Project Specification

Rev. 2005/09/04

1.0.0 Project Goal- To loft a 15 pound (6.8 kg) payload to an altitude exceeding 62 miles (100 kilometers).

1.0.1 Goal to be attained using Potassium Nitrate/Sorbitol (KNSB) Propellant. Minor modifications to the standard 65/35 formulation may be used providing the modified formulation is characterized for predictable performance, verified by static testing.

1.0.2 A non-staged vehicle will be used.

2.0.0 Payload- Payload will consist of a data logger with recovery system activation, an RF downlink, and a video camera as a minimum. All critical systems must be redundant.

2.0.1 Payload will not exceed 15 pounds (6.8 kg) in mass.

2.0.2 Payload volume will be a truncated cone approximately TBD inches (TBD cm) base diameter, TBD inches (TBD cm) upper diameter and TBD inches (TBD cm) length.

2.0.3 Payload will include a vehicle de-roll system.

3.0.0 Motor Construction- Motors will be constructed of a moderately high strength aluminum casing, such as 6061 alloy, low alloy steel, titanium alloy or composite construction. Motor assembly will be hydrostatic tested to minimum 120% MEOP, both prior to static testing and following static test (if same motor is used for flight).

3.1.0 Nozzle will have a graphite throat insert with a heat-resistant metallic expansion bell. Dual “O” rings will be used for sealing. Retention will be by means of a Smalley Retaining ring or radial bolt pattern. Casing will be sized to rupture prior to either bulkhead or nozzle ejection to minimize damage to the vehicle and static test equipment.

3.2.0 Head end bulkheads will preferably be aluminum attached with a bolt circle with provisions for a central igniter, pressure transducer and safe-arm.

3.3.0 Liners will be phenolic or similar heat resistant fibre-reinforced polymer material and will be limited to the space between bates grains with a suitable overlap. Steel failsafe bands to be wrapped around each grain joint.

3.4.0 Grains – BATES configuration to produce a reasonably neutral Kn profile over the burn duration.

3.5.0 Grains- Propellant grains will be cast into phenolic or similar heat resistant fibre-reinforced polymer material tubes with suitable bonding provisions made. A casting fixture will be used which will position the mandrel and retain it in position during cooling and curing. Casting fixture will have provision for compressing the cast propellant to TBD psi (TBD kPa) pressure for duration of TBD hours.

3.6.0 Igniter- Igniter will bring the initial volume of the completed motor to a pressure of no greater than 50% of MEOP when fired.

3.6.1 Igniter will impart 1500 calories/in^2/second (9.7 MJ/m^2/sec) to the cored surface of the propellant grain.

3.6.2 Redundant igniters will be used for each motor or charge.

3.6.3 Igniter will incorporate a 3-way valve as a safe-arm. This valve is to be actuated from outside the motor when assembled.

3.6.4 As an ignition aid, exposed ends of BATES segments to be painted with an “Ignition Primer” consisting of 80/20 potassium nitrate/charcoal using 70% IPA as a solvent. The primer must not contain any sulfur.

4.0.0 Airframe- Airframe to be monocoque; the motor casings comprise the major portion of the airframe. A fairing section located between the motor and nosecone to be incorporated for the recovery system.

4.1.0 Nose Cone- The nose cone will be of TBD shape, of TBD L/D, of titanium alloy or composite makeup. If composite, a heat-resistant tip for hypersonic ablation resistance will be required. The dimensions of the tip will be contingent on the results of aero-heating thermal analysis.

4.2.0 The nose cone will be supplied with a compartment for the payload in a form of a truncated cone, of dimensions indicated in paragraph 2.0.2.

4.3.0 If the nose cone is supplied with a barometric sensing port, such to be communicated from a position 2 diameters (minimum) aft of the nose cone.

4.4.0 Guidance of the vehicle to be achieved by passive fin stabilization. To minimize trajectory dispersion, a roll-rate of TBD hz. to be induced during ascent.

5.0.0 Recovery- the entire vehicle will be recovered by one or more parachutes. Recovery may be as a single unit or multiple units. Timers, Flight Computers, or mechanical releases triggered by other recovery events will be used for deployment.

5.1.0 Drogue chutes will be used for deploying parachutes for those components returning from apogee. A suitable delay will be incorporated so the main chute(s) will deploy at an altitude in the range of 5k to 20k feet (1.5 km to 6 km).

6.0.0 Ground Support Equipment- A launcher which guarantees a guided path to a velocity of 100 fps (30 m/s) minimum is needed. The launcher must be capable of supporting a 1 ton (1000 kg) vehicle.

6.1.0 Safe firing circuits are required with a standoff of 3k feet (1000 m.).

6.2.0 A grinder for potassium nitrate (KN) capable of 100 lbm/hr (50 kg/hr).

6.3.0 A hot mixer capable of mixing a minimum of 100 lbm (50 kg) of propellant at temperatures to 285˚ F (140˚ C).

6.4.0 A water truck for cleanup and fire prevention

6.5.0 An assembly tent, 10 feet x 40 feet (3 m x 12 m) for main assembly work on the vehicle.

6.6.0 An assembly and electronics tent 10 feet x 10 feet (3m x 3m) for the payload.

6.7.0 A Meteorological Station, 10 feet by 10 feet (3m x 3m) with theodolite and computer.

6.8.0 A Range and Flight Control center, 10 feet by 20 feet, (3 m x 6m) with computer, PA system, Firing Control Panel, and downlink receiver and display units

6.9.0 A dolly for transporting the assembled vehicle to the launcher.

Revision record

Rev.	Author
07-13-05	W.Colburn
2005-07-17	R.Nakka
2005-09-04	R.Nakka