LEVEL 3 ATTEMPT

"Miss Fire"

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TRA 7978, NAR 76945 - Level 2

This package submitted to the TAP members contains:

- overall plans
- rocket review sections with details
- data capture form
- airframe details
- parts list
- pre-flight details
- recovery system schematic
- RockSim/w-RASP simulations
- photos (pending) of Construction and drawings
    - booster,
    - backup system
    - airframe components

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A. General

I've been in this hobby a very short time and have achieved my Level 1 & 2 certifications. Now it's time to start building my level-3 certification rocket. After attaining my Level 3 goal I plan on concentrating on clustering and multi-staging. So I wanted my Level 3 Project to be a scratch built rocket, not a kit. It had to be a simple design capable of Level 3 and still be used with K & L motors. I'm going with simple, "three fins and a nose cone" rocket. I decided to build a simple rocket that would fall into the category of a basic rocket!

My simple rocket would have three fins, would use dual deployment, breaking above the booster section to deploy the drogue chute and between the upper payload section and nose cone for the main chute. I decided on a 4" airframe as a size that is easy to work with and would still allow future launches with a wide variety of K and L motors. As a good rule of thumb, I started using a 20:1 length to diameter ratio, yielding an 6'5" rocket, then added an altimeter bay and adjusted the length to accommodate motor, motor tube, baffle system, thus ending up with a 9'6'" rocket. This is still a handy size, while being large enough to handle a full M. So I plan a single motor mount for a 75mm motor (Level-3 certifications cannot be multi-stage or use clustering).

The data capture table and various diagrams are referenced in the appropriate sections. Printed versions of all information have also been submitted to the TAP members.

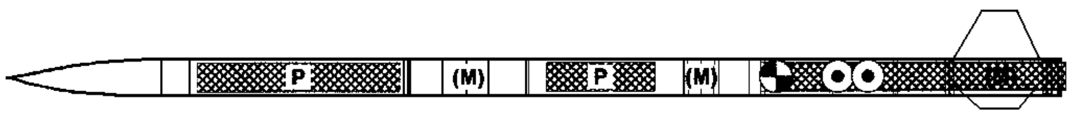
The entire airframe will be built after the modification of my Level 2 "Endeavour" to dual deployment simulating the design of "Miss Fire" with the dual deployment system and the recovery system outlined above to make it more reliable. Ejecting the 'chutes' out of the tube, I split the airframe for recovery at the point where the charges were located above and below the altimeter bay located in the center of the rocket. This means that the parachutes and rigging are pushed out of the tube after separation. This rearward and forward deployment worked very well with my modified Endeavour as planned for "Miss Fire" design.

B. Airframe

The design of the airframe is simple and intended to be purely functional. The rocket is approximately 9.5' long and the fins will be just larger than minimum for stability. The fins are trapezoidal, angled slightly forward to help avoid landing damage. The intention is to produce a simple, reliable, high-performance rocket. A rocket must maintain its rigidity in flight. Any tendency to bend will be magnified in flight resulting in a kinked tube and likely a failed flight. Holding the rocket horizontal by its tail section and any curvature in the rocket will need additional reinforcing of the airframe with coupling tubing being inserted and epoxied in place. This should not be a concern utilizing filament wound fiberglass tubing, See the overall sketch below. Note that this is a custom design, although everything was done according to standard practice, and will be named "Miss Fire."

The airframe tubes are 4" Pure Filament Wound Fiberglass tubes (100% compatible with Hawk Mountain Tubing) from Giant Leap. Construction uses mechanical means wherever possible and the adhesive used is West Systems epoxy (mostly using 404 high-density filler). The motor mount is attached to the airframe with five 3/8" centering rings, which are screwed as well as bonded to the airframe. The fins are triple laminated 0.125" G-10 fiberglass that has been covered with carbon fiber cloth to add weight and stiffen the fin to prevent fin shudder. They are attached to the motor mount tube with epoxy and reinforced with laminated fiberglass. The motor mount itself is a single 76-mm Pure Filament Wound Fiberglass tube (this is not a clustered flight). The flier, (with suggestions) will perform all construction.

