FNL Critical Design Report Response

Response 1

The over arching goals are to gather data, analyze it, draw conclusions and communicate the results.

Does vibration and roll affect a rocket's performance?

Our first goal is to achieve maximum altitude using the smallest motors common to as many rockets that we have by making our rockets as aerodynamically clean as possible. We intend to do this by monitoring selected parameters between two identical rockets for data comparison. If, after data analysis, there is a significant difference, we can then examine the rockets to determine why there is a construction anomaly and what can be done to correct it/them.

For our first experiment we want to acknowledge that in addition to the four main forces that affect a rocket's travel; lift, drag, thrust, and weight, there two specific dynamic forces that we want to measure and analyze to see if they affect a rocket's flight. These two are roll and vibration. We want to monitor and analyze roll and vibration so that we can improve our rocket flights through data analysis and applying what we've concluded to modifying our rocket construction techniques. We have two of the same kit rockets that we can compare data between them.

It is quite apparent that if roll and/or vibration have a significant impact on flight characteristics, it will be in the best interest of rocket designers and builders to reduce and hopefully eliminate these two undesirable forces.

How much does the temperature in the recovery bay increase during ejection charge detonation?

We want to collect data on the temperature in the recovery bay for our second experiment. The temperature in the parachute bay is particularly useful so that we can test various heat barriers.

This will be a data gathering and analysis project which will become baseline data for future experiments.

Does our student built flight computer and sensor system compares favorably to a commercial (R-DAS Tiny) system?

We have previously built a small micro controller system that measures many of the above listed elements; however, each sensor has been on a single-purpose system. We want to integrate as many of the sensors as is feasibly possible given the constraints of our data logging storage space and the micro controller's processing power.

We also want to determine spatial position via a student-built GPS unit; and we will also have a side-looking on-board video camera to record our flights.

The R-DAS Tiny provides acceleration, altitude, and velocity information. We want to use that data to compare and contrast with our in-house built flight computer systems.

Response 2

	Rocket	Dia.	Len.	Fin Type	Fin #	Nose	Launch
1	PML Ariel	3	58	Clipped Delta	3	Ogive	3/8 thin wall brass launch Lugs
2	LOC Hi-Tech H45	2.63	49.75	Clipped Delta	3	Ogive	3/8 thin wall brass launch Lugs
3	LOC Hi-Tech H45	2.63	49.75	Clipped Delta	3	Ogive	3/8 thin wall brass launch Lugs
4	PML D Region Tomahawk	3	71	Swept Delta		Ogive	3/8 thin wall brass launch Lugs
5	LOC Cyclotron	3	57	Tubular	6	Ogive	3/8 thin wall brass launch Lugs
6	MadCow Patriot	4	52.75	Swept Clipped Delta	4	Ogive	3/8 thin wall brass launch Lugs
7	LOC Magnum	5.54	80	Swept Delta	3	Ogive	½” launch lugs

Response 3

	Rocket	Motor	Delay	Predicted Altitude
1	PML Ariel	H73J	6	1048
2	LOC Hi-Tech H45	H73J	10	3120
3	LOC Hi-Tech H45	H73J	10	3120
4	PML D Region Tomahawk	H73J	6	974
5	LOC Cyclotron	H73J	10	1880
6	MadCow Patriot	H73J	6	845
7	LOC Magnum	J275W-14	14	2822

The Rocksim data, including flight profile charts are included as Appendix 1 to this document.

Response 4

All of our rockets are kits and come with manufacturer recommend parachutes. The smallest is 28” for rockets 2 & 3, the largest is 60” for rocket 7, rocket 4 has a 48” parachute and the remaining ones have 36” parachutes.

Response 5

All rockets will be using audible alarms which are modified personal alarms purchased from Radio Shack. The are a “pull to operate” device and will be connected to the shock cord in such a manner that when the recovery system is deployed, the alarm will be started.

