

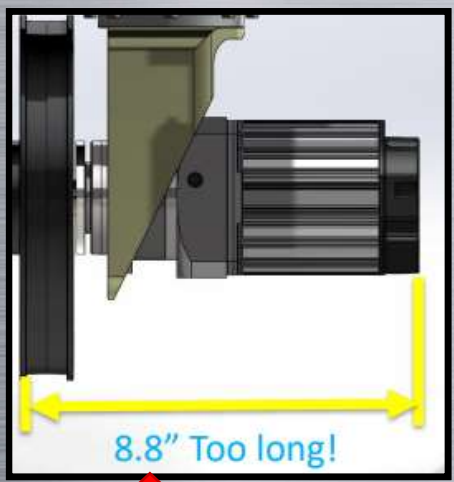
Robotic Wheel Drive

Team: The Basti-Boys

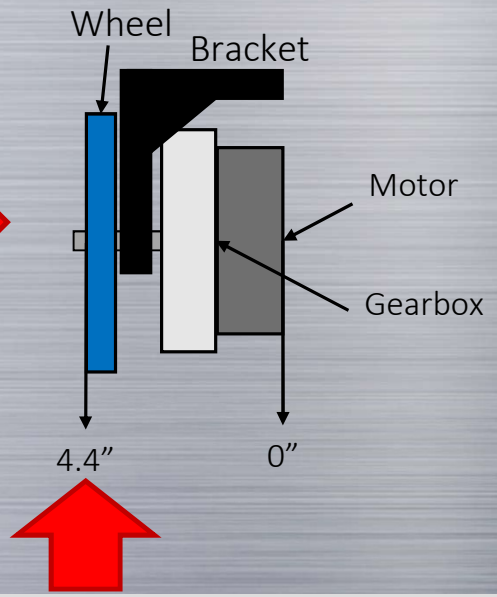
Members: Daniel Hein, Brad Morris,
Gabe Riggs, Jacob Riggs

Problem Statement

Current wheel drive system
(Designed by Bastian Solutions)



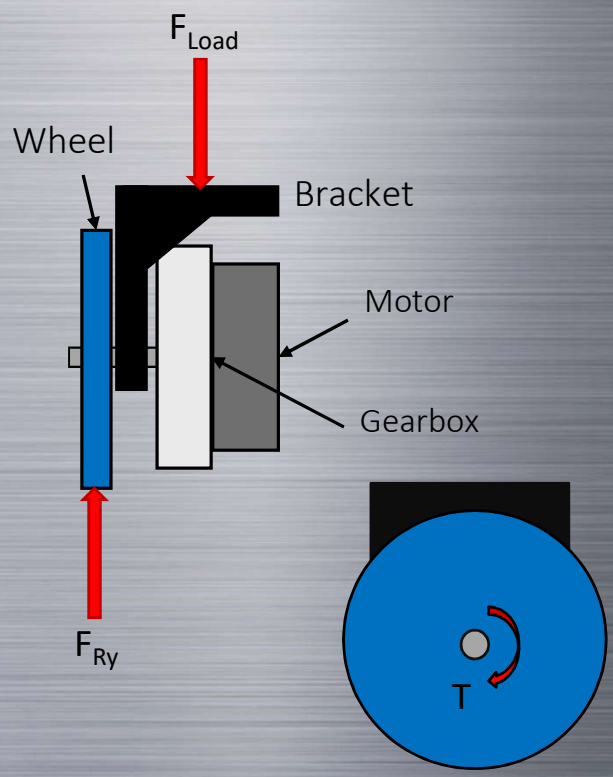
Requirement: Reduce length
to 4.4"



Problem Statement

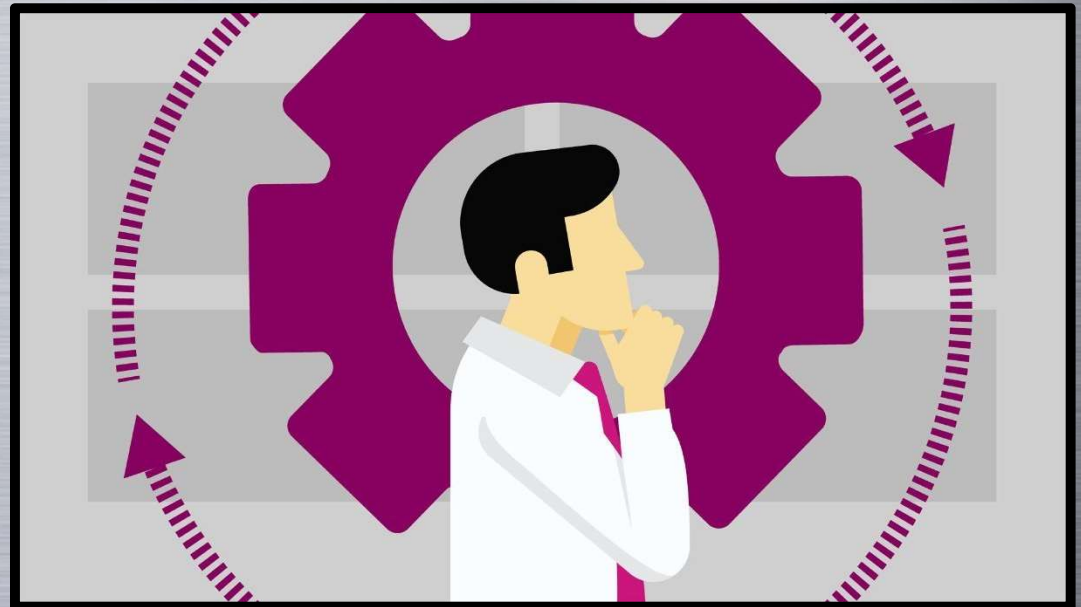
Load specs.

