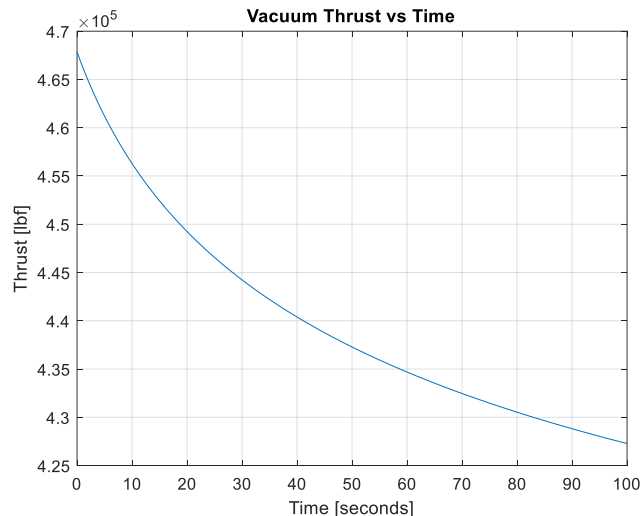


Name: Veronica

Homework 02HWB Summary One-Page Cover Sheet

Problem 11:4 and SP02B-A Summary of Results

| Result | Prob. 11-4 | SP02B_A | Comment on Reasons for Any Differences |
|---------------------------------------|------------|---------|---|
| Initial Port Diameter, $2R_{pi}$ (in) | 13.62 | 13.62 | |
| Web Thickness, w (in) | 12.435 | 9.567 | When assumed to be linear with time, the web thickness is larger since this assumes it is constantly burning at the same rate |
| Mid-web O/F ratio | 2.5 | 2.5 | |
| Grain Length, L (in) | 238.98 | 229.15 | This is for the same reason as the web thickness. When it is assumed that it is linear with time, more grain is burned |
| Motor Diameter, D (in) | 115.48 | 98.273 | Since the web thickness changed between the two, the motor diameter also changed |
| Initial Thrust, F , (lbf) | 500,000 | 467,850 | Assuming a cfv of 1.7 brings the initial thrust down |



Graph of Thrust as a Function of time from SP02B-A

Copy of the “Reflect” Section of Your Literature Review (McFarlane)

This paper highlights the hybrid rocket and dives into a test run on a motor being developed. Hybrid rockets are not used in regular launches, so this method still requires a lot of testing and research. It offers many advantages when compared to solid and liquid rockets. This is good to know as an aerospace engineer that there are always different ways of doing something that has always been done the same one or two ways in the past.

Two-Page Annotated Bibliography Template

Summarize

| | |
|-------------------------------------|--|
| Reference Document Examined: | McFarlane, J.S., “Design and Testing of AMROCS 250,000 pound Thrust Hybrid Motor,” AIAA Paper 1993-2551, 1993. |
| Reviewer: | Veronica Loomis |
| Source of Document: | Canvas |
| Date of Review: | January 31, 2023 |
| Electronic File Name: | 1993_McFarlane_AMROC_250klbf_Thrust_Hybrid_Motor.pdf |

Summary of Paper:

The American Rocket Company (AMROC) was developing a 250,000 pound thrust hybrid rocket motor that would be used on future space launch vehicles. A hybrid rocket motor was chosen since it offers significant advantages over both solid and liquid propulsion systems in terms of safety, cost, and operational flexibility. However, hybrid propulsion is less developed than either solid or liquid and so it is the goal of AMROC to bring this technology to commercial flight status. Specifically, AMROC was working on an orbital launch vehicle for delivering payloads to low Earth orbits.

Most of the fabrication took place in Camarillo, CA until the size grew too big and it was moved to Vandenberg AFB after a Joint Operating Agreement with the US Air Force. The motor was tested in a series of four firings in 1992. The first test on January 22 went smoothly with no chamber pressure overshoot. Three chamber pressure spikes were seen during the test and the motor dampened oscillations to provide stability. The second test on February 17 behaved similarly. The third test on March 11 aborted its first ignition attempt due to a faulty transducer downstream of the ignition valve. It was replaced and a successful test was ran showing similar results to the first two tests. The final test occurred on March 23 but was ended early when the motor case failed. This was caused by combustion gasses leaking through the insulation and exiting through the case cylinder. This weakened the material at the interface which caused failure.

