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## Trade Study Proposal: Engine Sizing

### Purpose:

The purpose of this study is to determine the proper sizing of the engine, including the dimensions of the inside of the cylinder – the length,  $L$ , diameter,  $d$ , and stroke length,  $S$  – and the mass,  $m$ , and pressurization,  $P$ , of the air that is to serve as the working fluid. The goal of the study is to size the engine such that the necessary power can be delivered while maintaining as high an efficiency as possible.

### Analysis:

The system will be analyzed as an ideal Stirling cycle, which will necessarily be a rough estimation. The balance between power and efficiency, which are both related to the design variables  $P$ ,  $m$ ,  $L$ ,  $d$ , and  $S$ , will be analyzed and a trade study will be conducted with a constraint on the minimum power and the merit being the efficiency achieved. Constraints will also be placed on the temperature, pressure, and weight of the engine. A computer code will be written to make plots of the properties of interest, which will be compared to find the optimal design.

### Resulting Information:

As a result of this analysis, the design variables mentioned above will be determined. Also, the maximum efficiency to be expected (which will differ from the ideal efficiency based on the design variables) will be determined; this is a key aspect of the feasibility of the project – without high enough efficiency in the engine, the design may not be feasible.

### Decisions Influenced:

The results of this study will not only affect the design of the engine in the design variables mentioned, it will also affect the parameters of the heat sink design and the crank to which the power will be transferred. Additionally, they will affect the design of the regenerator which is to be placed in the engine.

### Task Schedule:

- 11 Feb – Conduct initial research
- 12 Feb – Define design variables, parameters, constraints, and merit
- 14 Feb – Define key equations, relationships, state all assumptions
- 16 Feb – Write code used for analysis
- 19 Feb – Present preliminary results to group for suggestions, then revise
- 21 Feb – Present final results of trade study to group
- 23 Feb – Write report