Electronic Deployment

and a little bit of recovery too!

By: Gerald Meux, Jr.

NAR and TRA Level 3

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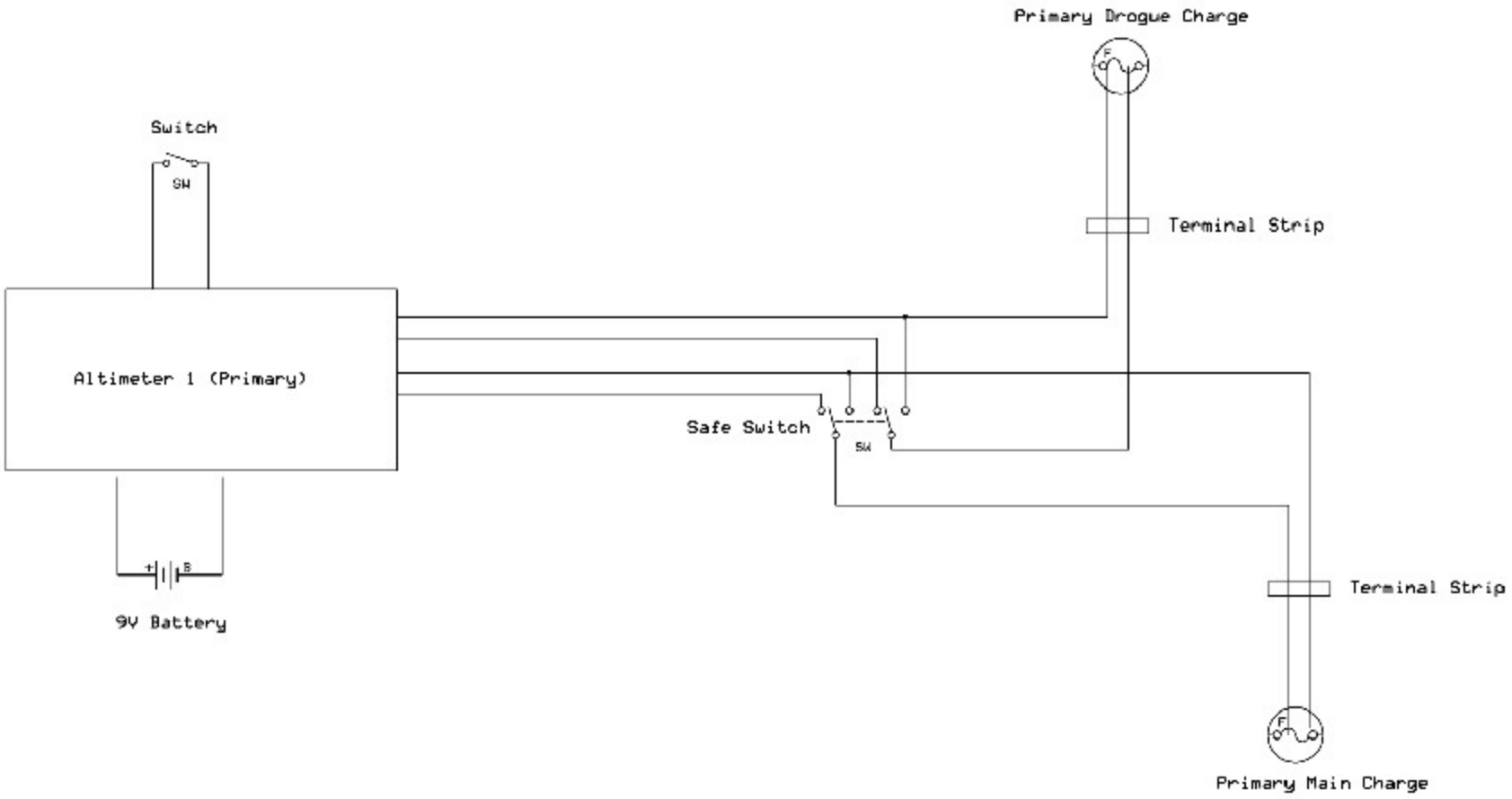
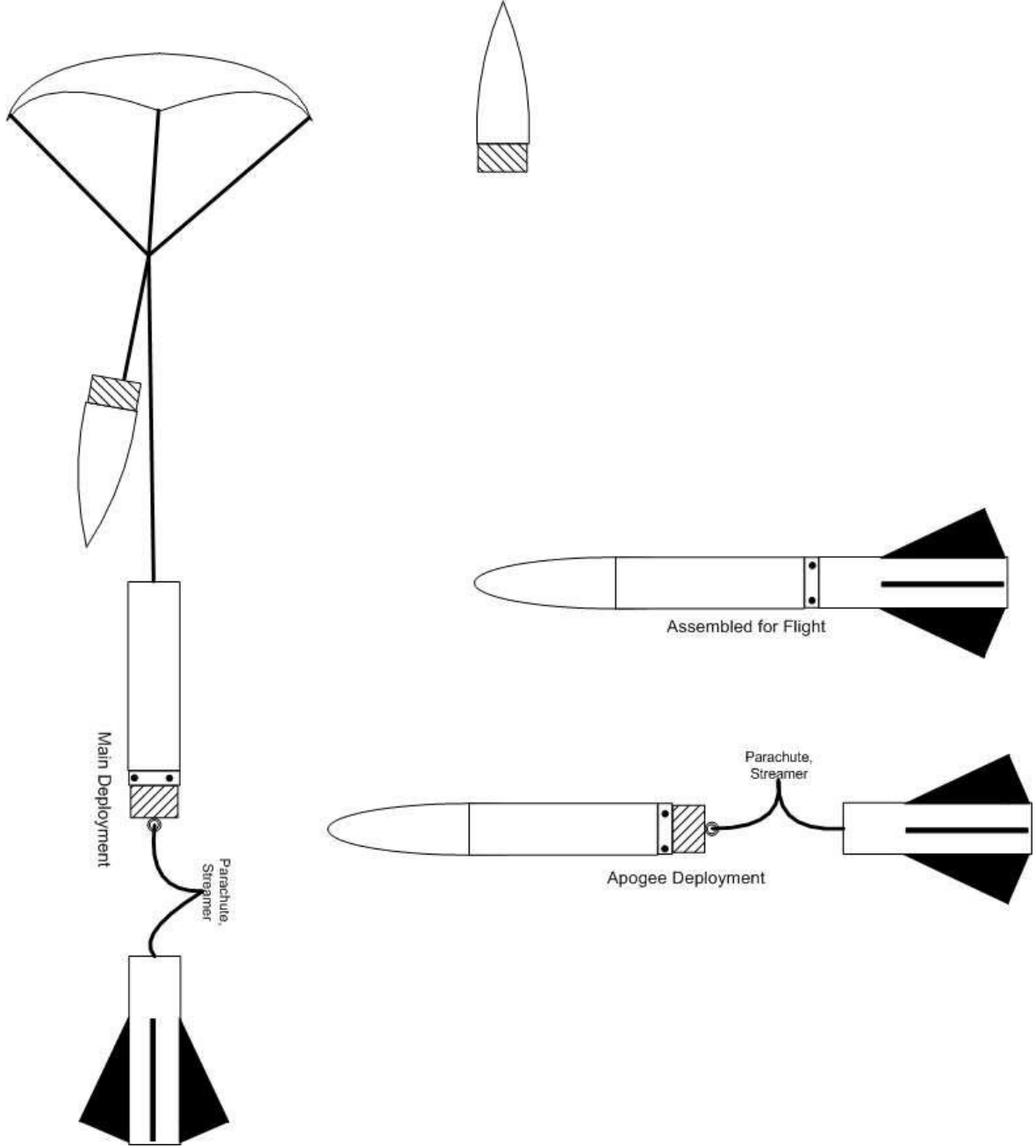
Ask yourself….