Safety: There should be no dangers due to design since the rocket is simple and standard. Poor airframe construction could lead to a shred, but the materials and techniques employed are ones known to be standard for high power rocketry.



Stability data for Sustainer
Barrowman: CG: 82.385 In., CP: 88.966 In., CNa: 12.653 , Static margin: 1.66, The rocket is stable.
RockSim: CG: 82.385 In., CP: 92.172 In., CNa: 16.023 , Static margin: 2.45, The rocket is stable.

C. Recovery System

The recovery system attachments will use Rod Eyebolts (solid eye with a threaded rod) and 1500lb.quick links. The bulkheads are all 3/8" aircraft" birch plywood .with 1/8" aluminum plate sandwiched to the bulkheads for added strength. The bridles are 1" tubular Nylon. To avoid zippering, the aft section of the rocket uses an anti-zipper design (coupler and bulkhead/baffle protrude forward).

Rocketman Pro-XP or Sky Angle Cert 3 chutes are to be used in a dual-deployment configuration. The deployment system will use black powder charges to pressurize the airframe to 15 psi and deploy the parachute as is typical for high-power rockets.

Drogue recovery uses a Rocketman or Sky Angle Cert 3 'chute to achieve 50 ft/s descent and main recovery uses one Rocketman or Sky Angle Cert 3 'chute to achieve 15 ft/s descent. The drogue chute ejects from the separation above the booster section and the lower payload section of the rocket (the charges are behind the parachute) plus the parachute is attached along the bridle, not directly to the airframe. . The main parachute ejects from the front payload section of the rocket (the charges are behind the parachute) plus the parachute is again attached along the bridle, not directly to the airframe.

Both the main and drogue chutes are protected from the ejection charges utilizing Nomex chute pads. The bridles also have Nomex sleeves to protect them

Safety: A separation or failure to deploy the recovery system would be very dangerous on a rocket this large and heavy. Mounting points for the recovery system use rod eyebolts, aluminum plates bonded to the bulkheads and bonded fiberglass joints are reinforced with steel all-thread rods.

D. Avionics Description

Primary avionics will be an Olsen FCP-M2 and a redundant Altacc as the secondary system, since they have been proven in many flights. Each altimeter will have a separate power source and separate electric matches as well as separate black-powder charges. These units will be located in the center section. The Olsen FCP-M2'and the Altacc are armed from the outside (see wiring diagram) so no additional wiring is needed.

Since I am using redundant system, I don't want both charges to go off simultaneously. While the airframe should be strong enough to withstand this, it is clearly a good thing to avoid. One of ejection charges will go off at apogee and the other will utilize a 1.75 second delay.

The main chutes will be set to fire at 800 ft agl and the backup system at 500 ft agl.

Safety: Again, failure deploy the recovery system would be very dangerous on a rocket this large and heavy. 100% redundant altimeters should minimize this risk.

E. Motor

The motor will be the RMS-75/6400 motor used with the M1315W rocket motor reload kit, which is a Tripoli, certified. Motor Ignition will use a Fire-in-the-Hole igniter dipped in Igniterman pyrogen. The motor will push the rocket using the reloadable RMS-75/6400 Motor Hardware with the rear closure pressing against the motor mount and rear centering ring. Positive motor retention will use the Aeropack motor retainer system. The motor tube is closed at the forward end and no ejection charge will be used.

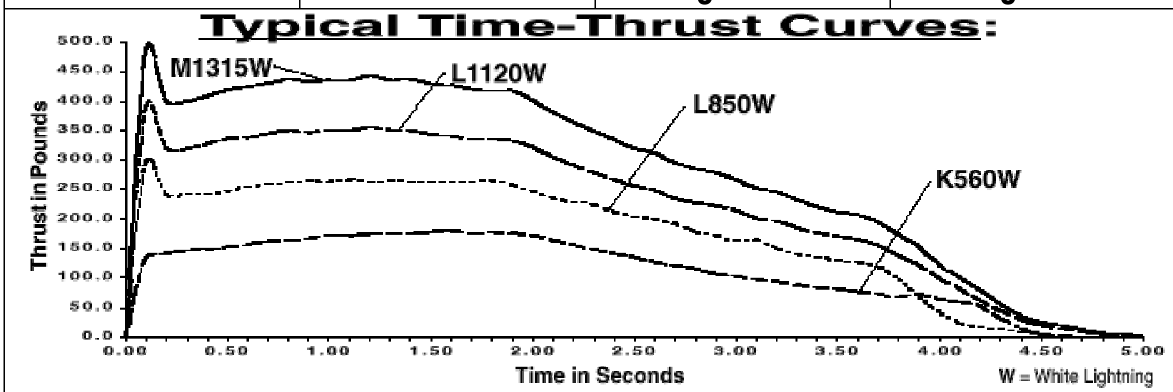
Safety: Using a well-known pre-manufactured motor should reduce the risk of a CATO or other failure to reasonable levels. A failure to ignite should pose no safety problems, and the motor is definitely powerful enough to lift the rocket. The motor mount/fin can has been strongly reinforced using fiberglass lamination to reduce the risk of shredding or losing a fin.

