

# Design & Manufacture of a Stirling Engine

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### Aim of the Project

The Aim of the project is to design, build and test an Alpha Stirling Engine using CAD and CAM.

### Objectives

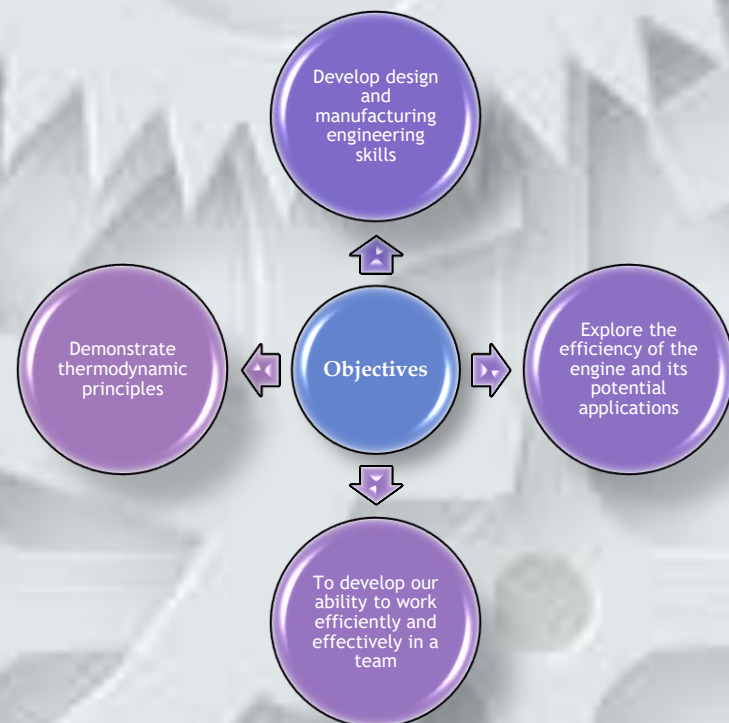


Figure 1: Objectives Outcome Flow Chart

### Background

Created by Robert Stirling, a Scottish clergyman, in 1816 as a substitute for steam engines. The Stirling cycle consists of four processes: isothermal expansion, constant volume (heat removal), isothermal compression, and constant volume (heat addition). Steam and internal combustion engines became more common due to higher power-to-weight ratios. Saw a resurgence in the 20th century for efficient energy conversion and renewable energy applications. Currently a focus of research and development due to efficiency and ability to use waste heat, despite lower popularity vs combustion.