- What are you into in regards to electronic deployment?
- Getting rocket back?
  - simple/cheapest setup usually works best
- Getting rocket back and DATA of flight?
  - More complicated set up
  - Higher risk = higher reward (yay data!)

Wiring Diagram

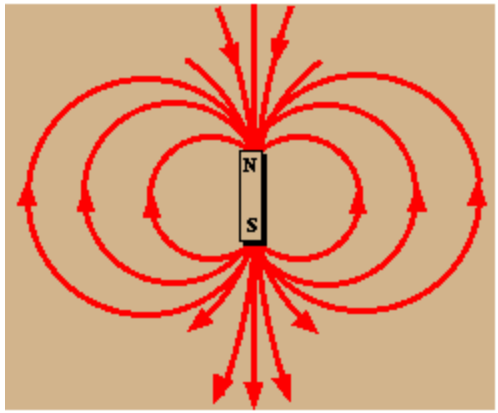


Example of Electronics Bay


Main Deployment
Parachute, Streamer
Assembled for Flight
Parachute, Streamer
Apogee Deployment

Types of Electronic Deployment Sensory

- Barometric
  - Change in air pressure
- Accelerometer
  - Change in speed of rocket
- Magnetic
  - Change in rocket orientation with starting position
  - http://www.aeroconsystems.com/electronics/mad.htm
- Timer
  - Activated by accelerometer or break wire
- Remote Control
  - Activated by operator (or whoever has the transmitter!)

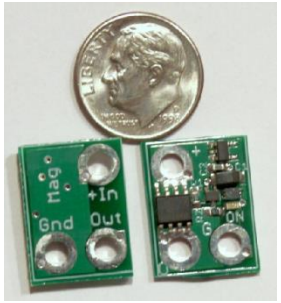


Switches

- Standard Switch
  - Slide (Like a light switch) or push button
  - Varies in size in application (SPST, DPDT, ect)
  - Can hide switch inside altimeter bay
  - If this switch is on the exterior of the rocket be careful of recovery not to hit switch and turn off
  - Can get fairly easy at stores such as Wal-Mart, Home Improvement Store, RadioShack, ect.

- Rotary/Key
  - A good switch to go with, robust
  - Have to drill a large hole into rocket if mounted on the exterior (5/8” Hole)
  - Spendy
  - Aerocon has the market on these switches ($5/switch)
  - http://aeroconsystems.com/cart/switches/through-mount-slotted-switch/

- Twist and Tuck
  - Expose wires on the exterior, twist and stick back inside rocket
  - Need a stop black so wires aren’t pulling on altimeter when exposed
  - Enter and exit hole with tape covering once on works best
  - If only can use one hole, the hole altimeter has to be disassembled to power off, can be dangerous
  - Risky is altimeter is sensitive, touch quickly
- Screw Switch
  - As simple as it sounds
  - Can make your own
  - Aerocon: http://aeroconsystems.com/cart/switches/pcb-screw-switch/
  - Featherweight Altimeters: http://www.featherweightaltimeters.com/Av-Bay_Components.php
- Magnetic Switch
  - New technology
  - Normally Closed Switch
  - Active Switch, will drain battery (slowly)
  - Featherweight Altimeters: http://www.featherweightaltimeters.com/Av-Bay_Components.php



Batteries

- 9V Batteries
  - Easiest to get
  - Altimeters base their functionality off this battery
  - YES, they can be used for multiple flights, always check voltage before each flight.
  - Depending on speed of flight, battery types matter (are the 1.5V Cells contact or solder?)
  - Duracell and Werker Brand are Solder
  - Depending speed of flight and energy of deployment, mounting of battery matters!
    - Using 9V Batter Holder is recommended
    - There are several types out on the market
    - Zip ties are always a great security blanket and highly encouraged to be used. Most battery holders secure the battery in one direction.

