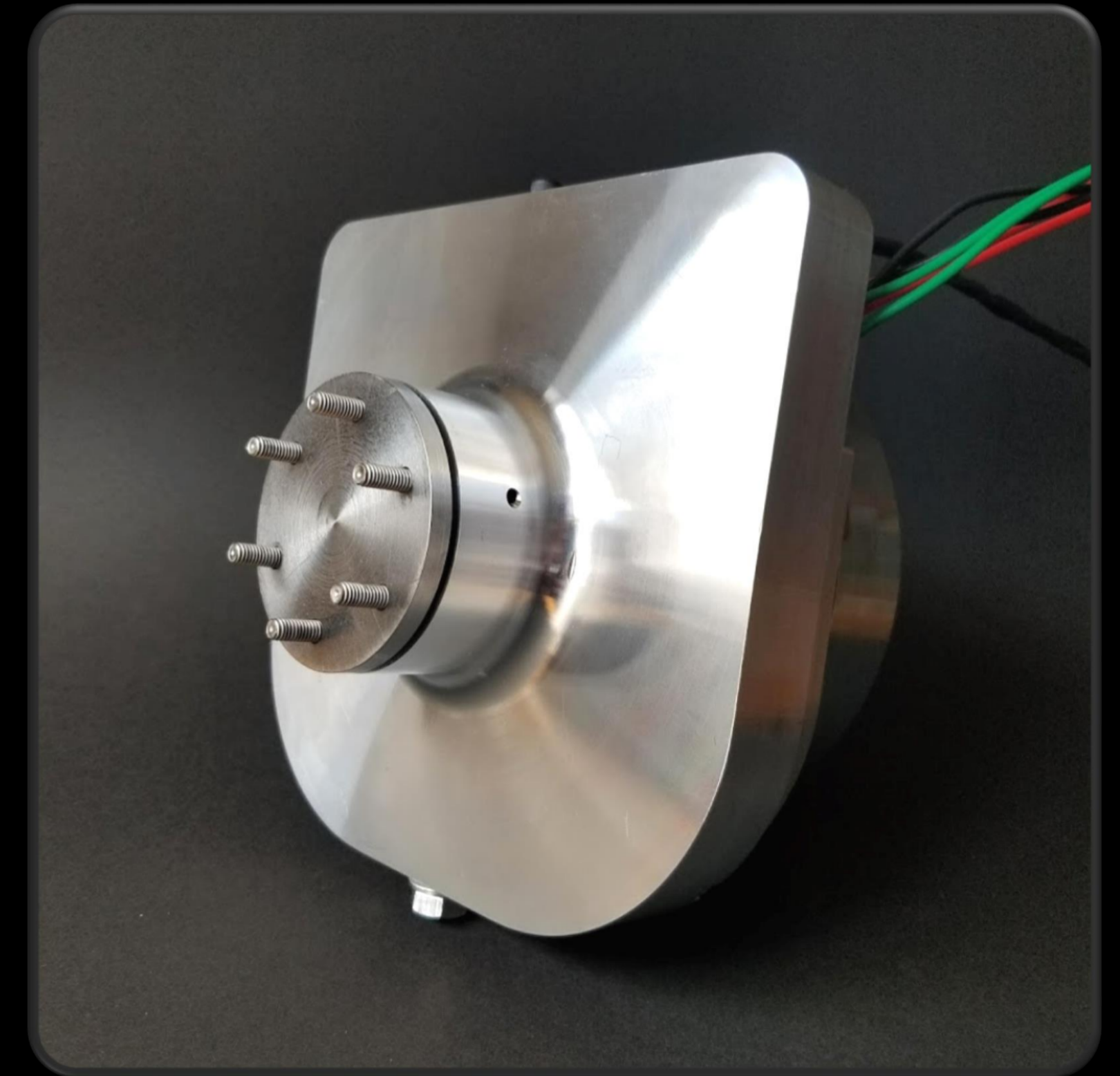
SOLUTION SUMMARY

Satisfies:

- Size requirement 4.5" length
- High speed condition 750 RPM, 25 lb-in
- Power limitations 48V, 80A
- Budget limitation \$2000

Does Not Satisfy:

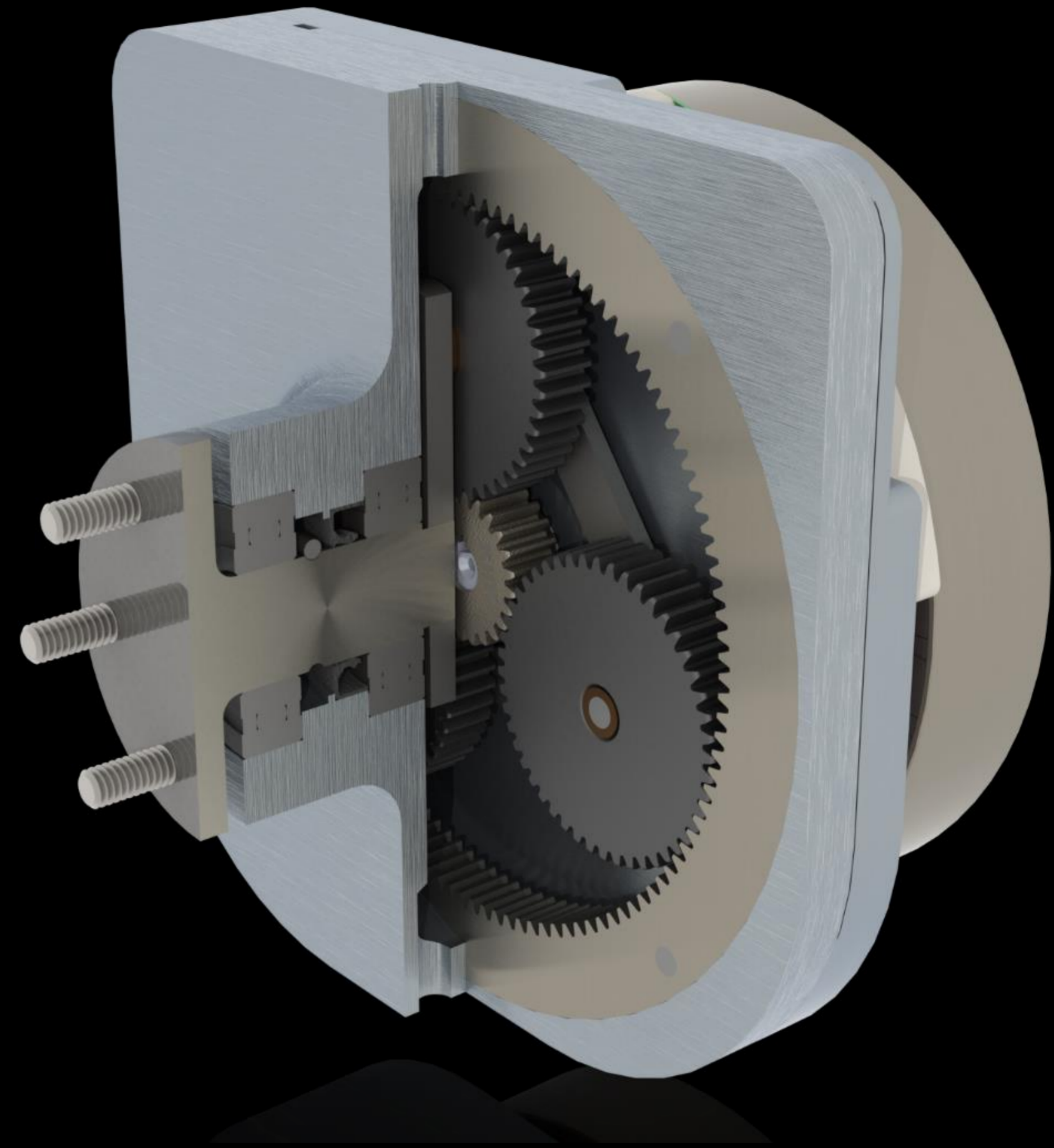
- Gear life desired 24hrs vs 2500hrs
- Low speed condition TBD vs 275 RPM, 146 lb-in



MOVING FORWARD

Current Solution:

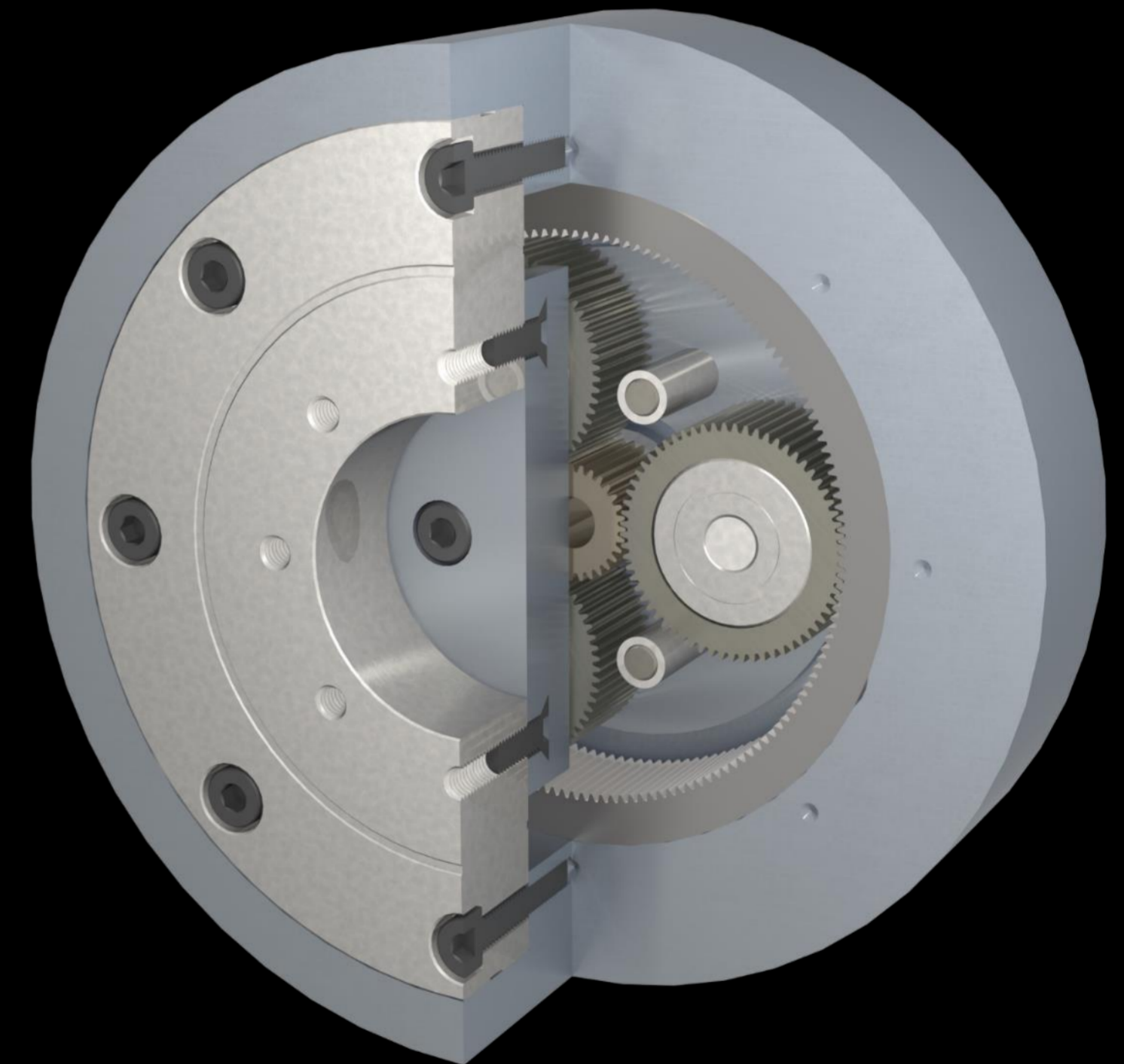
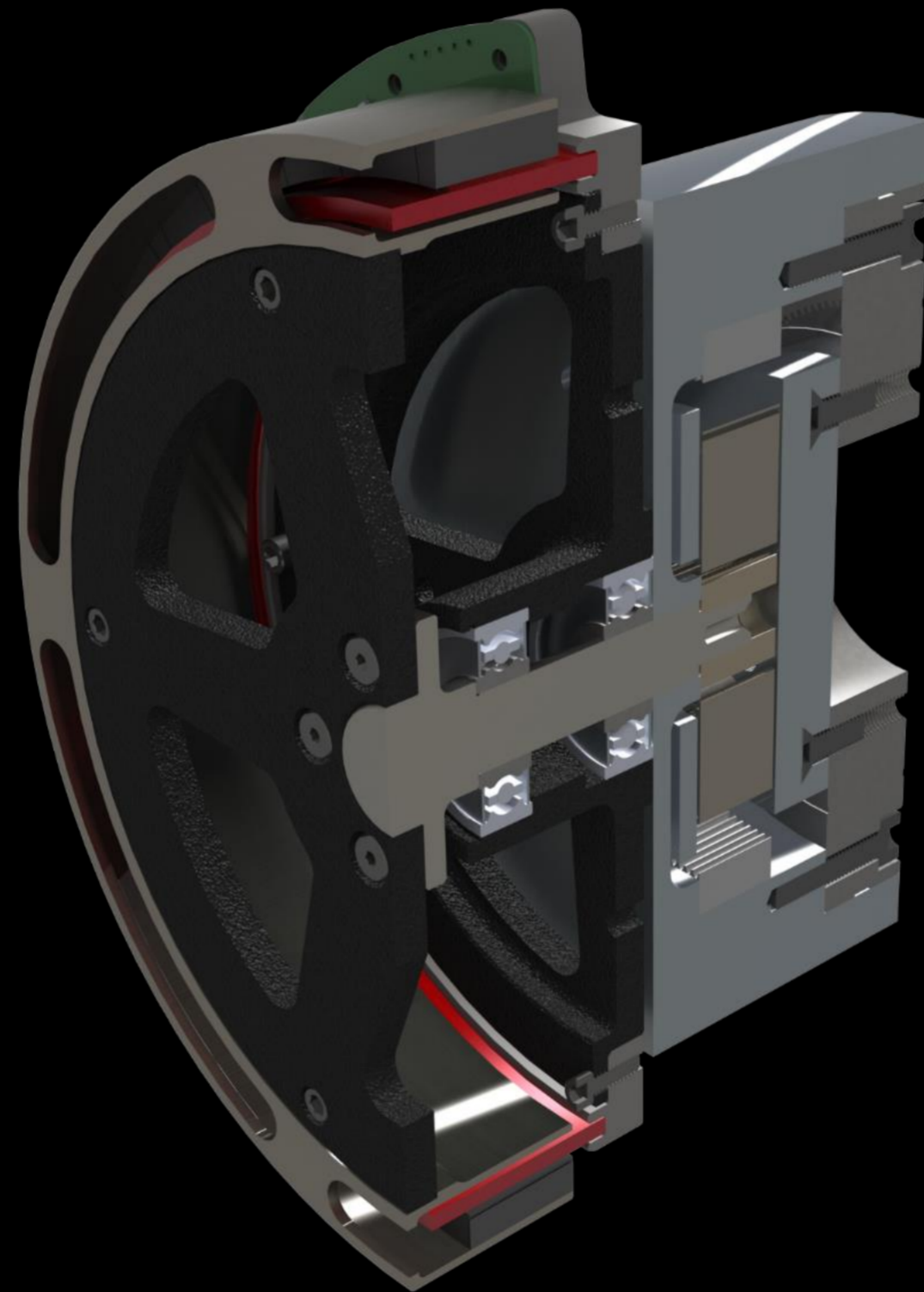
- Test to design conditions
 - Use adequate motor driver
- Integrate optimal gears
 - Carburized
 - More Compact
 - 2500hr life



