AIAA OC Section - Reflight Report

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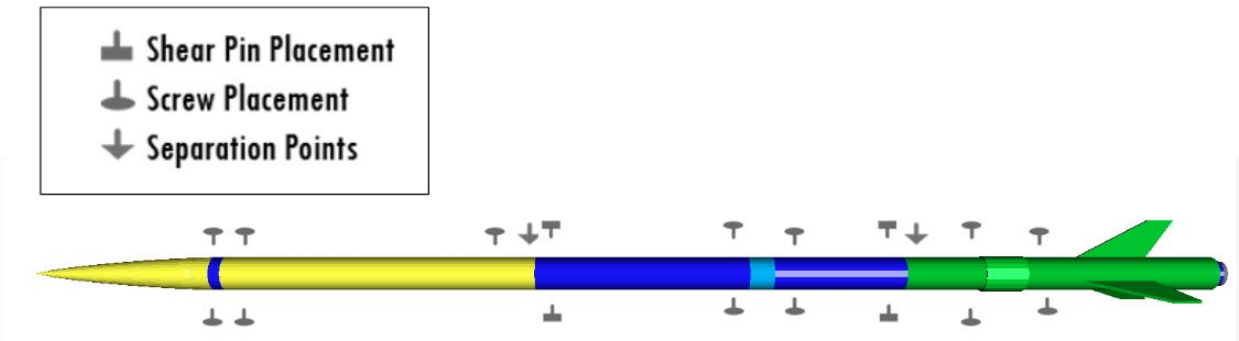
1 Vehicle Criteria

Gross Liftoff Mass (lbs)	30.64	27.61
Length (“)	144.75	144.75
Main Chute	60”	72”
Drogue Chute	18”	18”

Although this rocket carries air brakes, they are vestigial. The rocket will be unable to attain a one mile altitude.

1.1 Diagrams



Each color indicates an independent section. The blue collar on the left shows where the payload will be stowed.

1.1.1 Stability Margin

CG: 93.5”

CP: 106.9598”

