

SAE Baja - Drivetrain

Midpoint Review Presentation

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Overview

- Introduction
- Recap
- Updated CAD
- Manufacturing of gears
- Gear Testing
- Future Machining
- Gantt Chart
- Conclusion

Introduction

- SAE sponsored
- Design drivetrain within SAE Baja rules
- Customer requires reverse, lightweight, and safe
- Establish testing/operating environment
- Updated Gantt Chart for Spring 2015

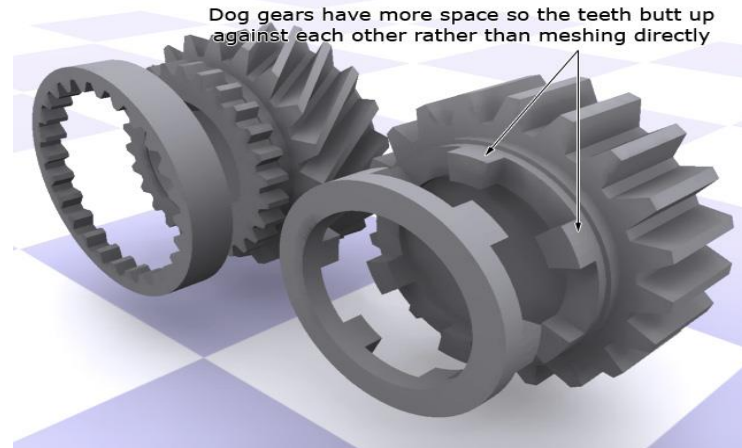
Problem Definition and Project Goal

Design and develop a drivetrain that is able to attain the desired torque and speed for the SAE Mini Baja in order to place in the top 10 in the Hill Climb and Acceleration challenges against competing universities

Recap

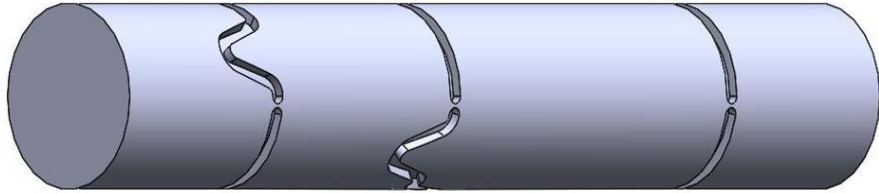
- Sequential Gearbox design chosen
 - **Short shift times**
 - Little loss of power
 - Lightweight/Compact
 - Simple to operate
 - Stronger and more reliable

(Sequential Dog ring compared to Manual Dog)
(<http://www.formula1-dictionary.net/gears.html>)

