NATIONAL ASSOCIATION OF ROCKETRY LEVEL 3 HIGH POWER CERTIFICATION

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NAR #89354 L3CC

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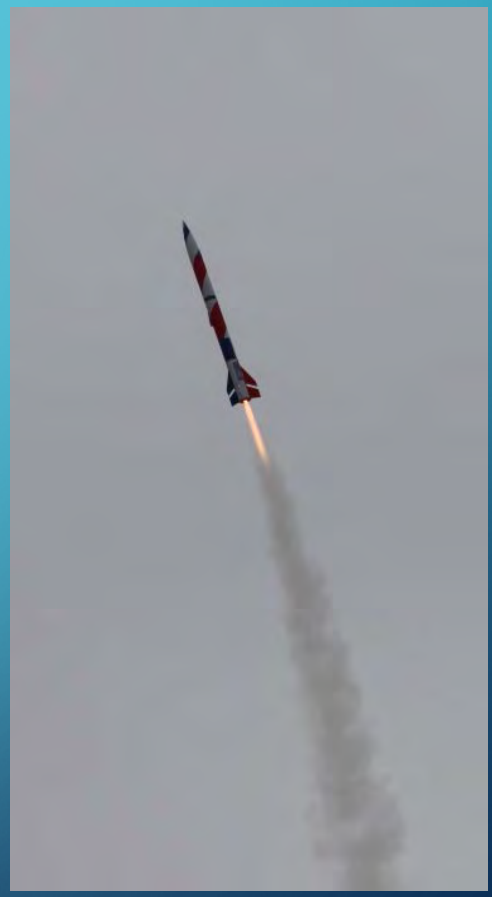
CERTIFICATION PACKAGE – MAIN PARTS

- Construction and Recovery Packages
- Calculation of center of pressure
- Description of flight profile (simulation) and which program used
- Prelaunch checklist covering airframe, electronic and motor preparation
- Post-recovery checklist for safing the rocket in the event of a failure
- A declaration of any design feature designed for break away or easy replacement, such as shear pins

FLYER REQUIREMENTS

- Must be a L2 high power certified NAR member in good standing
- Cannot submit a design for a Level 3 certification to the L3CC until Level 2 Certification has been successful*



- *from the NAR Level 3 High Power Certification requirements

LEVEL 3 ROCKET REQUIREMENTS

- The rocket must be substantially built by the flyer. At a minimum, this means
  - The engine mount
  - Alignment and mounting of the individual fins – prefab fin cans are disallowed
  - Installation of the attachment points for the recovery harness
  - Mounting and installation of the airframe electronics
  - Flight preparation including pyrotechnics installation, packing of recovery system, motor assembly and motor installation
- Certification rockets may be built from commercially available kits and may contain components built to the specifications of the certifying flyer but fabricated by others. For example, custom nosecones or recovery harness.