$$Static\ stability\ margin = \frac{CP - CG}{Diameter\ of\ Rocket}$$

$$= \frac{106.9598" - 93.5"}{4"}$$

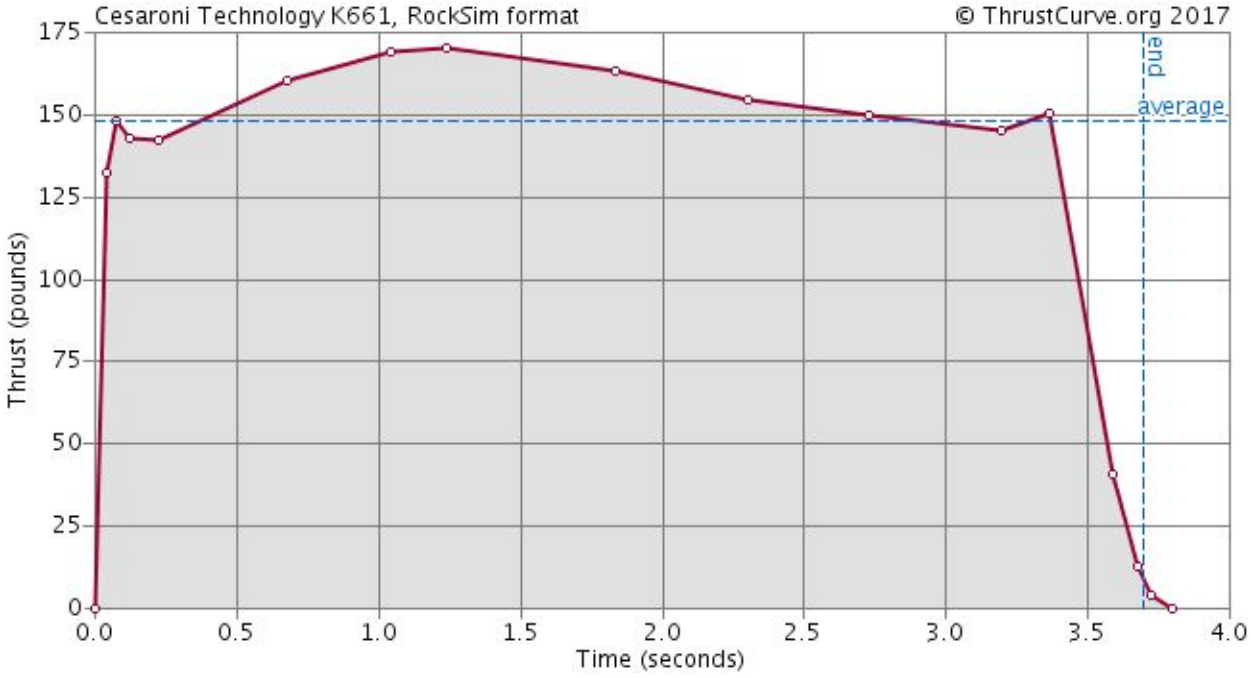
$$= 3.36\ calipers$$

1.1.2 Motor of Choice

CTI K661

Average Thrust: 144.21 lbs, or 641.6 N

Note that the average thrust corresponds to the value of the first peak in the thrust curve.



1.1.2.1 Motor Retention

We used an Aero Pack 75 mm retainer.

1.2 Liftoff Mass

12,620 g, or 27.820 lbs

1.2.1 Thrust to Weight (TTW) Ratio

$Gross\ Liftoff\ weight = mg = 12.620\ kg \times 9.81\ m/s^2 = 123.8022\ N$