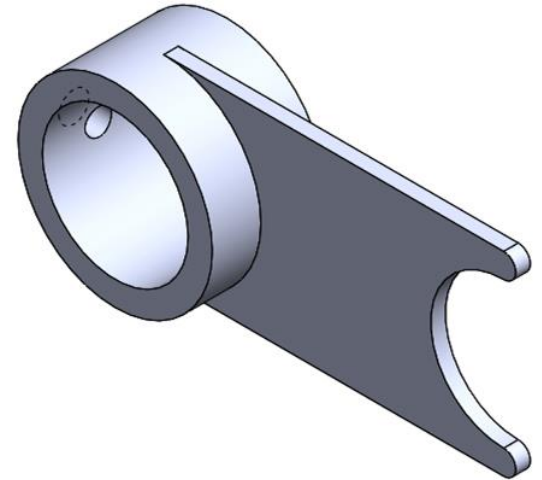


Updated CAD

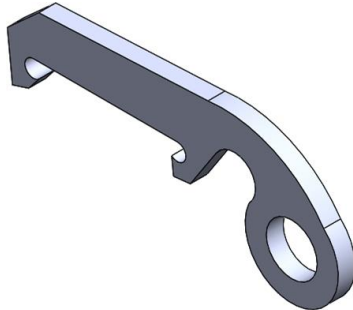
Shifting Shaft



Shift Fork

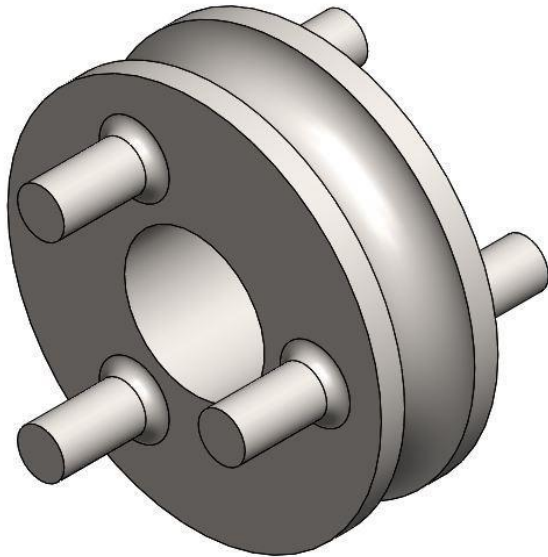


Shift Finger

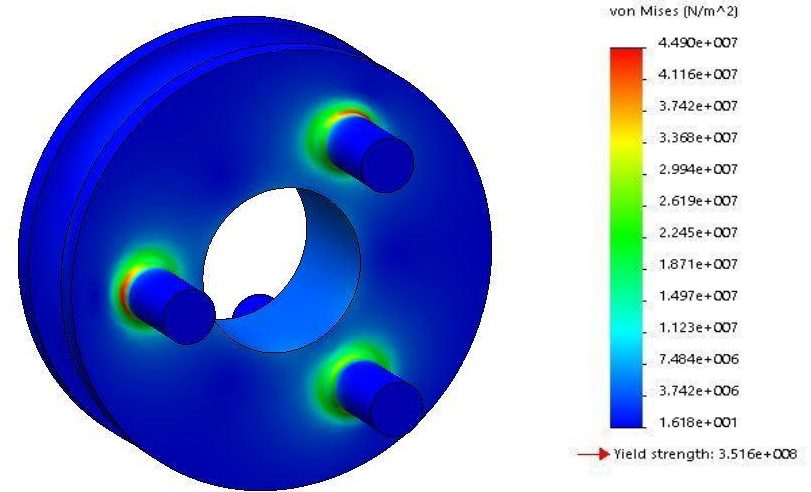


Dog Collar

(CAD of dog collar)



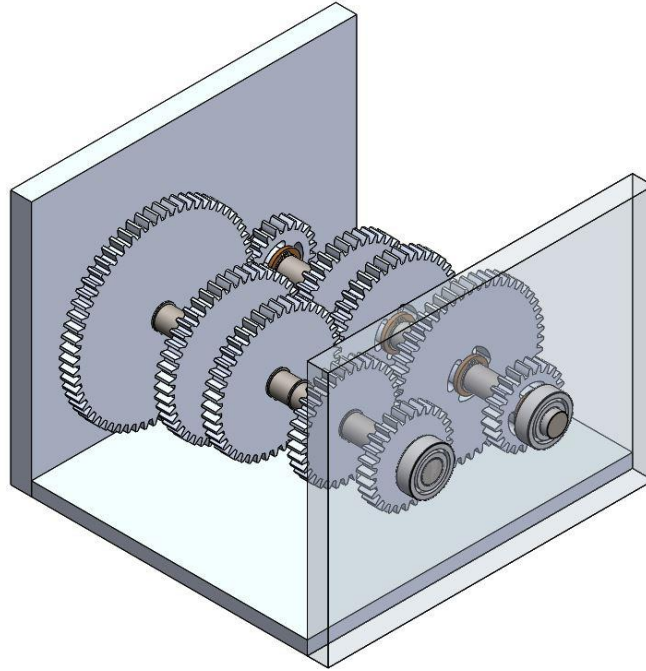
(Von Mises Stress of Dog Collar)