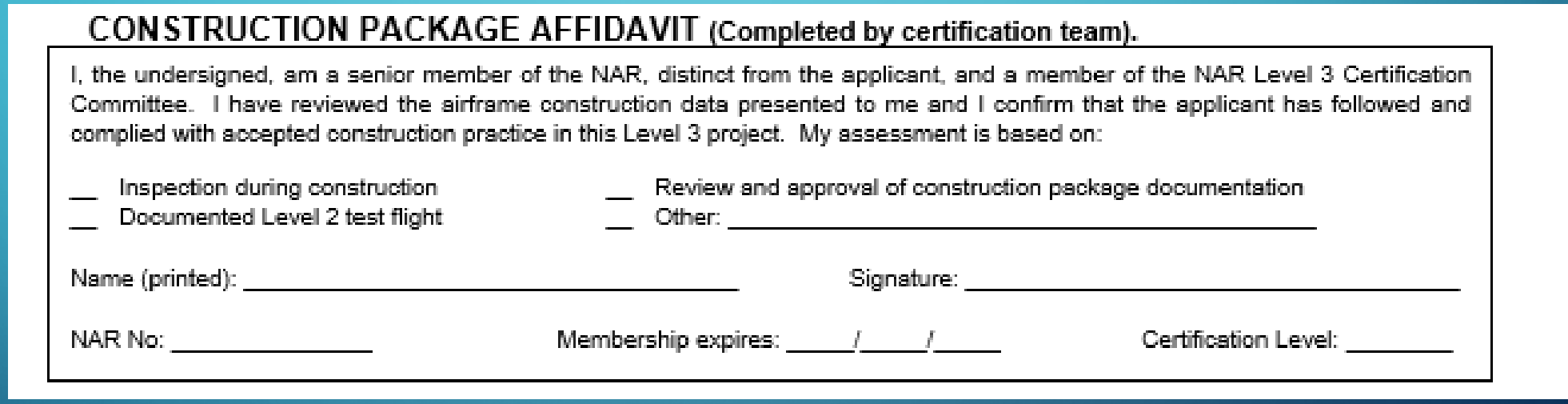
CERTIFICATION PROCEDURES

- 3.1 Download and complete a NAR Level 3 Certification Application – www.nar.org
- 3.2 Choose and contact your primary L3CC prior to the build, preferably before you begin assembling materials or buy a kit. You don't want to buy materials or a kit and find that they are disallowed

CERTIFICATION PACKAGE – CONSTRUCTION PACKAGE AFFIDAVIT

- 3.2 You are required to submit detailed plans for L3CC member review and approval. This is to ensure the rocket will be structurally and functionally adequate to meet the stresses encountered during launch and recovery.

- Complete the Construction Package Affidavit section of the Certification Application and obtain L3CC (Level 3 Certification Committee) member approval.



CONSTRUCTION PACKAGE AFFIDAVIT (Completed by certification team).

I, the undersigned, am a senior member of the NAR, distinct from the applicant, and a member of the NAR Level 3 Certification Committee. I have reviewed the airframe construction data presented to me and I confirm that the applicant has followed and complied with accepted construction practice in this Level 3 project. My assessment is based on:

__ Inspection during construction
__ Documented Level 2 test flight
__ Review and approval of construction package documentation
__ Other: _____

Name (printed): _____ Signature: _____

NAR No: _____ Membership expires: _____/_____/_____ Certification Level: _____

- 3.2.1 The flyer may invite a L3CC member to inspect the model during assembly when construction features are visible for inspection. The flyer assumes the risk, if a L3CC member has not inspected the model during construction and documentation of hidden features is not adequate, that the Rocket Construction package may not be approved.

- 3.2.2 ocument rocket features hidden during assembly using photographs using an easily recognized size reference (e.g. ruler, coin) unless other photographs permit easy determination of feature sizes.
- Photo of Tim Bookwalter

Photo #6

- Document rocket features hidden during assembly using photographs, with an easily recognized size reference .

Photo #6

Photo of Tim Bookwalter

- The Construction Package Affidavit section of the Certification Application must be approved before the flight.
- Technical data supporting the Construction Package Affidavit approval shall be made available to the L3CC member performing the review a minimum of 5 days prior to the flight attempt.