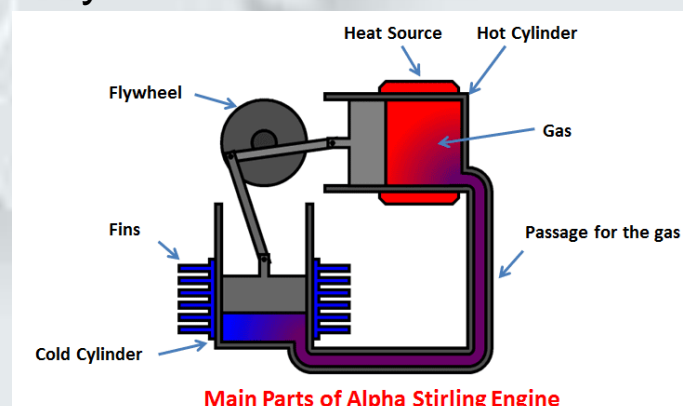


Figure 2: Alpha Stirling Engine Schematic

### CAD Model / Drawing

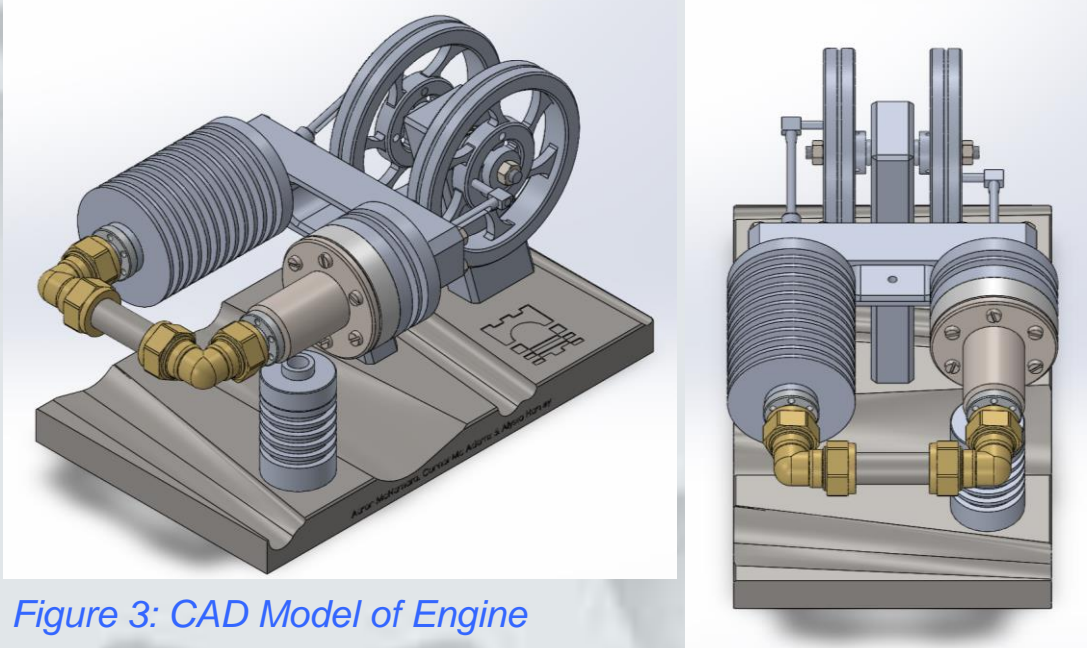


Figure 3: CAD Model of Engine

Our design was inspired by a horizontal conventional alpha Stirling engine. Consists of two separate hot and cold chambers with a power piston and a displacer piston. Alpha is the most powerful type of Stirling engine suitable for applications requiring high power output. It is also the most efficient because of its separate hot and cold cylinders. This design is the most complex of the three types as it requires high machining accuracy and required more design techniques.