Factor of Safety of Dog Collar: **7.8**

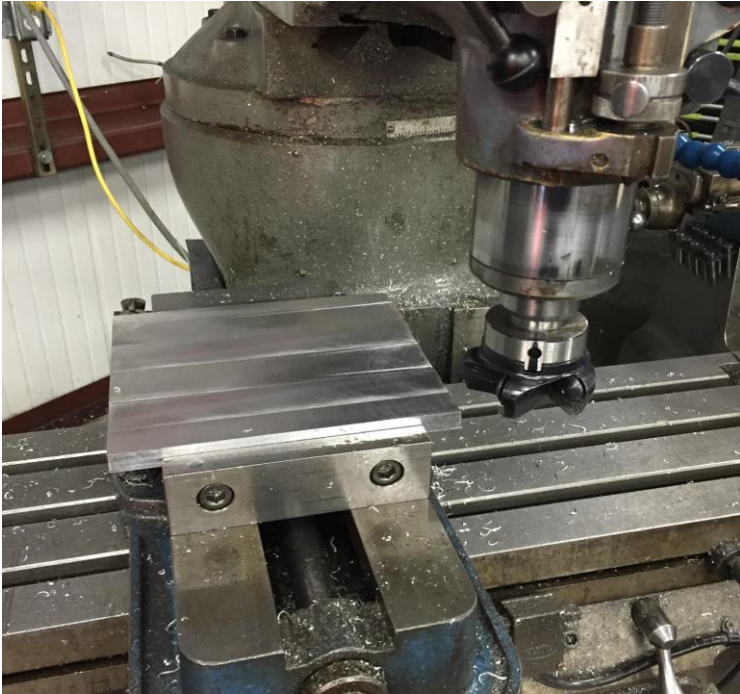
Updated Final Gearbox

(Overall Gearbox Design)



Manufacturing Gear Profiles

(Planing gear plates down to 0.5 inches)