- Lithium Polymer Batteries
  - Different sizes, shapes, voltages, and amperages
  - CAREFUL WITH CHARGING AND DISCHARGING RATES!!!
  - Need special charger that is expensive
  - Featherweight Altimeters uses this for Raven:
    - http://www.featherweightaltimeters.com/Av-Bay_Components.php

Barometric Sensor

- If you are using this type of altimeter, there needs to be a vent hole to outside air so it can measure the pressure difference.
- The size of the hole is based off the space where the altimeter is.
- Use 1/4" diameter hole for every 100 cubic inches in the altimeter bay compartment that is being vented.
- It is not recommended to have vent hole that is behind any obstructions or other holes, can negatively affect the readings.

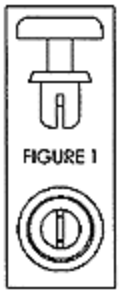
- If you are using a G-Switch for the altimeter or timer, ensure that it is oriented in the right direction. If not, it does not work.

Barometric Sizing Chart

Body Tube Inside Diameter	Drill Size for 3 Pressure Port Holes					
	3/32	1/8	5/32	3/16	7/32	1/4
1.145	40.97	72.84	113.81	163.89	223.07	291.35
1.525	23.10	41.06	64.16	92.39	125.75	164.24
2.152	11.60	20.62	32.22	46.39	63.15	82.48
2.560	8.20	14.57	22.77	32.78	44.62	58.28
3.002	5.96	10.60	16.56	23.84	32.45	42.38
3.900	3.53	6.28	9.81	14.13	19.23	25.11
5.375	1.86	3.31	5.16	7.44	10.12	13.22
7.512	0.95	1.69	2.64	3.81	5.18	6.77
11.410	0.41	0.73	1.15	1.65	2.25	2.93
	Maximum compartment length in inches					

Things to think about for Electronic Deployment

- Altimeter Redundancy
  - Reasoning
  - Completely independent? What are both dependent on?
- Switch Redundancy
  - One switch operate both altimeters?
  - Wired a break wire into same power switch?
- Terminal Blocks
  - European Style
- Wires
  - Gauge and Solder
- How to mount bay to rocket
  - Bolt in, glue in, or use rivets?



Types of Recovery Activators

- With Black Powder or Pyrodex
  - Electric match
    - Most Common
    - Many varieties (Estes, Quest Q2, Davey Fire, MJG Technologies)
    - http://www.electricmatch.com/product_us.html
    - Check resistance/firing amps for safety
  - Christmas Tree Light Bulb
    - From PerfectFlite
    - I like to use to test
  - Flash Bulb

- CO2
  - Rouse Tech CD3
    - Reason: High Altitude
    - http://www.rouse-tech.com/recovery.htm
    - Cost is $100 for system
- Mechanical
  - May be needed with high altitude or heavy

Shear Pins

- To prevent drag separation (early deployment) or having a compartment separating early it is recommended to you nylon shear pins to hold the compartments together until it needs to separate.

- #2 or 2-56 Shear around 35lbs of force
- #4 or 4-40 Shear around 50lbs of force
  - So it takes 70lbs of force to shear 2 #2's or 10

- It is not recommended to use just one shear pin, the part that is being retained could get cocked and stuck.
- There also needs to be a vent hole present in the compartment(s) for the recovery area so there isn't pressure build up in the compartment if using black powder.

- http://www.feretich.com/Rocketry/Resources/shearPins.html

Black Powder or Pyrodex

- Goex FFFFG Black Powder (Check your labels)
  - 4F best chance to burn completely and quickly
  - Have to order online or purchase at rocket launch
    - Cabela's doesn't have it, a specialty gun store may carry it.

