



Team Clearview Engines
See-through combustion chamber on combustible
engine
for USNA Mechanical Engineering Department



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Project Sponsor

USNA Mechanical Engineering Department

Background: When teaching engineering and science courses, instructors often use demonstrations or labs to aid them in conveying concepts to the students. Specifically, when learning about an engine and the cycle it goes through in order to provide power output, professors like devices to help students visualize the cycle. Current methods to provide an engine demonstrator include cutaway engine models that can be slowly run using a hand crank or battery power and fully functional engine models that can be run in labs to gather data. While these demonstrations are each useful in their own way, current methods are unable to run through the engine cycle using fuel while also providing students the ability to see the combustion process actually taking place. The Mechanical Engineering Department stressed a strong interest in the idea of allowing the inner mechanisms of a running combustion engine to be viewed during the cycle.

Objectives: With this background in mind, the goal of this project is to create a visual demonstration of an engine's power cycle, and obtain information about the combustion process.

Results: Team Clearview Engines began solving this problem by discussing the issue with the initial customer, Professor Jim Cowart of the Mechanical Engineering Department at the United States Naval Academy. While talking about how to tackle this issue, Professor Cowart suggested the Team talk to other professors in the Mechanical Engineering Department who teach different levels of thermodynamics. As a result, the customer base was expanded to include additional professors who would be able to utilize the thermodynamic engine demonstrator. The new customers were Professor Cody Brownell, CAPT Hamilton, and CAPT Carr, all of whom are members of the Mechanical Engineering Department at the United States Naval Academy. Each

member of Team Clearview Engines interviewed one of the customers and then together the group determined the most reasonable set of customer requirements that would please all the customers to the best of our ability. The list of customer requirements for the engine demonstrator includes having a transparent window through which combustion can be viewed, being easily transportable between classrooms and the engines lab, having a throttle and RPM gage for easy speed management, the ability to characterize combustion with optical equipment, and the ability to collect in-chamber data from the combustion cycle.

The next step of this project involves taking all of the customer requirements and engineering characteristics and establishing multiple methods for which this problem can be solved. The customer requirements cited include the engine having a transparent window into the combustion chamber, throttling capability, portability, able to be recorded with a high speed camera, fiscally responsible, and capable of transmitting data. Ultimately, the team then selects one of these methods for use and carries out a detailed development.

The choice of design was a hybrid of multiple designs, utilizing a cylindrical quartz combustion chamber held fast by steel plates at the engine head and block.

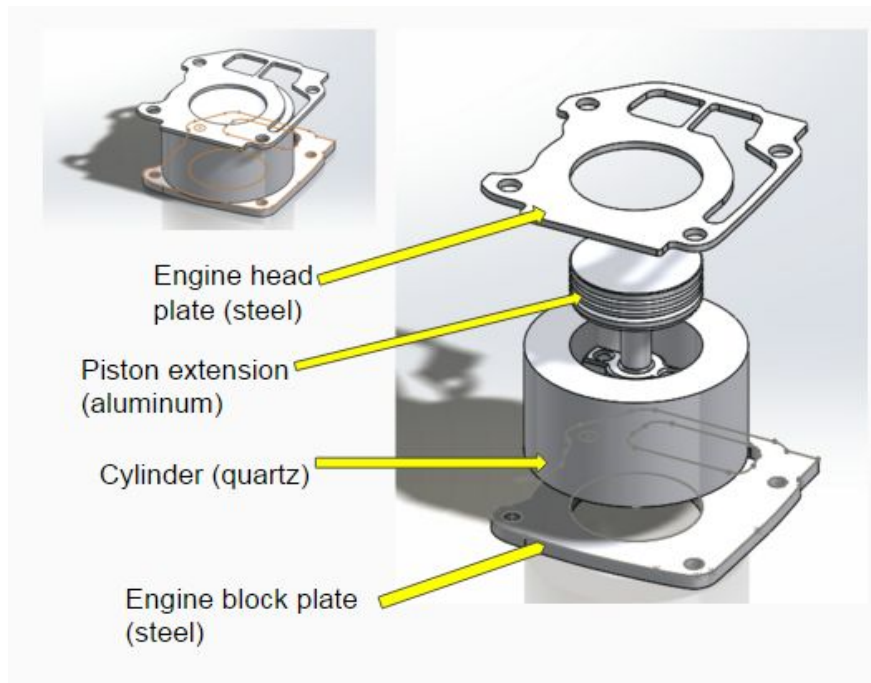


Figure 1. Final projected design concept

The project team milled a large portion of the engine head, allowing for the quartz to become a part of the combustion chamber as opposed to an addition. Dimensions became very important, and additional tests were done to ensure the engines push rods would not be impeded by the quartz viewing windows projected thickness.



Figure 2: Briggs and Stratton “Animal” Engine, with engine head milled



Figure 3. Clearview Engines is going to open windows to more learning!