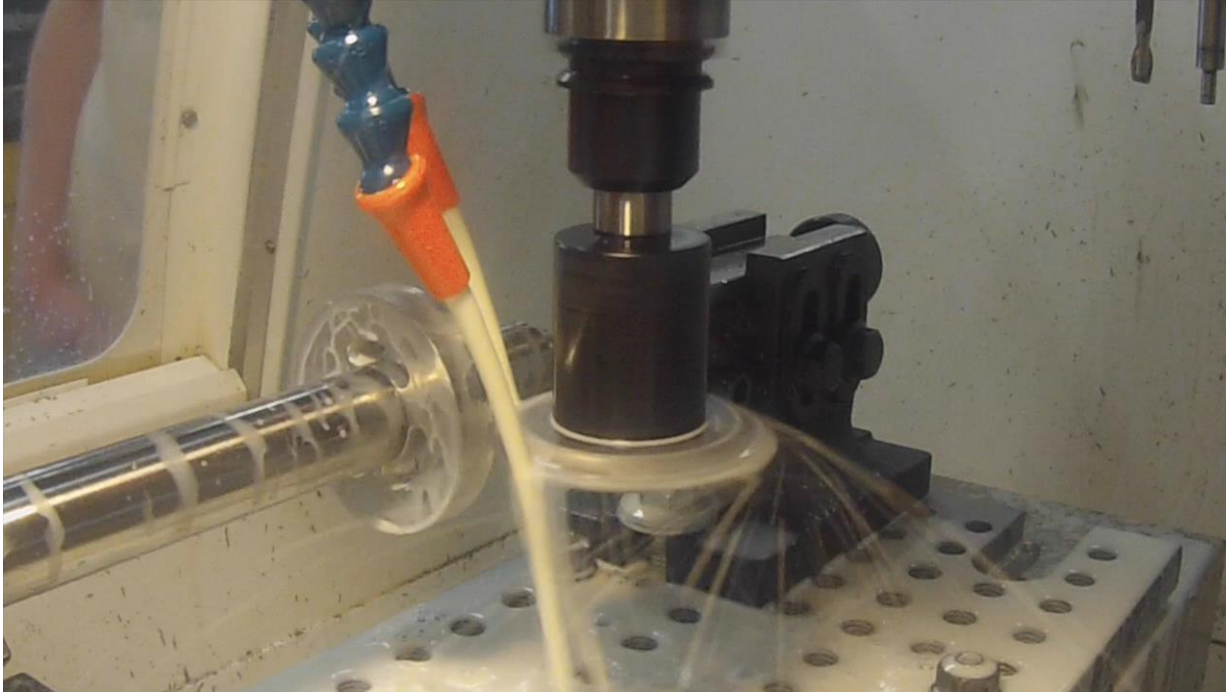


(Cutting Gear Profiles on Tormach CNC Mill)



Manufacturing Gear Teeth

(Video of 4 axis CNC machine cutting gear teeth)



Finished Gear

(3rd gear mesh, and crawler pinion)

