Design Objective

Avoid:

Goal:
Design Review

Payload
Drogue Chute
Payload/Avionics
Main Chute
Motor and Casing
Motor

- Propellant Selection:
  - HTPB with AP and Al
    - Non-detonable
    - Non-toxic
    - Medium cost
    - Good experience
    - Stable combustion
    - Good physical properties
    - Good burn rate

https://www.youtube.com/watch?v=I4wuotjglqY
Motor

- Motor Selection:
  - Aerotech L2200G-P “Mojave Green”
    - High Peak Thrust
    - Quick Burn Time
    - High Total Impulse

Motor Calculations

Assumptions:
- Mass of rocket: 16.78 kg ≈ 37 lb
- Mass of propellant: 2.518 kg ≈ 5.54 lb
- All propellant is burned up
Motor Performance

- Burn time: 2.4s
- Total Impulse: 5097.6 N-s
- Specific Impulse: 206.4 s
- Average Thrust: 2020.7 N
- Peak Thrust: 3101.8 N
- Mass Ratio: 0.85
- Impulse-to-weight ratio: 30.97
- Thrust-to-weight ratio: 12.28
- Effective exhaust velocity: 2024.4 m/s
Motor Case Material Selection:
- Aluminum
  - Provides good strength-to-weight ratio
  - Lightest metal
  - Isotropic (properties are same in all directions)
  - Cost effective
Casing

● Motor Case Design:
  ○ Based on RMS 75/5120

http://www.aerotech-rocketry.com/customersite/resource_library/aerotech_rms_ext_dim_dwgs/75mm_hp_rms/hp_75-5120.pdf
Nozzle Design

http://www.aerotech-rocketry.com/customersite/resource_library/aerotech_rms_ext_dim_dwgs/75mm_hp_rms/hp_75-5120.pdf
Igniter

- First Fire Starter for High Power Motors
  - H-size +
  - Requires 12 volt launch controller
- Ordered 6 packs of 3
  - Testing
  - Sharing

http://www.apogeerockets.com/Rocket_Motors/AeroTech_Accessories/First_Fire_Igniter
Fuselage

● Need to determine optimal weight
  ○ Propellant weight = 5.54 lbs
  ○ Case weight = 4-5 lbs
  ○ Payload weight = 10 lbs
  ○ Everything else = ??

● Use simulations to determine weight of “everything else”

● Design parts using these parameters
Optimal Weight

Rocksim:

524 oz = 32.75 lbs
Simulations - RASAero

Motor Selection: L2200G (AT)
Liftoff Weight (lb): 42.47
Weight - No Motor (lb): 32.00

L2200G
Max Alt = 9990 ft

Graph showing altitude (ft) vs. time (sec) for L2200G.
Simulations - Rocksim

Altitude: 10945 Ft
Weight: 40.8 Lbs
Current Model

- **Fuselage**
  - 1020 Steel
  - Length: 48 inches
  - ID: 3 inches
  - OD: 3.25 inches

- **Nose Cone**
  - Length: 8 inches
  - Ogive radius: 15 inches

- **Fins**
  - Root chord: 8 inches
  - Semi span: 4 inches
  - Tip chord: 3 inches
  - Leading edge: 6.4 inches
## Building Materials

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<thead>
<tr>
<th>Income</th>
<th>Type</th>
<th># of</th>
<th>Cost</th>
<th>Budget</th>
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<table>
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<tr>
<th><strong>Expenses</strong></th>
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<tbody>
<tr>
<td><strong>Motor Items</strong></td>
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<tr>
<td>AeroTech L2200G-P</td>
<td>Motor</td>
<td>4</td>
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<td>$799.96</td>
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<td><strong>Motor Case Items</strong></td>
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<td>75mm Forward Closure</td>
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<tr>
<td>75mm Aft closure</td>
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<td>Aluminum Tubing for Motor Case OD 3&quot; and ID 2.75&quot;</td>
<td>24&quot; pipe</td>
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<td>Steel Tubing OD 3-1/4&quot; and ID 3.01</td>
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# Building Materials

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**Shipping:**
- Next Day
- Two Day
- Three Day
- Ground
- Least
- Electronic Delivery

**Total:** $899.80
3 Team Plan?

- Recovery Systems and Aerodynamics: Solid Design Team
- Electronics for Combustion: Hybrid and Fluids Design Teams
Aerodynamics And Recovery

- Work on a common platform
  - Payload and Recovery System Placement
  - Similarly sized main and drogue chutes
  - Electronics for chute deployment and altitude recording
Common Rocket Fuselage Design

- 5in Diameter
- 96in Length
- 30lbs (with the solid motor)
Next Steps

● Motor case
  ○ Order aluminum piping
  ○ Turn/bore to correct diameters
  ○ Thread
  ○ Completed by 04/01/2015

● Fuselage
  ○ Optimize design
  ○ Order piping
  ○ Completed by 04/15/2015

● Nose cone & Fins
  ○ Optimize design using aerodynamics
  ○ Select method for fin attachment
  ○ Completed by 04/15/2015

● Recovery Electronics
  ○ Parachute and Shock Cord Sizing
  ○ 3 Team Plan Dependant
  ○ Completed by 04/17/2015
Thank You!

Questions?