State	A	B	C
Torque (oz-in)	2340	1970	500
Speed (rpm)	275	366	750
Acceleration (ft/s ²)	4	4	8
Duration of Load (seconds)	10	7.5	t > 10

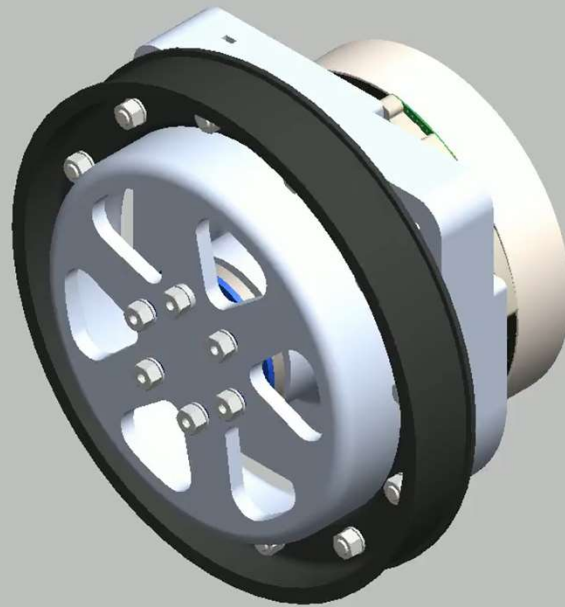


Problem Statement

- Power Constraints
 - Max 48 Volts
 - Max 80 Amps
- Gearbox Life
 - 30,000 hr
 - 5 year service life
- BOM Cost: \$2000 max



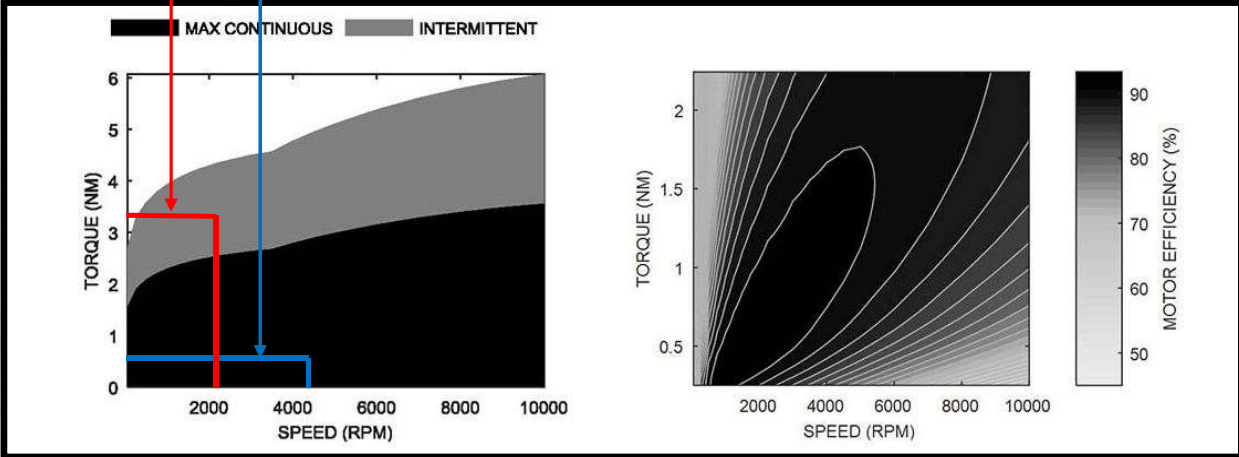
Solution



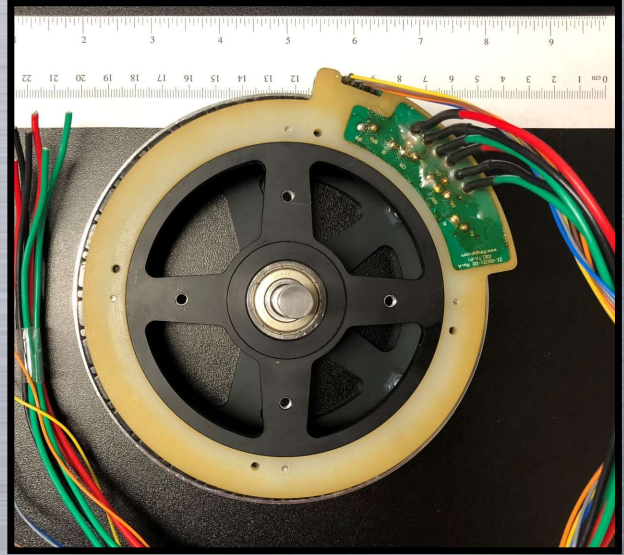
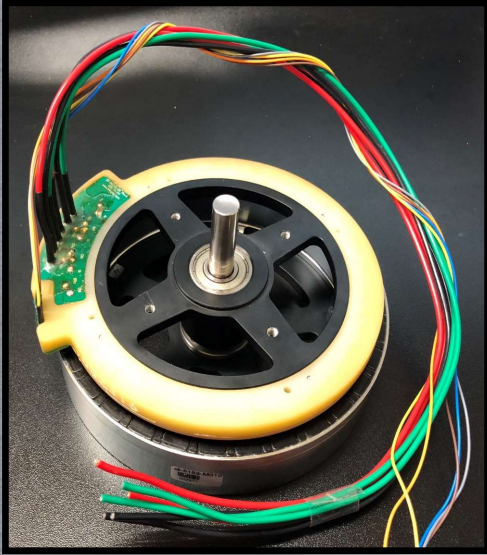
Solution - Motor

- Max Continuous Torque of TG5153 = 3.57 Nm
- 6:1 ratio allows for 21.42 Nm of Max Continuous Torque output

Torque (Nm)	Speed (RPM)	Voltage (Volts)	Current (Amps)
0.5883	4500	47 to 57	34 to 41
3.33	2250	25 to 30	68 to 83



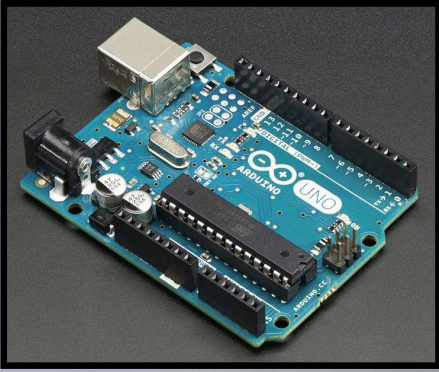
TG5153 Motor



OD = 5.45", Thickness = 1.53"

