Executive Summary

This month I showed that the class I engine performance was consistent, reliable, and ignition occurs in ~ 1.1 sec. The parameters were the same for each of the three test. Table I and table II below summarize the run-time test results. All three test used the same batch of distilled HTP with 2.0 ml of ethanol. The thrust was ~ 16.5N for each test.

Also, Fisher Space Systems, LLC played host to a group of future scientist and engineers. After a brief safety overview, I ran the test and everything was perfect.

Technical Stuff

This month I showed that the class I engine performance was consistent, reliable, and ignition occurs in ~ 1.1 sec. The parameters were the same for each of the three test: propellant tank pressure, 130 psig; HTPE blend O/F ratio, 27.5, initial HTPE flow rate, 14.8 ml/sec; mass flow rate for HTP and ethanol, 19.7 gm/sec and 0.4 gm/sec, respectively; cross sectional area for the fuel cores, ~1.1 cm^2; and the ignition "oxidizer" flux, ~ 17.6 $gm/cm^2/sec$. The results were consistent as shown in Table I below.

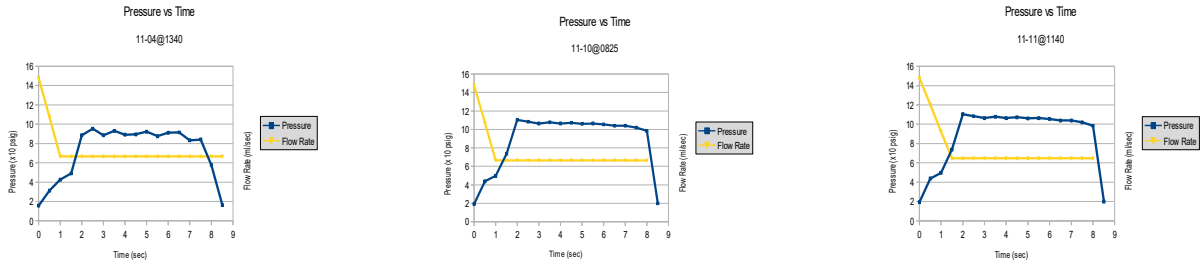

Table I. Pressure and Flow Rate

Table II below is a summary of the run-time test. I used the same diagnostic procedure as detailed in the September and October end of month reports. All three test used the same batch of distilled HTP with 2.0 ml of ethanol. The thrust was ~ 16.5N.

Date	t_1 (sec)	t_2 (sec)	Flow $Rate_{ox}$ (ml/sec)	G_{ox} ($gm/cm^2/sec$)	G_{ox} ($lb/in^2/sec$)	Regression (mm/sec)
11/04/21	1.1	7.9	6.6	7.9	0.11	0.24
11/10/21	1.5	7.6	6.8	7.9	0.11	0.21
11/11/21	1.1	8.1	6.5	7.8	0.11	0.19

Table II. Run-time Test Results

Date	$(P_c)_{ns}$ (psia)	Avg A_t (cm^2)	m_t flow rate (gm/sec)	O/F	c* (m/sec)	c^*_{eff} (%)
11/04/21	104.6	0.22	12.4	2.7	1276	86
11/10/21	120.9*	0.22	12.0	3.0	1522*	102*
11/11/21	120.3*	0.23	11.6	3.3	1641*	110*

* See Note

Table II. Run-time Test Results

Note: I lost pressure probe calibration on the 11/10 test. I accidentally dropped the diagnostic and the bias voltage pin came off. I plugged it back into the wrong pin port. As such, my pressure reading on the 11/10 and 11/11 test are suspect. The resulting characteristic velocity and efficiency are greater than theoretical (if only it were true). Since the remaining test results are approximately the same, I surmised that the chamber pressure, characteristic velocity, and efficiency were approximately the same. I didn't think it was necessary to repeat the last two test. As shown in table I, the trend in the pressure and flow rate is about the same for all three test.

I completed the test series on 11/11 and was hoping to have a flight system by the end of November. However, fabricating a lightweight fuselage has been challenging. According to regulations, the total mass allowed for a class I rocket is 1.5 kg. This includes 100 gm of propellants. I was going to use fiberglass but the mass of the fuselage was to great (~ 450 gm).

I have been experimenting with hand laying up carbon fabric. I'm on my third fuselage and still not satisfied. With each lay up, I learn something new. The mass of the first fuselage was 328 gm and the mass of the second fuselage 300 gm (see picture below).

So, I'm learning but, it looks like there is going to be a delay. The new target date is the end of the year (weather permitting). I've designated the class I flight system the Mk I Viper.

A special thank you for the VIP observers on the 11/10/2021. I've run enough test to feel confident of the safety in the HTP/PLA hybrid. So, Fisher Space Systems, LLC played host to a group of future scientist and engineers. After a brief safety overview, I loaded the oxidizer, ran the test, and everything was perfect. They, of course, are invited back this summer to observe the launch and landing of the Mk I Viper.


Vivitar