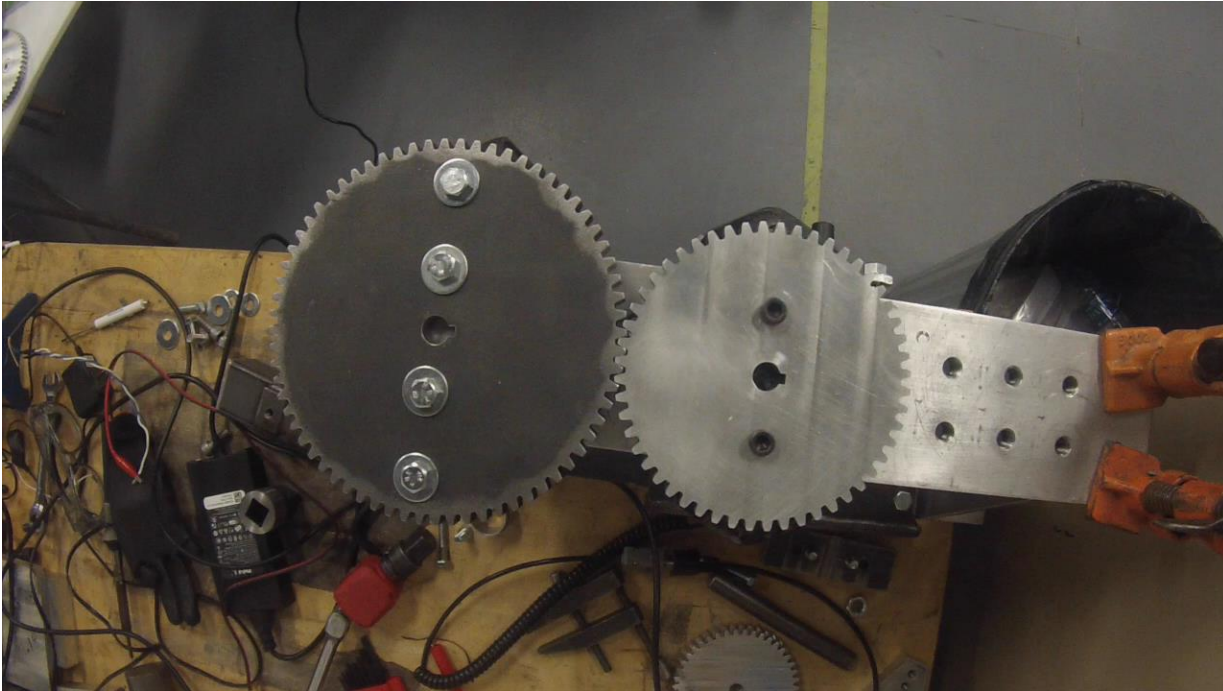
Finished Aluminum Gears

- 1/2" thick gears
- Diametral Pitch: 10
- Pressure Angle: 14.5°

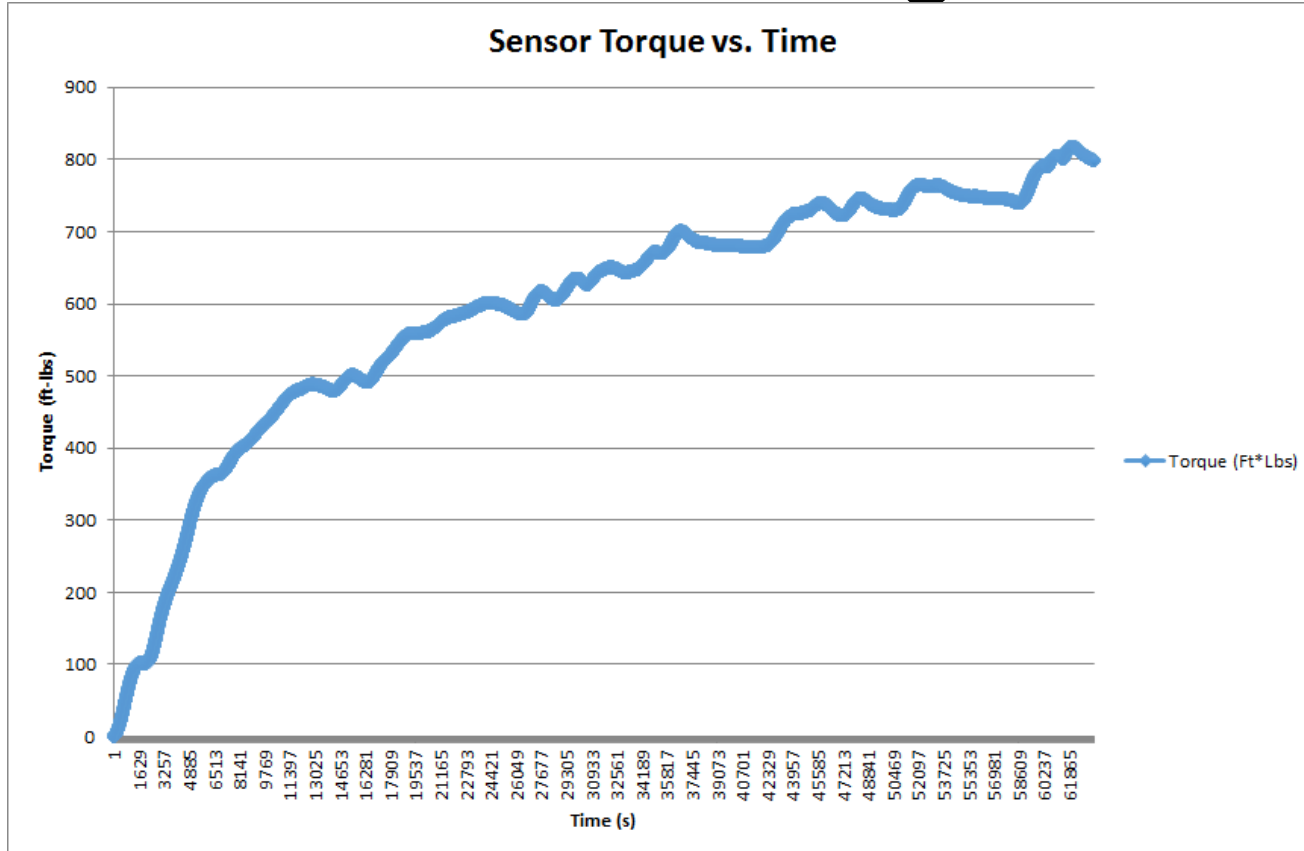


Gear Testing

(Gear Test Video)