Motor Action Items

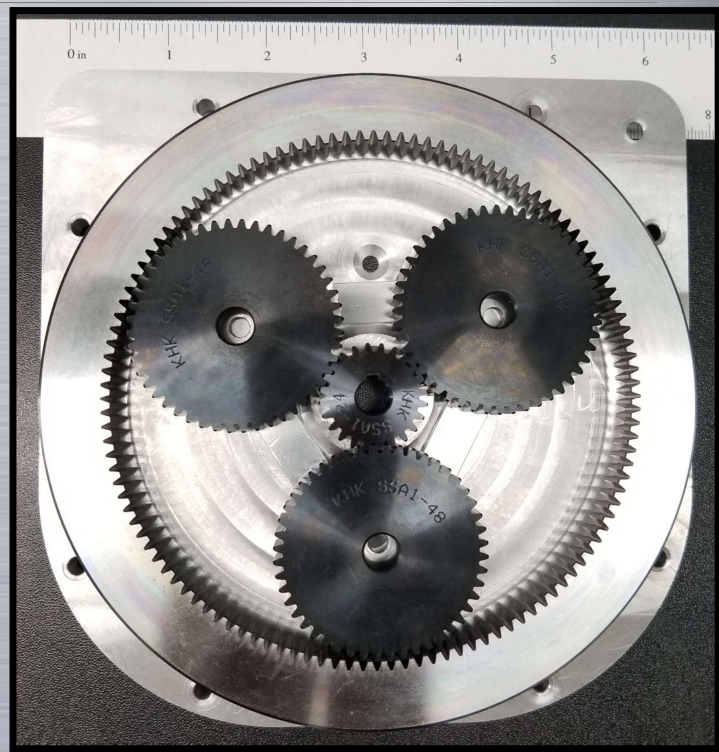
- Obtain power supply (ordered)
- Write code for duty cycles
- Test motor capabilities
 - Create representative visuals



Solution - Gearbox

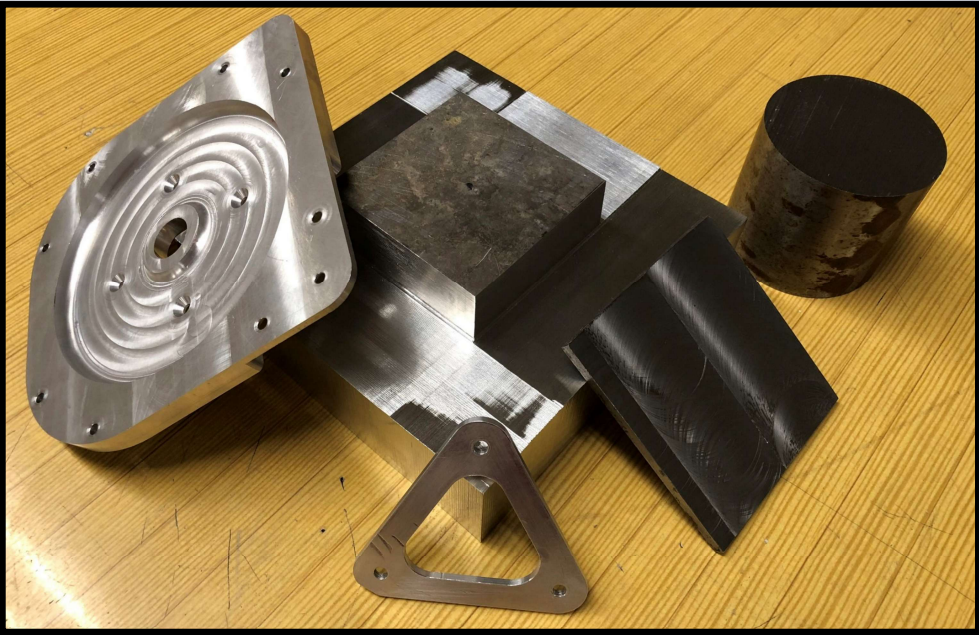
- 6:1 Planetary Gearset
 - Single Stage
 - Input Sun
 - Output Carrier

	Sun	Planets	Ring
Teeth	24	48	120
PD	24 mm (.945")	48 mm (1.89")	120 mm (4.72")
Bore size	8 mm (0.3")	8 mm (0.3")	150 mm (OD) (5.9")



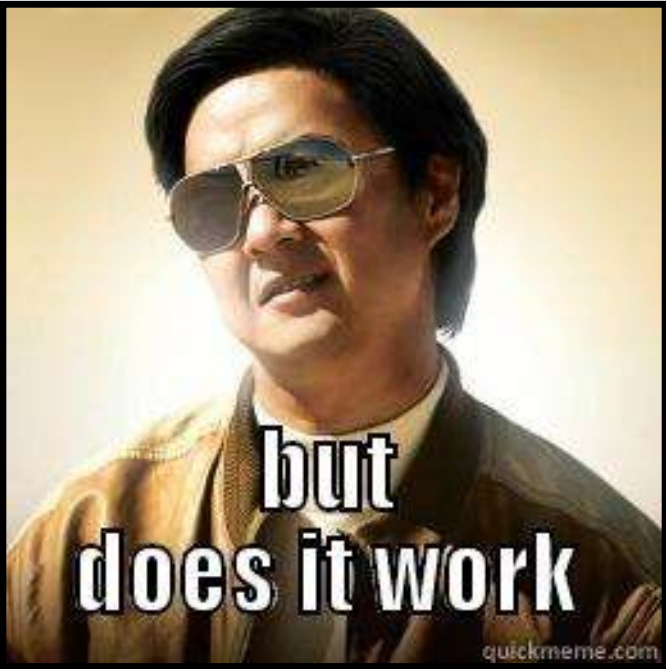
Current Progress – Machining

- Parts Machined:
 - Carrier Guide
 - Rear Case
- Parts to Machine:
 - Front Case
 - Planet Carrier
 - Output Shaft



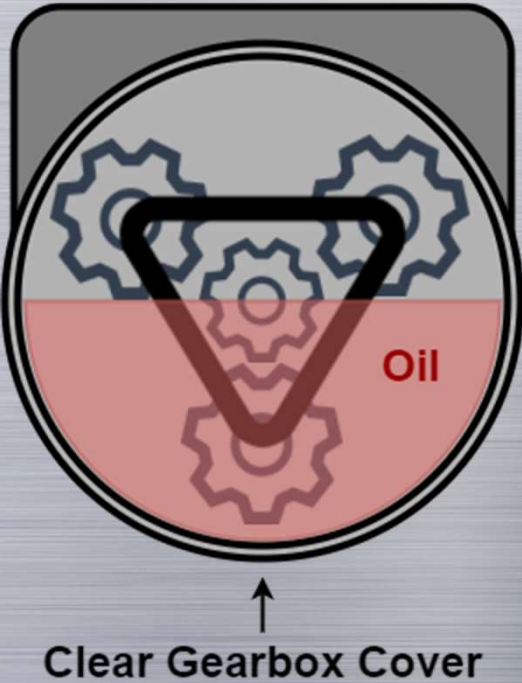
Validation

- Oil Fill
- Torque
- Impact
- Thermal



Validation – Oil Fill

- Machine acrylic gearbox cover
- ATF and various transmission fluids
 - Maximum efficiency
 - Maintain fluid properties
- Test under maximum speed