CONSTRUCTION PACKAGE DESCRIPTION – COURTESY OF MITCH GUESS

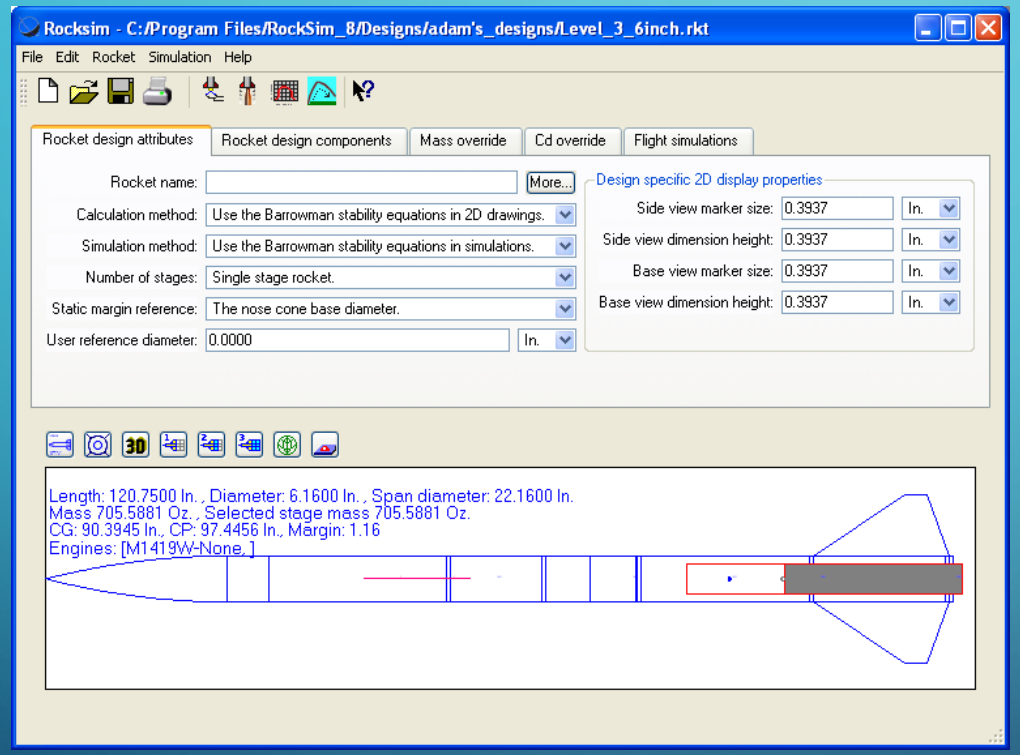
Construction Package

For strength and ease of construction I decided to buy fiberglass tubing rather than trying to fiberglass phenolic or cardboard tubing. I like using G10 fiberglass sheet for fin material but I was a little concerned about the flexibility of G10 for a large level 3 project. So I decided to bite the cost and weight bullet and ordered ¼ inch thick G10 sheet material from McMaster Carr.

Airframe Materials

• Body Tubes	Filament-wound fiberglass (Giant Leap Rocketry)
• Fins	¼ inch thick FR4 spec. G10 Fiberglass (McMaster Carr)
• Centering Rings	½ inch thick 9 ply Birch (Giant Leap Rocketry)
• Bulk Plates	½ inch thick 9 ply Birch (Giant Leap Rocketry)
• Coupler	Fiberglass (Giant Leap Rocketry)
• Rail Guides	Unistrut (Performance Hobbies) 1515 Large rail buttons (Railbuttons.com)
• Adhesives	West Systems 105 Epoxy, 205 Hardener, 405 Filler
• Nosecone	5 to 1 Ogive fiberglass (Performance Rocketry)