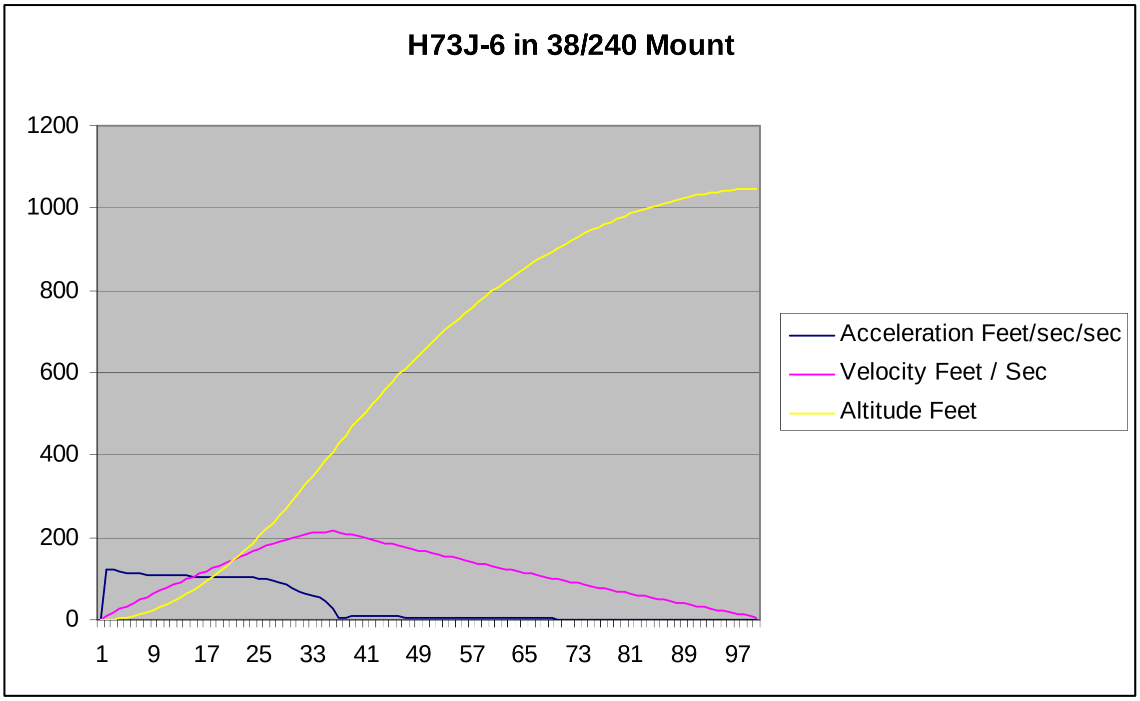
Response 6

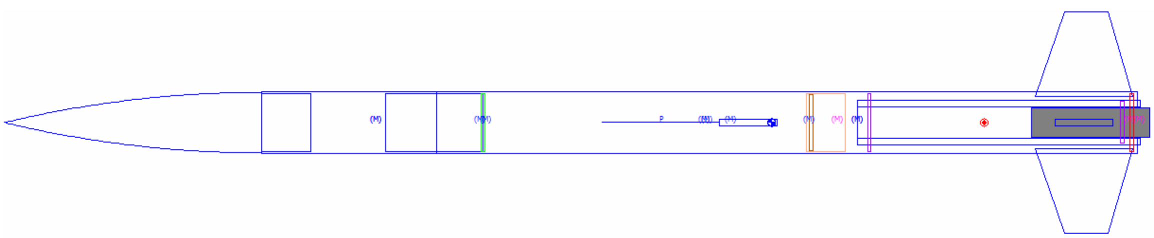
Our preliminary pre-launch and launch checklists are included as Appendix 2. We are hoping to launch several of our rockets mid March using G engines. After a couple of launches, we will be in a better position to evaluate our check lists.

Each team member is planning on bringing their own rocket; therefore each will be responsible for their science payload, main parachute system, and arming and programming the altimeters. The remaining members will be launch team members and recovery team members.

