

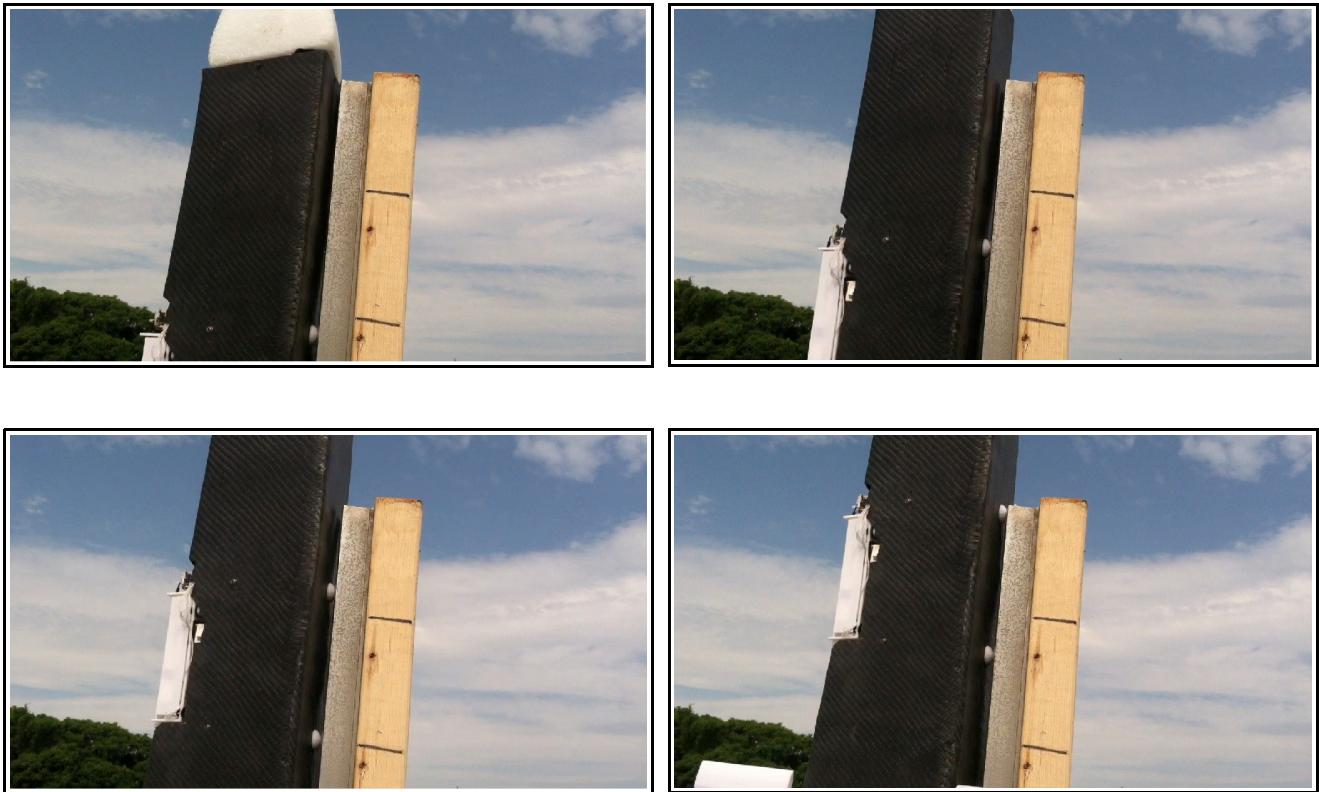
Executive Summary

This month I launched the Mark I Viper. The Mk I Viper cleared the rail guide at 2 m/sec and it was under thrust for ~ 7 seconds. I used 50 ml of unstabilized ~ 90% HTP plus 2 ml of ethanol for an O/F ratio of 25. Ignition occurred in ~ 0.3 seconds. The mass flow rate was about 13.29 gm/sec resulting in a total propellant mass of ~ 93.0 gm for the 7.0 seconds of thrust.