EXAMPLES FROM CONSTRUCTION



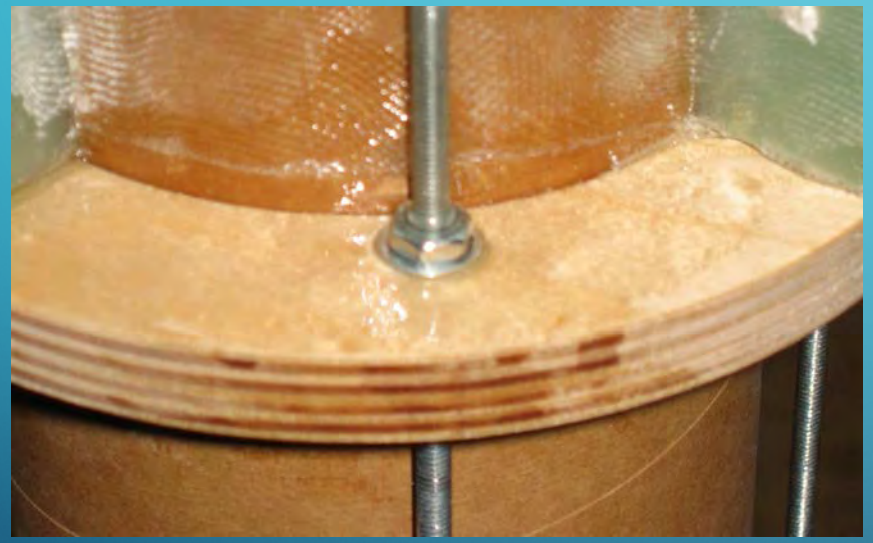
Courtesy of Adam Martin

FURTHER EXAMPLES

- Tip to tip glassing of the fins to the motor mount, using 9.5 oz E glass

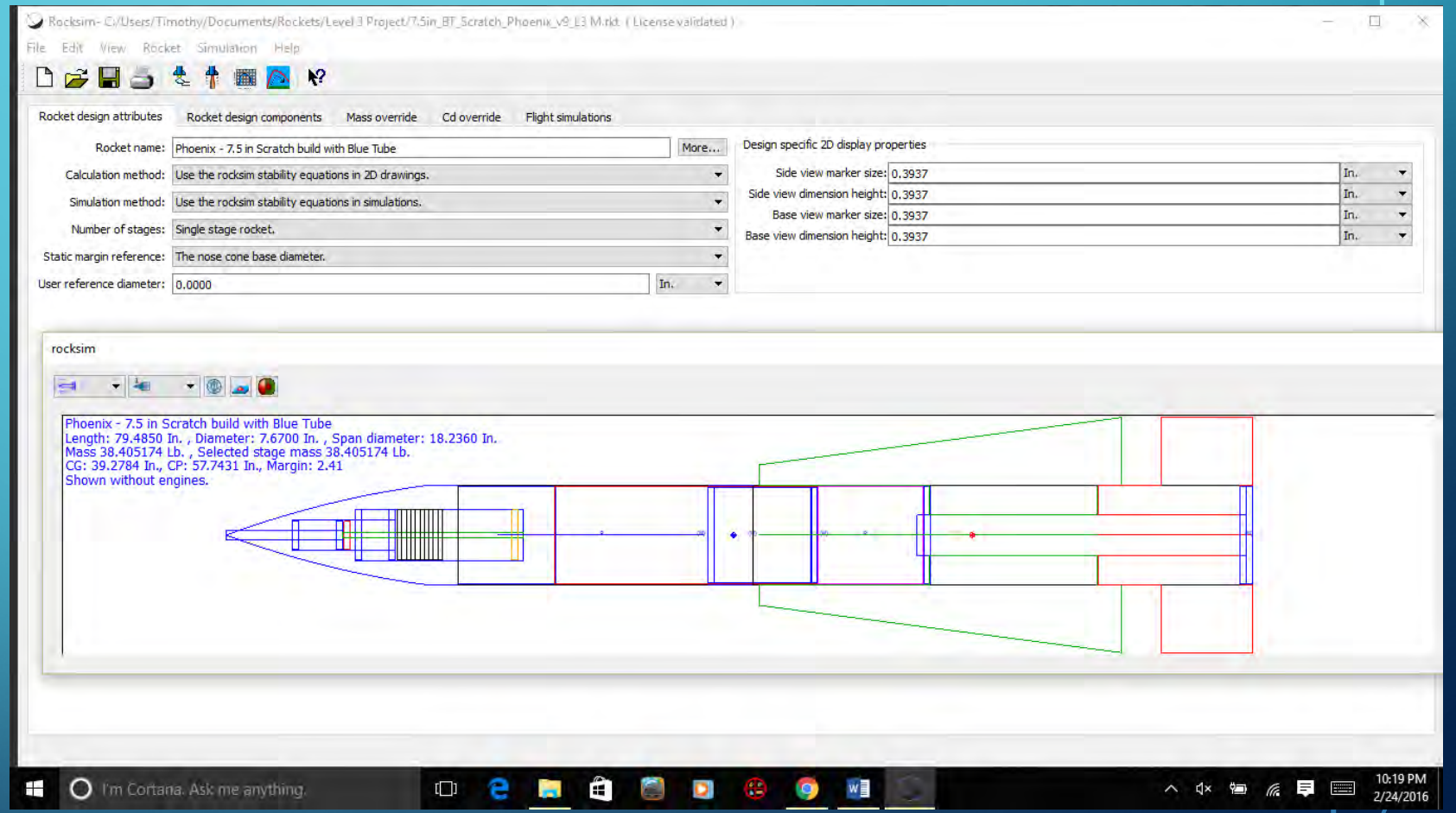
Courtesy of Adam Martin

- Added threaded rods between all of the centering rings surrounding the motor mount, the bottom centering ring is left off to apply foam between each of the fins



