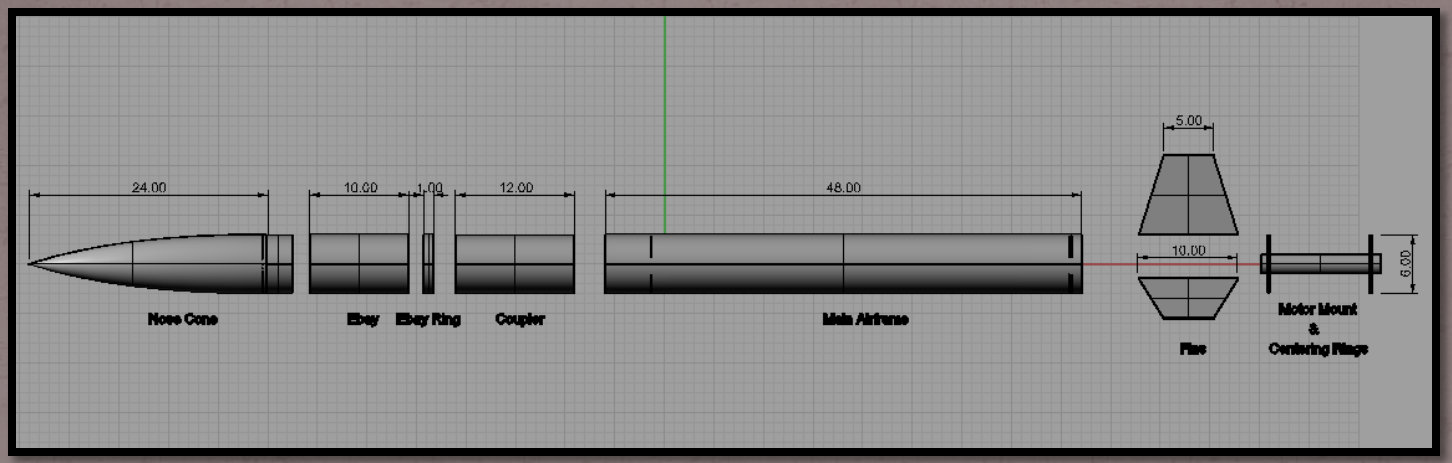
Northwest Indian College Space Center

Team RPGs

Preliminary Design Review

Vehicle Dimensions

Length	83.00	Diameter	6.00
Weight	5.00	Fin Span	22.00
Center of Gravity	41.55	Center of Pressure	65.49
Static Stability	3.92		



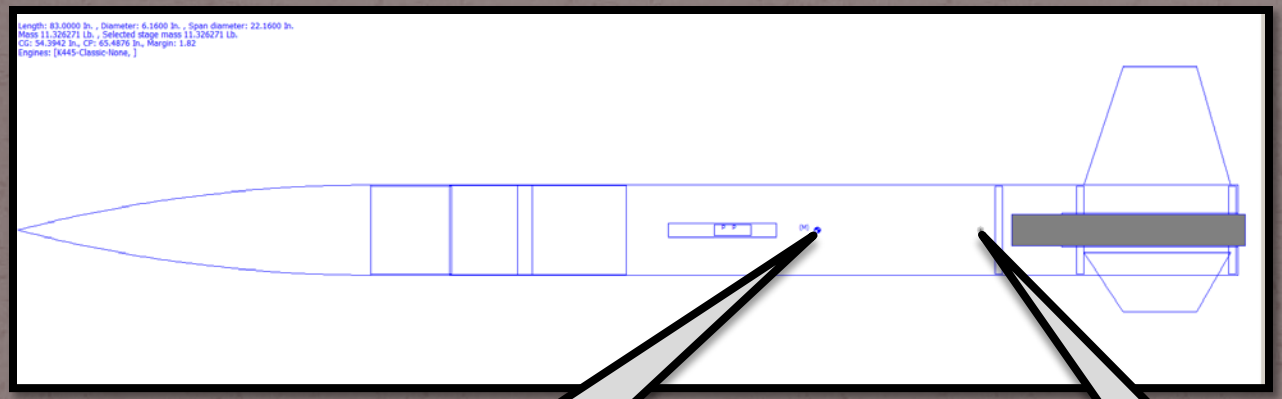
Materials

- The rocket airframe is carbon fiber
- The nosecone is fiberglass
- The fins are ¼" aircraft-grade plywood
- Three fins are attached through the wall to the 54 mm motor tube 1/2 inch above the aft edge of the airframe.
- The fins are fastened in place with West Systems 2-part epoxy resin and reinforced with a fiberglass inlay across the inside.

