NASA'S SPACE GRANT 2015-2016 MIDWEST HIGH-POWER ROCKET COMPETITION – THE "ACTIVE DRAG CHALLENGE"

(SPRING 2016 COMPETITION LAUNCH HOSTED BY THE MN SPACE GRANT CONSORTIUM AND BY TRIPOLI MN)

Informational telecon slides: September 22, 2015
Repeated: January 21, 2016

Introductions

- MN Space Grant Organizer

  U of MN's Prof. James Flaten

  <flate001@umn.edu>

- Technical Advisor

  Tripoli MN's Gary Stroick

  <president@offwegorocketry.com>

- Round Robin Introductions

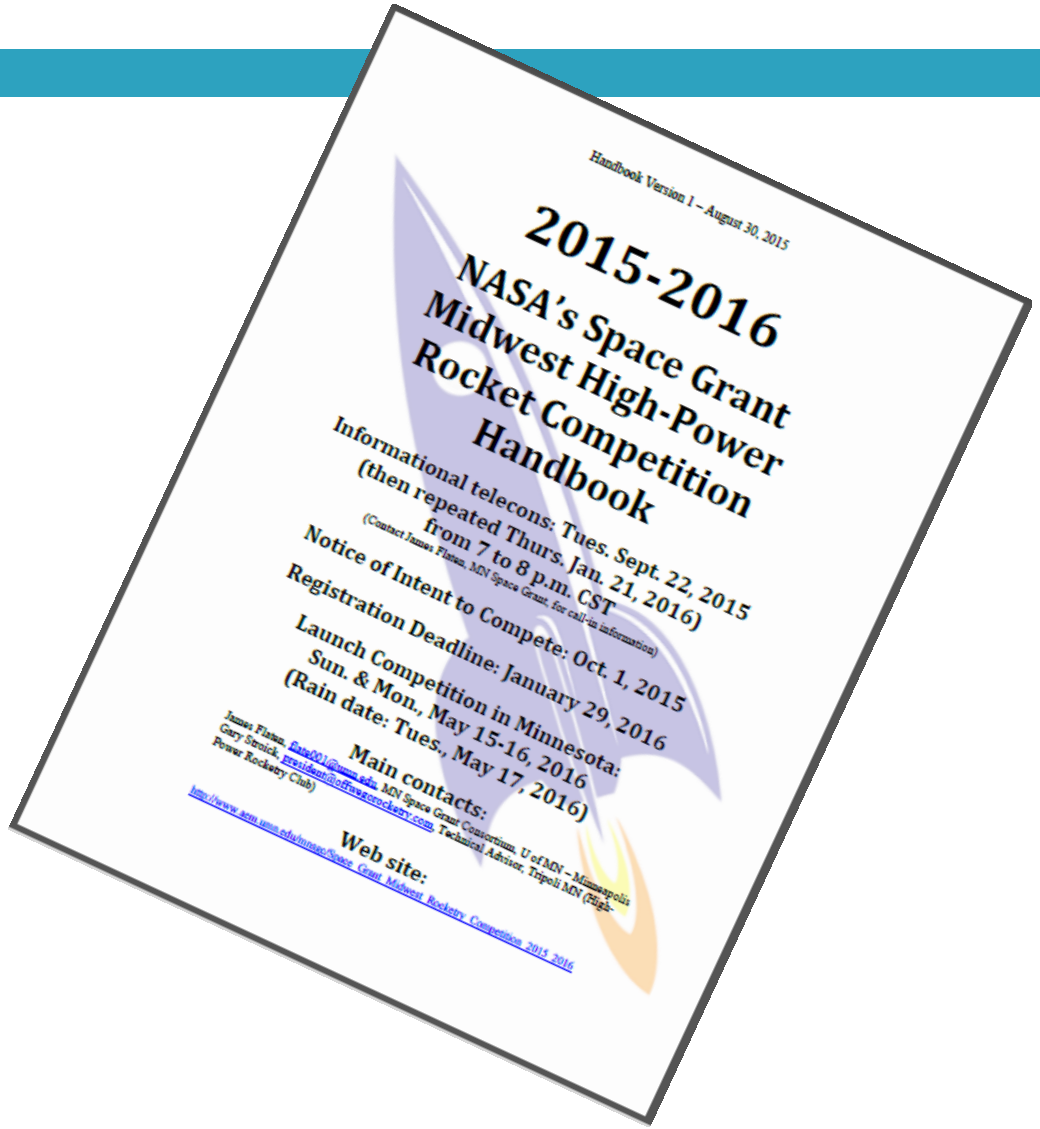
Number of Teams Participating

- Teams competing last year (spring 2015)
  - 18 teams, mostly from the Space Grant "Great (Lakes) Midwest" Region but open to entire nation
  - MN (4), WI (3), IL (2), AL (1), IA (1), KS (1), OH (1), TX (1), VA (1)
  - 3 other teams were involved but dropped out
- This year we will continue to allow teams from across the country to participate and are hoping to attract over 20 teams.