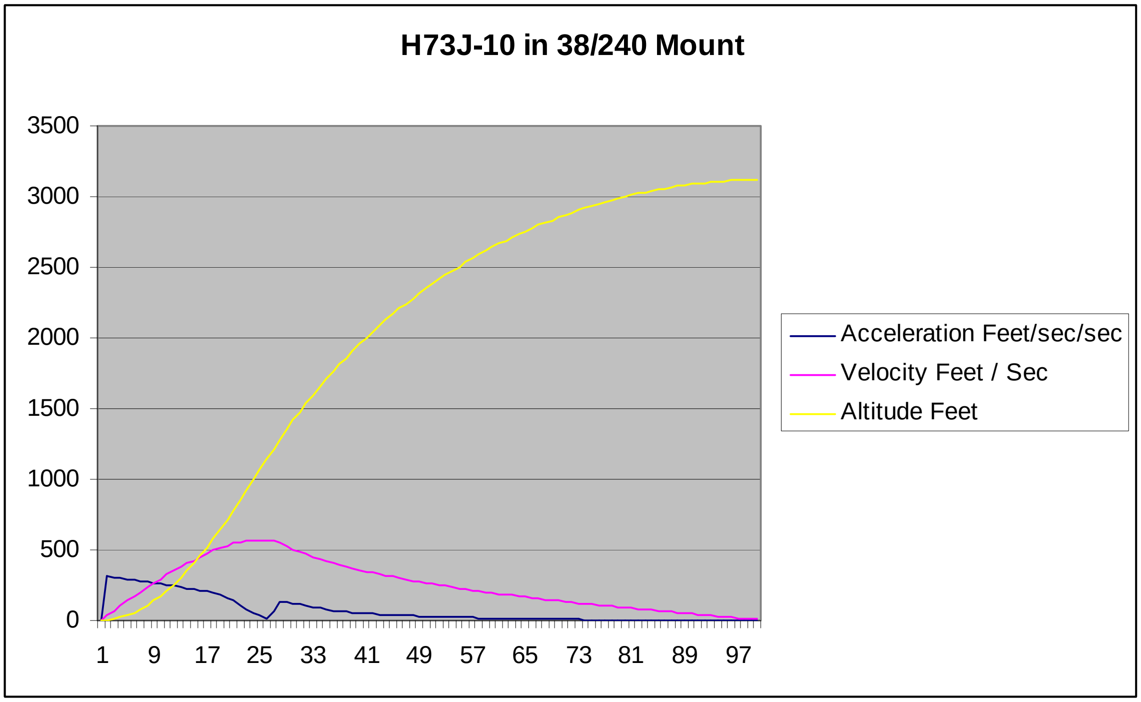
Appendix 1

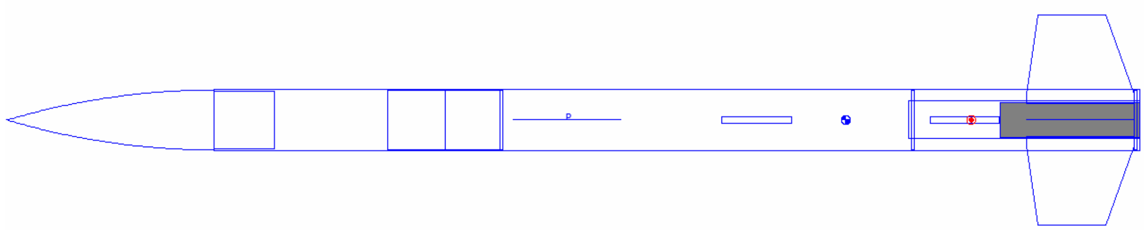
Public Missiles Ariel
Length: 58.3750 In. , Diameter: 3.1260 In. , Span diameter: 13.1260 In.
Mass 64.4136 Oz. , Selected stage mass 64.4136 Oz.
CG: 39.4515 In., CP: 50.3749 In., Margin: 3.52 Overstable
Engines: [H73J-6,]