MOVING FORWARD

Prototype Two:

- Integrate optimal gears
- Crossed-roller bearing
 - More compact
 - Higher load support
 - Lower precision required
 - Simplifies custom components



ACKNOWLEDGMENTS

Hans Leidenfrost – Client

Dr. Mathew Swenson – Project Instructor

Coleton Bailey – Mentor

Bill Magnie – Shop Manager

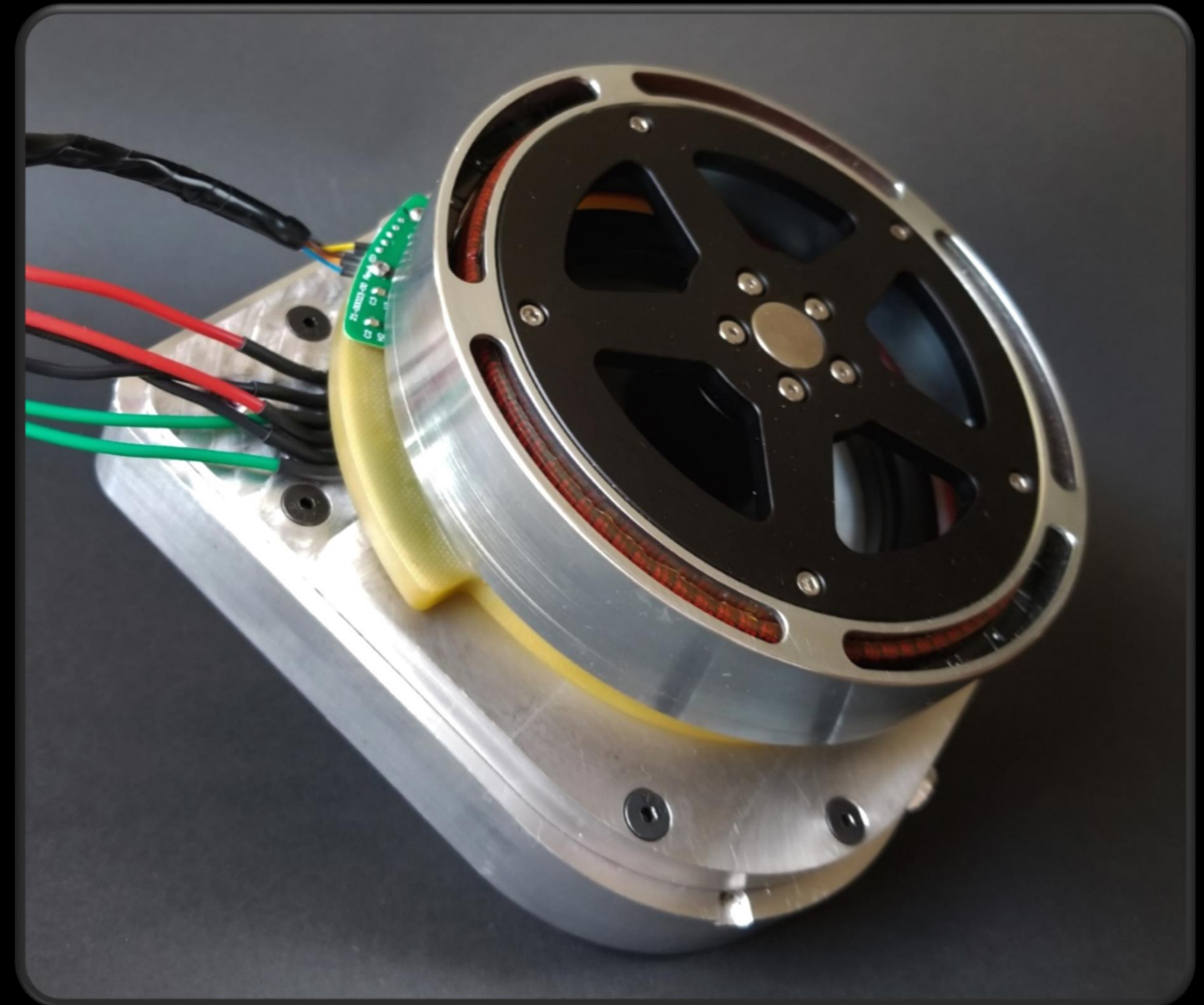
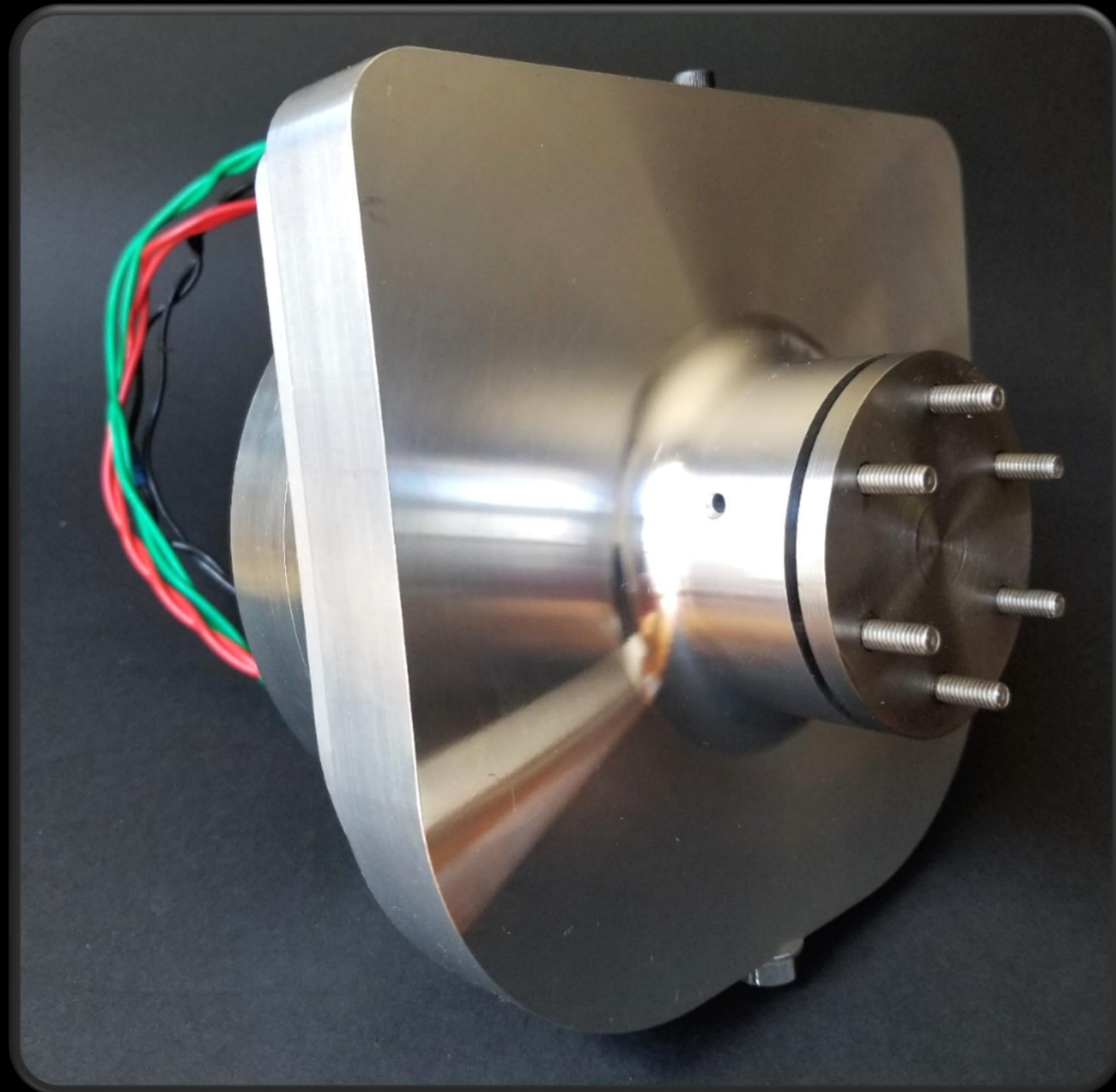
Dr. Edwin Odom – Instructor