$TTW = \frac{641.6\ N}{123.8022\ N} = \frac{5.18}{1}$

This meets the minimum requirement of 5:1 TTW.

1.3 Payload

The launch vehicle carried a CO_2 payload, which was safely stowed in the rocket. All electronics necessary for a functioning payload were on board. It will not be separated at any point from the rocket.

2 Launch Day Conditions

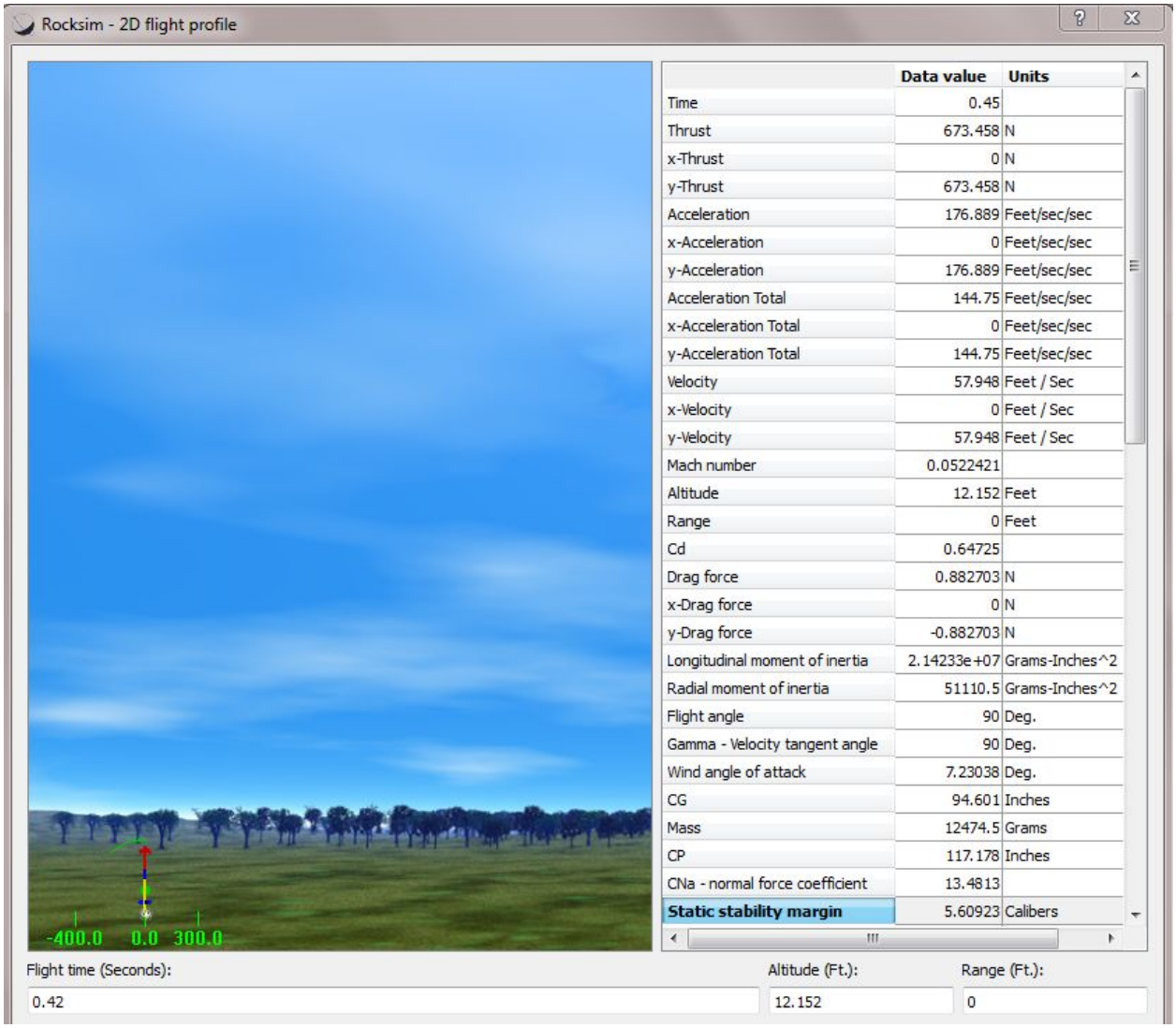
The launch took place in the Mojave Desert, with Friends of Amateur Rocketry. 35.34° N, 117.8° W