Courtesy of Adam Martin

- Construction photos courtesy of Tim Bookwalter



RECOMMENDATIONS

- Structure your certification package with every point on the requirements addressed. A good example is Ted Cochran's Table of contents
- Include a scale drawing and simulation
- Include photos of internal structures for review by your L3CC member, especially if it is difficult to visually inspect during construction.
- More pictures are better.

3.3 RECOVERY PACKAGE

- Complete the recovery package affidavit section of the certification application and get L3CC member approval.
- A safe rate of descent must be demonstrated – 20ft/sec is recommended
- Prior to the certification flight, the Recovery Systems Package is provided to one L3CC member.

3.3.1 CONTENTS OF RECOVERY SYSTEMS PACKAGE

The Recovery Systems Package should include a description of the components, including

- Drogue parachute
- Main parachute
- Parachute bags
- Anchor and connecting hardware
- Risers
- Compartments, covers

RECOVERY SYSTEMS PACKAGE

- Include a description of recovery initiation control components including:
  - Logic and control modules
  - Power sources
  - Safe and arm procedures
  - Output devices (electric matches, etc)
  - Schematic OR wiring diagram showing connections
  - Mounting structure and access
  - Pyrotechnic devices, including type, quantity, pyrotechnic materials and method of calculation

RECOVERY SYSTEMS PACKAGE

- Description of expected descent rate with main recovery device deployed and calculations/rationale for choices.
- Documentation of methods of testing of recovery electronics
  - ground testing or flights
  - In either case document the extent of the tested components including recovery electronic modules, power supplies, safe and arm provisions, and bridgewire (e.g.flashbulb, electric match) type.

RECOVERY SYSTEM PACKAGE – COURTESY OF MITCH GUESS

Recovery System Package

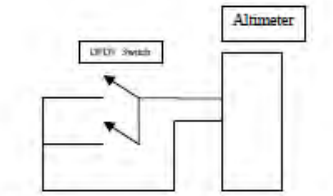
The recovery system on this rocket follows the design of the recovery system on most of my HP rockets. The booster is connected to the bottom of the altimeter bay located in the upper airframe with 48 feet of ½ inch tubular Kevlar. The top of the altimeter bay is connected to the bottom of an ejection piston with 11 feet of ½ inch tubular Kevlar. The top of the piston is connected to the 17 foot diameter parachute with 41 feet of 1 inch tubular nylon. The nose cone is attached to the tubular nylon 6 feet down from the parachute connection.