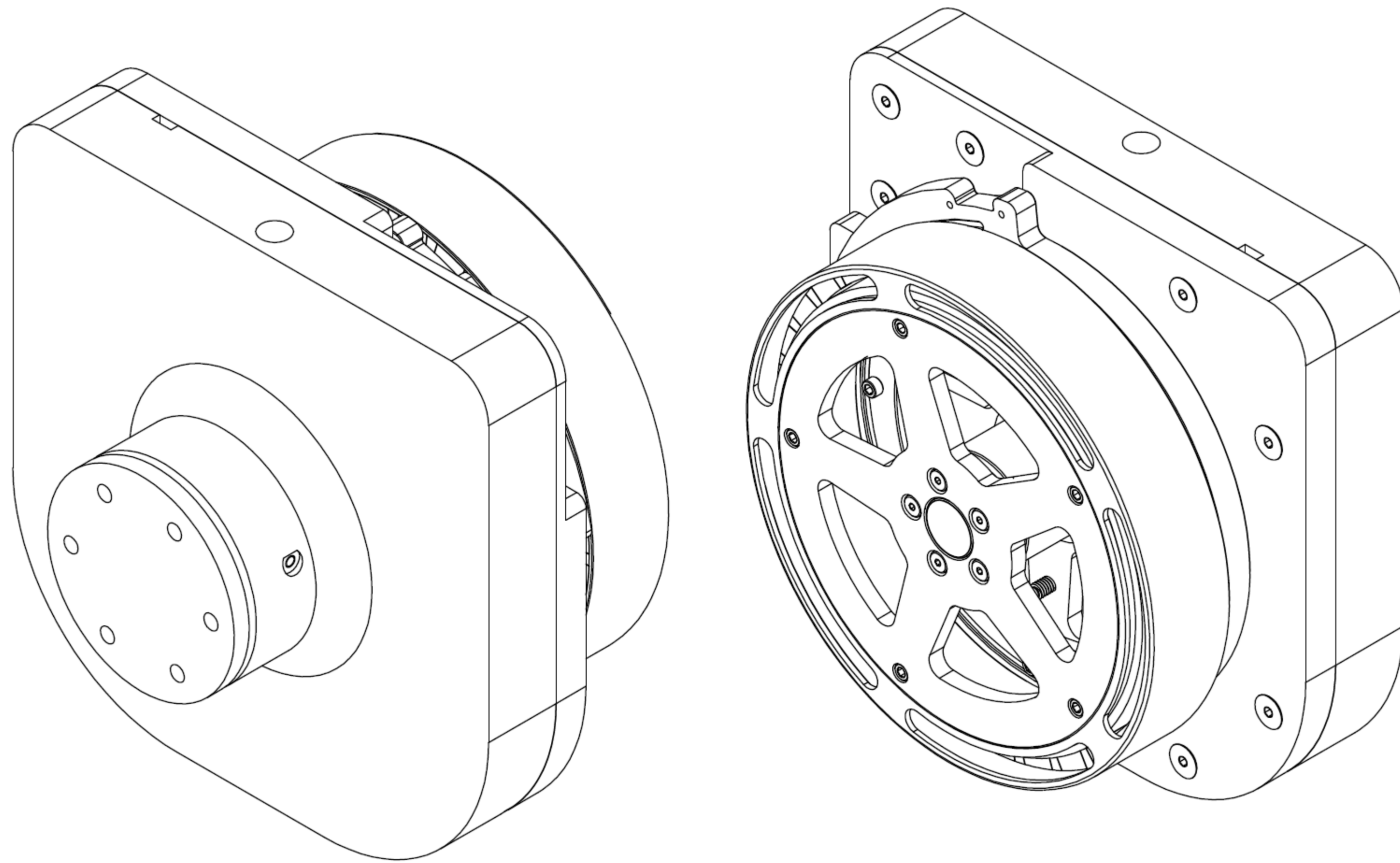
Dr. Dev Shrestha - Instructor

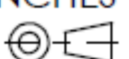
**THANK
YOU**

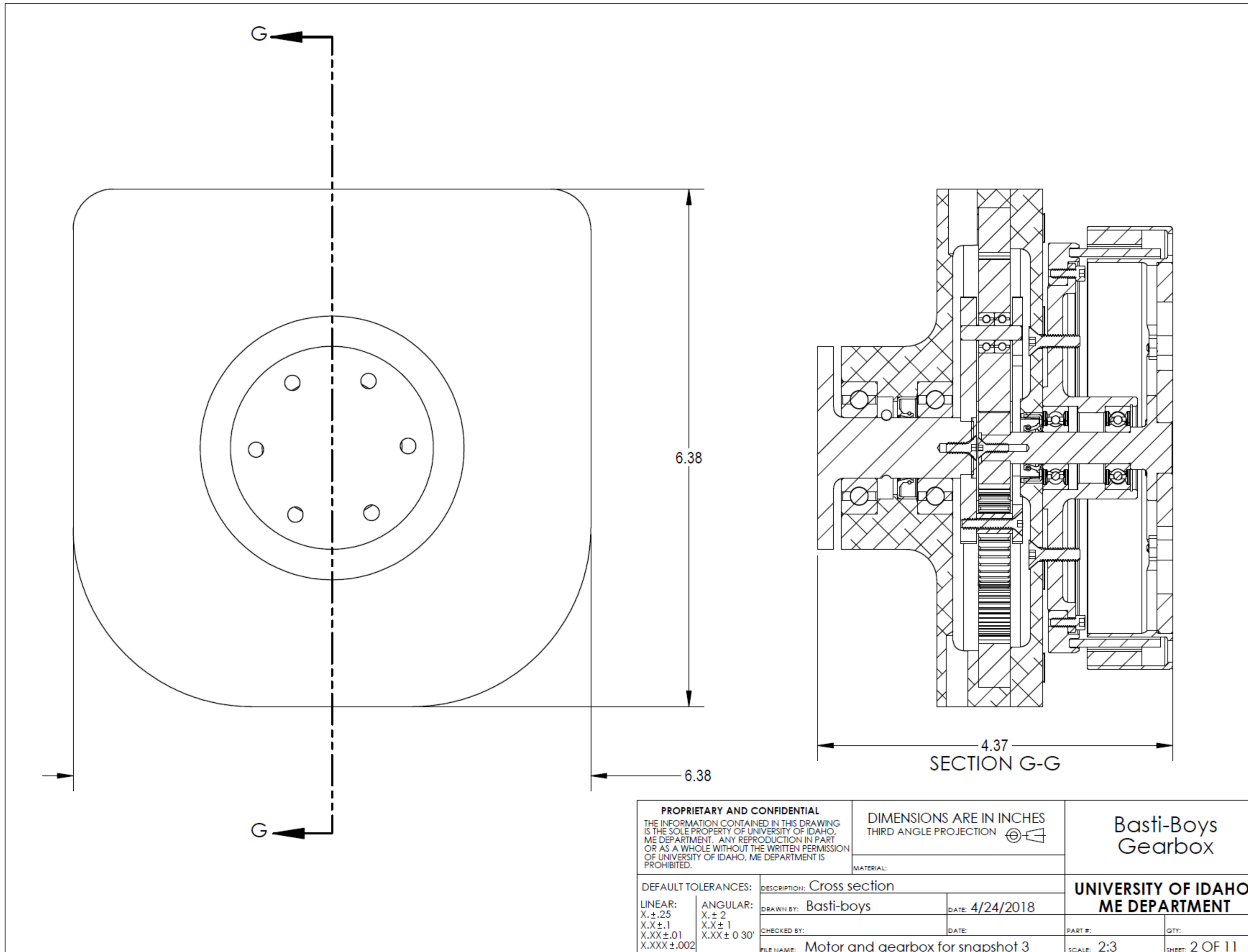


QUESTIONS?

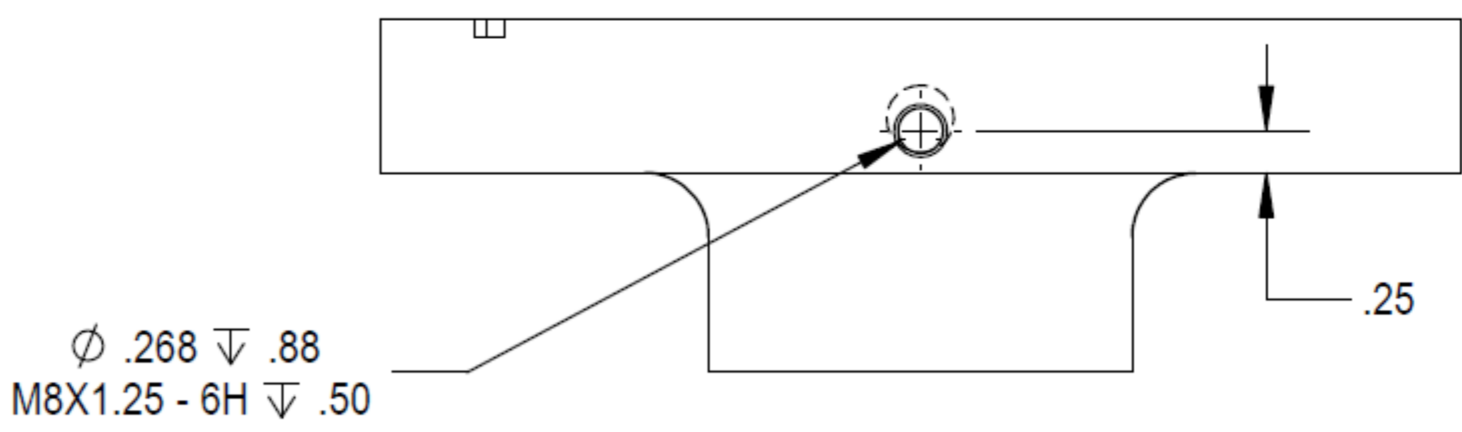
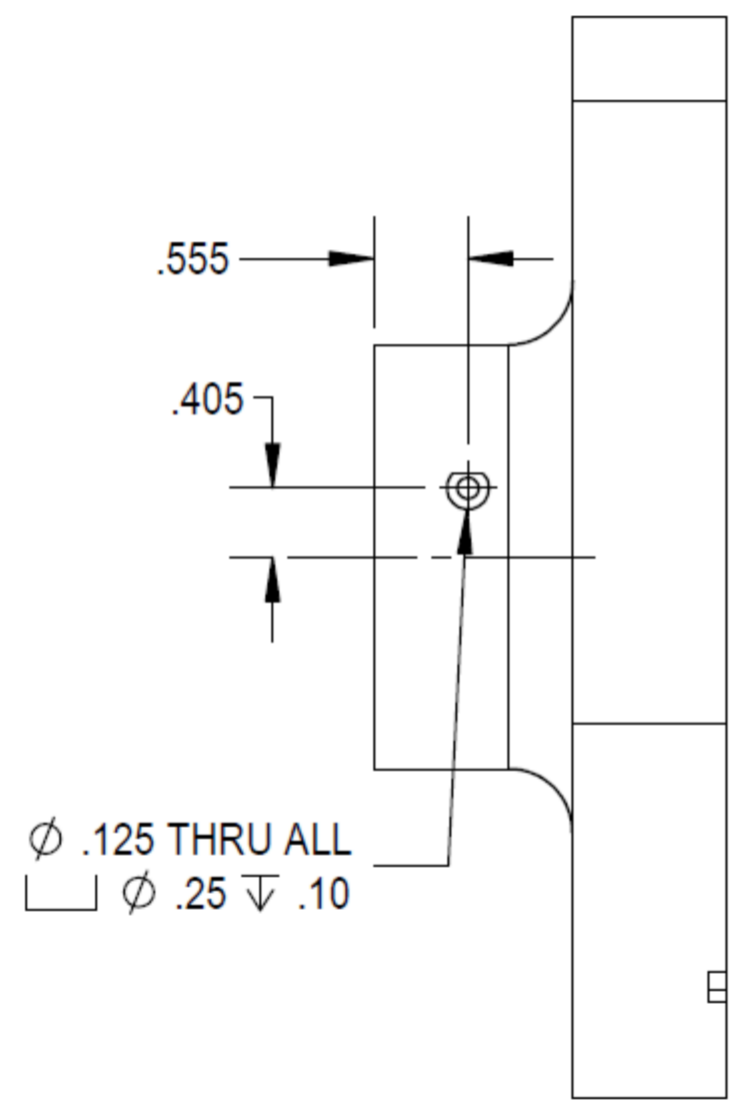
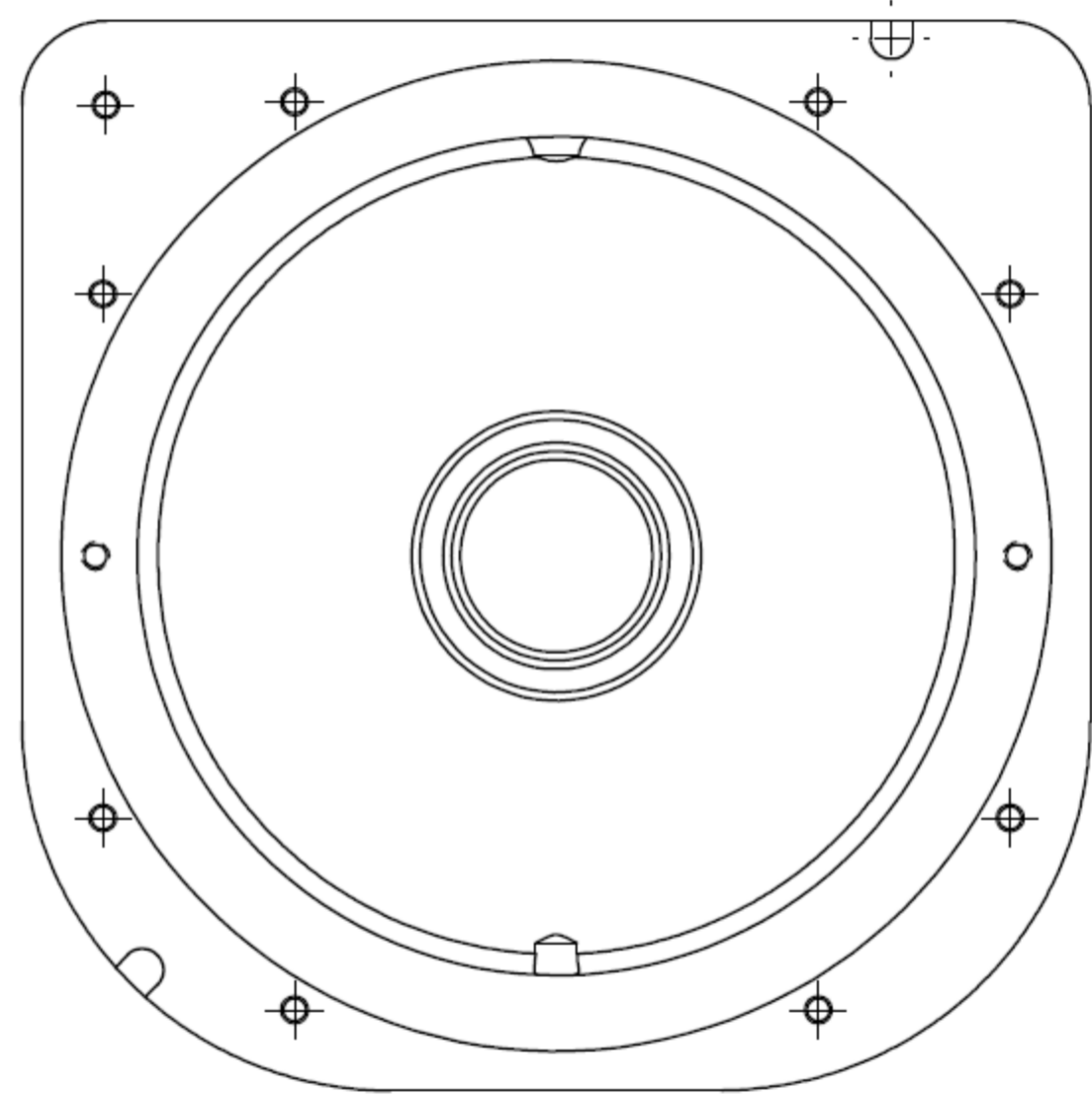
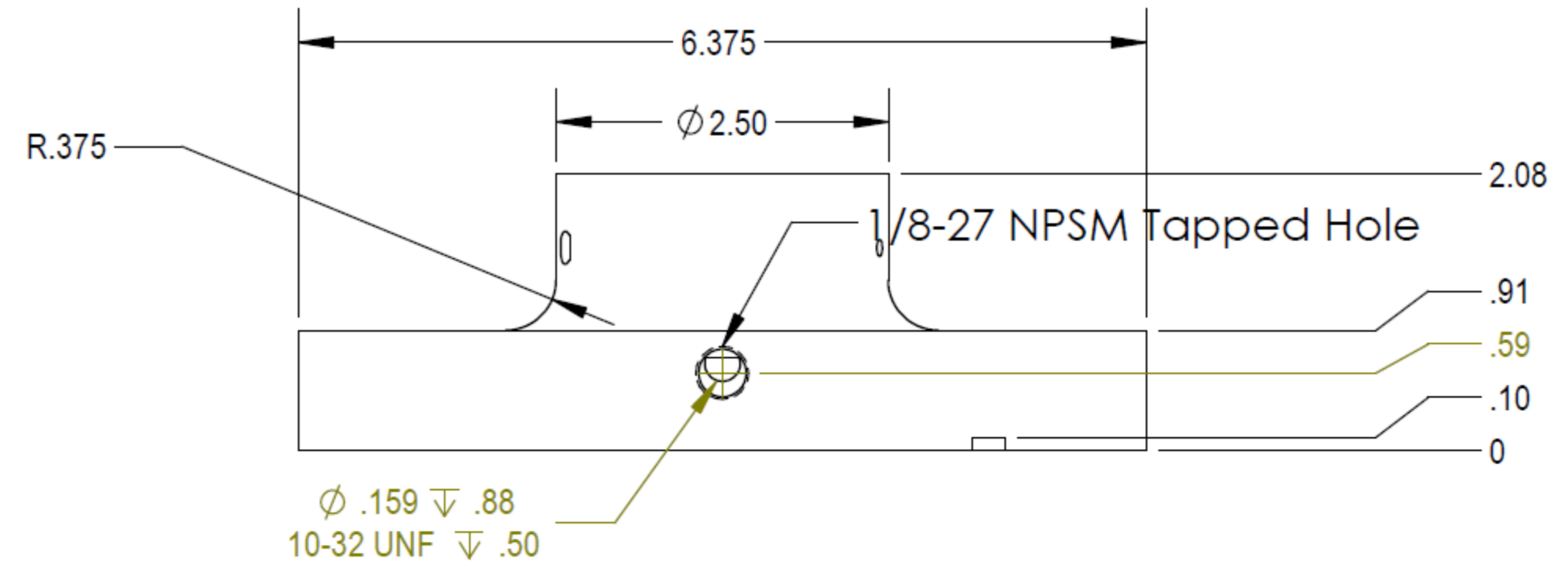




