

Stirling Engine Redesign

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ME 449 Redesign & Prototype Fabrication

Semester Project Presentation

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Introduction



- Design Criteria
 - RPM
 - Aesthetics
 - Build Quality
- Re-design objectives:
 - 1) Improve Seals
 - 2) Decrease Friction
 - 3) Improve Flywheel
 - 4) Decrease the heat losses
 - 5) Improve Aesthetics

Redesign / Improvements



- Improve seal by machining new bushing



Smoke Test



New Bushing

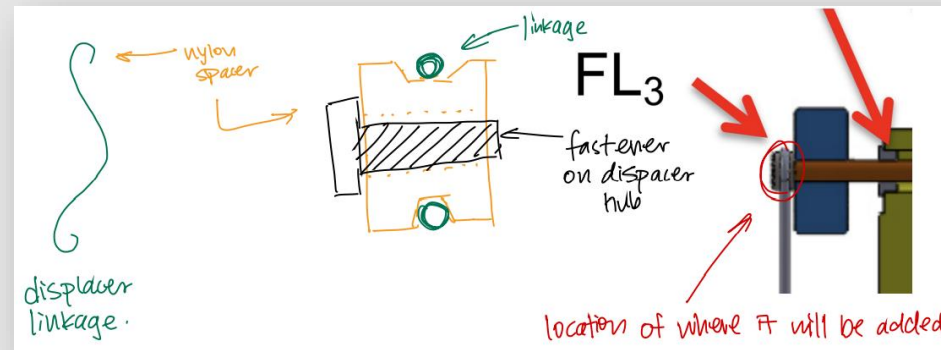
Redesign/Improvement



- Decrease Friction between linkage and screws

$$\mu_{\text{steel - steel}} = 0.8$$

$$\mu_{\text{steel - nylon}} = 0.4$$



Ideas



Machined Part

Resulted in 40RPM drop.