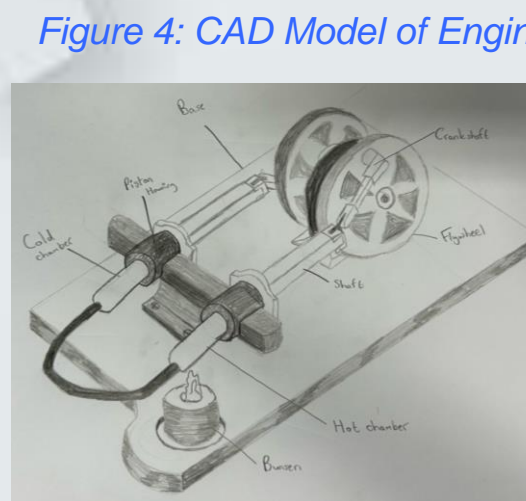


Figure 5: Alpha Engine Sketch

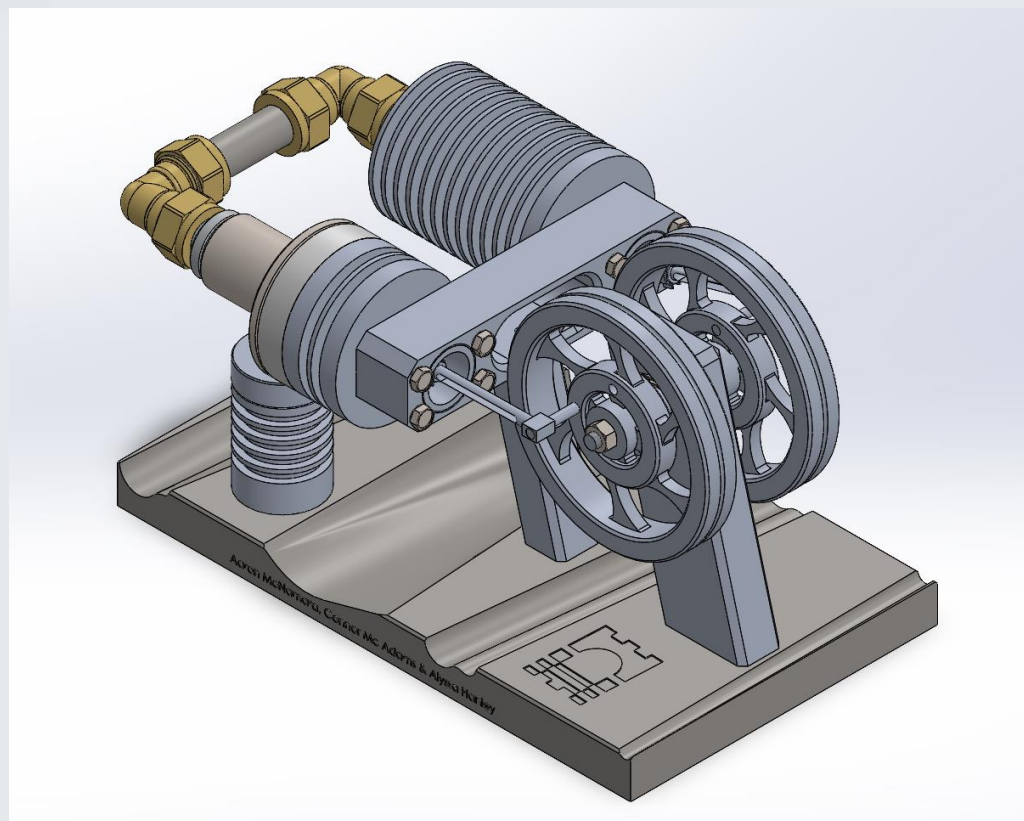


Figure 6: CAD Model Of Engine

### Simulation

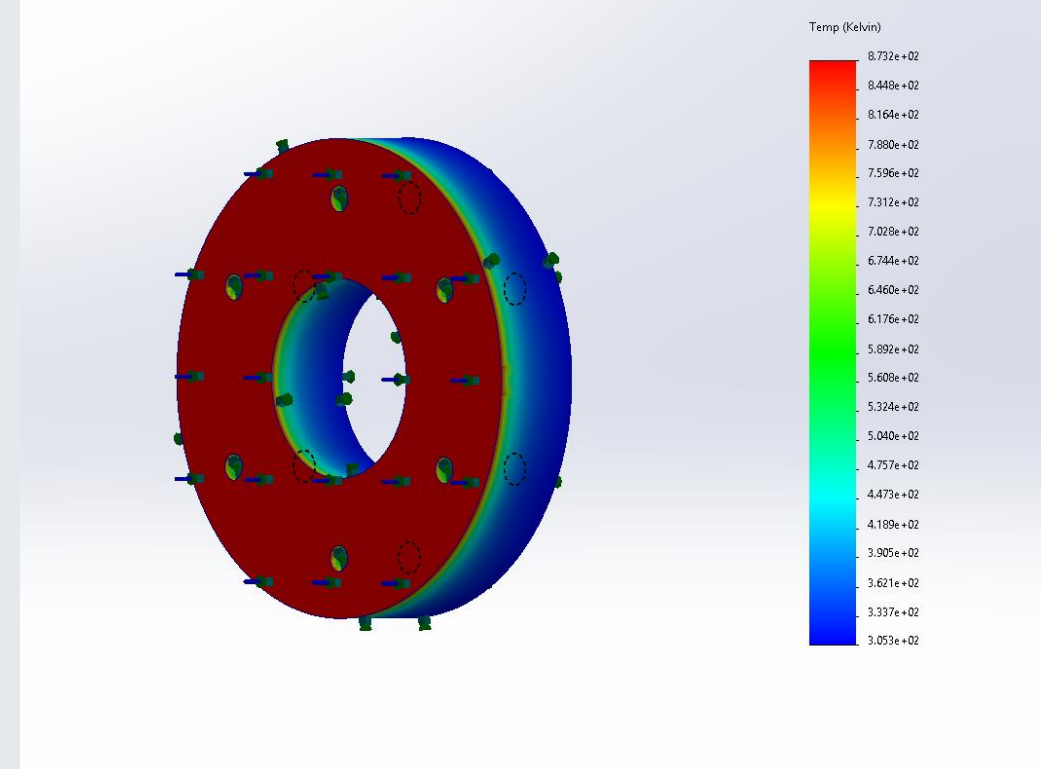


Photo of: Simulation of Thermal Break

A thermal brake was utilized in our design to avoid the conduction of heat to unwanted areas. PTFE was the material chosen. A simulation was conducted to analyze the effectiveness of the thermal brake. The thermal load of 800 K was applied to the hot side of the and the thermal brake reduced the temperature to 305K on the cold side. After reviewing these results, a thermal brake of 12mm was decided on to eliminate the possibility of air expansion behind the piston while a thermal load is applied.