The dry weight of the rocket is estimated at 10.8# including the entire recovery system (reasonably light for such a heavily built 10' rocket). The candidate motor for this rocket is an M1315W for the certification flight . RockSim demo calculates the C.P. at 88.966" (Barrowman) and 92.172" (RockSim) and the average is 90.57". The C.G. is estimated at 82.385" and I will balance the rocket to determine the C.G. with simulations of the motor weight and add nose weight if needed to make the rocket quite stable with the M1315W.

Motor Designation RMS-75/6400

NOTICE: 75mm reload kits do not include a delay or ejection charge. These motors must be used in conjunction with a timer, altimeter or radio actuated recovery system.

Motor Diameter	Casing Length	Hardware Weight	Options Available
2.965" (75mm)	31.52"	1684 g	n/a
Reload Kit	Total Impulse	Propellant Wt.	Loaded Weight
M1315W	6400 N-sec	3351 g	5675 g



F. Launcher

The rocket will be fitted with Black Sky Research ProRail guides and can be launched from a standard 6' Blacksky Rail. Three guides will be used: one at the rear of the rocket, one about halfway to the C.G. and one on the altimeter bay (well forward of the C.G.).

There are no special launch requirements and I intend to launch the rocket straight up. Since this is a single-motor rocket, only a standard launch system is required. I intend on using a Black Sky rail mounted to a 1" pipe on a heavy duty (homemade) launch pad.

Safety: The projected speed of 76ft/s off the rail is above the user specified 55ft/s for windy conditions which is reached at 39.83" which is ample for a stable flight with this rocket and the loaded weight of around 25#. This is well within the capabilities of the Black Sky rail. Forty-four ft/s (30mph) is generally accepted as a minimum safe speed for stable flight. Faster speeds are necessary to achieve stability in windy conditions.

G. Performance

Rocket design and simulation was done with Apogee Component's RockSim (see Attachments.)

Safety: This rocket is a very standard design: three fins and a nose cone so standard stability and performance calculations should yield a close match to reality. Note that the rocket's basic shape makes it very stable so the allowable error for this rocket is minimal.

H. Operations/Pre-flight Checklist

As called for in the TAP Pre-Flight Review, the following pre-flight checklist has been prepared.

- Visually inspect for transportation damage
- Don Lexon glasses or face shield
- Replace batteries and test altimeters (safe all switches)
- .Load 4 ejection charges (apogee 2.3grams, main 2.3grams.)
- Attach (drogue) lower payload section & (main recovery) upper payload section with six 8-32 ss machine screws into nuts in altimeter bay.
- Pack main recovery system, Pack drogue recovery system and pin upper and lower payload sections with three 2-56 nylon shear pins each section
- Finish assembly of rocket
- Build M1315 (plugged) per mfg. instructions and install with retainer
- Load onto Blacksky rail
- Verify pad is not hot,
- Install igniter and connect to launch system and verify continuity
- Arm Olsen FCP-M2' and Altacc and verify continuity
- Arm ejection charges
- Return behind flight line
- Check cloud cover, any traffic in area and with RSO
- Launch
- Determine visually deployment of Recovery system (drogue and main)
- Post-flight Recovery
- Disarm any unfired ejection charges
- Visually inspect for damage

I. Parts List

The intention is to use general good practice high-power rocket techniques and materials throughout. Attention being paid to strength and redundancy. All metal hardware is stainless steel unless otherwise noted.