Technical Stuff

This month I launched the Mk I Viper. The Mk I Viper cleared the rail guide at 2 m/sec, pitched forward, rotated to counter clockwise, yawed to starboard, flipped a few times, hit the ground, and scooted up the hill before it came to rest. There was a lot of smoke when it came to rest but since the grass was green, there was little chance of the yard catching on fire. Total burn time was about seven seconds. I expected the pitching forward. But, I also expected the Mk I viper to clear the rail guide at 4 m/sec velocity. As such, I didn't have the aerodynamic control I needed to correct the trajectory.

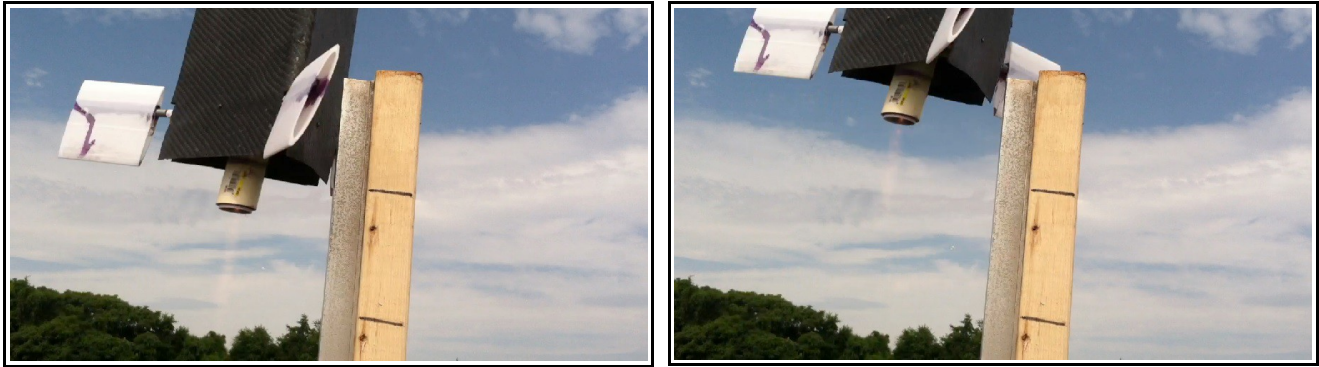
The pictures below show the Mk I Viper clearing the rail guide at 2 m/sec.



I used an iphone 5 to measure the velocity. The iphone 5 has a frame rate of 30 frames/sec. The length between each black mark is 10 cm. The first rail guide button hit the 20 cm mark at $t=0$ in the first frame. There are 3 frames until the first button cleared the rail guide. At 30 frames/sec, that's about 0.1 sec to clear 20 cm or 2 m/sec.

The two pictures below show the Mk I Viper pitching forward and rotating counter clockwise as it leaves the rail guide. I anticipated the pitching forward so I had the port and starboard fins fully angled at about ten degrees. I did not anticipate the rotation or the 2 m/sec velocity. However, at about

this time, all hell broke loose and I was in full panic mode. The Mk I Viper did a few flips, hit the ground, and scooted up the hill ([video](#)). Before launch, I had decided to leave the valve open no matter what (useless it headed toward the house). I wanted to empty the tank of HTPE. The only damage was a scuffed up nose cone and a broken rudder.



I used 50 ml of unstabilized ~ 90% HTP plus 2 ml of ethanol for an O/F ratio of 25. Ignition occurred in ~0.3 sec and the total burn time was about 7.3 sec. The Mk I Viper was under thrust for about 7.0 seconds. The average volume flow rate of HTPE was ~ 7.0 ml/sec. The mass flow rate was about 13.29 gm/sec resulting in a propellant mass of ~ 93.0 gm.

Finally, this month I've been upgrading the flight system. For this launch, the solenoid valve was in the six o'clock position. I moved it to the 12 o'clock position to bring the CM further line with the thrust vector. Also, to get more surface area exposed on the starboard and port fins, I've repositioned the servos to accommodate a longer lever arm. Also, I plan on increasing the throat diameter to 6.5 mm to further increase the thrust.

I will launch the Mk I Viper again next month. This time it will fly straight and true, be under thrust for six seconds, and set a new record for Fisher Space Systems, LLC!