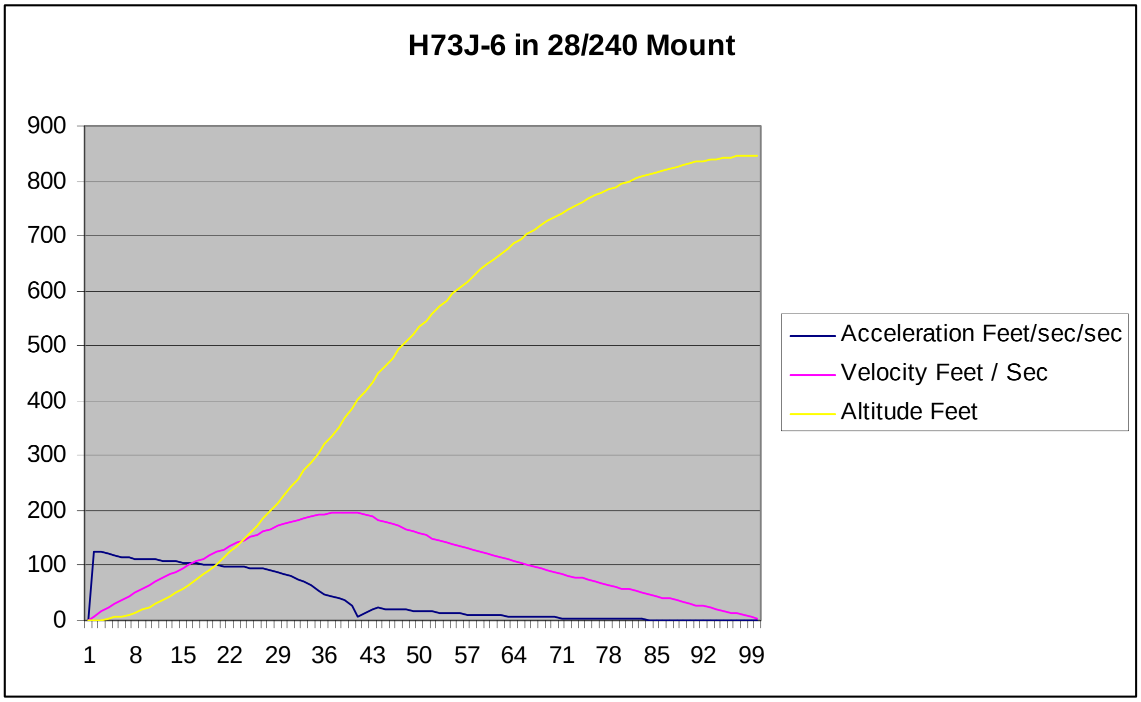


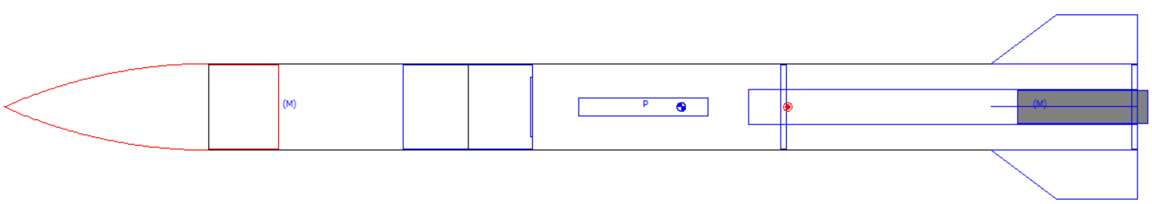
HI TECH H45
Length: 49.0790 In. , Diameter: 2.6299 In. , Span diameter: 10.5433 In.
Mass 24.9824 Oz. , Selected stage mass 24.9824 Oz.
CG: 36.3469 In., CP: 41.7843 In., Margin: 2.09
Engines: [H73J-10,]