4" bt filament wound fiberglass 48"	1
4" bt filament wound fiberglass 36"	2
3" mt filament wound fiberglass 36"	1
4" ct 7" filament wound fiberglass	3
Fins 9" x 5"x 4" G-10 .375 thick	3
4" bt centering ring to 54mm	2
4" bt centering ring to 76mm	14
4" ct bulkhead 4hole/29 mm	10
4" bt bulkhead	8
4" ct bulkhead	4
g-10 stock.093 (square foot)	1
BlackSky rail guides	3
Rod Eyebolts w/washers and nuts	4
!/4" all-thread (Ft) w/washers and nuts	6 ft
1" tubular nylon/foot	60 ft
nose cone 3.90" PML PNC-390	1
Nomex chute protector	2
Nomex sleeves	2
main chute	1
drogue chute	1
AeroPack Motor Retainer 76mm	1
1/8" aluminum bulkhead plates	5
fiberglass cloth and tape	yards
carbon fiber cloth	yards
epoxy 20 min set w/fillers (west systems)	gallons
Sandpaper, paint primer, etc, etc	bunches

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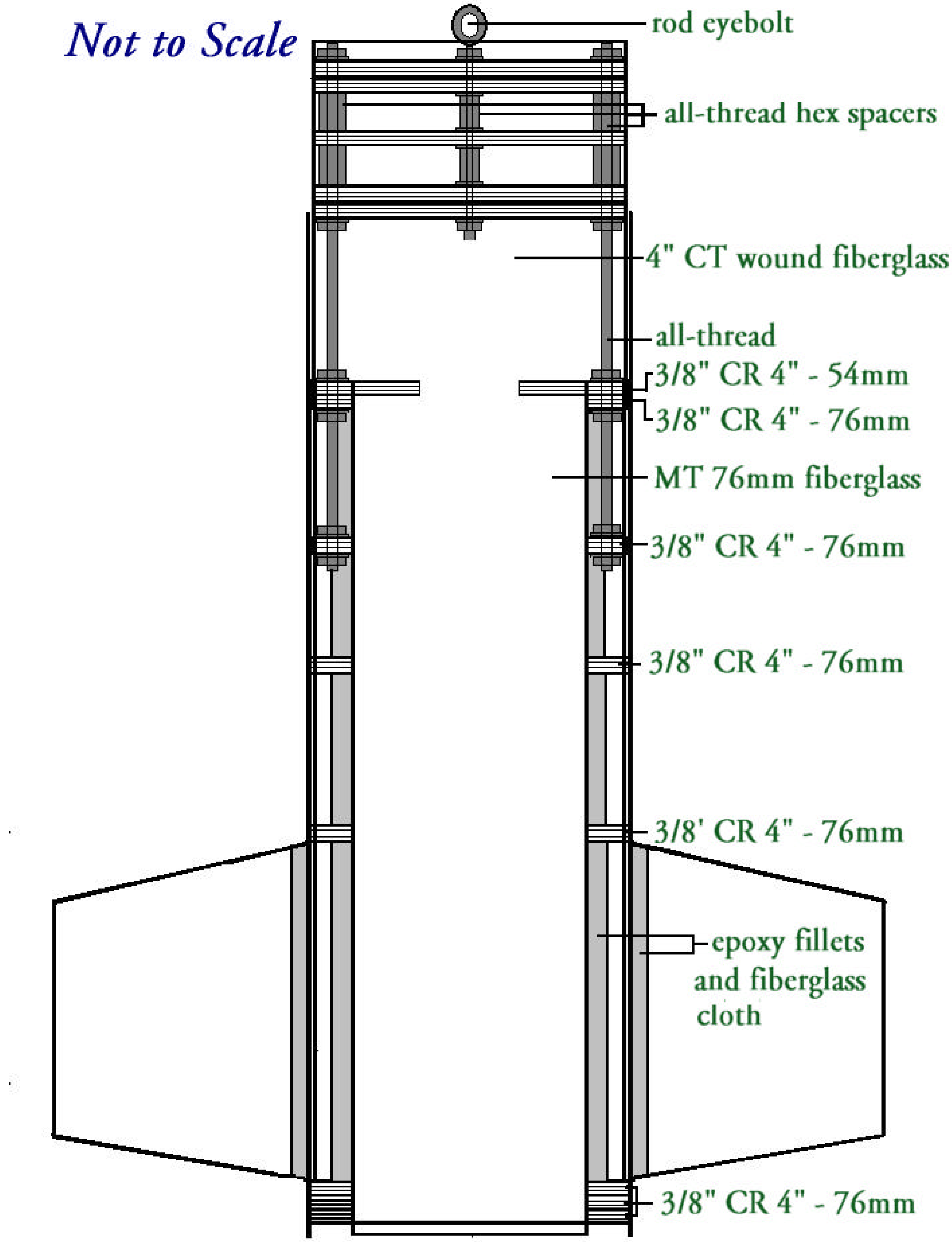
J. TAP Data