B. Assess:

Important Facts from Document:

1. Hybrid propulsion are less developed than either solids or liquids, but offer advantages in terms of safety, cost, and operational flexibility.
2. The hybrid combustion process is independent of chamber pressure.
3. There were 4 tests ran but only 3 were successful.
4. There were plans to produce a LEO booster known as the Aquila launch vehicle.
5. This privately funded project got to test at the US Air Force Vandenberg AFB.

Key Figure from Document:

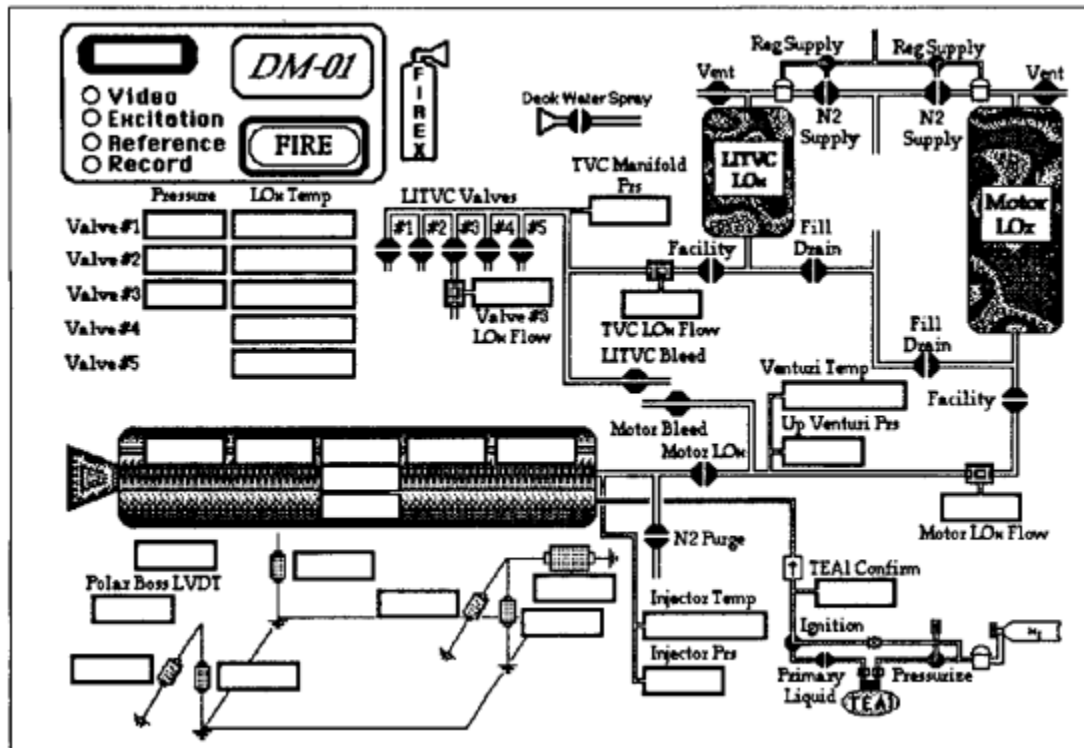


Figure 1: DM-01 Process Flow Diagram

Important Relationships among Parameters Described in the Paper:

1. When combustion gasses leak through the insulation, the structure and material of the motor can fail.
2. Good dynamic stability means that the severity of oscillations does not increase

C. Reflect

This paper highlights the hybrid rocket and dives into a test ran on a motor being developed. Hybrid rockets are not used in regular launches, so this method still requires a lot of testing and research. It offers many advantages when compared to solid and liquid rockets. This is good to know as an aerospace engineer that there are always different ways of doing something that has always been done the same one or two ways in the past.