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DEFAULT TOLERANCES: LINEAR: X. ± .25 X.X ± .1 X.XX ± .01 X.XXX ± .002		DESCRIPTION: Isometric View DRAWN BY: Basti-Boys CHECKED BY: FILE NAME: Motor and gearbox for snapshot 3		MATERIAL: DATE: 4/24/2018 DATE: SCALE: 2:3	
		UNIVERSITY OF IDAHO ME DEPARTMENT		PART #: QTY: SHEET: 1 OF 11	

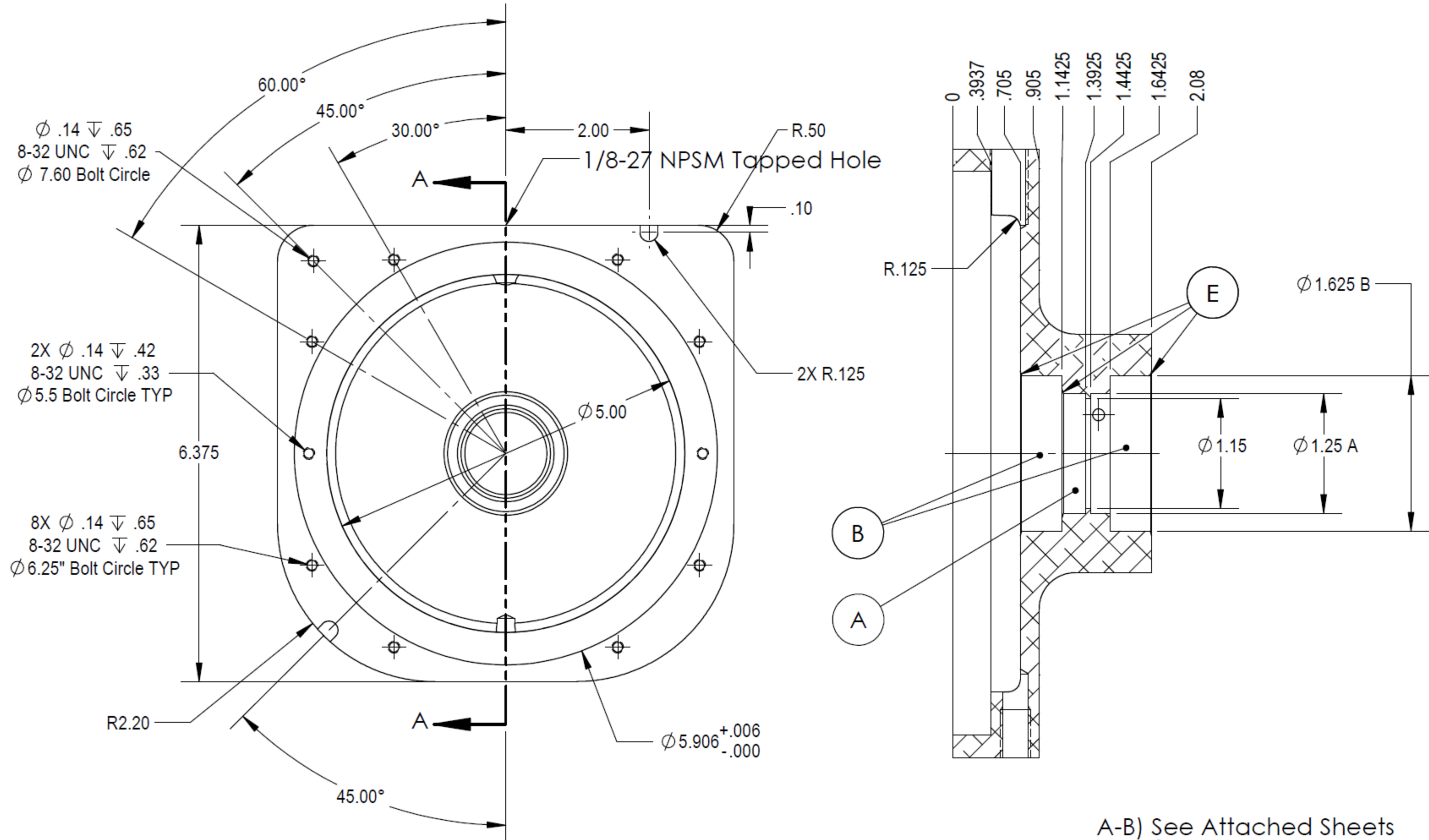


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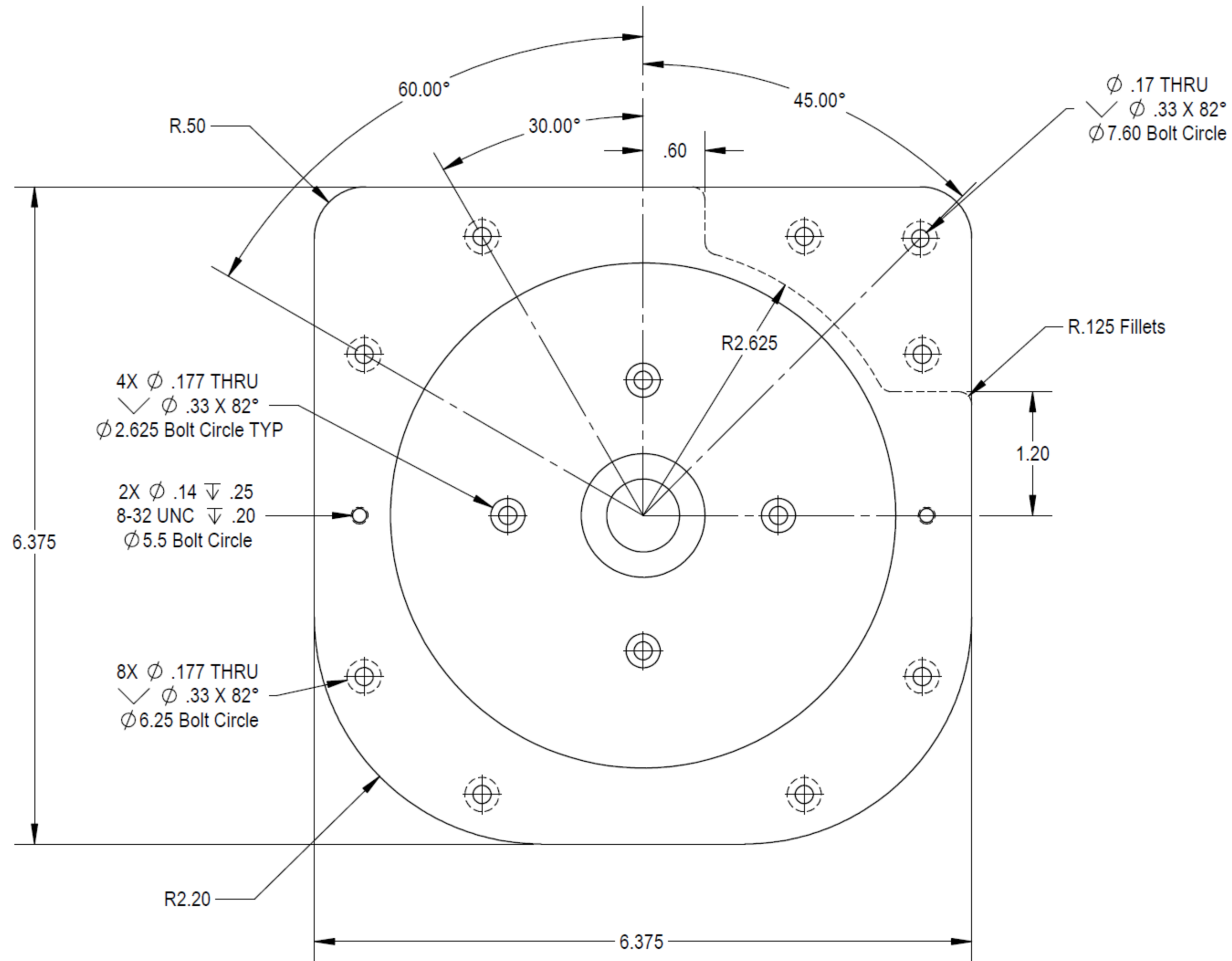
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DEFAULT TOLERANCES:		DESCRIPTION: Frontcase		UNIVERSITY OF IDAHO ME DEPARTMENT	
LINEAR: X. $\pm .25$ X.X $\pm .1$ X.XX $\pm .01$ X.XXX $\pm .002$	ANGULAR: X. ± 2 X.X ± 1 X.XX $\pm 0.30'$	DRAWN BY: Basti-Boys	DATE: 4/24/2018	PART #:	QTY:
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		FILE NAME: Motor and gearbox for snapshot 3			