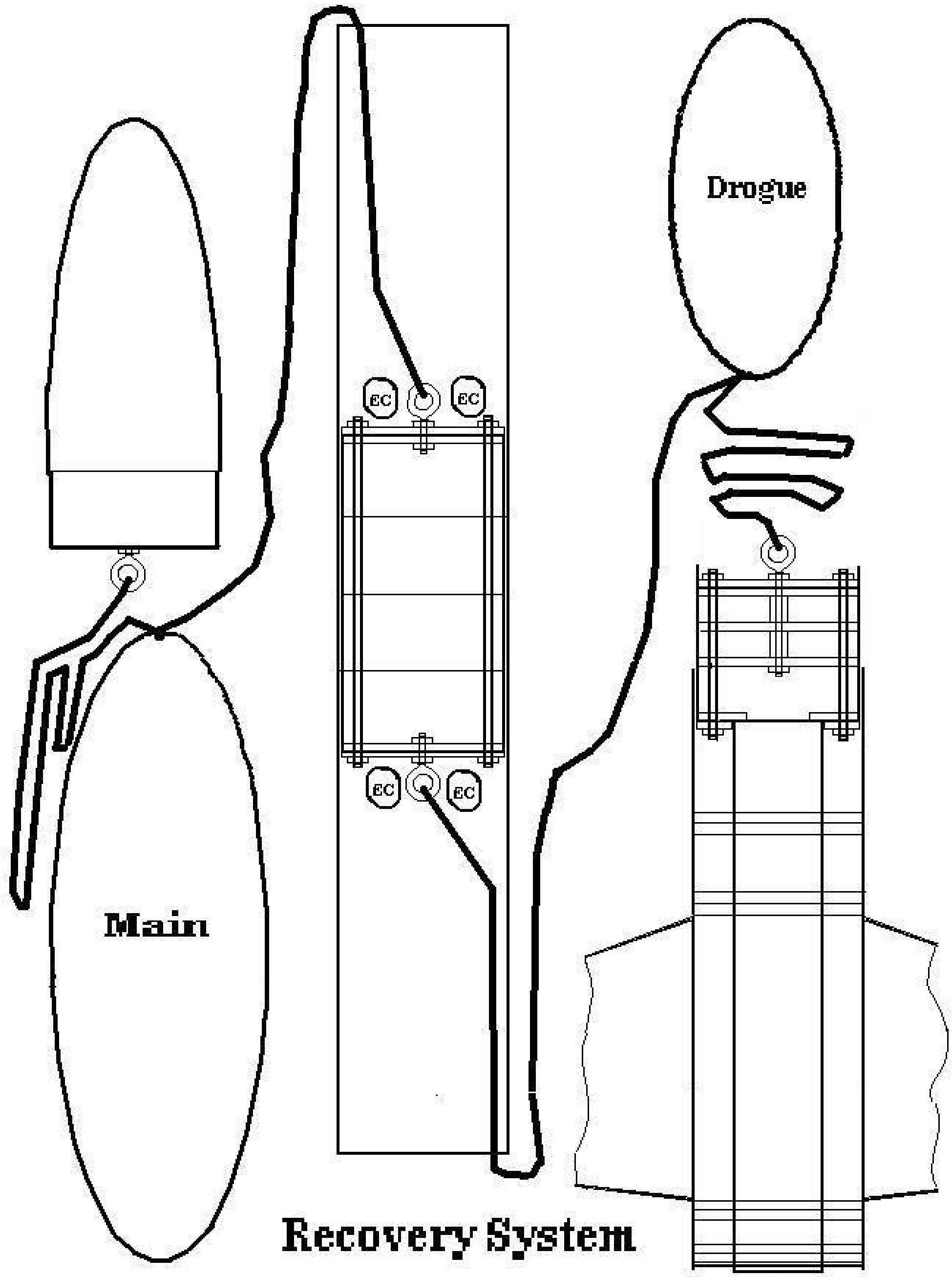
Name: Greg Sargent	Address: Harlingen, Tx. 78550	Phone #:
TRA #: 7978	Launch Location:	Date:
Rocket Source: Scratch	Rocket Name: "MISS FIRE"	Colors: Yellow/Black
Rocket Diameter: 4"	Rocket Length: 112.75 "	Rocket Weight, Loaded: 23.35 lbs. (373.75 oz)
Avionics Description: Olsen FCP-M2 and Altacc	Motor Type: Dr. Rocket 75mm/6400 RMS M1315	Thrust/Weight Ratio: 12.04 (greater than 5)
Launcher Requirements: BlackSky rail	Length: 6 ft. (72")	
Center of Pressure: 92.17" (Barrowman 88.96"):	How Calculated: RockSim	
Center of Gravity: 82.385"	How Calculated: RockSim	
Max. Velocity: 1462.37 ft/sec.	How Calculated: RockSim	
Max. Altitude: 14800 ft.	How Calculated: RockSim	
Successful flight:	Yes	No
TAP Committee Members:	Tom Montemayor	Stephan White