Courtesy of Mitch Guess

EXAMPLES OF SCHEMATICS

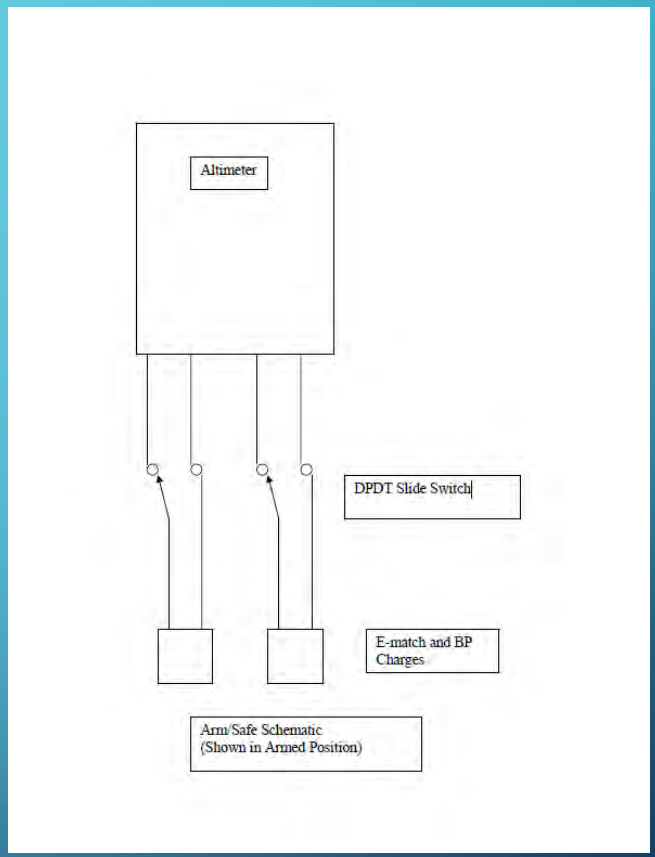
Recovery Components

Altimeters – Two Missile Works RRC2 barometric altimeters are used on this project. The Missile Works altimeters have their own 9V battery as part of the assembly. Power is applied with a separate DPDT slide switch for each altimeter. These two switched are mounted on the back side of the altimeter sled. The two poles of the power switches are wired in parallel to allow for redundant switch contacts.



Power Switch Schematic

Both Altimeters are mounted to a G10 fiberglass sled which mounts to the two all-thread rods in the electronics bay. The e-matches of the pyro charges will be isolated and shorted with 2 DPDT slide switches which are mounted to the back side of the altimeter sled.



Courtesy of Mitch Guess

SCALE DRAWING EXAMPLE

2. Scale Drawing

Stretched Goblin
Length: 117.0000 In. , Diameter: 10.2500 In. , Span diameter: 33.6230 In.
Mass 56.292613 Lb. , Selected stage mass 56.292613 Lb. (User specified)
CG: 75.1443 In., CP: 96.0328 In., Margin: 2.04
Engines: [M2400T-None,]

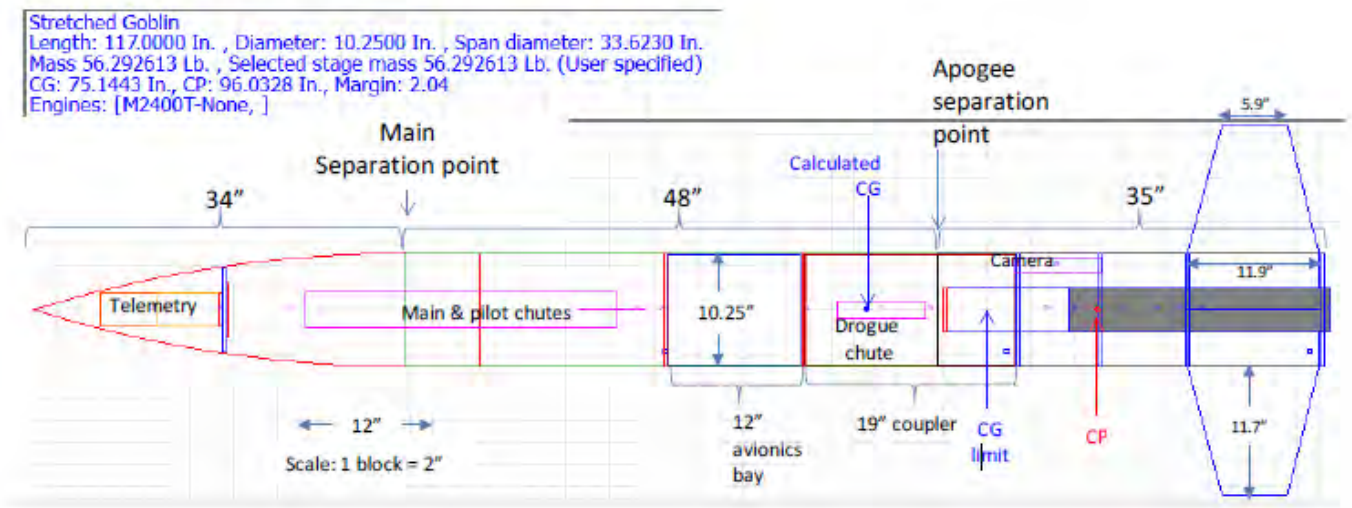


Figure 1. Scale drawing of vehicle showing key dimensions, separation points, and major components.