Design Justification

- We have to deal with a very wet recovery area which means a water resistant rocket.
- Needed a very lightweight rocket for our engineering project
- Examined fiberglass, blue tube, and carbon fiber.
- Carbon fiber had the best qualities.

Static Stability Margin



Center of Gravity
53.39

Center of Pressure
65.49

Center of Gravity	53.39
Center of Pressure	65.49
Static Stability	1.82

Stability Margin
1.82 with motor

Stability Margin = (CP-CG)/Diameter

Vehicle Safety Verification & Test Plan

Safety Officer – Justin is responsible for ensuring that all safety procedures, regulations, and risk assessments are followed.

The Northwest Indian College Space Center has a 5000 foot waiver from the US and the Canadian aviation agencies. We can launch our rockets from 9:00 to 1300 on Friday, Saturday or Sunday.

Safety Rules and Regulations
Potential Failure Modes and Mitigation

Motor Selection & Justification

Motor	Maximum Thrust		Loaded Weight (lbs)	Ratio	Propellant Weight	RocSim Altitude	Lift Off (fps)
	Newtons	Pounds					
I100RL_LB	358.4	80.6	10.24	8	350	2592	45.93
J140-WH_LB	221.8	49.9	11.29	4	680	4808	39.32
J210-Classic	335.0	75.3	10.32	7	396	2714	51.00
J240-RL	299.4	67.3	10.39	6	446	2372	49.74
J293BS	386.1	86.8	10.32	8	416	3309	53.60
J295-Classic	450.5	101.3	10.93	9	594	4052	64.15
J325TT	540.3	121.5	10.93	11	537	3634	67.20
J355-RL	434.3	97.6	11.05	8	669	4368	60.76
K160-CL	282.5	63.5	11.71	5	772	5237	44.97
K500-GR	484.5	108.9	11.88	9	924	5280	63.83
K445	664.8	149.5	11.55	13	792	5523	77.46
K500-RL	607.9	136.7	11.72	12	892	5275	69.79

Low Altitude Tests

Potential Competition Motor

- Motor has enough thrust to get the rocket safely off the launch rail.
- Motor has enough thrust to achieve the predicted altitude.

Thrust-to-Weight Ratio

Thrust to Weight Ratio = Pounds of Thrust/Weight of Salish Star

Motor	Maximum Thrust		Loaded Weight (lbs)	Ratio	Propellant Weight	RocSim Altitude	Lift Off (fps)
	Newtons	Pounds					
K500-GR	484.5	108.9	8.3	9	924	5280	63.83

Rail Exit Velocity
63.83 fps

Launch Vehicle Verification

- Ground Tests
- Simulation Examinations
- Visual Inspections
- NAR Mentor Inspections
- Test Flights
- Data Analysis

Test Plan Overview

- Black Powder Ground Tests
- Avionics Inspection and Tests
- Visual Inspections
- NAR Mentor Inspections
- Scheduled Test Flights
- Data Analysis

