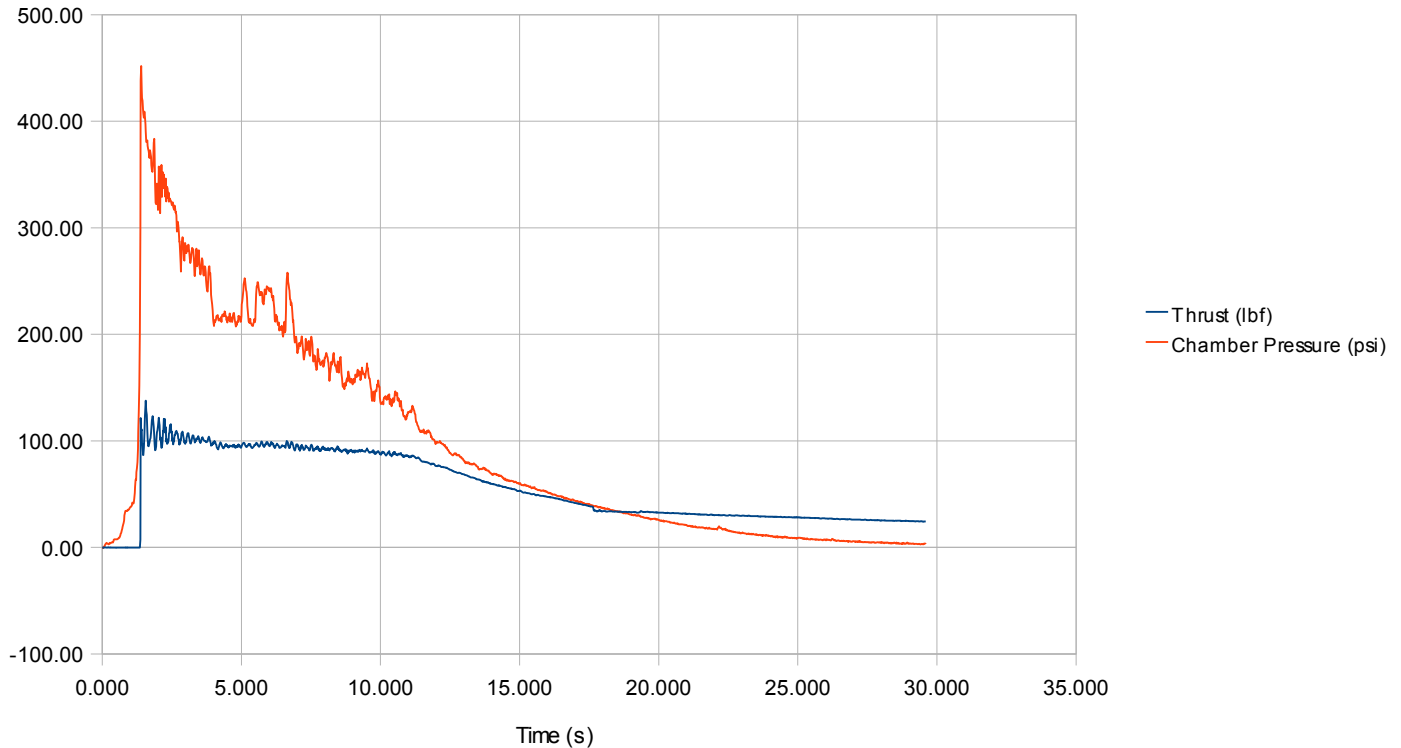


## Thrust and Pressure Data from Tropos 2 Static Firing, 4/13/09

Thrust and Chamber Pressure  
Tropos 2 Motor Static Test 4/13/09



### Notes:

The thrust curve is “as read”--the weight of the rocket (approximately 28 lbs, decreasing by about 7 lbs during the course of the burn, along the thrust axis) reduced the measured thrust and should be added to the curve. Also, some straps were around the rocket body for safety. They were relatively loose (and configured to allow movement toward the load cell), but may have taken some of the thrust load. The rail buttons may have also taken some of the load.

The distinct drop in pressure is not reflected in a corresponding drop in thrust. The nozzle coefficient must have increased as the chamber pressure dropped.

The thrust and chamber pressure do not correlate with the predicted nozzle coefficient of approximately 1.5 (at peak thrust). A chamber pressure of 452 psi (peak pressure) should have resulted in a peak thrust of about 205 lbs. The most optimistic peak thrust is about 138 lbs (measured) + 28 lbs (weight) + 10 lbs (straps and rail buttons) = 176 lbs. And the 138-lb measured peak thrust may be exaggerated due to the oscillation discussed below.