Validation – Torque

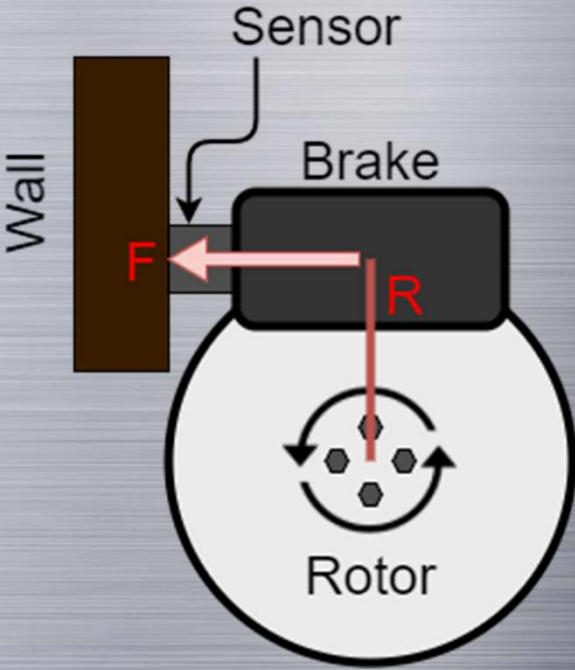
- Machine adaptive plate for brake rotor
- Fix brake to load cell
- Test variety of torques



Example Compression Load Cell

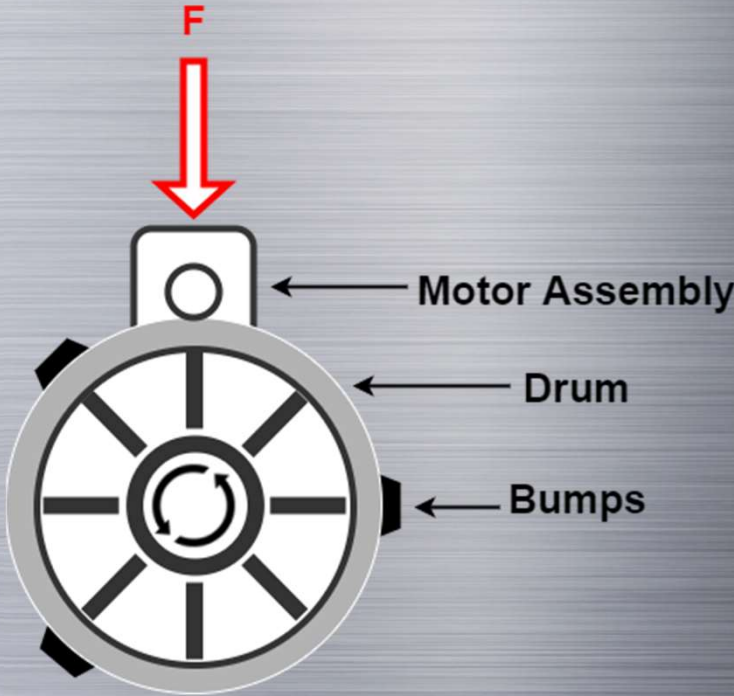
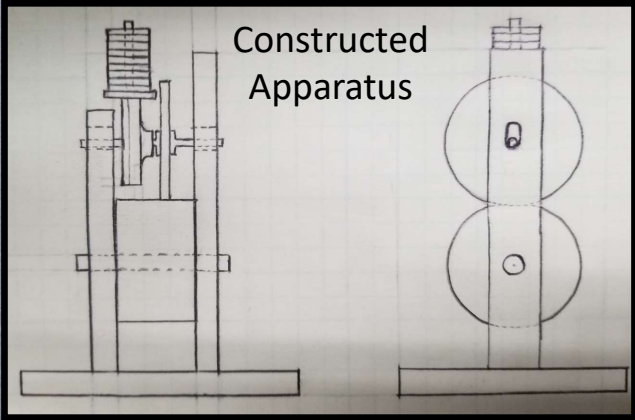


Bicycle Brake Assembly



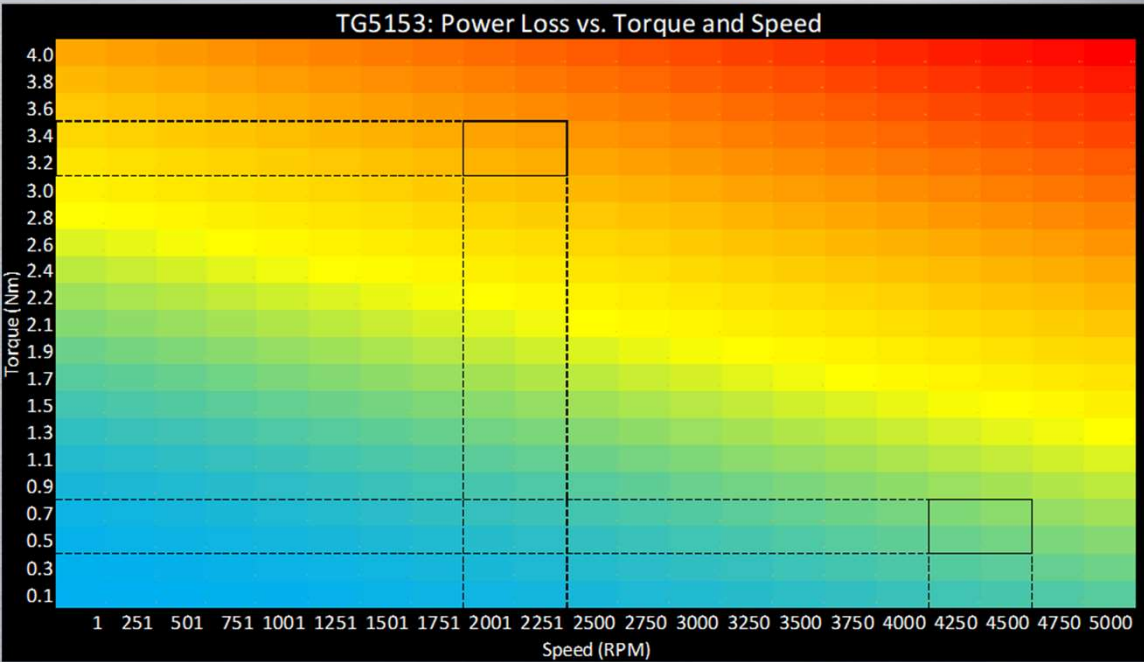
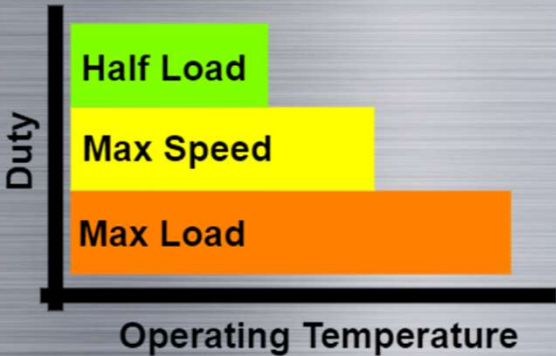
Validation – Impact