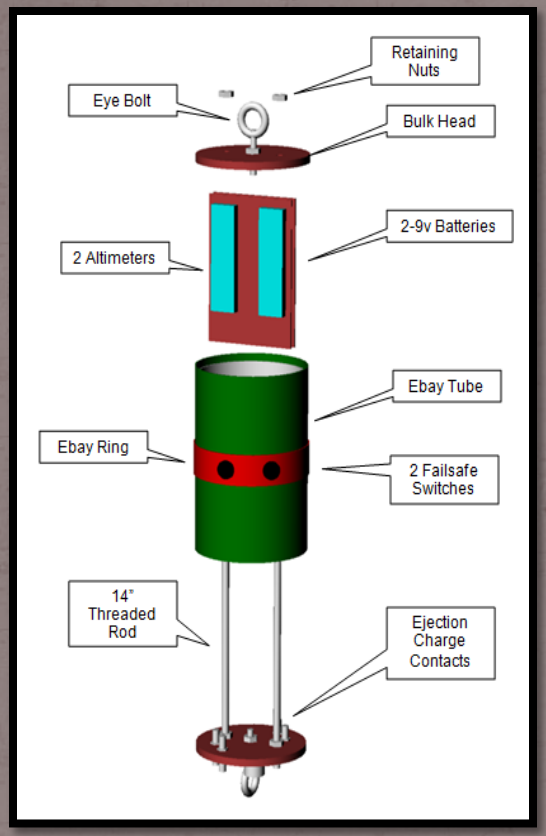
Component Discussion

- Airframe
- Ebay
- Power Management System
- Fin Can
- Recovery System

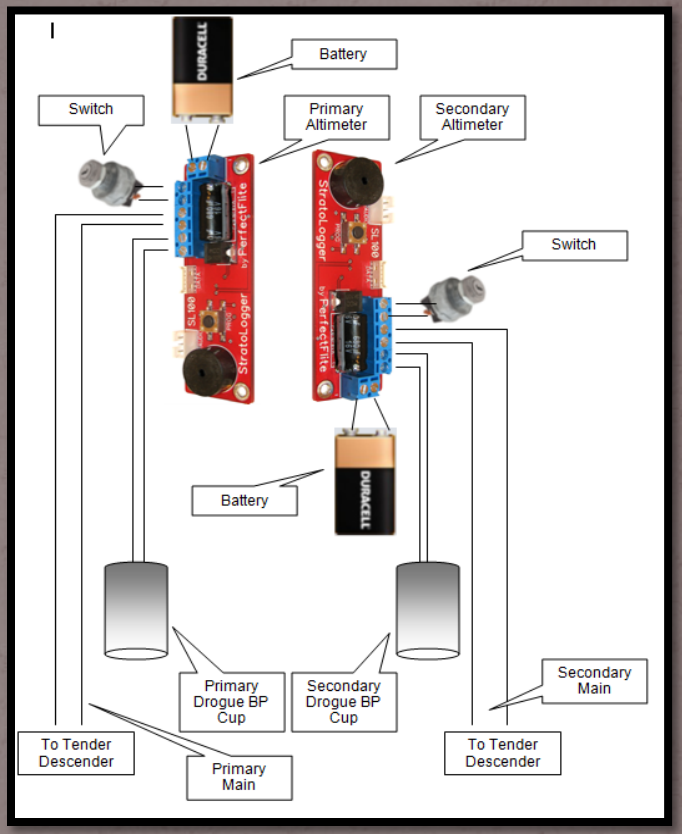
Airframe

- Constructed of lightweight carbon fiber
- Permanent Joints Connected with West Systems Epoxy
- Temporary Connections Fastened with 10-54 T-nuts and Screws
- Ebay Fastened with #2-56 Nylon Machine Screws acting as shear pins

