Bipropellant Safety and Testing

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Part 1: Safety Documentation

- MSDS
- Federal and State Guidelines
- NAR regulations
- Supplier and Industry Standards
Various Safety Procedures

- Liquid Nitrogen Shock Test
- Liquid Oxygen Filling
- Downrange rules
- Launch Prep
- Ignition procedures
- Testing safety procedures
- Testing/Launch Positions
Part 2: Detailed Safety Procedures

- Written procedure
- Citation from sources
- Compliance with university guidelines
- Verification with competition guidelines
Part 3: Safety Checklists

Safety Checklist Heuristic

- Flight/Test Number
- Date
- Checklist Name, Scope, Revision Number
- Step by Step Safety Operation
- Final Go/No-Go
- Sign-Off of Relevant Officer
Safety Roles

Delegating Roles for Launch and Test Days
Each Role will have a checklist

- Flight Director
  - Gives final go

- Lead Safety
  - Maintains records
  - Ensures Electronics Compliance

- Range Officer
  - Downrange operations

- Filing operator
  - Fills tanks

- Equipment Coordinator
Test Stand Design

- Provide structure for engine testing
- Evaluate engine operation
- Determine force and pressures
  - Pressure regulators, load cell
Test Stand

What Data we are recording and why

- Chamber pressure
- Tank pressures
- Nozzle Exit pressure
- Lead to further changes or design constraints

Low/High Pressure Water

- Low Pressure Water
  - Objective: Determine Injector Flow and Impingement Pattern
## Test Plan

<table>
<thead>
<tr>
<th>Test</th>
<th>Purpose</th>
<th>Parts tested</th>
</tr>
</thead>
<tbody>
<tr>
<td>High Pressure Water</td>
<td>Verify the integrity of high pressure system confirm performance</td>
<td>Injector</td>
</tr>
<tr>
<td>High Pressure Ethanol GOX</td>
<td>Determine the flame temperature of injector</td>
<td>Injector</td>
</tr>
<tr>
<td>High Pressure Water and LN2</td>
<td>Cold shock the system to check for leaks determine if freezing</td>
<td>Tanks/Piping/Injector</td>
</tr>
<tr>
<td>High Pressure Ethanol LOX</td>
<td>Determine characteristic length of Combustion Chamber and Finalized Design</td>
<td>Full Propulsion System</td>
</tr>
</tbody>
</table>
Future Plans

What we plan to do next and when to complete it

- Build test stand 3/28
- Construct Prototype 4/4
- Begin testing 4/5
- Avionics/Recovery
- Flight Vehicle Design
Thank You

Antares Rocket [Orbital Sciences]