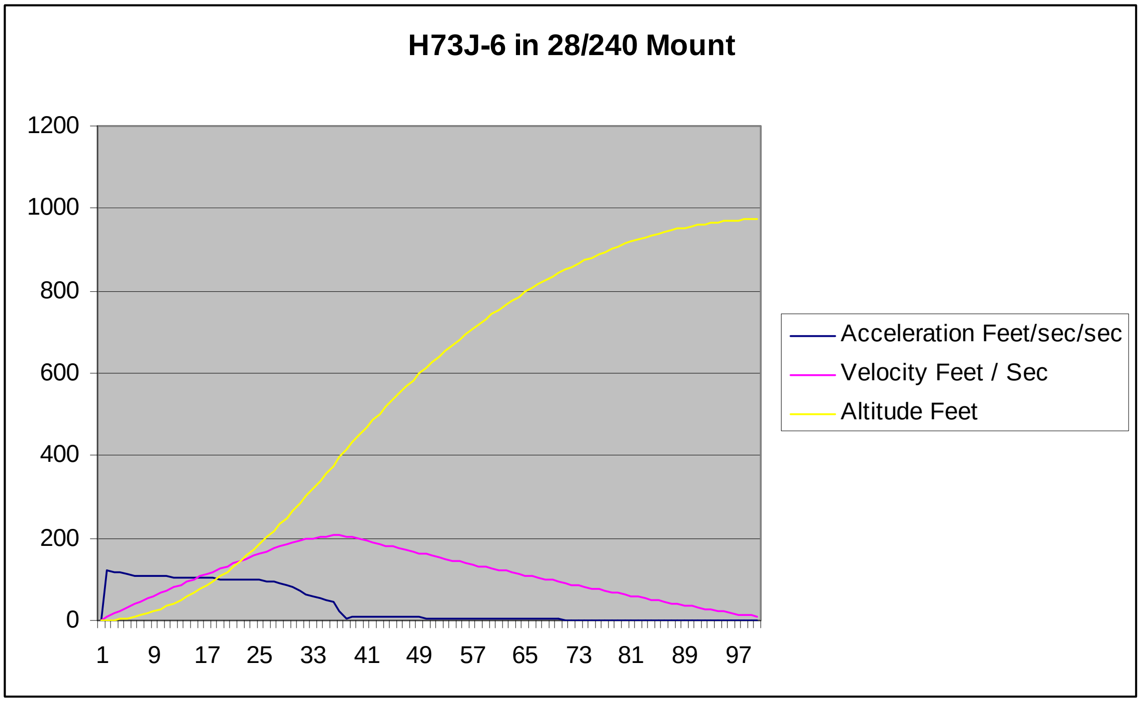


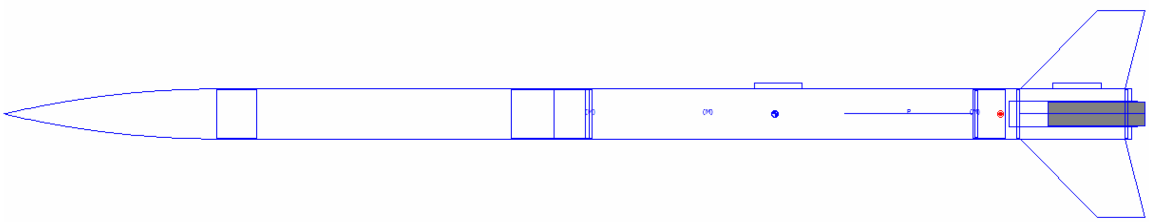
Patriot - Copyright 2007 All RIghts Reserved Madcow Rocketry
Length: 52.5000 In. , Diameter: 4.0000 In. , Span diameter: 8.5000 In.
Mass 62.8751 Oz. , Selected stage mass 62.8751 Oz. (User specified)
CG: 31.3862 In., CP: 36.3132 In., Margin: 1.23
Engines: [H73J-6,]