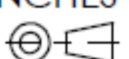
SECTION A-A
SCALE 1 : 1.5

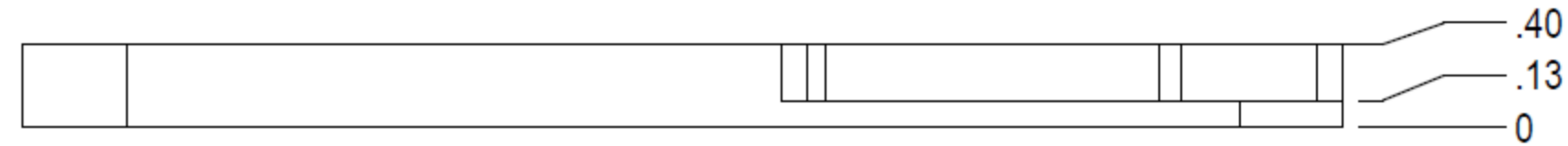


A-B) See Attached Sheets
E) 15° Chamfer for Press Fits

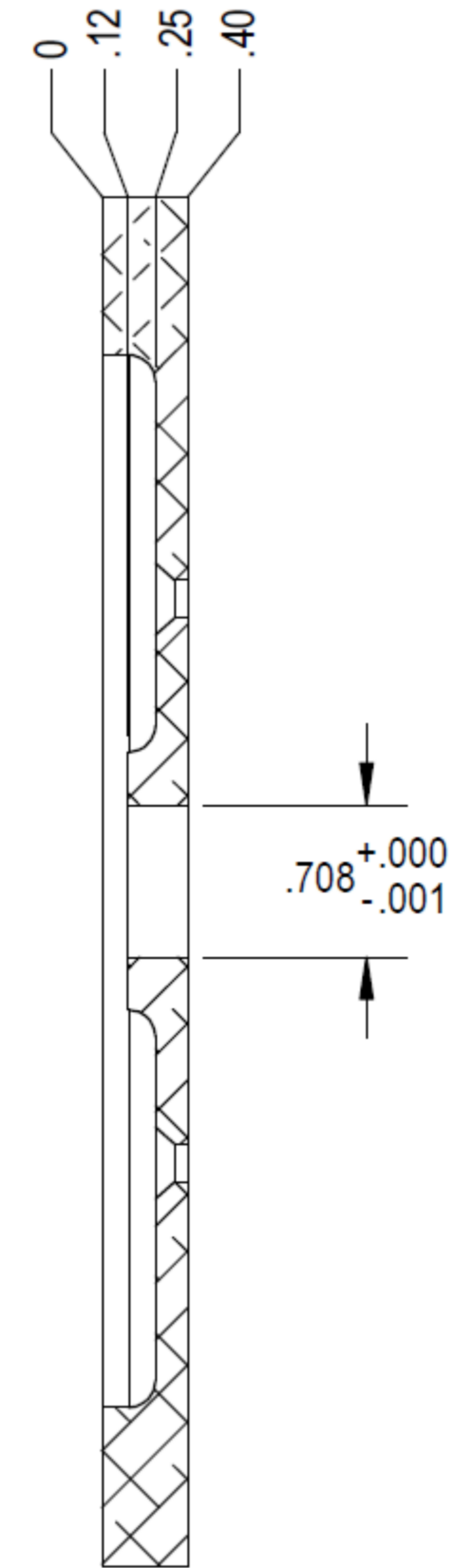
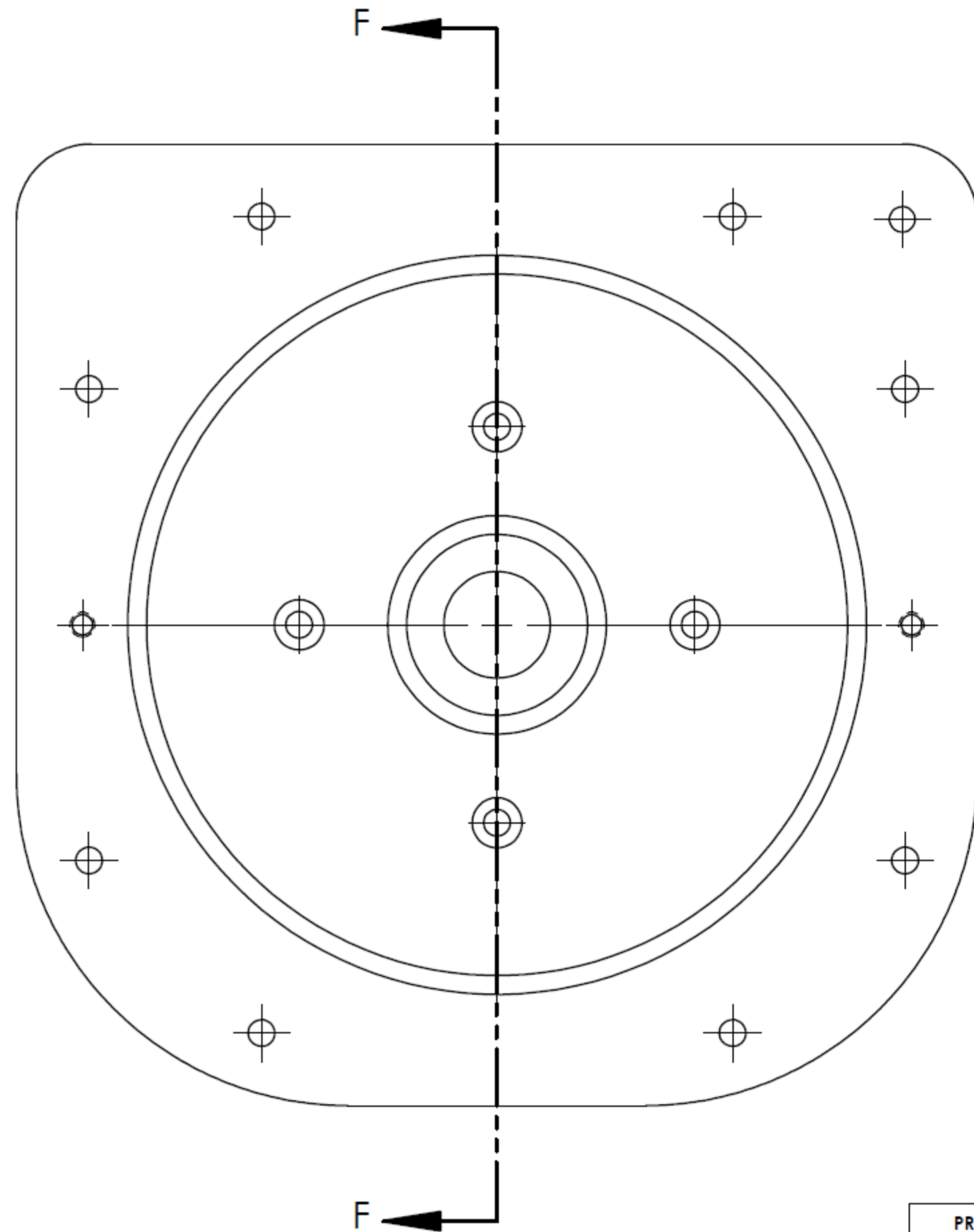
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<p>DEFAULT TOLERANCES: LINEAR: X. ± .25 X.X ± .1 X.XX ± .01 X.XXX ± .002</p>		<p>DESCRIPTION: Frontcase DRAWN BY: Basti-Boys DATE: 4/24/2018</p>		<p>UNIVERSITY OF IDAHO ME DEPARTMENT</p>	
<p>ANGULAR: X. ± 2 X.X ± 1 X.XX ± 0.30°</p>		<p>CHECKED BY: _____ DATE: _____</p>		<p>PART #: _____ QTY: _____</p>	
<p>FILE NAME: Motor and gearbox for snapshot 3</p>		<p>SCALE: 1:2</p>		<p>SHEET: 4 OF 11</p>	



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MATERIAL: 6061 Alloy		DESCRIPTION: Gearbox Casing Back		UNIVERSITY OF IDAHO ME DEPARTMENT	
DEFAULT TOLERANCES:		DRAWN BY: Basti-Boys		DATE: 4/24/2018	
LINEAR: X. ± .25 X.X ± .1 X.XX ± .01 X.XXX ± .002	ANGULAR: X. ± 2 X.X ± 1 X.XX ± 0.30'	CHECKED BY:		DATE:	
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		SCALE: 2:3		SHEET: 5 OF 11	

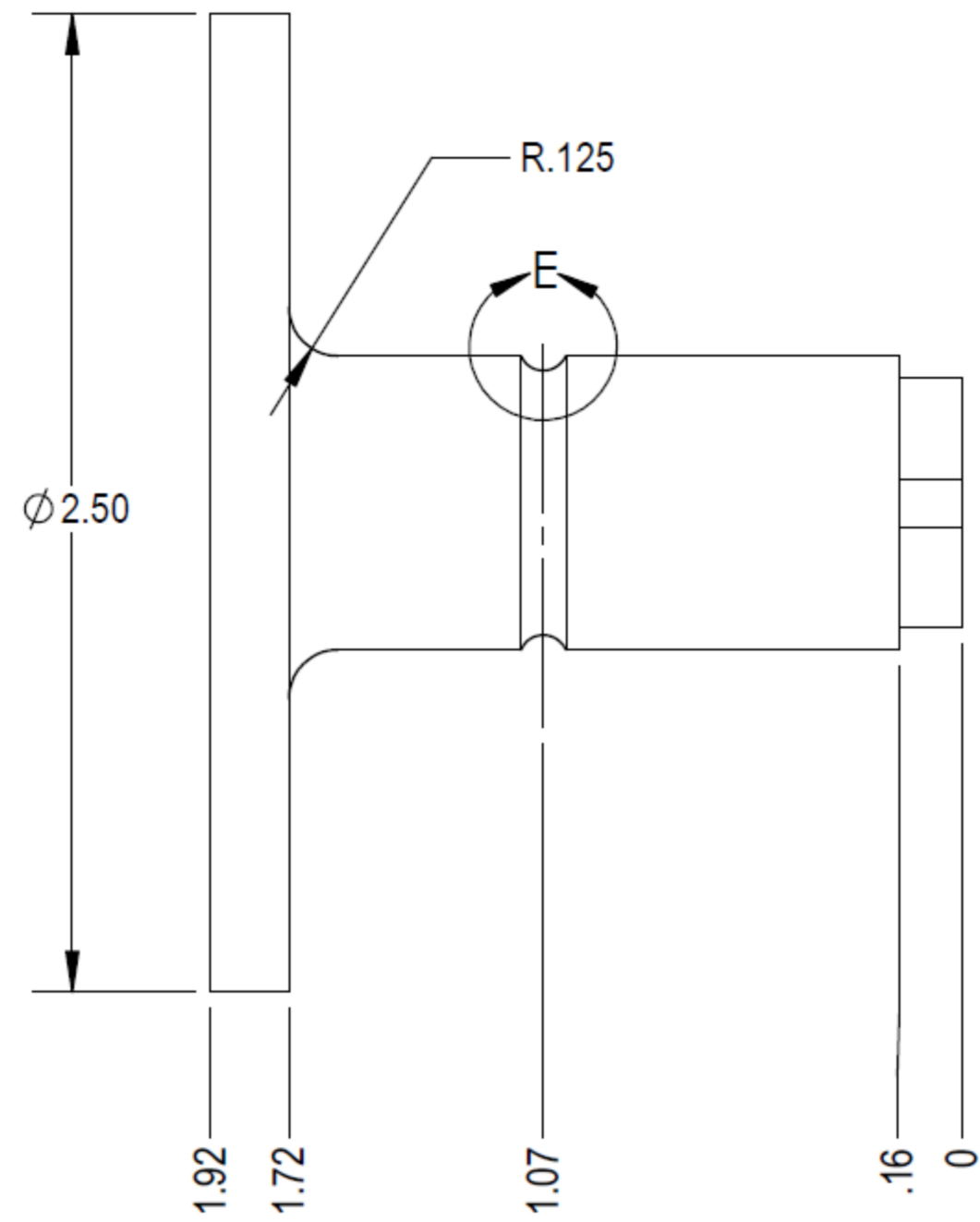
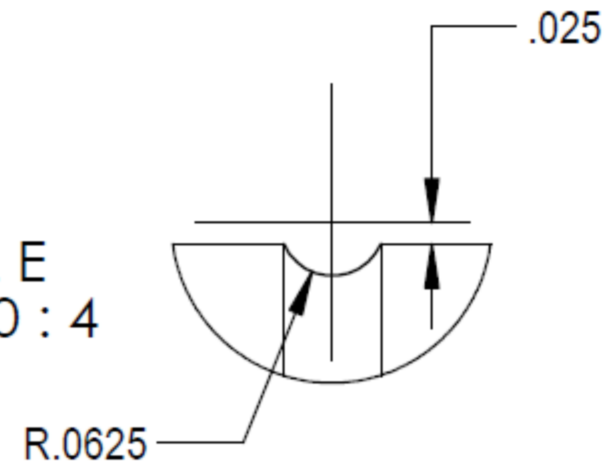