Redesign/Improvement



- Decrease Friction between linkage and screws

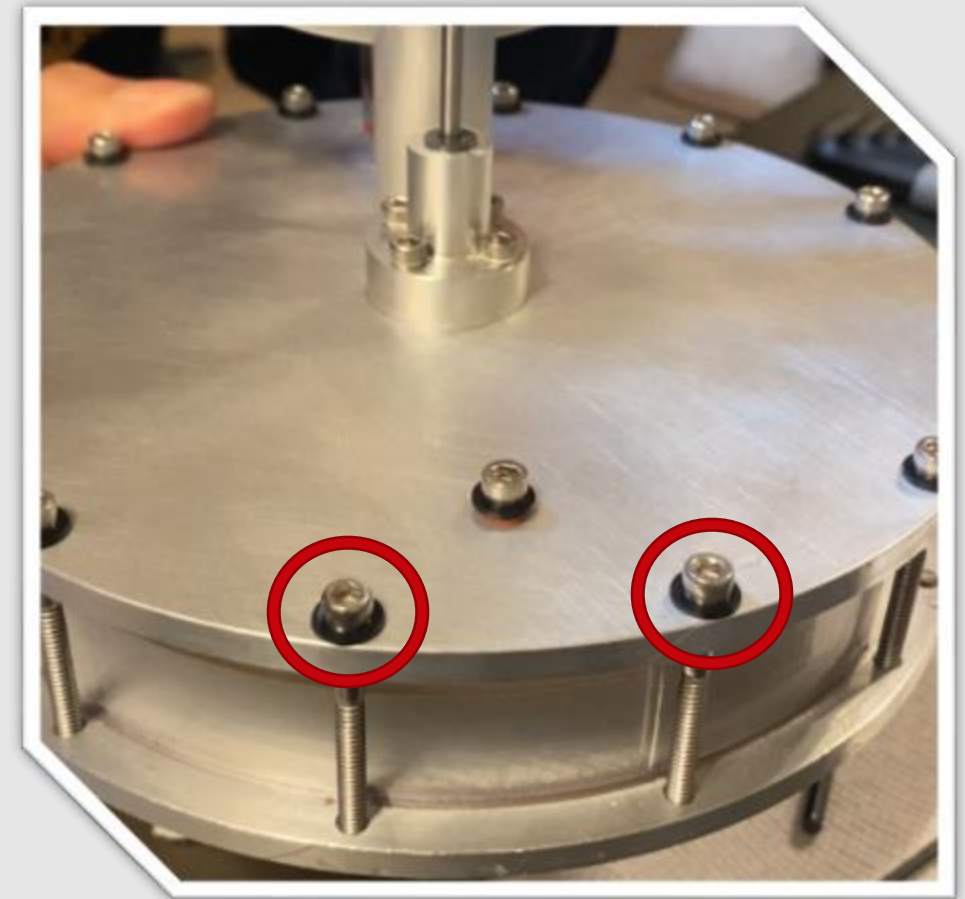


Increased to 160RPM

Redesign / Improvements



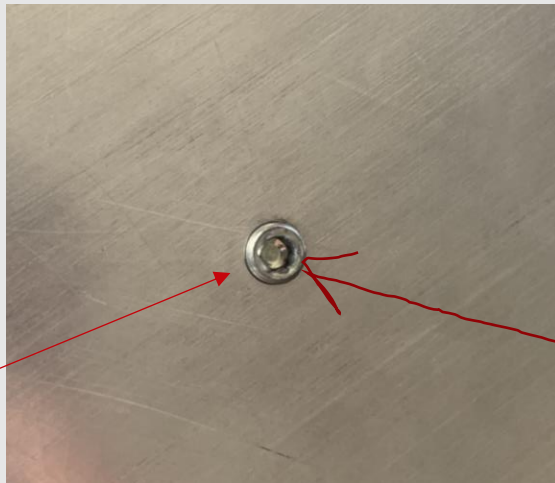
- Decrease Heat losses by using plastic washers.
 - Low heat conductivity
 - Serve us an insulator
 - Clamping
 - Better load distribution



Redesign/Improvement

- Using Helium as the working fluid
 - Main working fluid for modern Stirling engine
 - Higher heat transfer rate
 - Lower Density

Bottom Plate
NPT Hole



Feed Helium



Resulted in 80RPM increase

Redesign / Improvements



- Redesigned the Flywheel



Old

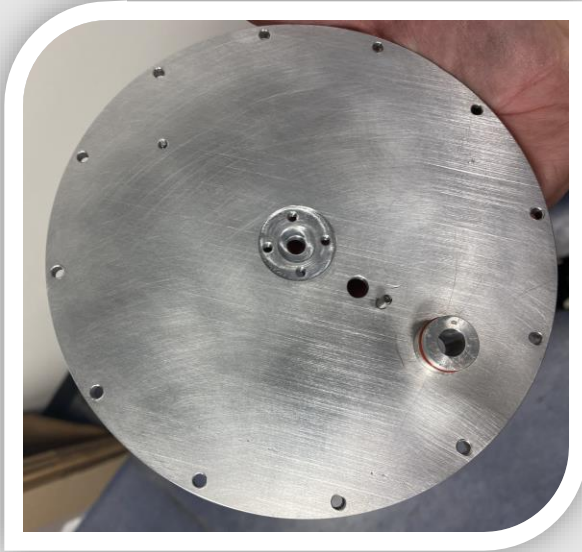


New

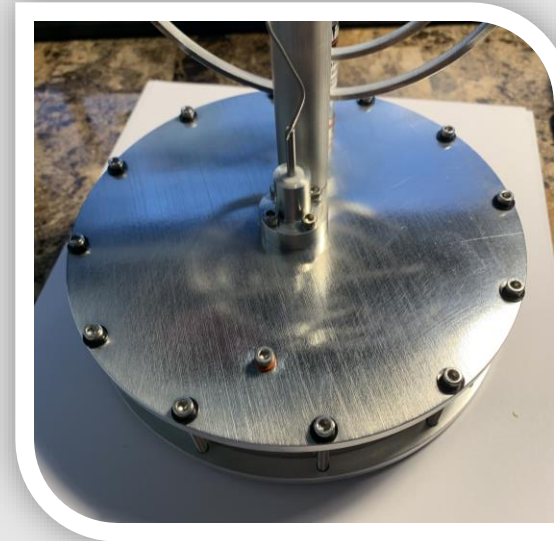
Redesign / Improvements



- Cleaned off all surfaces and polished them.



Old



New



Testing Plan and Results

- How would you test the engine as part of the redesign process?
 1. RPM speed test and compare to previous model
 2. Smoke test again to check for leaks
 3. Check temperature of top plate (hot side)
 4. Survey for Aesthetics and Build Quality

Final RPM = ~ 250RPM

Summary



- Our Stirling engine redesign was a success
- Lessons learned
 - Things will go wrong
 - Perseverance is key
 - Assembly is fragile small improvements can have a drastic impact
- Acknowledgement

A big thank you to:

 - Professor Frank Pfefferkorn and our TA Mrs. Aishwarya Deshpande
 - TEAM Lab staff (Jeff, Jay, and Mike)
- Questions?



Final Stirling Engine