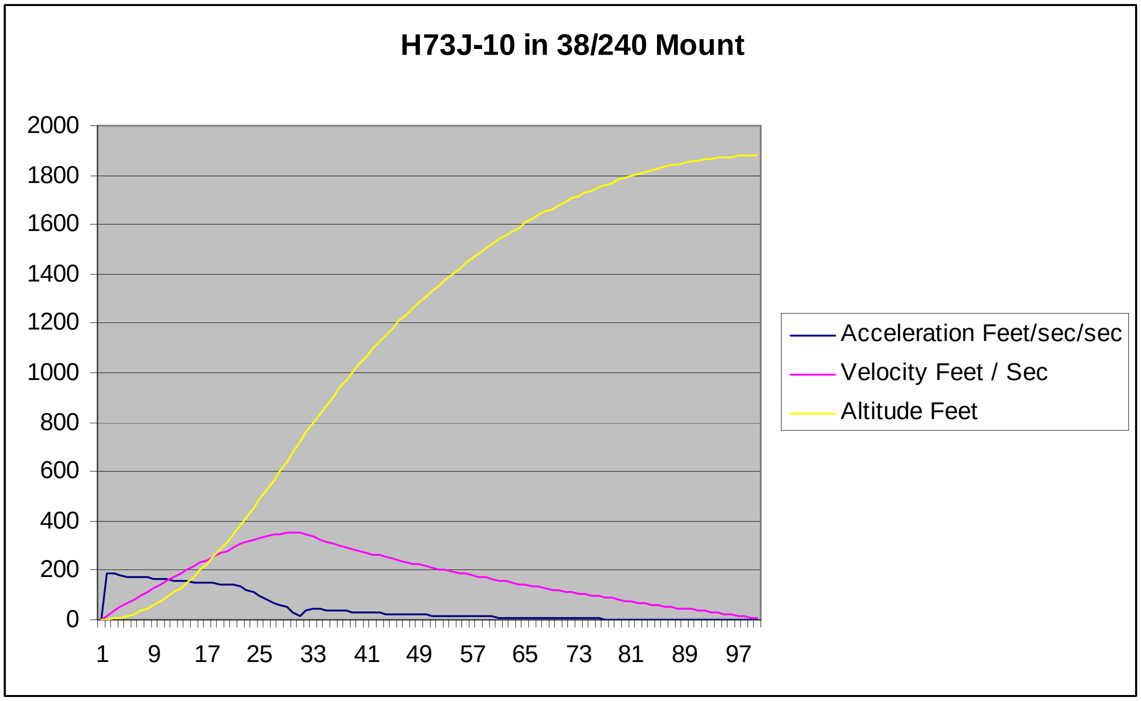


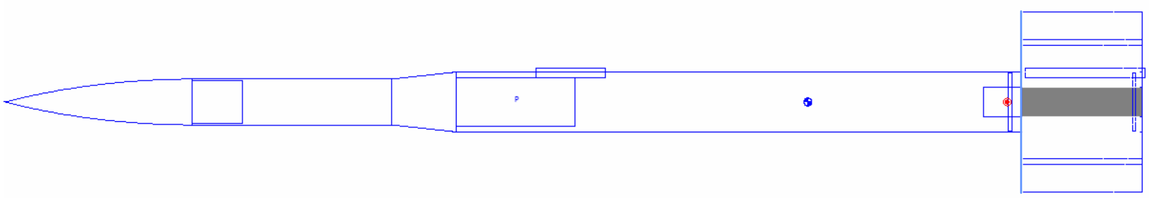
Public Missiles D-Region Tomahawk
Length: 71.1257 In. , Diameter: 3.1260 In. , Span diameter: 12.8760 In.
Mass 65.6925 Oz. , Selected stage mass 65.6925 Oz.
CG: 48.0461 In., CP: 62.1075 In., Margin: 4.54 Overstable
Engines: [H73J-10,]