Ebay and Avionics



Ebay Concept



Redundant dual deployment avionics system

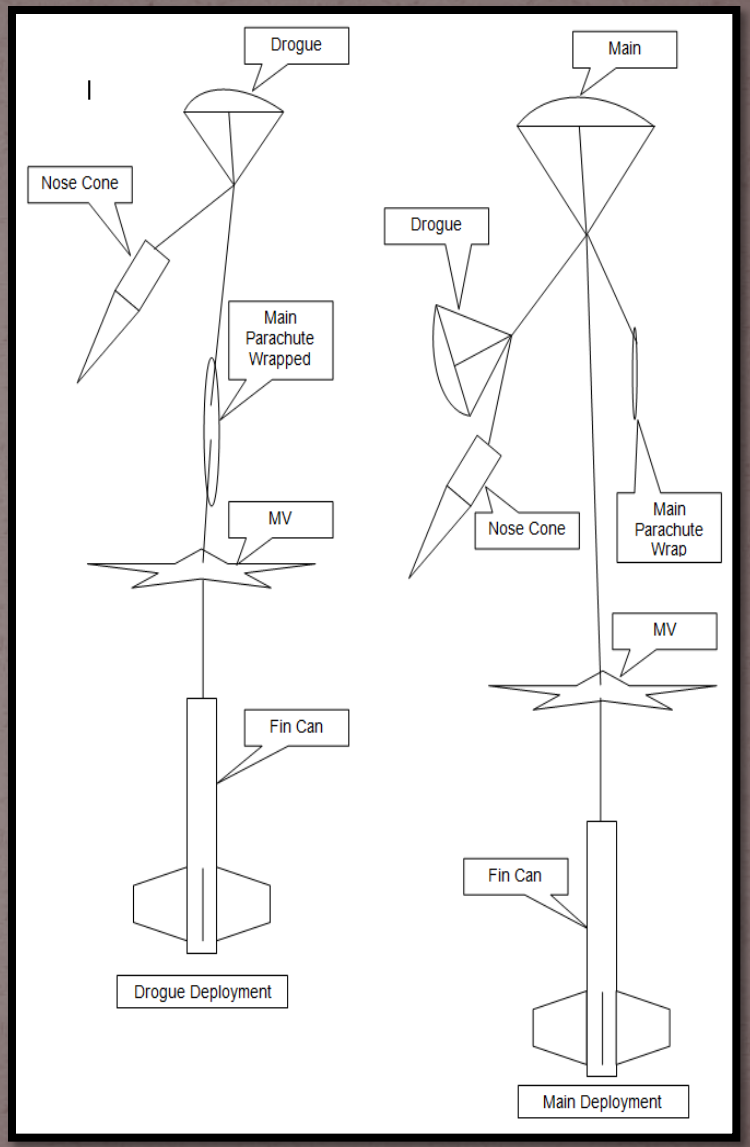
Fin-to-Fin Can Construction

Typical Fin Construction

- Through-the-Wall Construction
- Fiberglass reinforcement

Recovery System

- Recovery harnesses - 9/16’ tubular nylon.
- Drogue harness - 24 feet long.
- Main harness - 24 feet long.
- Each harness end is connected to a 1/4” closed-eye eyebolt with quicklinks.

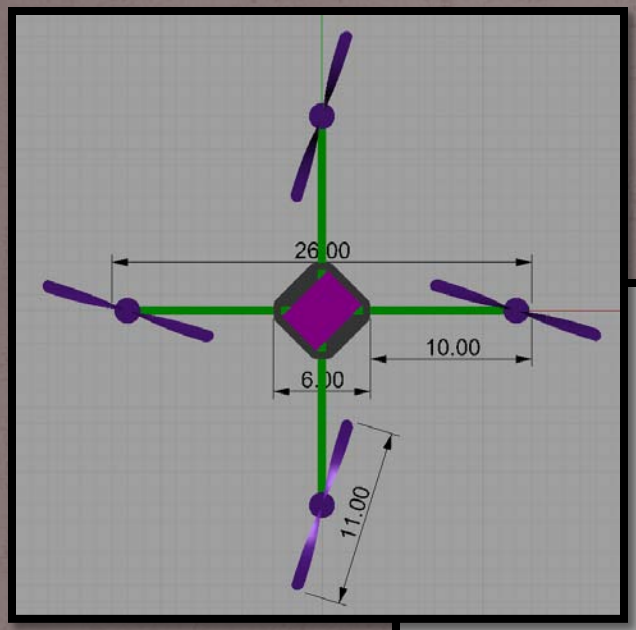


Recovery System Properties

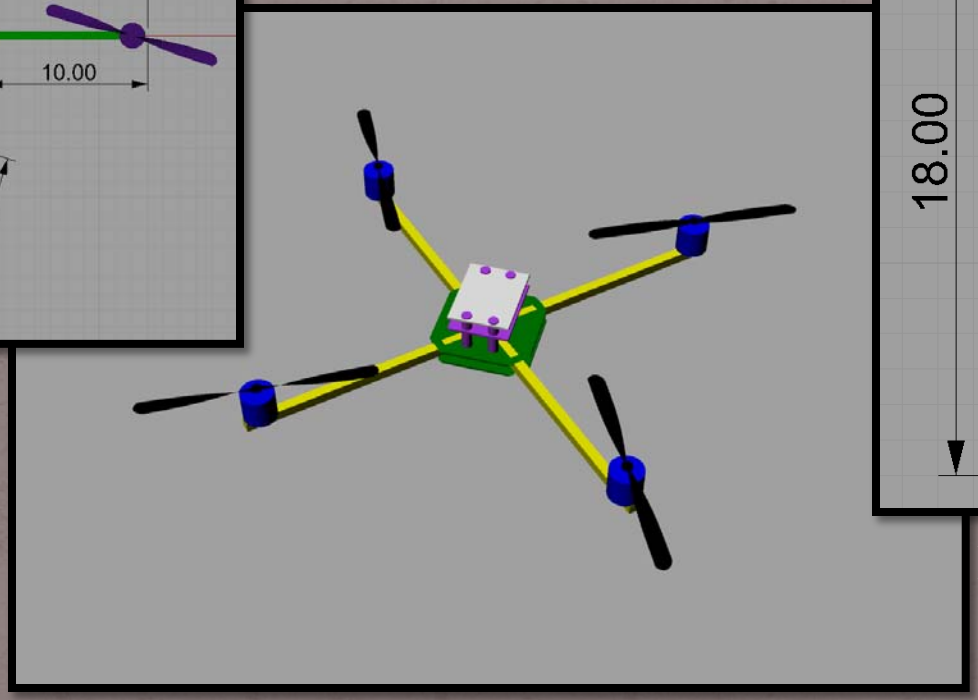
Recovery System Properties				
Drogue Parachute				
Manufacturer/Model	Top Flite			
Size	18"			
Altitude at Deployment (ft)	5,280			
Velocity at Deployment (ft/s)	0.03			
Terminal Velocity (ft/s)	93.66			
Recovery Harness Material	Tubular Nylon			
Harness Size/Thickness (in)	1/2			
Recovery Harness Length (ft)	24			
Harness/Airframe Interfaces	1/4' closed-eye steel eyebolt			
Kinetic Energy During Descent (ft-lb)	Section 1	Section 2	Section 3	Section 4
	691	639		