SECTION F-F
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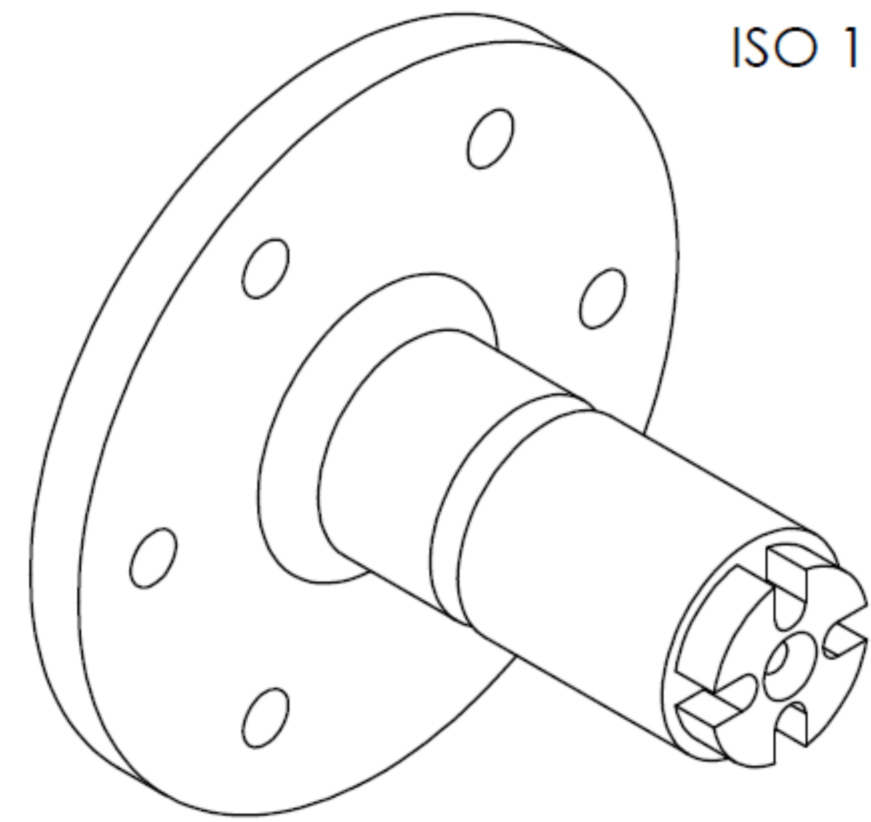
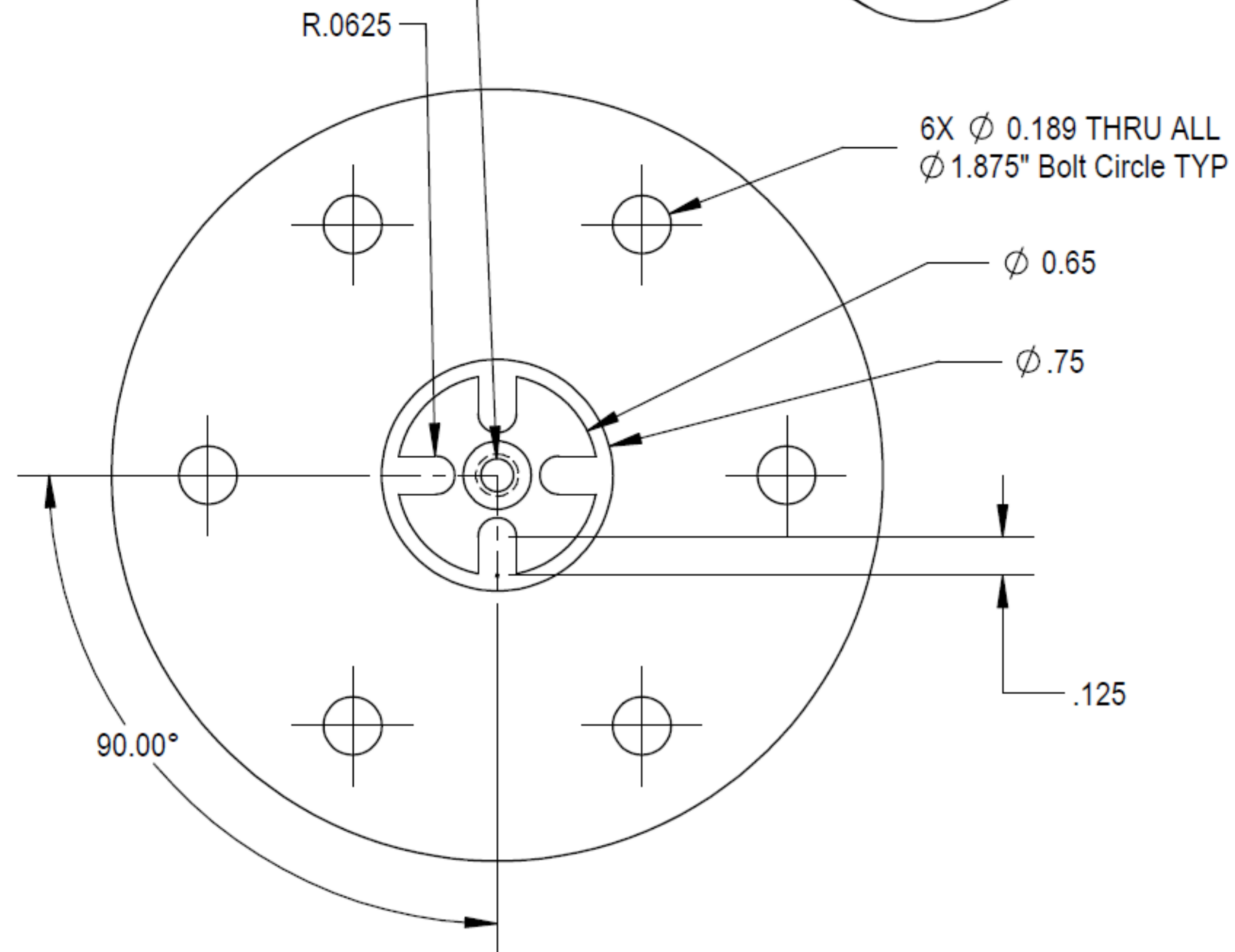


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DEFAULT TOLERANCES: LINEAR: X. ± .25 X.X ± .1 X.XX ± .01 X.XXX ± .002		DESCRIPTION: Gearbox Casing Back DRAWN BY: Basti-Boys CHECKED BY: FILE NAME: Motor and gearbox for snapshot 3		MATERIAL: DATE: 4/24/2018 DATE: SCALE: 1:2	
ANGULAR: X. ± 2 X.X ± 1 X.XX ± 0.30°		UNIVERSITY OF IDAHO ME DEPARTMENT		PART #: QTY: SHEET: 6 OF 11	

DETAIL E
SCALE 10 : 4

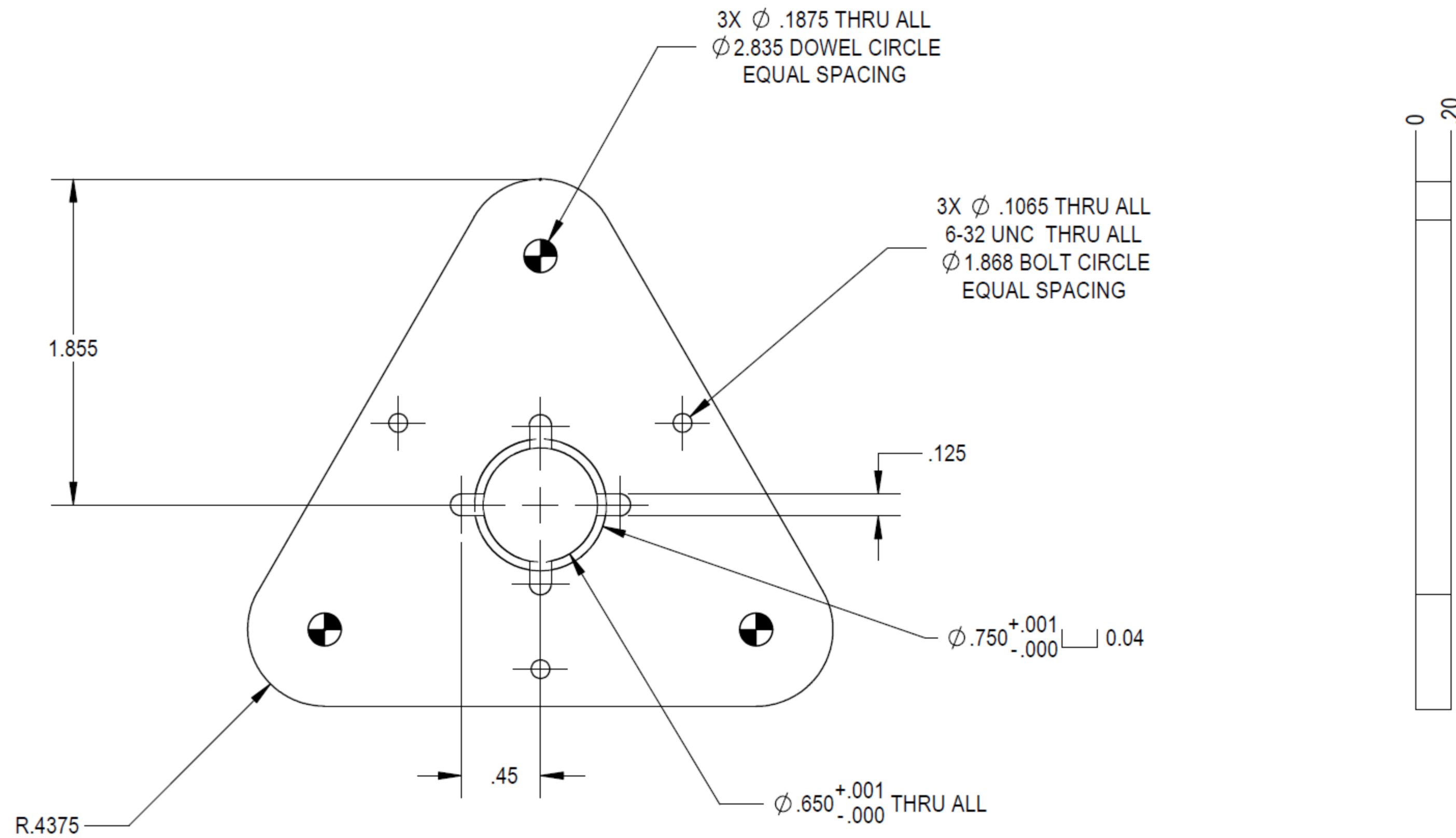


$\phi .1065 \nabla .45$
6-32 UNC $\nabla .38$
 $\surd \phi 0.22 \times 82^\circ$, NEAR SIDE

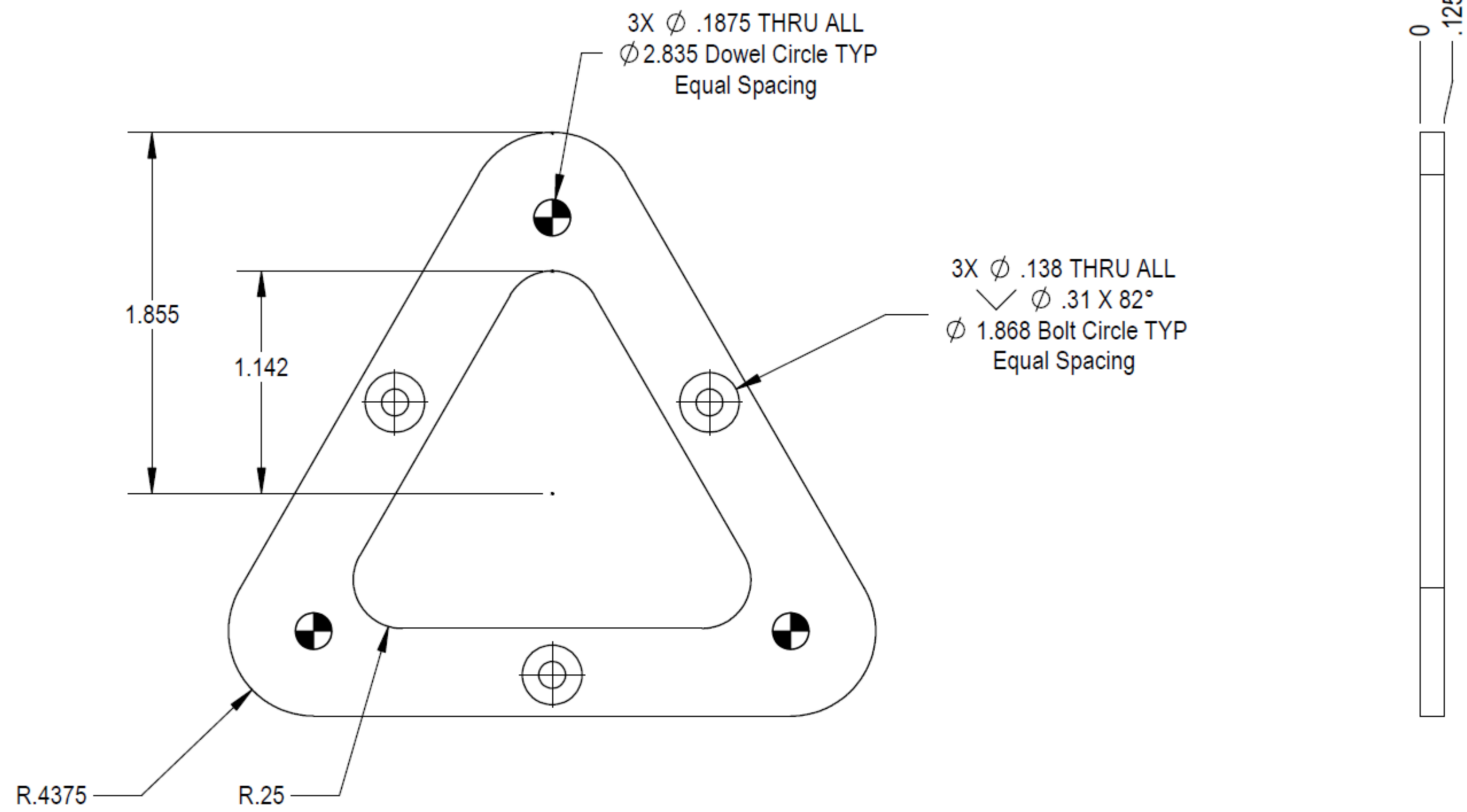


ISO 1:1

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<p>DEFAULT TOLERANCES:</p>		<p>DESCRIPTION: Output Shaft</p>		<p>MATERIAL: AISI 1020 Steel, Cold Rolled</p>	
<p>LINEAR: X. ± .25 X.X ± .1 X.XX ± .01 X.XXX ± .002</p>	<p>ANGULAR: X. ± 2 X.X ± 1 X.XX ± 0.30'</p>	<p>DRAWN BY: Basti-Boys</p>	<p>DATE: 4/24/2018</p>	<p>UNIVERSITY OF IDAHO ME DEPARTMENT</p>	
<p>CHECKED BY:</p>		<p>DATE:</p>	<p>PART #: 04</p>	<p>QTY:</p>	
<p>FILE NAME: Output Shaft_05_Idea_2</p>		<p>SCALE: 5:4</p>	<p>SHEET: 7 OF 11</p>		