- Removable speed bumps
- Apply appropriate downward force
- Measure impact with accelerometer



Validation – Thermal

- Develop duty cycle(s)
- Record temperatures
- Determine efficiencies



Cost Analysis – Prototype 1

Basti-Boys Capstone Project Budget											
	2/9/2018 Last Updated			Today							
Expense Items	2017				2018					Item Total	
	Sept	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May		
Equipment											
Travel											
Trip to Boise - Fall	\$ 318									\$ 318	
Trip to Boise - Spring								\$ 500		\$ 500	
Supplies / Services											
TG5153 Purchase				\$1,631						\$ 1,631	
Gears from SDP				\$ 248						\$ 248	
McMaster parts				\$ 74						\$ 74	
Metals Depot					\$ 28					\$ 28	
Input Seal					\$ 14					\$ 14	
Power Supply					\$ 148					\$ 148	
Oil (projected)					\$ 50					\$ 50	
Liquid gasket (projected)					\$ 10					\$ 10	
Test Apparatus (projected)						\$ 100				\$ 100	
Load Cell (projected)							\$ 50			\$ 50	
									Subtotal	\$ 3,171	
Graduate Student Support										\$ 1,024	
Shop Overhead										\$ 1,450	
University Overhead (5%)										\$ 286	

Totals	\$7,000	\$ 1,069	\$ 5,931
	Original	Remainder	Charged

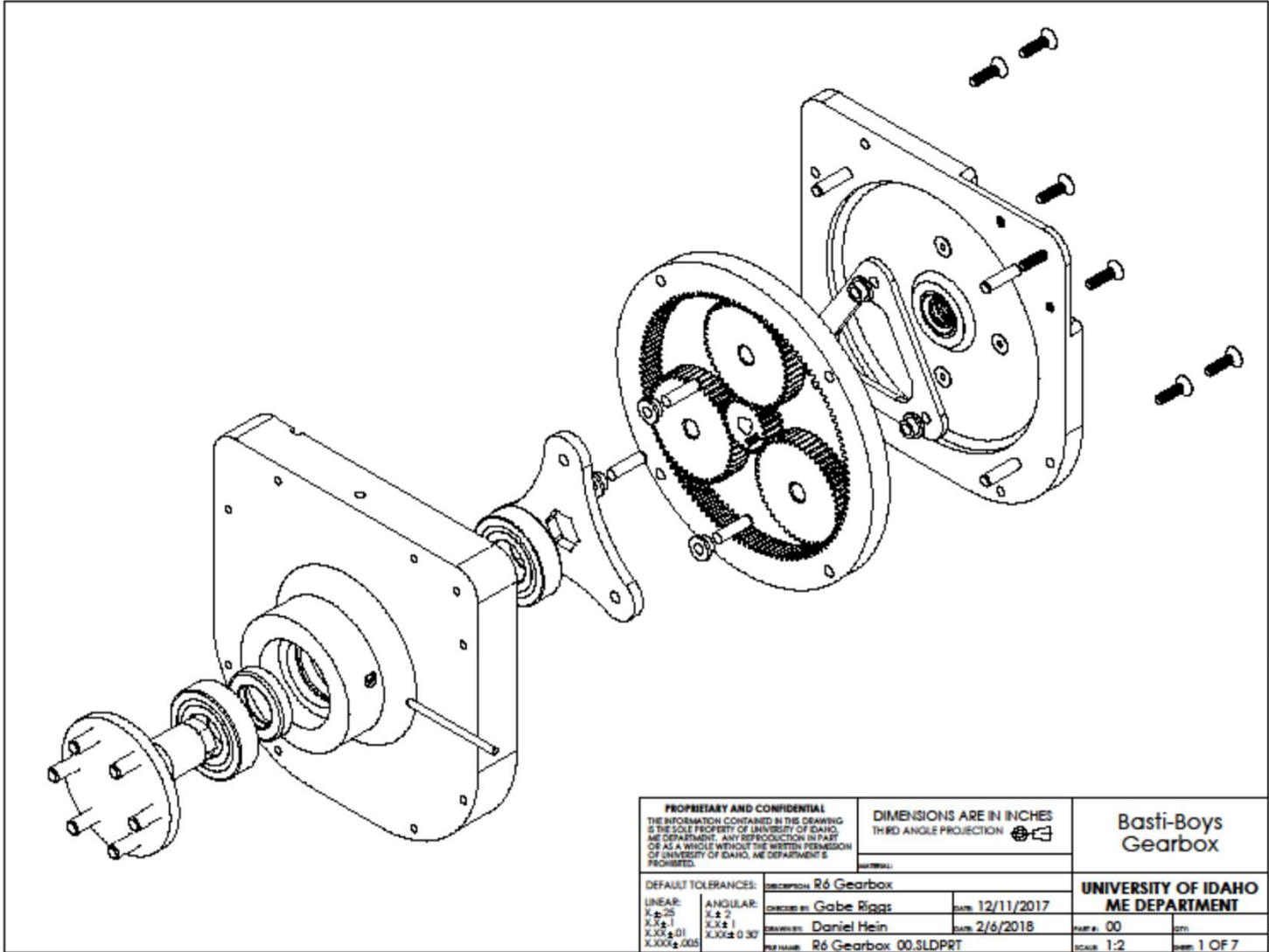