- Pyrodex
  - Pyrodex is more energetic per unit of mass than black powder, but it is less dense, and can be substituted at a 1:1 ratio by volume for black powder in many applications.
  - It needs a greater degree of confinement to ensure a complete burn and generation of sufficient ejection pressure.
  - There is no know 4F Black Powder Equivalent
  - Can Be purchased at Cabela's
  - http://www.pyrodex.com/

Black Powder Sizing

- Math for smaller diameters:
  - $N = 0.006*D^2L$ (grams)
- Math for larger diameter rockets
  - $N = 0.00052*FL$ (grams)

- N = number of grams needed for rocket (unknown)
- D= Diameter of Body Tube (in)
- L= Length of parachute compartment (in)
- F= Force of ejection (300-350lbs good rule of thumb) (lb)

- http://vernk.com/EjectionChargeSizing.htm

Black Powder Sizing Chart

Body Tube Inside Diameter	Estimated Ejection Charge Size
1.53 inch	0.5 grams per 36 inches of length
2.15 inch	1 gram per 36 inches of length
2.56 inch	1 gram per 25 inches of length
3.00 inch	1 gram per 18 inches of length
3.90 inch	1 gram per 11 inches of length
5.38 inch	1 gram per 6 inches of length
6.00 inch	1 gram per 6 inches of length
7.51 inch	1 gram per 6 inches of length

Where to put the black powder

- Can be mounted against bay plate.
  - More rigid and best for main area (if standard configuration)
  - Not the greatest for drogue area (if standard configuration)
  - Can use PVC cap or Blastcap
    - http://www.blastcaprocketry.com/