Gear Testing



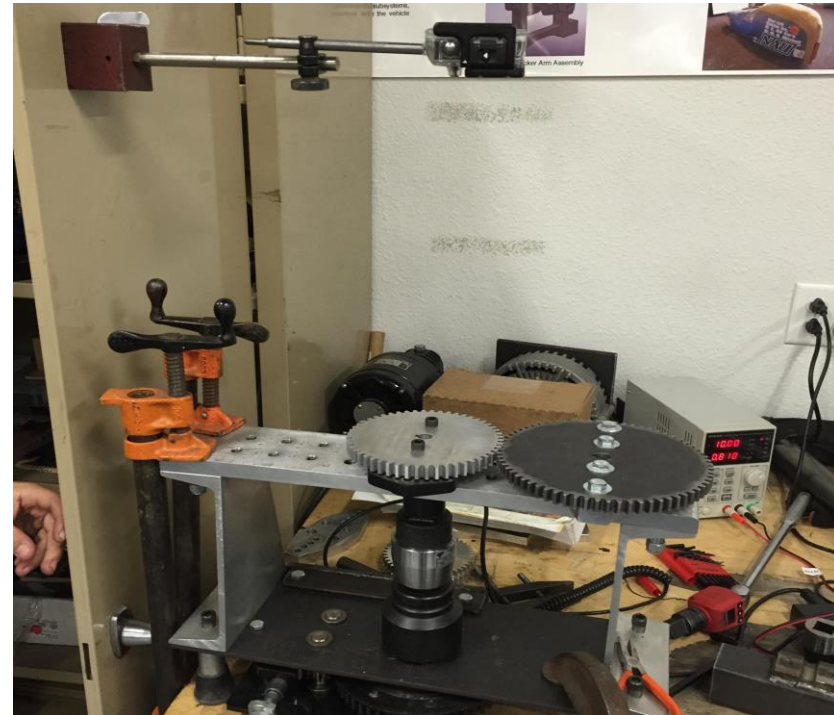
Gear Testing

Results of Shear Test:

- Gear did not shear, apparatus bent first
- Applied a torque of 600 ft-lbs
- 230.8 lbs of force on each tooth

- Max torque by gearbox 40 ft-lbs
- 15.4 lbs of force on each tooth
- Factor of safety from test: **15**

(Gear Testing Apparatus)



Parts/Materials Ordered

- 3 feet of 4340 $\frac{3}{4}$ " rod
 - Yield Strength: 68.5ksi
 - \$27.43 from McMaster-Carr
- 3 feet of 1 $\frac{5}{8}$ " hollow 1018 rod
 - Wall thickness: 0.134"
 - \$26.88 from McMaster-Carr
- Alloy 932 Bronze flanged sleeve bearings
 - $\frac{3}{4}$ " inner diameter
 - \$3.60 each from McMaster-Carr