Spring Semester Timeline

12/21/17 1/10/18 1/30/18 2/19/18 3/11/18 3/31/18 4/20/18 5/10/18 5/30/18

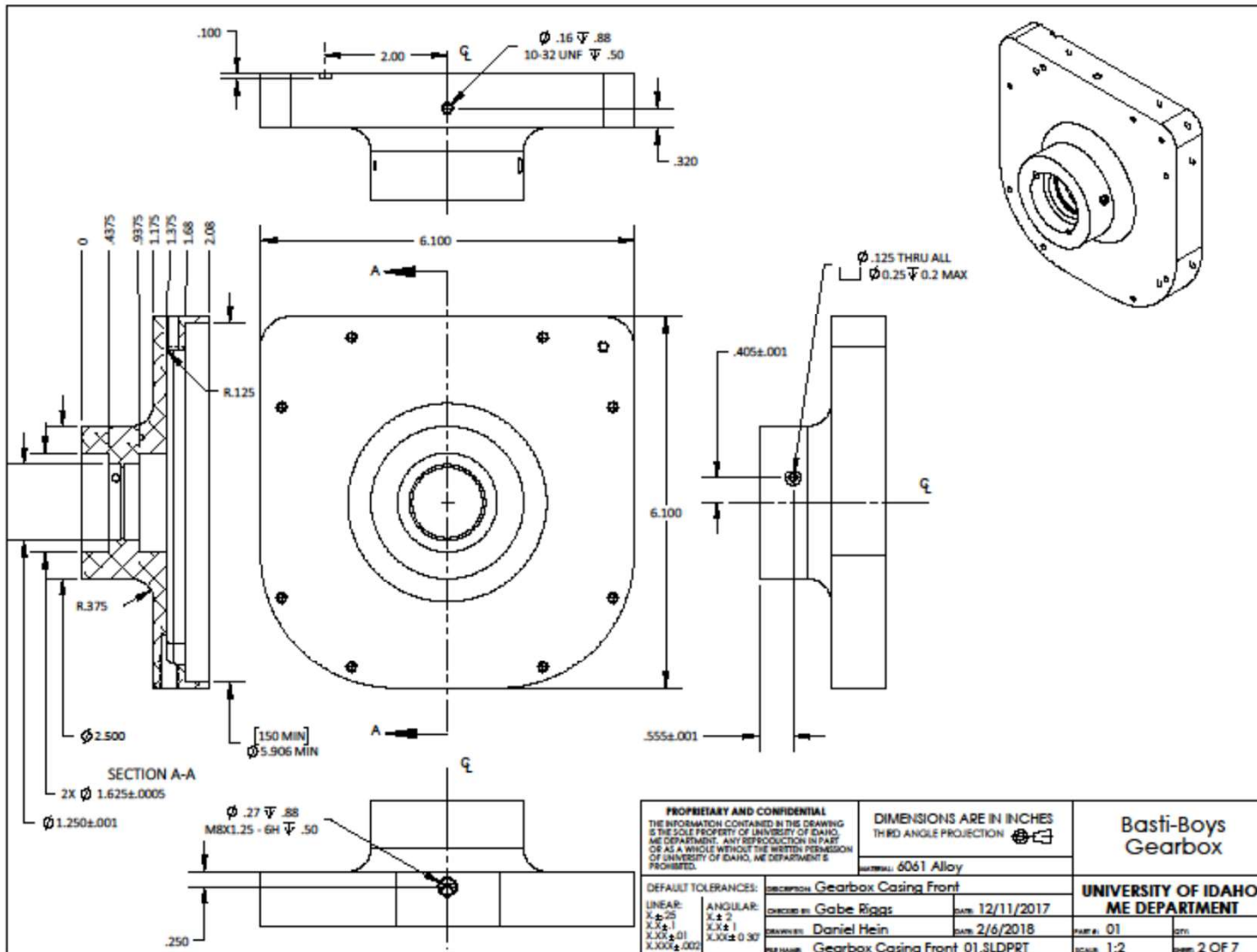


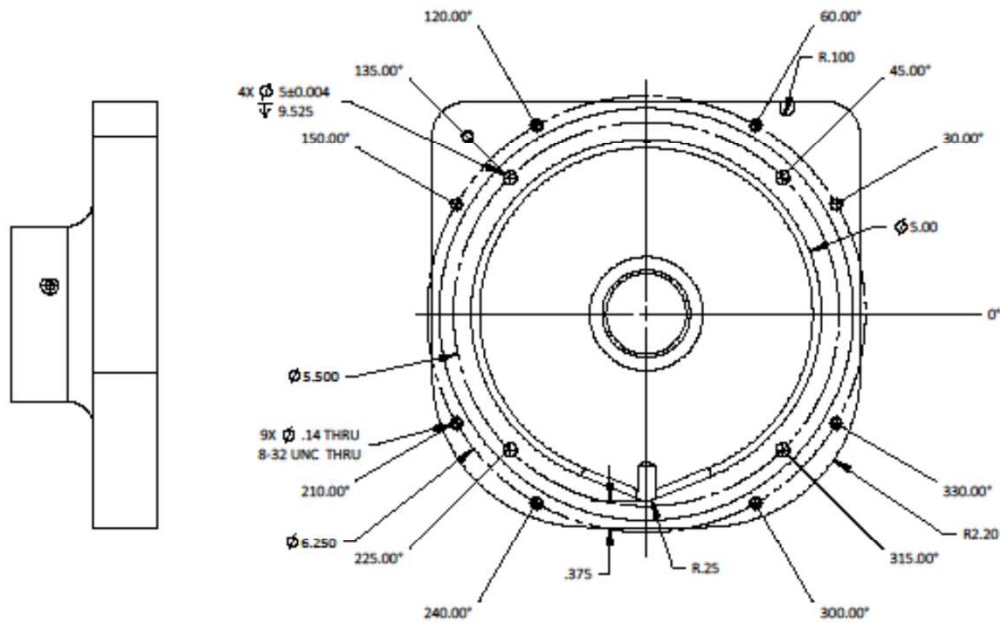
Questions



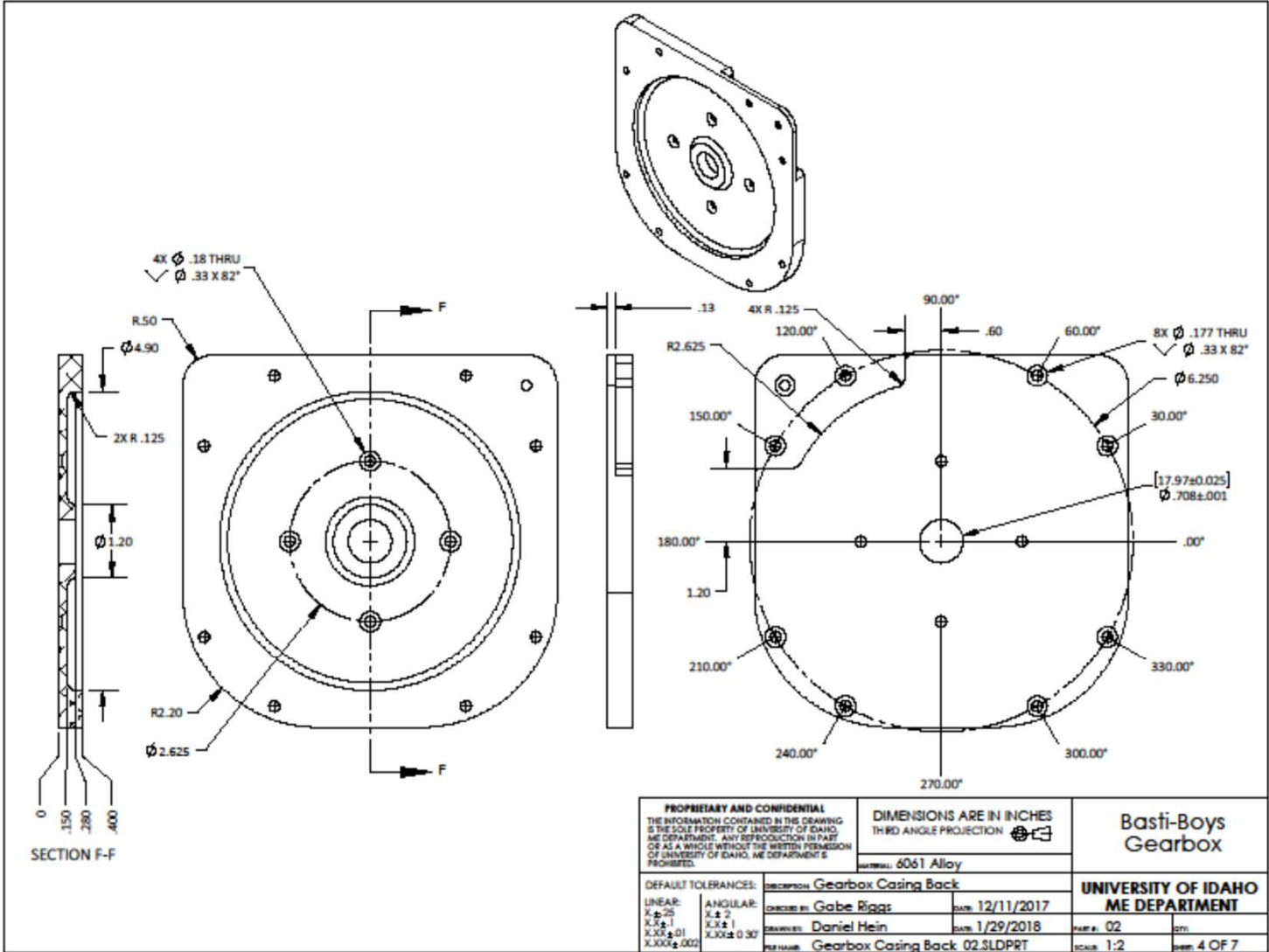


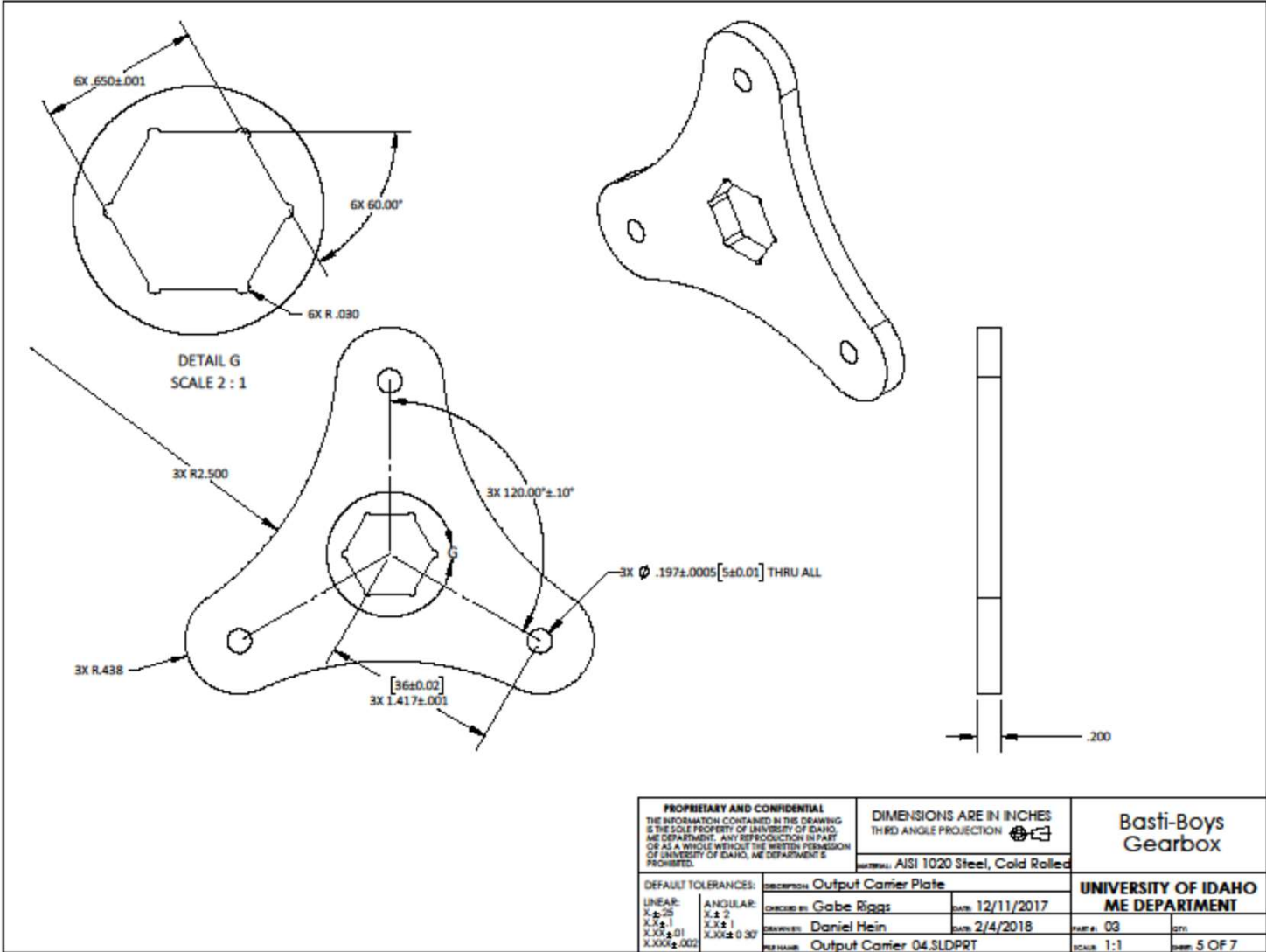
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DEFAULT TOLERANCES: LINEAR: X.X ± .25 X.XX ± .1 X.XX ± .01 X.XXX ± .005		DESCRIPTION: R6 Gearbox DESIGNED BY: Gabe Riggs DRAWN BY: Daniel Hein PART NAME: R6 Gearbox 00.SLDPRT		UNIVERSITY OF IDAHO ME DEPARTMENT	
		DATE: 12/11/2017 DATE: 2/6/2018		PART #.: 00 SCALE: 1:2	
				SHEET: 1 OF 7	