Altitude (ft)	2066
Humidity (%)	26
Wind Speed (mph)	5-10
Latitude (°)	35.34
Temperature (°F)	54
Barometric Pressure (Hg in)	27.582
Rail Size*	15-15, 12’

*The rail was originally just under 20’, but the rocket was placed so that it would run along only 12’ of the rail.

2.1 Simulation with Launch Day Conditions

Rail Exit Velocity: 57.66 fps
Static Stability Margin at Rail Exit: 5.6093
Max Velocity:



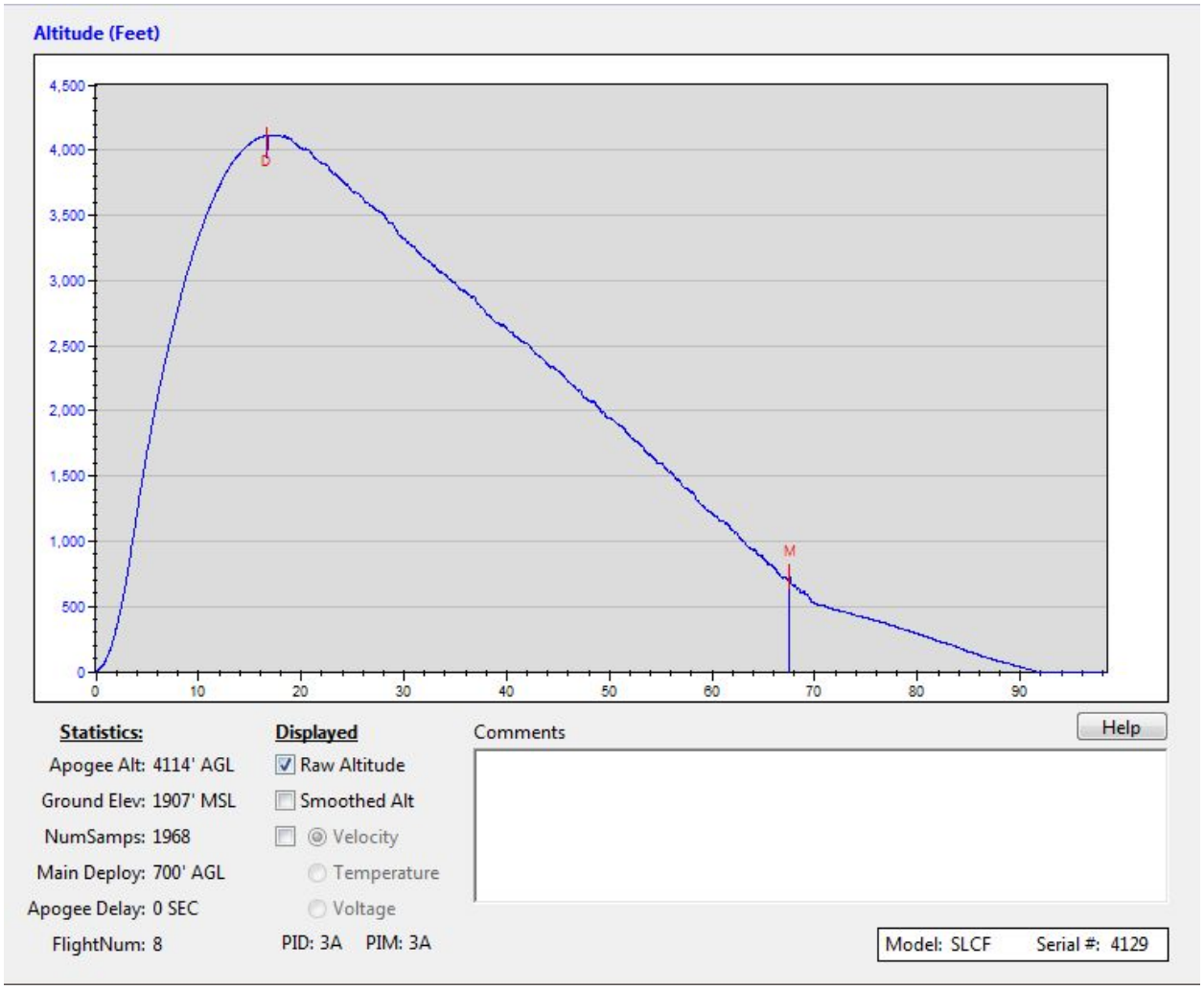
2.1.1 Predicted Maximum Altitude

4370’

3 Launch Day Results

The results of the flight can be seen on this YouTube Video.

The rocket achieved a 4115’ apogee.



3.1 Analysis of Flight

Due to the fairly strong winds, we observed some weather cocking, which significantly increased the rocket's drift and reduced the rocket's achievable altitude.

Notably, the blast protector for the main chute did not stay tethered to the recovery harness. Given the nature of how quickly the tubular nylon experiences tension, we can attribute this event to having used the blast protector twice in previous flights. The extended use of this blast protector in real full-scale flights wore out the hole that keeps the protector connected to the harness.

The blast cloth did not pose a major concern, as it had sufficient drag to the point that it descended at a slower velocity than the rocket on its main chute and weighs a tiny fraction of the rocket itself.

We will have a new blast cloth ready for Huntsville.

3.1.1 Comparison of Predicted Flight Model to Actual Flight Data

The simulated flight data indicated that the rocket would have taken a vertical flight upward, more or less, instead of the somewhat extreme angle of attack that the actual rocket assumed.

The drift was also significantly more than what we had predicted (about 800') compared to the predicted drift from simulations, which was about 300' from the launch pad.

3.1.2 Errors Between Predicted and Actual Flight Data

Despite this change, the predicted flight data was still accurate enough to be within a few hundred feet of the actual flight data.

We can also attribute this error to variance in the motor's impulse.

3.1.3 Estimated Coefficient of Drag (CD)

The calculated coefficient of drag in RockSim is 0.686.

Based on today's results, we estimate the CD is 0.70.

4 Flight Diagram