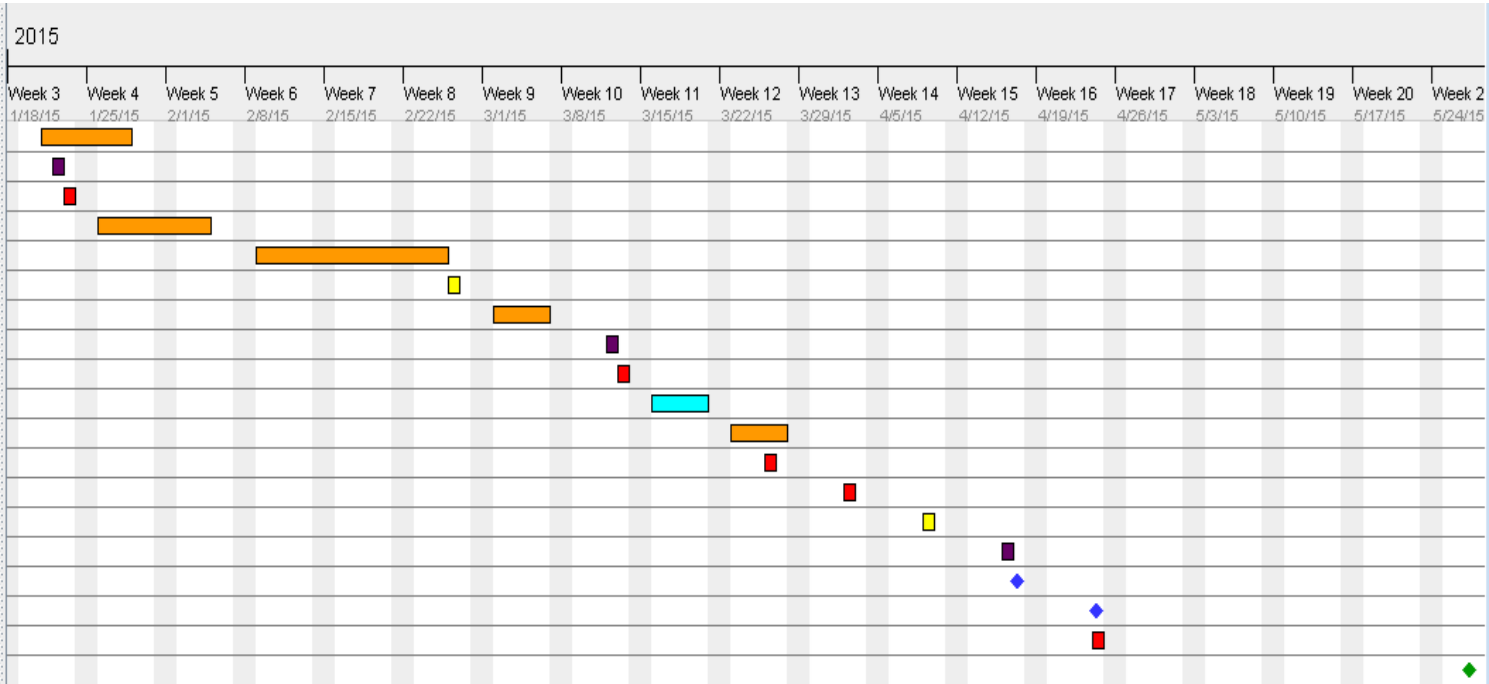
Future Machining

- Cutting keyways in shafts
- CNC milling dog collars
- Installing Bronze bushings to pinion gears
- Machine shifting shaft on 4 axis CNC
- Machine shifting forks on CNC mill
- Mill out housing

Gantt Chart



Name	Begin date	End date
• Gear Shear Te...	1/21/15	1/28/15
• Progress Pres...	1/22/15	1/22/15
• Progress Rep...	1/23/15	1/23/15
• Bearings, Gea...	1/26/15	2/4/15
• Gears and Shif...	2/9/15	2/25/15
• Staff Meeting	2/26/15	2/26/15
• Transmission ...	3/2/15	3/6/15
• Midpoint Revie...	3/12/15	3/12/15
• Midpoint Revie...	3/13/15	3/13/15
• Spring Break	3/16/15	3/20/15
• Transmission ...	3/23/15	3/27/15
• Peer Evaluatio...	3/26/15	3/26/15
• Lifelong Learni...	4/2/15	4/2/15
• Staff Meeting	4/9/15	4/9/15
• Walkthrough P...	4/16/15	4/16/15
• Final Report a...	4/17/15	4/17/15
• UGRADS Pres...	4/24/15	4/24/15
• Operations Ma...	4/24/15	4/24/15
• Portland, Oreg...	5/27/15	5/27/15



- Orange = Gear/Transmission Building
- Purple = Presentations
- Red = Deliverables
- Yellow = Staff Meetings

- Light Blue = Spring Break
- Blue = Final Report and Presentation
- Green = Portland, Oregon Competition

Conclusion

- Recap of gearbox design
- Updated CAD of Gearbox
- Manufacturing process of Gears
- Gear Testing results
- Shafts and Materials ordered
- Future machining of Gearbox
- Gantt Chart update

Questions?