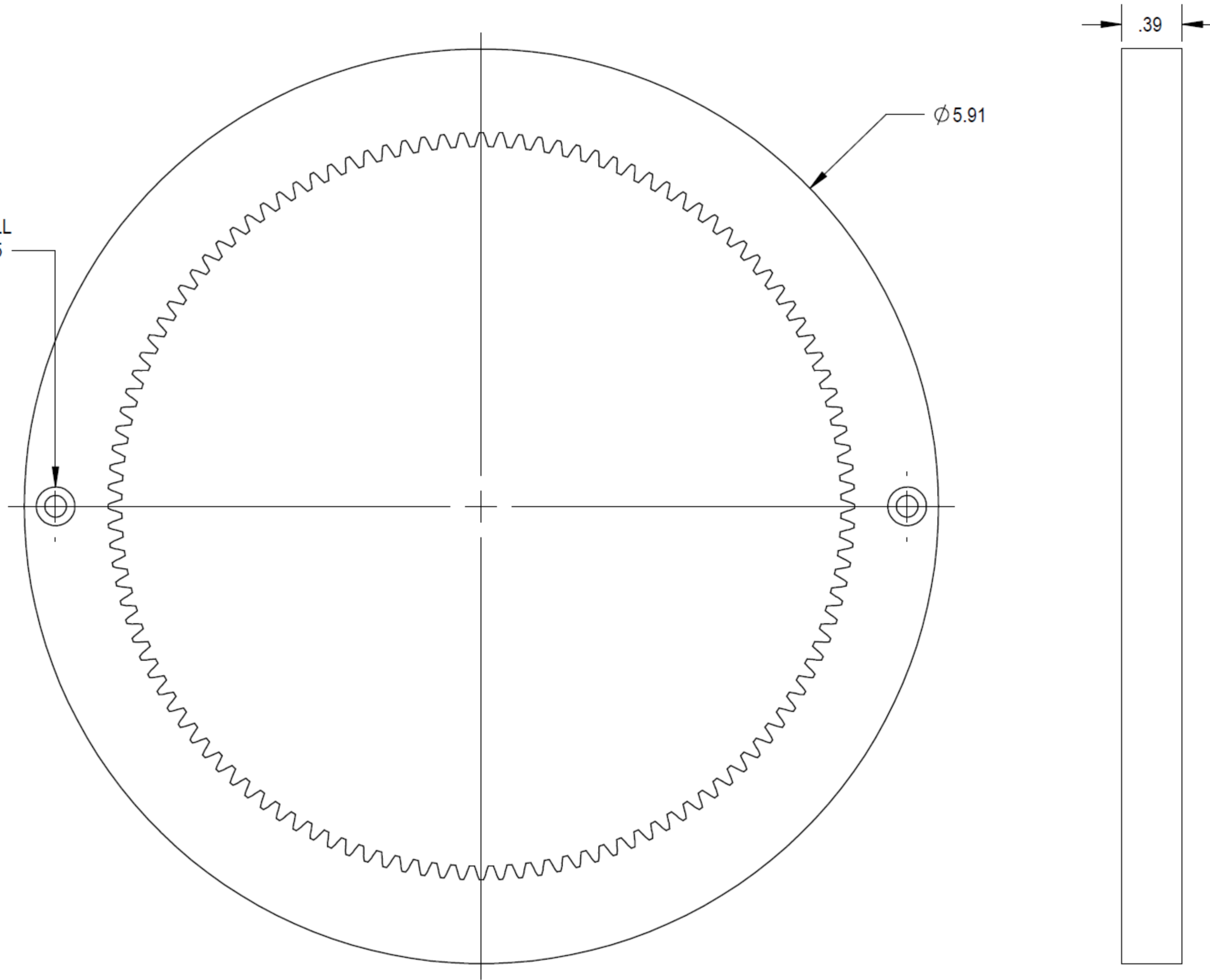


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DEFAULT TOLERANCES: LINEAR: X. ± .25 X.X ± .1 X.XX ± .01 X.XXX ± .002		ANGLAR: X. ± 2 X.X ± 1 X.XX ± 0.30°		MATERIAL:	
DESCRIPTION: Output Carrier		DRAWN BY: Basti-Boys		DATE: 4/24/2018	
CHECKED BY:		DATE:		PART #:	
FILE NAME: Motor and gearbox for snapshot 3		SCALE: 1:1		SHEET: 8 OF 11	
				UNIVERSITY OF IDAHO ME DEPARTMENT	

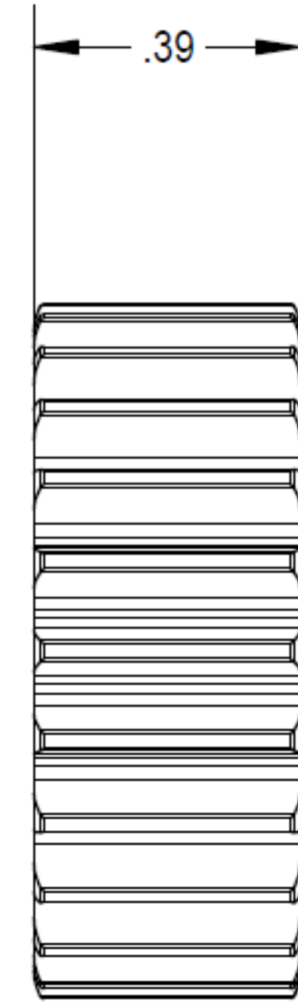
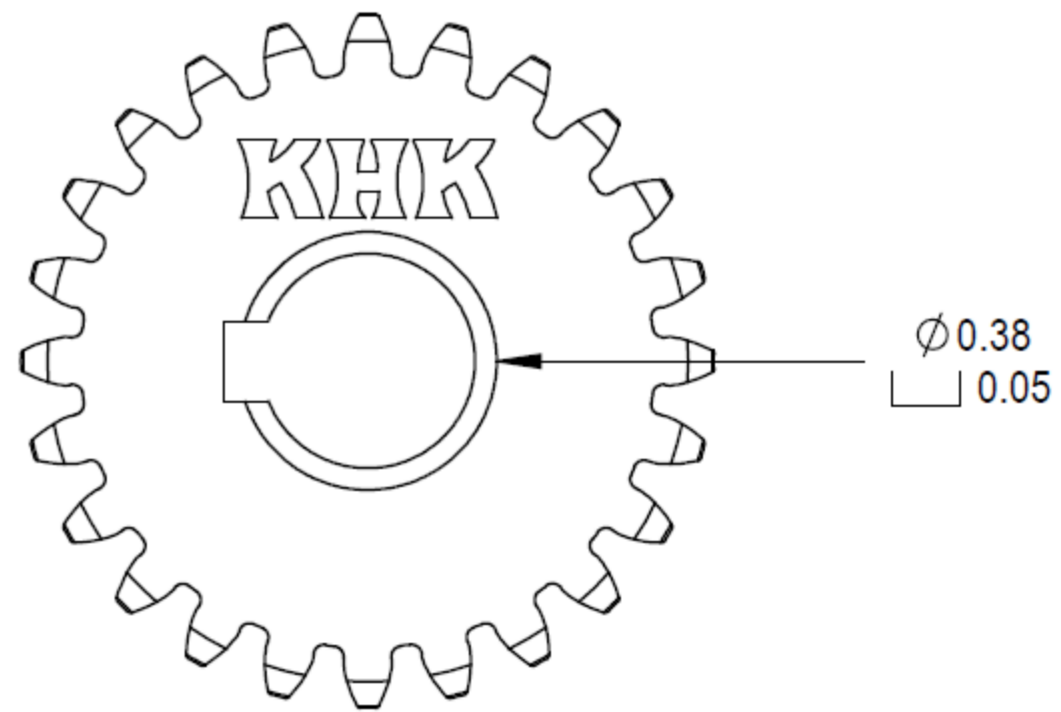


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DEFAULT TOLERANCES: LINEAR: X. \pm .25 X.X \pm .1 X.XX \pm .01 X.XXX \pm .002		DESCRIPTION: Carrier Guide DRAWN BY: Basti-Boys CHECKED BY: FILE NAME: Motor and gearbox for snapshot 3		MATERIAL: DATE: 4/24/2018 PART #: QTY: SCALE: 1:1 SHEET: 9 OF 11	
ANGULAR: X. \pm 2 X.X \pm 1 X.XX \pm 0 30'		UNIVERSITY OF IDAHO ME DEPARTMENT			

2X ϕ .14 THRU ALL
 \square ϕ .25 ∇ .15
 ϕ 5.5 Bolt Circle



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DEFAULT TOLERANCES: LINEAR: X.±.25 X.X±.1 X.XX±.01 X.XXX±.002		ANGLAR: X.± 2 X.X± 1 X.XX± 0.30°		MATERIAL:	
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FILE NAME: Motor and gearbox for snapshot 3		SCALE: 1:1		PART #:	
				QTY:	
				SHEET: 10 OF 11	



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DEFAULT TOLERANCES: LINEAR: X. ± .25 X.X ± .1 X.XX ± .01 X.XXX ± .002		DESCRIPTION: DRAWN BY: XXXX CHECKED BY: FILE NAME: Motor and gearbox for snapshot 3		MATERIAL: DATE: 4/24/2018 UNIVERSITY OF IDAHO ME DEPARTMENT	
ANGULAR: X. ± 2 X.X ± 1 X.XX ± 0 30'		DATE: SCALE: 2:1		PART #: QTY: SHEET: 11 OF 11	