courtesy of Ted Cochran

EXAMPLE OF PRE-FLIGHT CHECK-LIST

- ❑ Zip-tie batteries to altimeter sled
- ❑ Attach wires per wiring diagram
- ❑ Install e-matches
- ❑ Install electronic sled and screw in e-bay
- ❑ Confirm that altimeters are working properly, then safe them
- ❑ Load 4grams black powder in each of the 4 charge wells
- ❑ Tape over “pushout” hole in the sustainer
- ❑ Build motor (have witness)
- ❑ Install motor
- ❑ Ensure 4 ends of both shock cords are connected & screwed in
- ❑ Pack Parachutes
  - Make sure that Drogue is protected by Nomex® chute protector
- ❑ Install sheer pins, 6 in total
- ❑ Tape igniter to fin, and proceed to check-in

Courtesy of Adam Martin

EXAMPLE CHECK LIST AT THE PAD

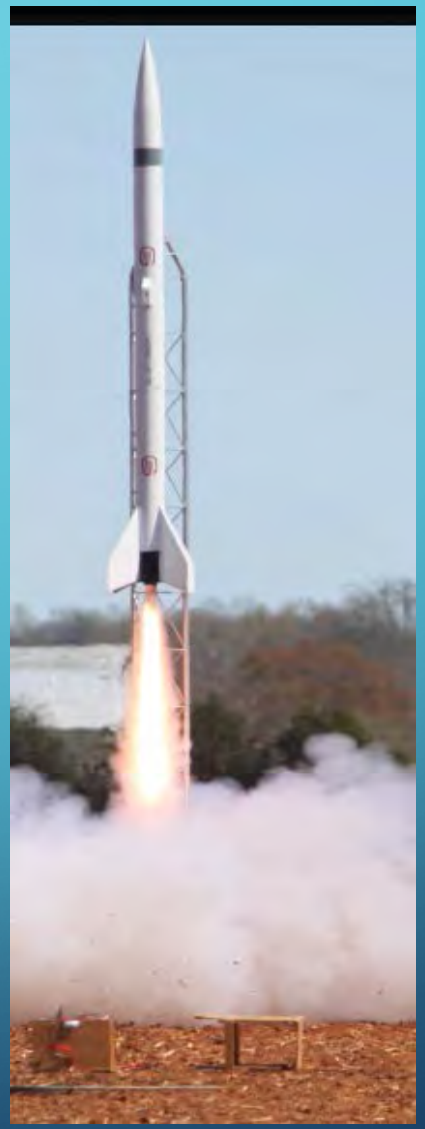
- ❑ Load rocket on the pad
- ❑ Turn on all switches, and confirm individually that both altimeters are beeping properly.
- ❑ Install igniter, and attach alligator clips
- ❑ Confirm continuity
- ❑ Hold breath ;-)

EXAMPLE POST FLIGHT CHECK LIST

- ❑ Find the rocket
- ❑ Document landing condition
- ❑ Confirm that four charges have fired
  - ❑ If not, safe electronics
- ❑ Perform post flight inspection
- ❑ Read altitude
- ❑ Field pack parachute
- ❑ Return to flight line to preform thorough post flight inspection

FLIGHT DAY

- Make sure you have made arrangements with your L3CC to be there.
- Prior to the certification flight, present the certification rocket and certification package to the flight witnesses.



- Flight witnesses are a member of the L3CC and another L2 or L3 flyer.
- Both must inspect the rocket and approve for flight.
- You CAN have multiple L3CC members for the different parts of the certification package and the flight.

- Take a deep breath
- Enjoy your flight – you earned it!

QUESTIONS??