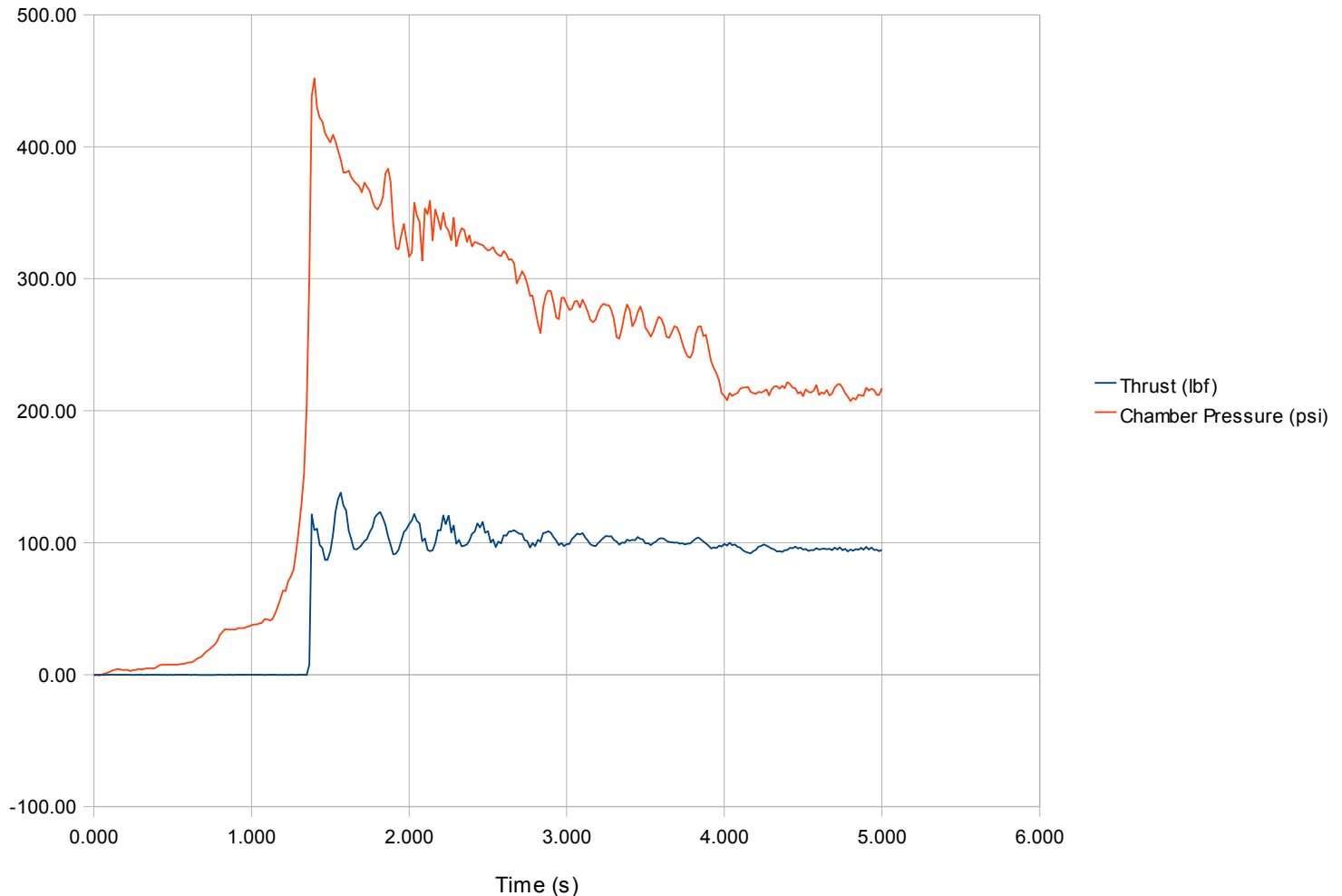
Thrust never returns to zero, instead it stays at about 25 lbf. This is most likely due to the safety straps not letting the rocket settle back from the load cell after the firing.

There is also some question about the calibration of the load cell which we hope to resolve soon.

The thrust curve shows a 4.5-Hz oscillation throughout, which is most pronounced at the beginning of the burn. It is surmised that this is a mechanical vibration of the test setup since the frequency does not match known frequencies for combustion instability, feed system feedback, or acoustical resonance. Also, the thrust oscillation is not reflected in the chamber pressure plot. A more detailed plot of the first five seconds is shown below:

### Thrust and Chamber Pressure

First five seconds



Approximately 7 lbs of nitrous oxide and 2.5 lbs of caramel was consumed during the burn. Depending on the method used to estimate total impulse, the specific impulse appears to be around 140 seconds. This is quite poor, only about 60% of the value predicted by GDL/Propep for nitrous oxide and sugar (237 sec).