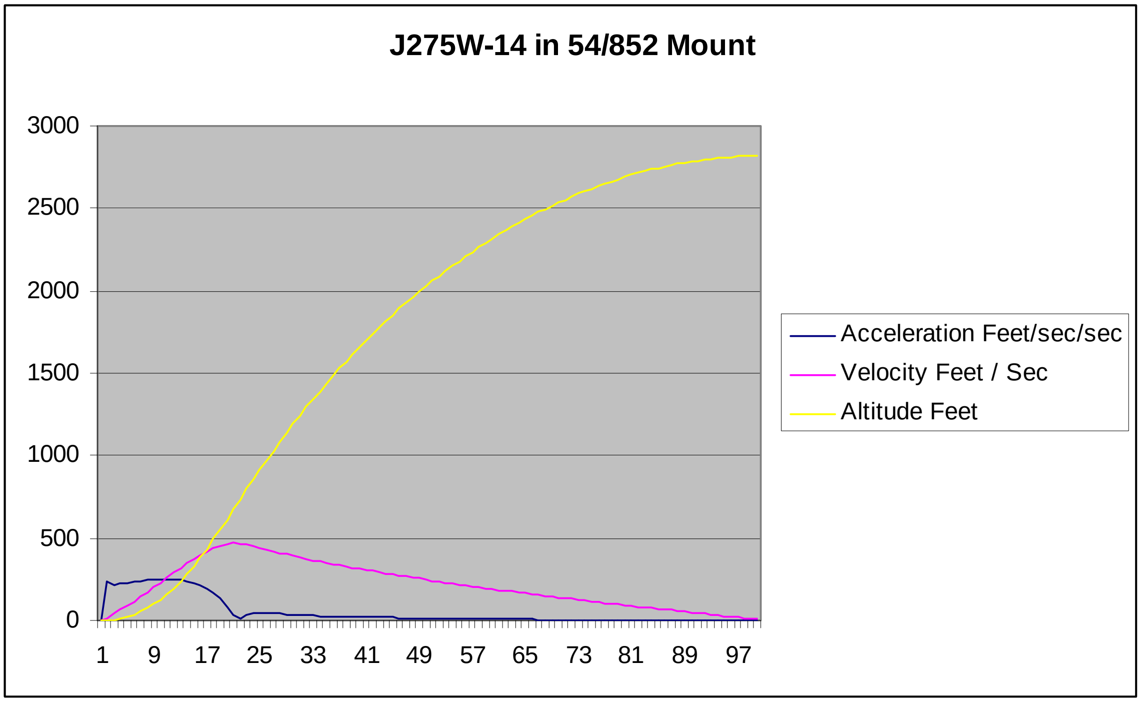


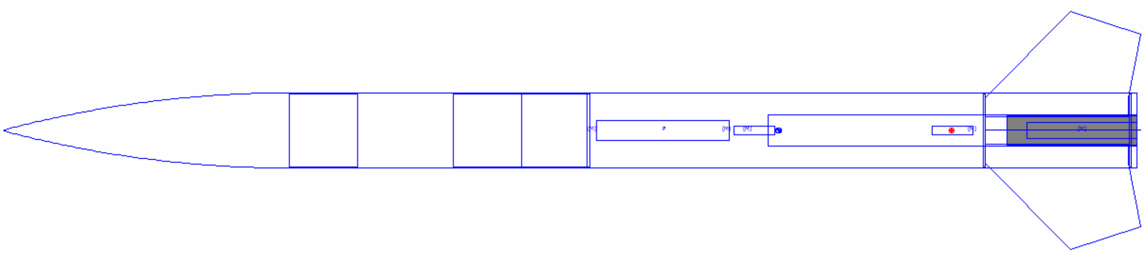
Cyclotron
Length: 57.3750 In. , Diameter: 3.0000 In. , Span diameter: 12.0000 In.
Mass 41.2275 Oz. , Selected stage mass 41.2275 Oz.
CG: 40.4401 In., CP: 50.4623 In., Margin: 4.36 Overstable
Engines: [H73J-10,]





PK-84 LOC Magnum
Length: 83.2950 In. , Diameter: 5.5400 In. , Span diameter: 20.0400 In.
Mass 159.7650 Oz. , Selected stage mass 159.7650 Oz.
CG: 56.7929 In., CP: 69.4507 In., Margin: 2.30
Engines: [J275W-14,]





Appendix 2

NWIC Space Center HPR Checklists

Pre Departure Checklist

Rocket Checklist

- ❑ Is the airframe and fins sufficient for the motor's thrust?
- ❑ Are the fins securely attached to the airframe without significant damage?
- ❑ Is the nose cone secure, but not too tight?
- ❑ Is the launch lug size sufficient for the rocket's weight and securely attached?
- ❑ Verify launch weight
- ❑ Verify Center of Gravity
- ❑ Check the rocket's CP vs. CG.
- ❑ Review Rocksim data for rocket/motor combination.
  - ❑ Does it have enough thrust for a stable flight off the launch pad?
  - ❑ Will the rocket attain a reasonable altitude so that the recovery system will safely deploy?
  - ❑ If motor ejection is used to deploy the recovery system, is the delay the right amount of time?

