Sterling Engine Project

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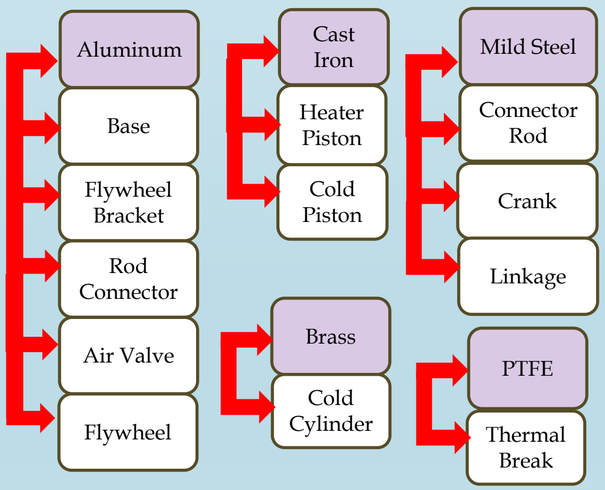
Aim of the Project

The aim of this project is to research, design, manufacture a sterling engine. Then to test the engine by comparing the thermal difference between the hot and cold cylinders.

Background

The Sterling engine, invented by Robert Stirling in 1816, is an external combustion engine that converts heat into mechanical work using a closed regenerative cycle. It operates by cyclically compressing and expanding a working fluid (air, helium, or hydrogen) between hot and cold regions. The Stirling cycle consists of isothermal expansion, isochoric heat transfer, isothermal compression, and isochoric heat removal. Known for high efficiency and versatility, it can run on various heat sources but faces practical challenges in heat transfer and materials.

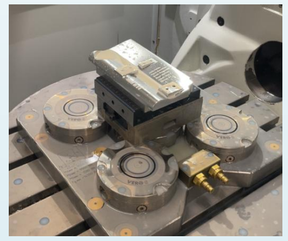
Materials



Manufacturing

Various methods of manufacture were used to machine all the parts to this sterling engine. For the base plate of this project, we required the use of 3D milling in order to get the desired waved surface as well as the various fillets with changing radius. To make this base possible a fixture had to be designed to allow the base to be held by 4 bolts once the bottom had been faced off.

Another part of the manufacture required us to drill holes for the flanges of the cylinders, to do this we needed to first find centre of each cylinder using the clock on the mill, once centre was found we were able to use Cartesian coordinates to precisely locate and drill the holes.



Design

The Final design of the sterling engine can be seen to the right. This design consists of fifteen manufactured components and six standard components. Both the flywheel and the base plate for the engine are made using CNC due to the complexity of the parts, making them difficult to manually machine. The flywheel will be machined using mill-turn on the spinner and the base will be 3D milled on the Mazak in the Cam workshop as the waved surface and engraving isn't possible to do on the manual machines. The Burner which can be seen to the right was also CNC machined due to the loft on the lid, this loft would be difficult to machine in the manual workshop.

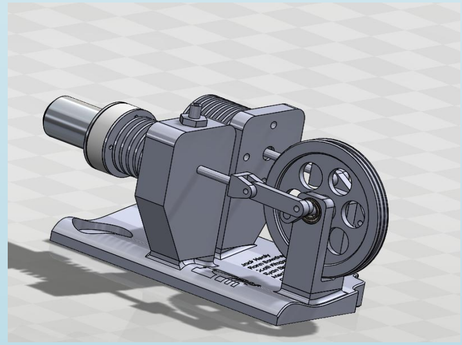


Figure 1: sterling Engine Assembly.

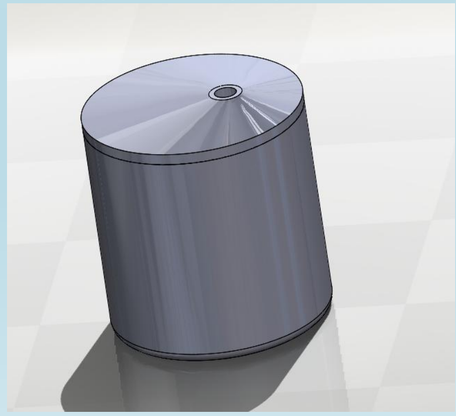


Figure 2: Burner assembly

Exploded View

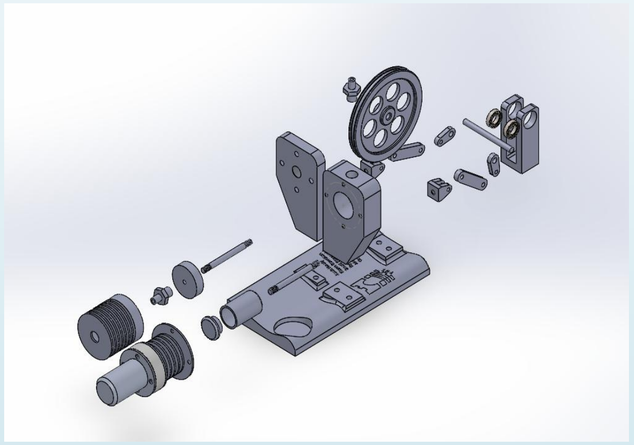
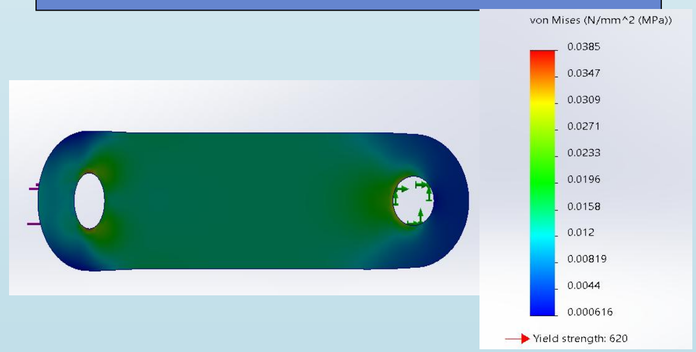


Figure 3: sterling Engine Assembly. (Exploded View)

Simulation



Conclusion

In conclusion the main goal of this project was achieved, We have designed and manufactured a functional Sterling Engine. The most significant challenges we faced were time and Manufacturability constraints, both issues had to be taken into account for each component. This led to several parts needing to be redesigned to be completed in a timely and efficient manner. During the duration of this project the team utilized and further developed their already existing skills such as CAD, Solid CAM and Manual machining to complete this project.

References

Modern Uses of Stirling Engines
Stirling Engine Applications: Uses and Examples