Attachments

- RockSim Data
- Drawings
  - Booster/Fin can
  - Recovery
  - Altimeter Wiring Diagram
- Construction Photos



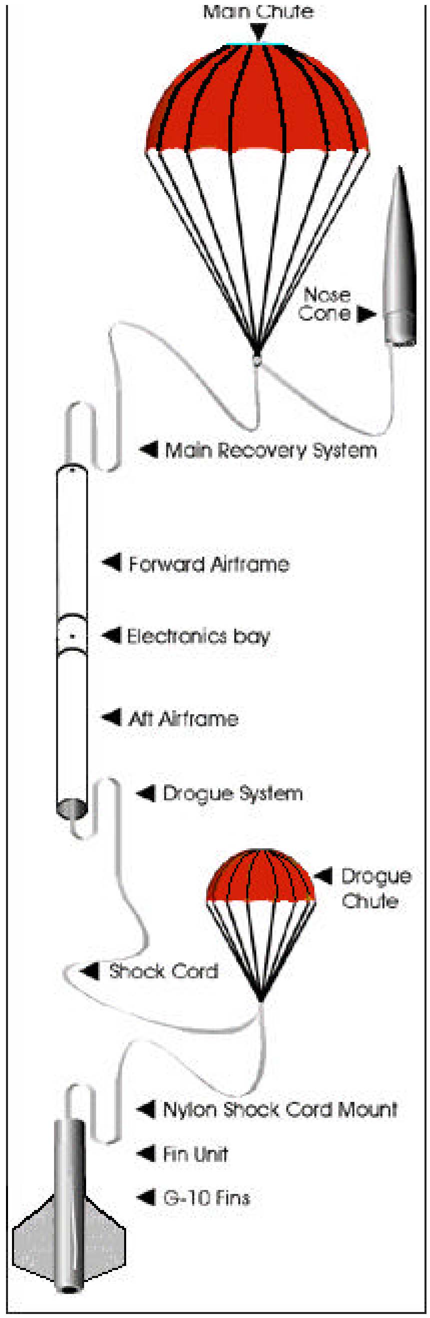
Booster/Fin Can Section
4" Filament-Wound Fiberglass Airframe