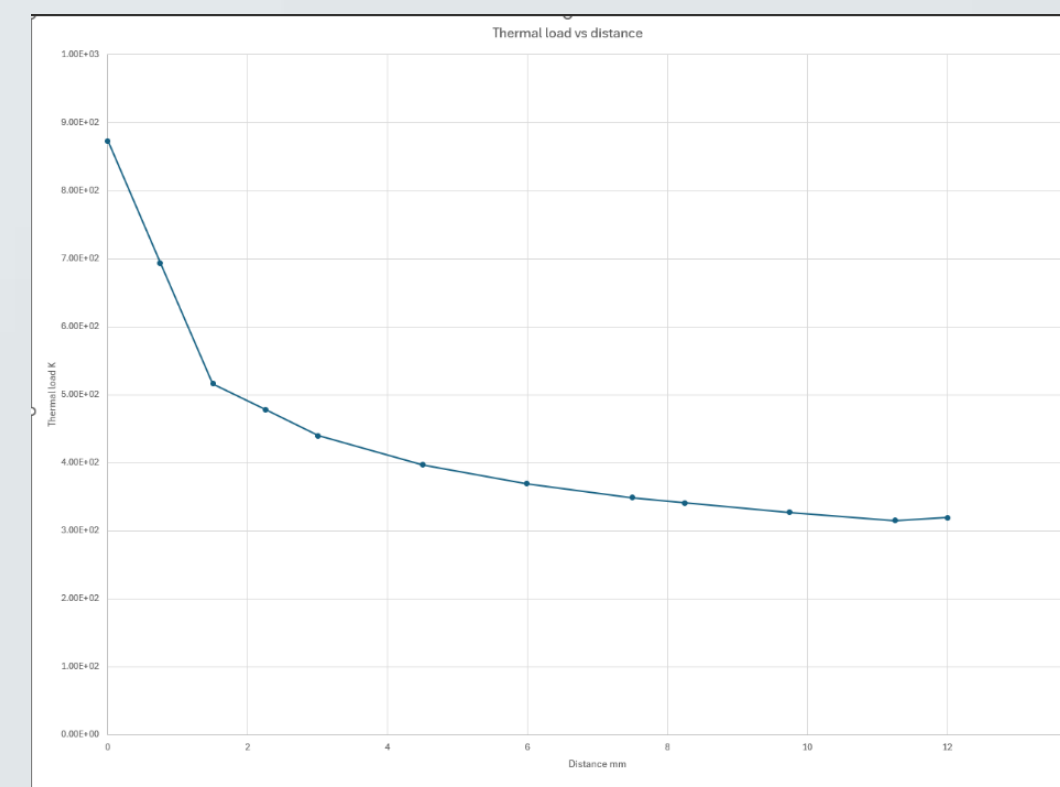
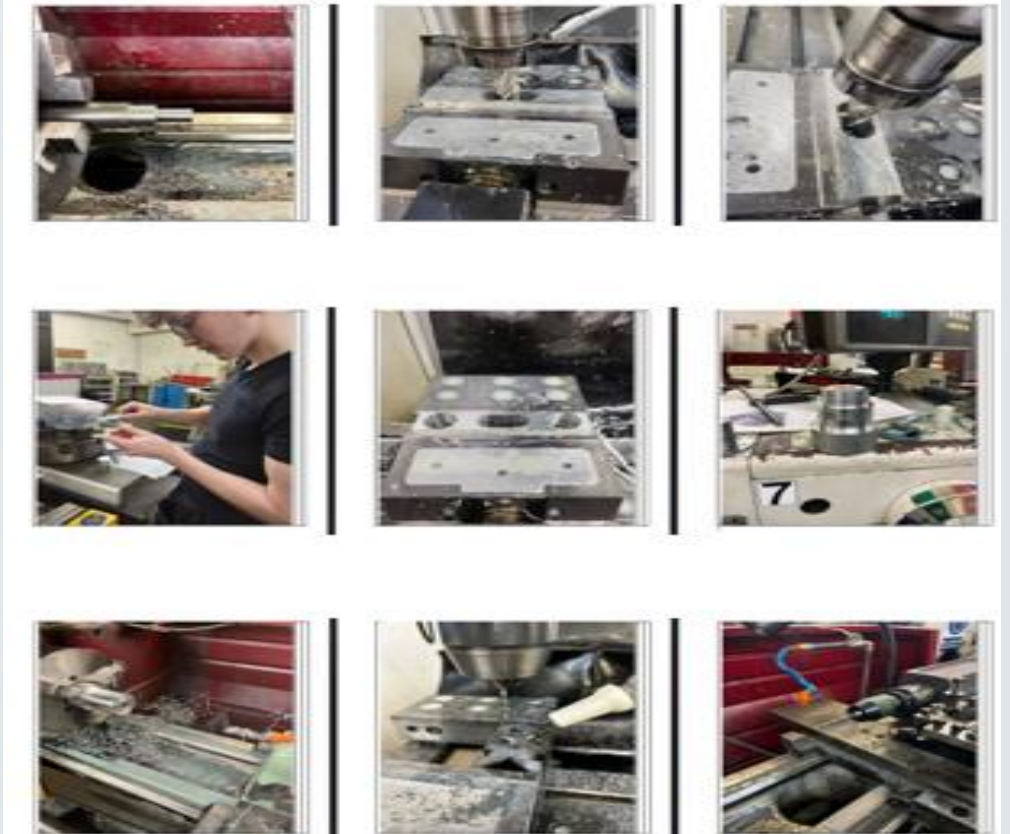


Photo of: Graph of simulation

### Manufacturing



Photos of: Manufacturing Processes

During the manufacturing process of this project, we were able to develop our skills and understandings of how to manufacture workpieces. We used Manual and CNC operated machines to achieve our project.



### Conclusion

This Stirling engine project exemplifies the technical skill, creativity, and teamwork behind its design and manufacture. From thermodynamic analysis to precision machining, every step reflects industry-ready expertise and a commitment to sustainable engineering. The result is a reliable, efficient engine that not only performs — it showcases the capabilities of a team prepared to lead in advanced manufacturing, clean energy, and mechanical innovation. We don't just build engines — we build the future. here