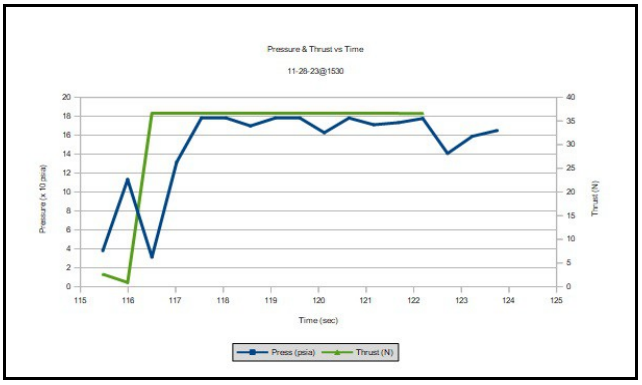
Executive Summary

This month, in an effort to get maximum thrust with minimum hardware, I ran two tests without the check valve and with a 7.5 mm nozzle throat diameter. The HTPE tank pressure was 140 psig. The first test streamed PLA out the nozzle and the second test blew up. After careful consideration, I have decided to add the check valve back into the plumbing.

Technical Stuff

This month, in an effort to get maximum thrust with minimum hardware, I ran two tests without the check valve and with a 7.5 mm nozzle throat diameter. The HTPE tank pressure was 140 psig. The first test streamed PLA out the nozzle and the second test blew up (see video, it was an awesome explosion). The explosion destroyed my pressure sensor, plastic mounting bracket, and solenoid valve. I believe that in the second test PLA plugged up the throat and over pressurized the mixing chamber. The pressure sensor topped off at 180 psia and was destroyed in the explosion. The rocket engine jumped off the load cell and maxed out at 36 N. This is the total weight of the rocket engine, test stand mounting bracket, and extra mass. This was not the outcome I was looking for, but a data point none the less.



Calculations show that the ignition surface flux (ISF) was ~ 0.3 gm/cm^2/sec as compared to ~ 0.2 gm/cm^2/sec on previous test using the check valve. Last month, the two successful test without the check valve was with the same ISF of ~ 0.3 gm/cm^2/sec but with a nozzle throat diameter of 6.0 mm. I surmise that the smaller throat diameter slowed the flow rate enough for ignition to occur while the larger throat diameter did not.

There are several things I can try to run the system without a check valve, increase the thickness of the edzieba flow restrictor to slow down the orifice erosion, lower the tank pressure to 120 psig to reduce the initial flow rate, and/or increase the surface area of the PLA/$KMnO_4$ fuel core. All of these require trade offs in performance and mass. But, I'd rather not see anymore explosions that destroy my equipment or diagnostics. So, after careful consideration, I've decided to reinstall the check valve.

Next month, weather permitting, I plan on testing the phenolic graphite nozzle with a 7.5 mm throat diameter using the check valve and at 140 psig. If the weather goes bad, I'll work on the flight system. I've decided to put the servo motors in the rudder and wings. It's looking more like a colonial viper everyday.