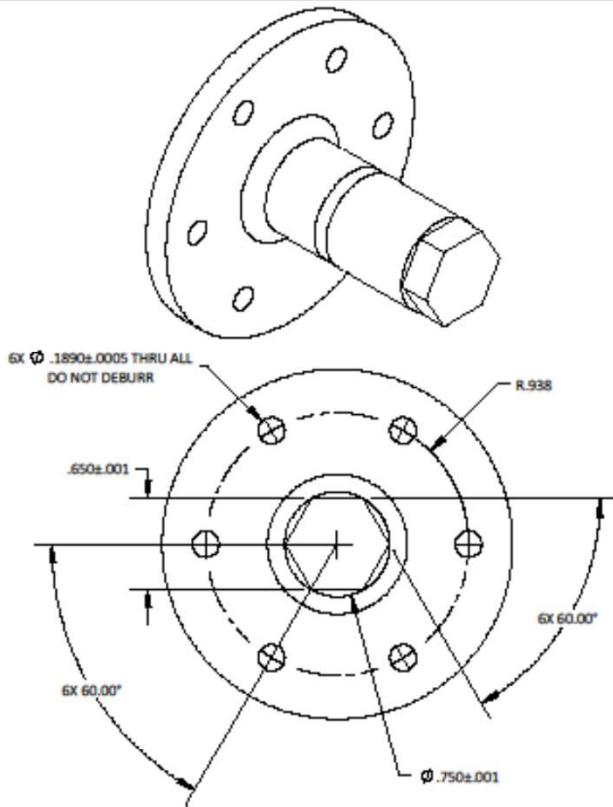
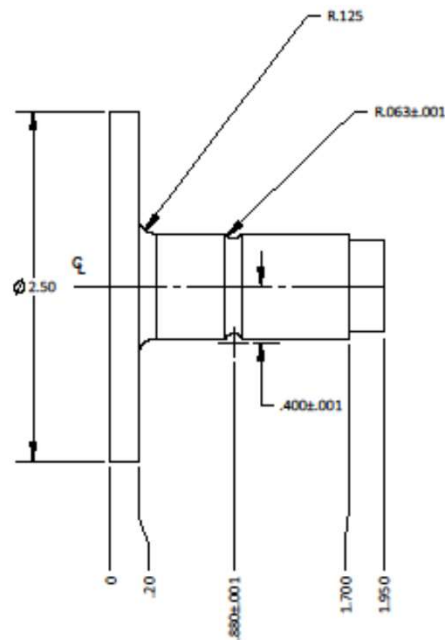


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MATERIAL: 6061 Alloy		DESCRIPTION: Gearbox Casing Front		UNIVERSITY OF IDAHO ME DEPARTMENT	
DEFAULT TOLERANCES: LINEAR: X ± .25 XX ± .1 XXX ± .01 XXXX ± .002	ANGULAR: X ± 2 XX ± 1 XXX ± 0.30	CHECKED BY: Gabe Riggs DRAWN BY: Daniel Hein PART NAME: Gearbox Casing Front 01.SLDPRT	DATE: 12/11/2017 DATE: 2/6/2018	PART # 01 SCALE 1:2	SHEET 3 OF 7

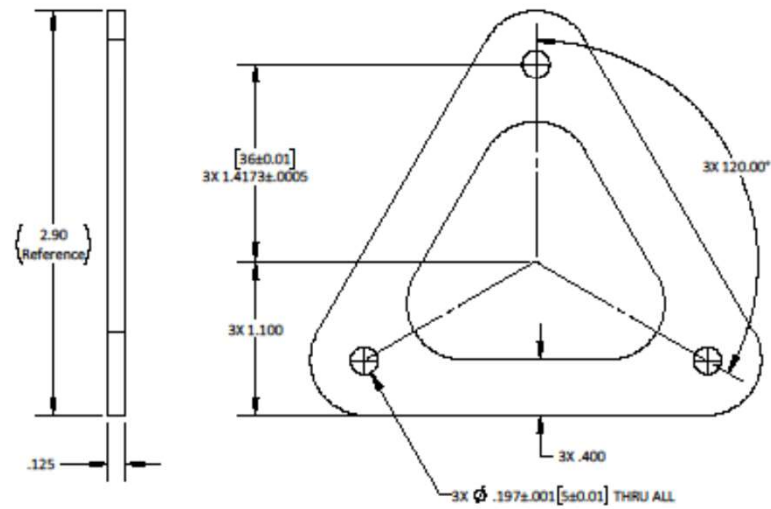




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MATERIAL: AISI 1020 Steel, Cold Rolled		UNIVERSITY OF IDAHO ME DEPARTMENT	
DEFAULT TOLERANCES: LINEAR: X±.05 X±.1 X±.01 X±.002	ANGLUAR: X±.2 X±.1 X±.030	DESCRIPTION: Output Carrier Plate DRAWN BY: Gabe Riggs DATE: 12/11/2017 CHECKED BY: Daniel Hein DATE: 2/4/2018 PRT NAME: Output Carrier 04.SLDPRT	PART: 03 QTY: SCALE: 1:1 SHEET: 5 OF 7



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MATERIAL: AISI 1020 Steel, Cold Rolled		UNIVERSITY OF IDAHO ME DEPARTMENT	
DEFAULT TOLERANCES: LINEAR: X±.05 X.X±.1 X.XX±.01 X.XXX±.002	ANGLUAR: X±.2 X.X±.1 X.XX±0.30	DESCRIPTION: Output Shaft DRAWN BY: Gabe Riggs DATE: 12/11/2017 DRAWN BY: Daniel Hein DATE: 1/29/2018 PART NAME: Output Shaft 05.SLDPRT	PART #: 04 DATE: 1/1 SHEET: 6 OF 7



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MATERIAL: AISI 1020 Steel, Cold Rolled				UNIVERSITY OF IDAHO ME DEPARTMENT	
DESCRIPTION: Carrier Plate Guide		DATE: XX/XX/XX		PART NO. 05	
DESIGNED BY: XXXXXXXXXXXX		DATE: 1/29/2018		SHEET 7 OF 7	
DRAWN BY: Daniel Hein		PER NAME: Carrier Guide 03.SLDPRT		SCALE: 1:1	
DEFAULT TOLERANCES: LINEAR: X±.005 X±.01 X.X±.01 X.XXX±.002		ANGULAR: X±.2 X.X±.1 X.XX±.030			