Range Box Checklist

- ❑ FRS Radios, load with fresh batteries
- ❑ Forceps
- ❑ Scissors
- ❑ Hammer
- ❑ Wet Wipes
- ❑ Weather Station
- ❑ Talcum Powder
- ❑ Duct Tape
- ❑ Screw Driver
- ❑ Batteries for Electronics
- ❑ DVM Multitester
- ❑ Igniters

Vehicle Checklist

- ❑ Motor Box
- ❑ HPR rockets
- ❑ HPR launch pad(s)
- ❑ Camera bag
- ❑ Camera tripod
- ❑ Laptop and AC inverter
- ❑ Weather station
- ❑ Tent/sunshade
- ❑ Chairs
- ❑ Table

Pre-Launch Checklist

This is the pre-launch checklist as required as part of the Level 3 Certification procedures. NWIC Space Center has modified it to fit our needs

Motor Preparation and Installation

- ❑ Prepare motor per packaged instructions for launch.
- ❑ Tape motor casing for snug fit in motor tube.
- ❑ Install motor.
- ❑ Install motor retaining devices.
- ❑ Insure all electronic deployment devices are in the non-dischargeable safed mode.

Recovery System Preparation

Recovery System Chute

- *Check piston if using one*

- ❑ body tube clean
- ❑ piston slides easily
- ❑ nylon cable untangled, clean, sound and secure

- *Check all connections. Insure all devices are in good condition and properly secured:*

- ❑ Shock cord to shock cord mount
- ❑ Shock cord to chute

- *Pack chute keep lines even and straight.*

- ❑ Fold main chute per manufacturer's instructions.
- ❑ Insure shroud lines are free from tangles.
- ❑ Insure all quick links are secure.
- ❑ Insert ejection charge protection.
- ❑ Insert main bag/chute into recovery compartment
- ❑ Check separation force between sustainer and payload/nose cone.
- ❑ Check nose cone security in place.

Electronics

Prepare avionics #1

- ❑ Be sure all arming switches are off.
- ❑ Ohmmeter test of *NEW* battery under load
- ❑ Install battery in altimeter.
- ❑ Secure battery in place with positive battery retention system.
- ❑ Altimeter properly programmed and verified.
- ❑ Connect aft pyrotechnic leads to electronic deployment device.
- ❑ Connect forward pyrotechnic leads to electronic deployment device

Prepare avionics #2

- ❑ Ohmmeter test of *NEW* batteries under load
- ❑ Install batteries in flight computer.
- ❑ Secure batteries in place with wire ties and tape.
- ❑ Flight computer properly programmed and verified.
- ❑ Install Avionics

Final Launch Preparations

Load Rocket on Pad

- ❑ Take rocket to assigned pad
- ❑ Prepare launch pad.
- ❑ Verify pad will hold rocket properly
- ❑ Mount proper rod/rail onto pad
- ❑ Tilt pad, slide rocket onto rod/rail
- ❑ Tilt pad/rocket upright
- ❑ Activate and final check electronics
- ❑ Verify pad power is OFF

Prepare Igniter

- ❑ Insert igniter. Be sure it is positioned correctly
- ❑ Secure igniter in position
- ❑ Assure that launcher is not hot. Assure that key IS NOT remote device and that arming switch is off.
- ❑ Attach leads to ignition device.
- ❑ Be sure all connectors are clean.
- ❑ Be sure they don't touch each other or that circuit is not grounded by contact with metal parts.
- ❑ Check tower's position and be sure it is locked into place and ready for launch.
- ❑ Assure that key IS NOT in remote device and that arming switch is off.

Final Launch Sequence

- ❑ Insure Flight Witnesses are in place and ready for launch.
- ❑ Arm all devices for launch.
- ❑ Return to Safe Area
- ❑ Ready cameras
- ❑ Signal LCO & RSO that rocket is ready for launch.
- ❑ Countdown and launch

Misfire Procedures

- ❑ Safe all pyrotechnics to pre-launch mode.
- ❑ Remove failed igniter
- ❑ Resume checklist at "Final Launch Preparations/Prepare Igniters."

Normal Post Flight Recovery

- ❑ Check for non-discharged pyrotechnics.
- ❑ Safe all ejection circuits.
- ❑ Remove any non-discharged pyrotechnics.

Flight Failure Checklist

- ❑ Disarm all non-fired pyrotechnic devices.
- ❑ Continue Normal Post Flight Recovery procedures.
- ❑ Fall on ground and cry.