# Experimental Solid Rocket Propulsion

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## Abstract

The project's primary goal is to research, design, and manufacture solid rocket motors for competition and hobby use. Solid rocket propulsion is one of the most common forms of propulsion and is used primarily for rocket boosters and in model rocketry. Unlike other forms of propulsion, the manufacturing cost is significantly lower, and the manufacturing process is less involved. This research project is primarily focused on the hobby side. The current stage of the project is to collect data from static test fires of our propellant. The data recorded will give all the information needed to predict how our propellant will burn when scaled up or down. The manufacturing of these motors is being conducted with the assistance of Embry-Riddle Future Space Explorers and Developers Society, and tests will be performed at the Northeast Florida Association of Rocketry. The end goal of this project is to manufacture low cost, high-performance rocket motors, that will be used at Spaceport America Cup.

## Conclusions

The data found from our test fire is shown below in figure 4. The data from this burn was different from the expected results. The burn should have been neutral, but results showed that there was a large peak. The reason for this was most likely that the core of the fuel grains was not drilled straight and was angled. Using this data, the team will soon be able to characterize our propellant and predict what scaled up motors will be.

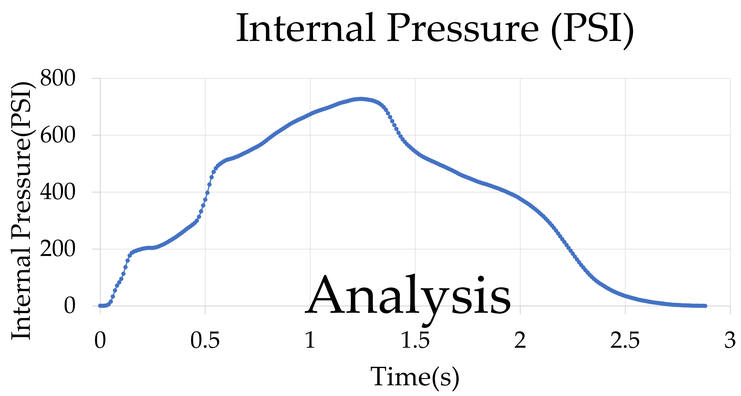


**Figure 4:** Plot of the burn time vs internal pressure.

## Analysis

For this project, we had to determine whether or not our propellant formulation was a viable option. To check whether or not our propellant could work, a test fire was conducted this past weekend. Using a test stand provided by Embry-Riddle Future Space Explorers and Developers Society, we were able to record internal pressure, and load. However, due to a power issue during the test fire, the load produced could not be measured. For our purposes this was negligible. Our goal was only to get a proof of concept and characterize the propellant. When you characterize a propellant, the goal is to find the burn rate coefficient and burn rate exponent. Both values are independent of thrust and only rely on the internal pressure. Therefore the load data was not important. From this test

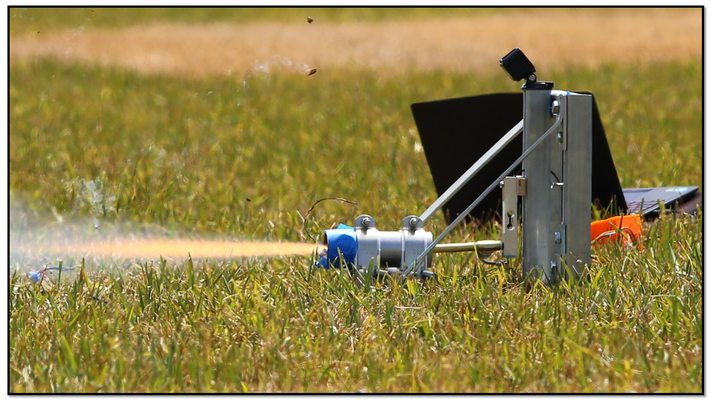

**Figure 5:** First successful test fire.

## Manufacturing

For manufacturing the motors, a 6qt. Kitchen Aid mixer was used. This process may be done by, hand but for consistency throughout batches, a mixer is needed. Before beginning the manufacturing process, a formulation was picked. A significant amount of time had gone into deciding what formulation to use, and eventually our current formulation, BV5 was picked. The BV5 formulation was picked because of its ability to operate on a wide variety of nozzles, causing fewer failures in the future.

**Figure 1:** Mixing the AP motors

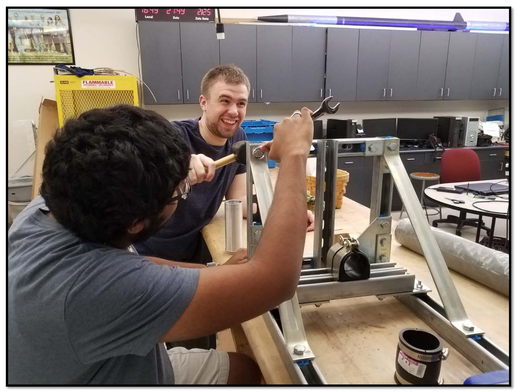

**Figure 2:** Assembly of our test stand

**Figure 3:** Three manufactured fuel grains

## Future Goals

For the near future the goal is to upscale our motor diameter to 3”. The motor will be a 22% L, producing 3000N*s of force. This will be used on a competition rocket at Spaceport America Cup.