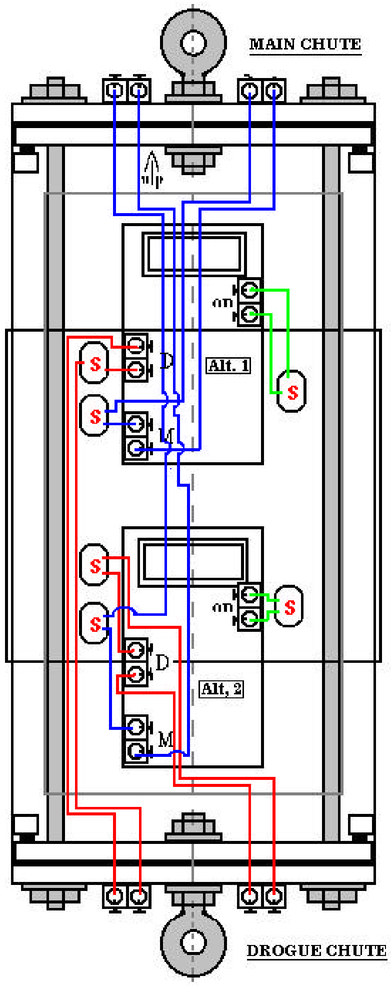
Recovery System

Dual Deployment

utilizing forward and aft deployment controlled by dual altimeters (main altimeter and back-up).



"Miss Fire" Altimeter Wiring Diagram



Miss Fire" utilizes an altimeter bay with 2 altimeters. One as the main altimeter and the second as a back up altimeter.

The Main altimeter will fire the drogue chute ejection charge at apogee and the main chute ejection charge at 800 feet.

The back-up altimeter will fire the drogue chute charge 1.75 seconds after apogee and the main chute ejection charge at 500 feet.

Both altimeters are wired to external switches to arm the altimeter and the ejection charges prior to launching. This feature is installed as a safety measure. (see diagram)

- Simulation detail report

- Simulation results
  - Engine selection
    - [M1315W-21}
  - Comments
    - **0 mph**
  - Simulation control parameters
    - Resolution: 1000 samples / second.
    - Simulation method: Explicit Euler.
  - Launch conditions
    - Altitude: 0.000 Ft.
    - Relative humidity: 50.000 %
    - Temperature: 84.992 Deg. F
    - Pressure: 29.920 In. Hg
    - Wind speed:0.000
    - Wind starts at: 0.000 Ft.
    - Launch guide angle: 0.000 Degrees from vertical
    - Latitude: 45.000 Degrees

Results
- Maximum acceleration: Vert: 519.500 Feet/sec/sec, Horz: 0.0000 Feet/sec/sec, Magnitude: 519.500 Feet/sec/sec
- Maximum velocity: Vert: 1473.460 ft/s, Horz: 0.000 ft/s, Magnitude: 1473.460 ft/s
- Maximum range from launch site: 0.000 Ft.
- Maximum altitude: 14929.926 Ft.
- Velocity at deployment: 10.579 ft/s
- Altitude at deployment: 14929.926 Ft.
- Launch guide length: 72.000 in.
- Velocity at launch guide departure: 76.177 ft/s
- The launch guide was cleared at: 0.212 Seconds
- User minimum velocity for stable flight: 55.000 ft/s
- Minimum velocity for stable flight reached at: 39.331 In.

The recovery system deployed at apogee. Perfect!

Time information
- Time to burnout: 5.949 Sec.
- Time to ejection: 26.949 Sec.
- Time to apogee: 27.279 Sec
- Optimal ejection delay: 21.330 Sec.

- Simulation detail report

- Simulation results
  - Engine selection
    - [M1315W-21}
  - Comments
    - **5 mph**
  - Simulation control parameters
    - Resolution: 1000 samples / second.
    - Simulation method: Explicit Euler.
  - Launch conditions
    - Altitude: 0.000 Ft.
    - Relative humidity: 50.000 %
    - Temperature: 84.992 Deg. F
    - Pressure: 29.920 In. Hg
    - Wind speed: 4.999
    - Wind starts at: 0.000 Ft.
    - Launch guide angle: 0.000 Degrees from vertical
    - Latitude: 45.000 Degrees

Results
- Maximum acceleration: Vert: 518.988 Feet/sec/sec, Horz: 9.984 Feet/sec/sec, Magnitude: 519.536 Feet/sec/sec
- Maximum velocity: Vert: 1472.364 ft/s, Horz: 0.000 ft/s, Magnitude: 1473.385 ft/s
- Maximum range from launch site: 0.001 Ft.
- Maximum altitude: 14911.898 Ft.
- Velocity at deployment: 25.350 ft/s
- Altitude at deployment: 14911.989 Ft.
- Launch guide length: 72.000 in.
- Velocity at launch guide departure: 76.177 ft/s
- The launch guide was cleared at: 0.212 Seconds
- User minimum velocity for stable flight: 55.000 ft/s
- Minimum velocity for stable flight reached at: 39.331 In.