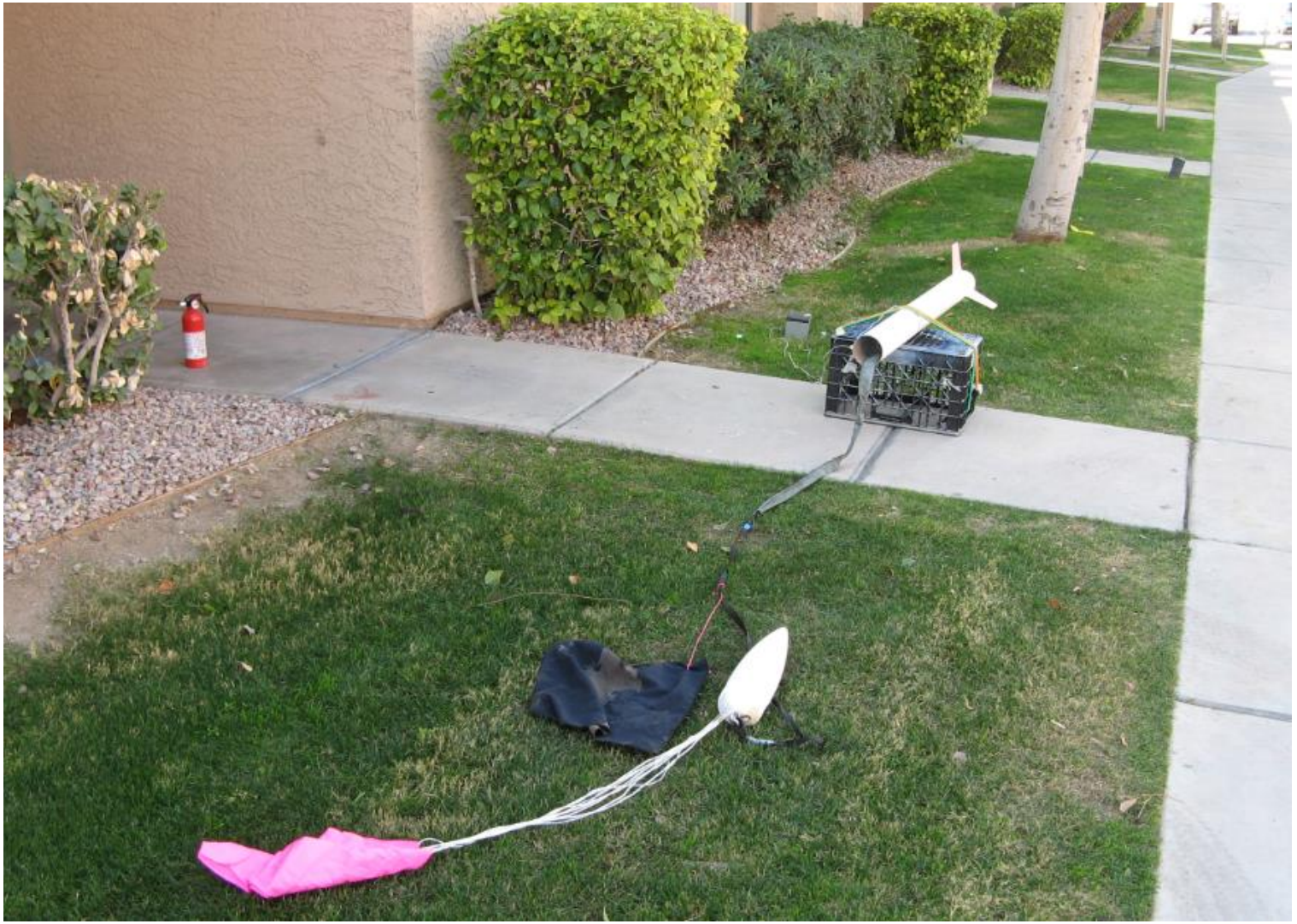
Where to put the black powder

- Wires run long and free
  - Take more time on placement of charges.
  - If charge is running behind drogue chute, be careful of the wires tangling with the shock cord.

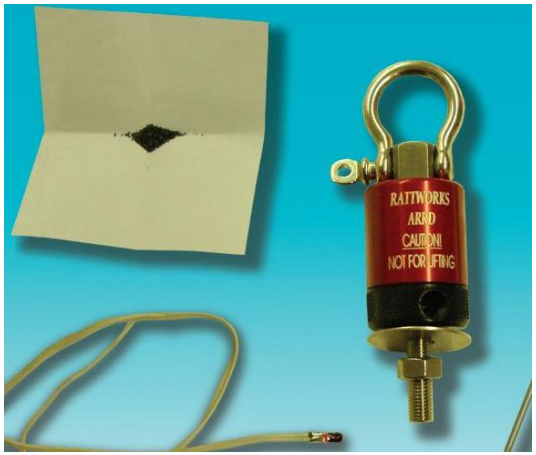
Ground Testing

- It is always recommended to ground test your recovery system to ensure you are using enough black powder.
- It can be done as simply running the charge wire outside of the rocket to any batter or as complicated as testing it through the altimeter's interface (should it have one)

Ground Testing



Dual Deploy Tether



Parachute Types

- Rocketman/Sky Angle/Giant Leap Type (Panel)
- X-Form
- Spherical
- Military Surplus
- Star Shape

- Streamers
  - Need something for dual deplotment

Parachute Sizing

- Sizing
  - Best decent for main recovery is 20 feet/second or slower
  - Math:
    - Diameter in inches = sqrt(rocket_weight_in_pounds * 0.454) * 39.6
  - Or check manufacturer specs for decent rates based on rocket weight before purchasing your parachute

Hardware

- Nuts and Bolts
- Eyebolts
- Quick Links
- U-Bolts
- Swivels

Shock Cord

- Rule of thumb you want the cord to be 3X length of the entire length of the rocket.
- Materials
  - Tubular Nylon
    - 9/16” = 2000lbs
    - 1” = 4000lbs
  - Kevlar®
    - 1/4”= 1200lbs
    - 3/8” = 3600lbs

Protection

- Shock Cord Protector
  - Can also use tape as an alternative
- Parachute
  - Cellulose insulation
  - Nomex®/Kevlar® Blanket
  - Nomex®/Kevlar® Deployment Bag
- Anit-Zipper
  - Giant Leap Fireball
  - Foamie
  - Hose Clamp around body tube

Altimeters

- PerfectFlite
  - Know for MAWD, HiAlt45K, and Timers. Now have new products
  - http://perfectflite.com/index.html