TABLES

Row 1	First Column Gold	
Row 2		
Row 3		

Row 1	First Column Black	
Row 2		
Row 3		

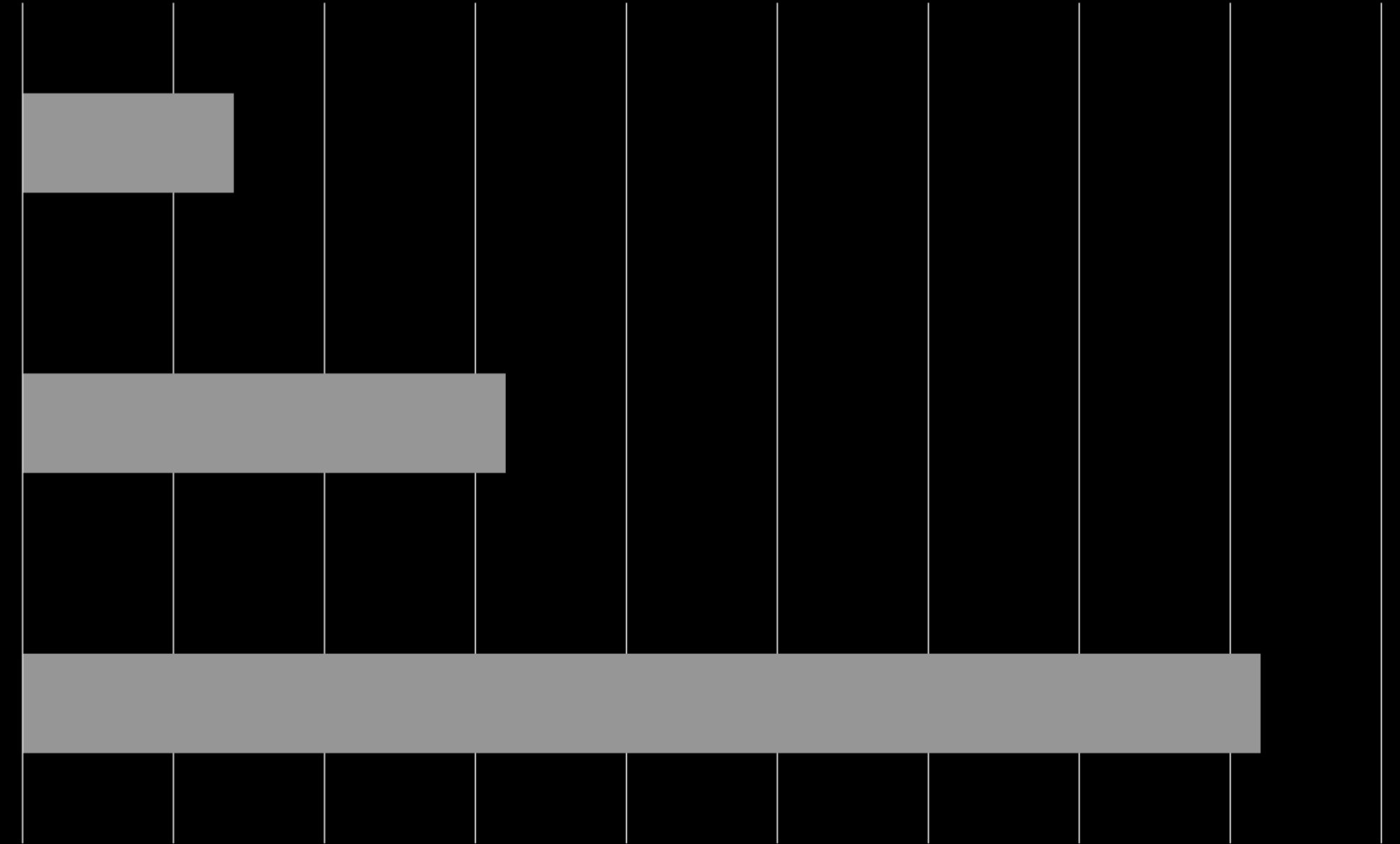
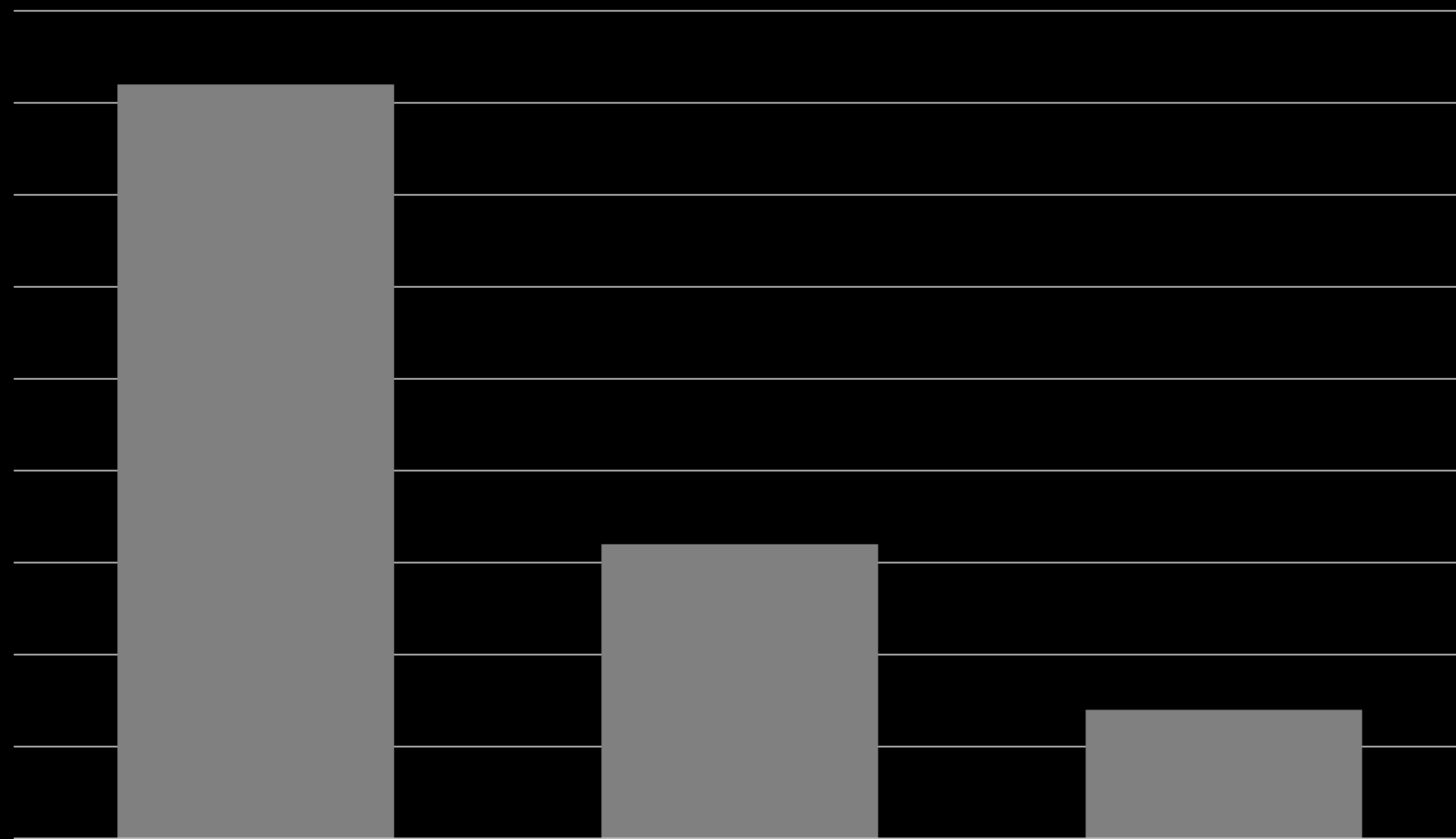
	Column 1	Column 2	Column 3
Row 1	Header + First Column Gold		
Row 2			
Row 3			

	Column 1	Column 2	Column 3
Row 1	Header + First Column Black		
Row 2			
Row 3			

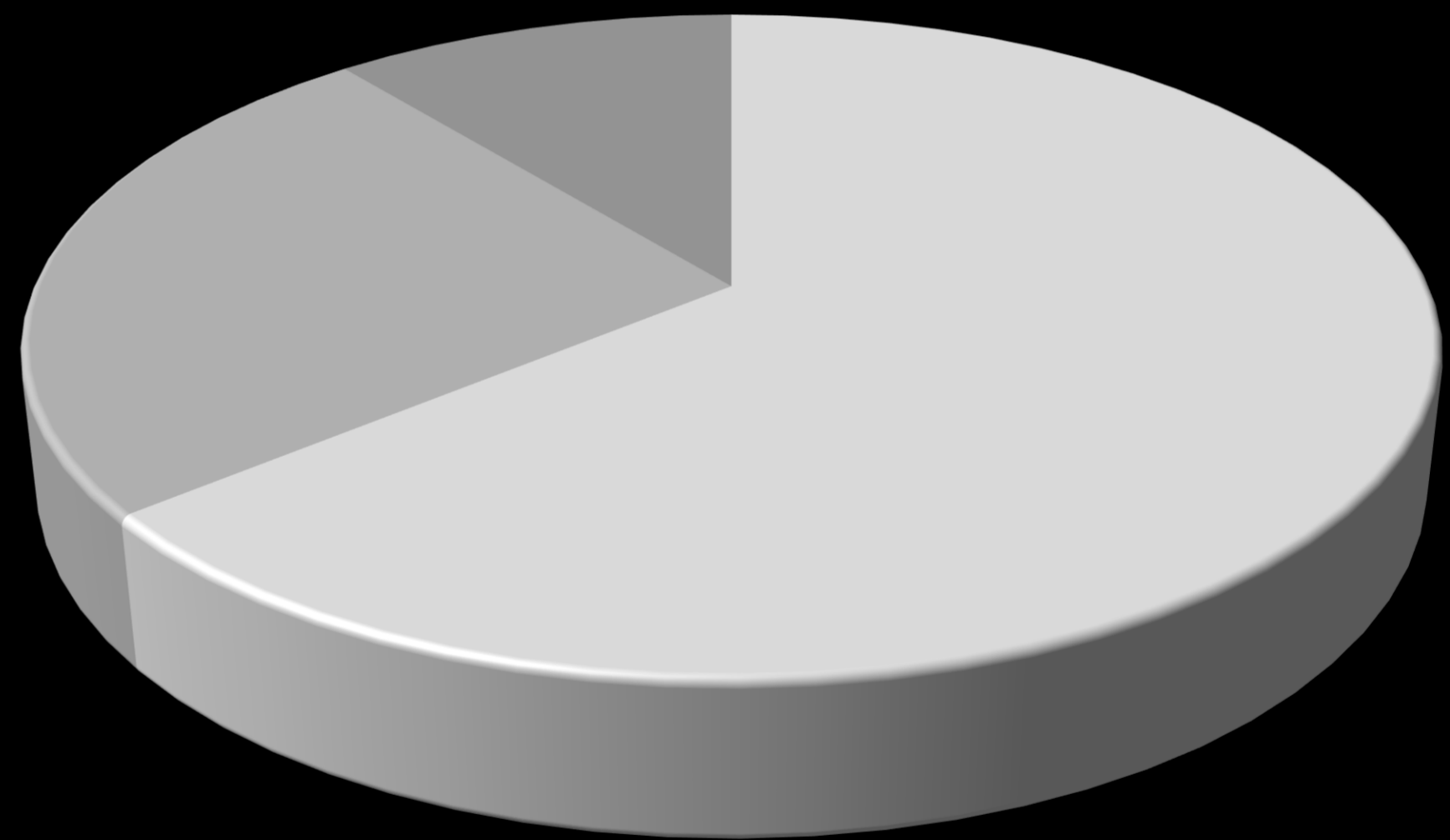
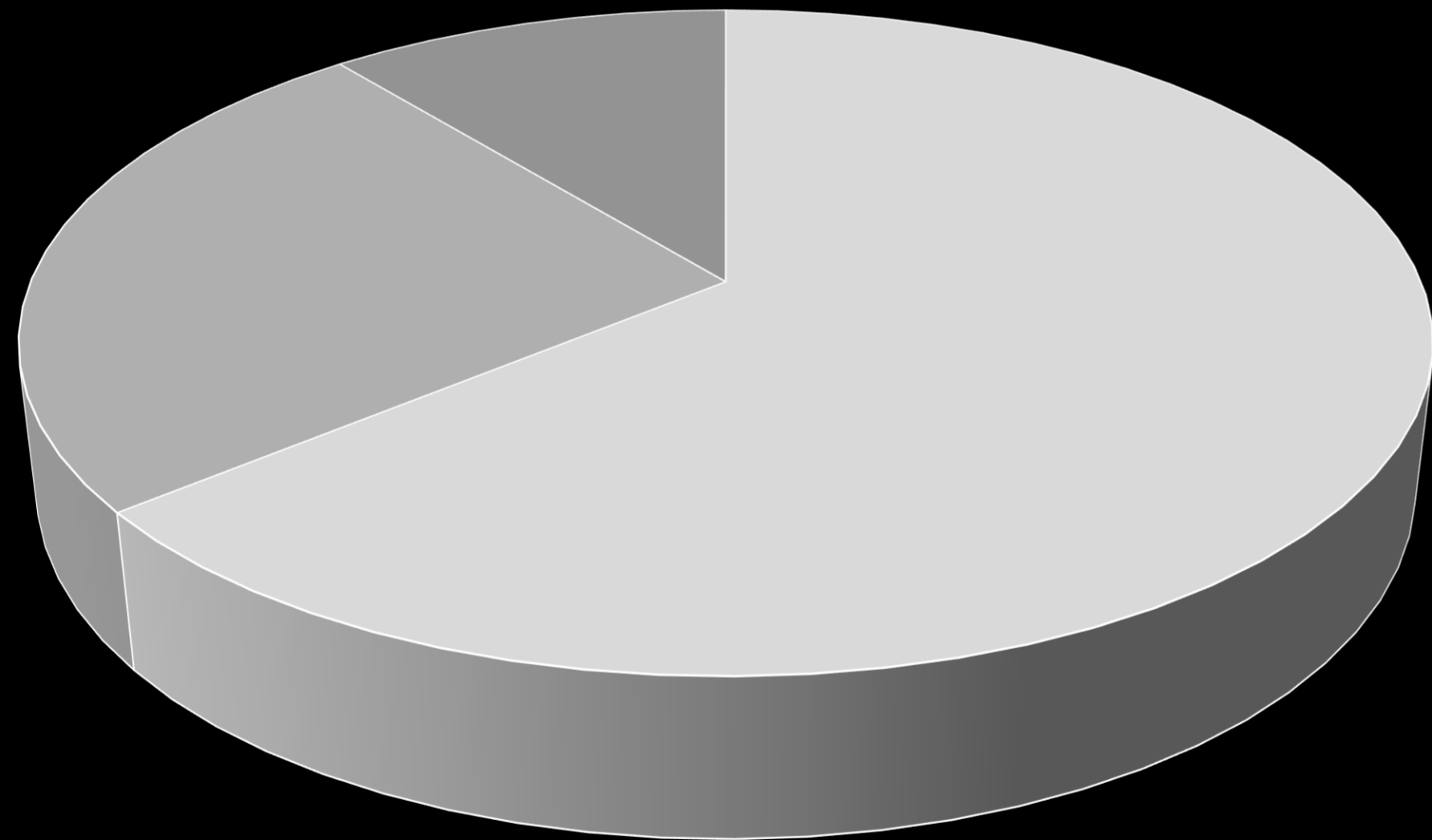
	Column 1	Column 2	Column 3
Row 1	Adv. Gold/Black		
Row 2			
Row 3			
TOTAL			

	Column 1	Column 2	Column 3
Row 1	Adv. Black/Gold		
Row 2			
Row 3			
TOTAL			

CHARTS



PIE CHARTS



TABLES

Column 1	Column 2	Column 3
Basic Gold		

Column 1	Column 2	Column 3
Basic Black		

Column 1	Column 2	Column 3
Alternating Rows Gold		

Column 1	Column 2	Column 3
Alternating Rows Black		

Column 1	Column 2	Column 3	Column 4
Alternating Columns Gold			

Column 1	Column 2	Column 3	Column 4
Alternating Columns Black			