The recovery system deployed at apogee. Perfect!

Time information
- Time to burnout: 5.949 Sec.
- Time to ejection: 26.949 Sec.
- Time to apogee: 27.257 Sec
- Optimal ejection delay: 21.308 Sec.

- Simulation detail report

- Simulation results
  - Engine selection
    - [M1315W-21}
  - Comments
    - **10 mph**
  - Simulation control parameters
    - Resolution: 1000 samples / second.
    - Simulation method: Explicit Euler.
  - Launch conditions
    - Altitude: 0.000 Ft.
    - Relative humidity: 50.000 %
    - Temperature: 84.992 Deg. F
    - Pressure: 29.920 In. Hg
    - Wind speed:9.999 MPH
    - Wind starts at: 0.000 Ft.
    - Launch guide angle: 0.000 Degrees from vertical
    - Latitude: 45.000 Degrees
  - Results
    - Maximum acceleration: Vert: 517.730 Feet/sec/sec, Horz: 18.942 Feet/sec/sec, Magnitude: 519.615 Feet/sec/sec
    - Maximum velocity: Vert: 1469.609 ft/s, Horz: 0.000 ft/s, Magnitude: 1473.298 ft/s
    - Maximum range from launch site: 0.011 Ft.
    - Maximum altitude: 14865.259 Ft.
    - Velocity at deployment: 45.030 ft/s
    - Altitude at deployment: 14865.259 Ft.
    - Launch guide length: 72.000 in.
    - Velocity at launch guide departure: 76.177 ft/s
    - The launch guide was cleared at: 0.212 Seconds
    - User minimum velocity for stable flight: 55.000 ft/s
    - Minimum velocity for stable flight reached at: 39.331 In.

  - The recovery system deployed at apogee. Perfect!
  - Time information
    - Time to burnout: 5.949 Sec.
    - Time to ejection: 26.949 Sec.
    - Time to apogee: 27.204 Sec
    - Optimal ejection delay: 21.255 Sec.

- Simulation detail report

- Simulation results
  - Engine selection
    - [M1315W-21}
  - Comments
    - **15 mph**
  - Simulation control parameters
    - Resolution: 1000 samples / second.
    - Simulation method: Explicit Euler.
  - Launch conditions
    - Altitude: 0.000 Ft.
    - Relative humidity: 50.000 %
    - Temperature: 84.992 Deg. F
    - Pressure: 29.920 In. Hg
    - Wind speed: 14.999
    - Wind starts at: 0.000 Ft.
    - Launch guide angle: 0.000 Degrees from vertical
    - Latitude: 45.000 Degrees

Results
- Maximum acceleration: Vert: 509.583 Feet/sec/sec, Horz: 24.763 Feet/sec/sec, Magnitude: 512.284 Feet/sec/sec
- Maximum velocity: Vert: 1493.253 ft/s, Horz: 0.000 ft/s, Magnitude: 1500.105 ft/s
- Maximum range from launch site: 0.056 Ft.
- Maximum altitude: 15571.401 Ft.
- Velocity at deployment: 71.927 ft/s
- Altitude at deployment: 15571.401 Ft.
- Launch guide length: 72.000 in.
- Velocity at launch guide departure: 75.499 ft/s
- The launch guide was cleared at: 0.213 Seconds
- User minimum velocity for stable flight: 55.000 ft/s
- Minimum velocity for stable flight reached at: 40.020 In.

The recovery system deployed at apogee. Perfect!

Time information
- Time to burnout: 5.949 Sec.
- Time to ejection: 26.949 Sec.
- Time to apogee: 28.052 Sec
- Optimal ejection delay: 21.103 Sec.