Recovery System Properties				
Main Parachute				
Manufacturer/Model	Sky Angle 50			
Size	50 inches			
Altitude at Deployment (ft)	500			
Velocity at Deployment (ft/s)	93.66			
Landing Velocity (ft/s)	21.22			
Recovery Harness Material	Tubular Nylon			
Harness Size/Thickness (in)	1/2			
Recovery Harness Length (ft)	24			
Harness/Airframe Interfaces	1/4" closed-eye steel eyebolt			
Kinetic Energy Upon Landing (ft-lb)	Section 1	Section 2	Section 3	Section 4
	45	41		

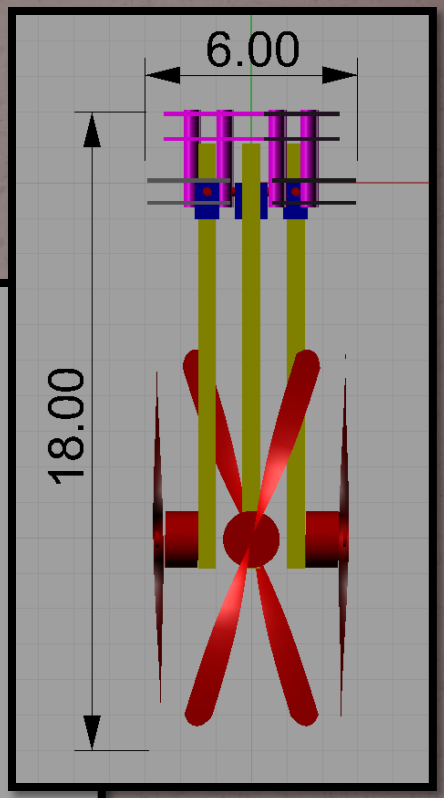
Science Payload



Plan View



Multirotor Vehicle Concept



Folded View

Payload Subsystems

System	Subsystem	Evaluation	Verfication
Fuselage	Body	Construction Insptection	Test Flights
	Arms		
Propulsion	Motors	Thrust Tests	
	ESC	Voltage tests	
	Propellers	Balancing	
Electronics	Batteries	Voltage check	
	Flight Controller	Bench testing	
	Autopilot	Bench testing	
Tow Harness	Upper Section	Ground and air testing	
	Lower Section		
	Connecting quicklinks		
RC Equipment	Transmitter and Receiver	Ground and air testing	

Payload Test & Verification

Feature	Verification Plan	Status
Construct MV fuselage	Inspection	Work in progress
Arm folding	Inspection	Work in progress
Motor thrust testing	Bench test	Work in progress
Propeller balancing	Bench test	Complete
Flight controller construction	Inspection	Complete
Flight controller testing	Bench test	Work in progress
Autopilot construction	Inspection	Complete
Autopilot testing	Bench test	Work in progress
RC Testing	Flight tests	Work in progress

Payload Test Plan

- Test each component as it's built
- Gather baseline data for each component
- Integrate one component at a time and verify it's functioning satisfactorily
- Ground test entire system
- Flight test payload