What you need to know

- Competition Handbook
- Fees & Supplied Equipment
- Schedule
- Competition Parameters
- Pre-Competition Requirements
- Five Aspects of the Competition
- Flight Safety
- Judging
- Q & A

Competition Handbook & Website



Website: http://www.aem.umn.edu/msgc/Space_Grant_Midwest_Rocketry_Competition_2015_2016/

Fees & Supplied Equipment

- Registration Fee: $400* (due January 29, 2016)
- The Registration Fee Covers (on Launch Day):**
  - Competition Flight Data Recorder (one Altimeter Two per rocket) to monitor altitude and other basic parameters
  - Two Competition Motor Reloads & Igniters – Cesaroni H through K motors only (team must pay the difference if the two motors chosen total more than $100)
  - Note: Teams are allowed to bring additional motors, or purchase more at the competition, and fly more than twice

**Tentative value – might possibly go up or down (a little) depending on the number of teams that sign up and depending on our success in raising funds from outside sponsors – changes, if any, announced no later than December 31, 2015.*

***If we garner enough outside sponsorship support we may be able to provide more things or possibly reduce the registration fee. More details coming no later than December 31, 2015..*

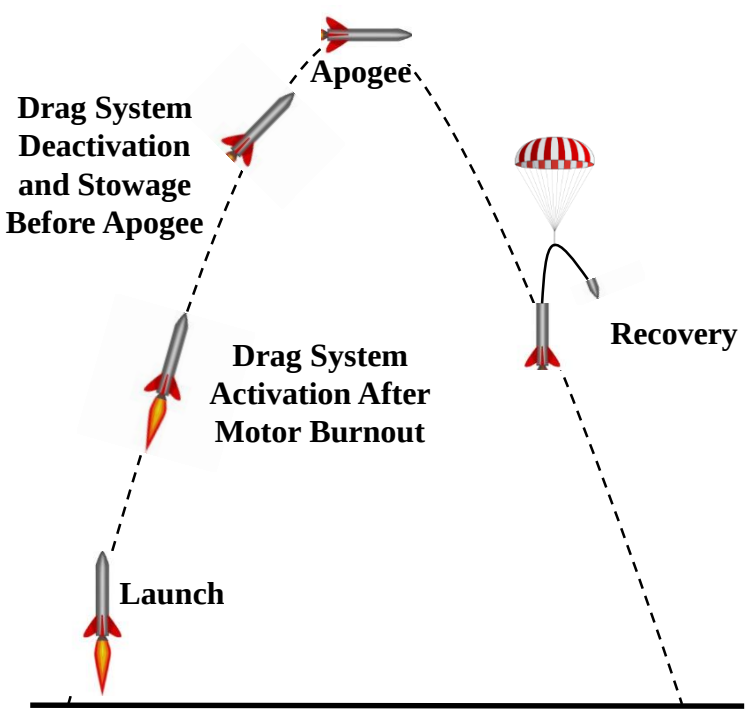
Space Grant "Sponsorship"

To help us keep tabs on participants for Space Grant Reporting, we require that every team contact their state's Space Grant to "get sponsorship." We are not suggesting to Space Grants what "sponsorship" might mean for them – this is to be negotiated on a case-by-case basis. For example, such sponsorship doesn't necessarily entail full (or even partial) financial support, so most teams will need to find other sources of funding.

However we hope that Space Grants will at least consider helping with some basic competition expenses such as:

(a) registration fee ($400)
(b) travel to MN for the competition launch in May, 2016 ($ varies widely)
(c) building and instrumenting the rocket itself (will vary; perhaps ~$500-1500)
(d) paying for a motor casing, with closure (depends on motor selected, ~$50-$150)
(e) buying motor(s) for the required practice launch and, potentially, additional test launches (~$50-$150).

Competition Parameters



RULES/CONSTRAINTS

- Team specified competition motor.
- Level 2 or higher certified mentor and faculty adviser required.
- Minimum of one test flight with drag system activated. A second test flight with drag system deactivated is highly recommended.
- Drag system must be activated after burnout and deactivated (and stowed) prior apogee (i.e. prior to the first recovery event).
- Teams must be able to prep their rocket for flight within 1 hr.
- The recovery system must be electronically deployed using a commercially-available altimeter. The motor eject must remain in place, as a back-up.
- One competition altimeter provided – an "Altimeter Two"
- Radio-tracking of rocket is optional, but highly recommended.
- Required non-commercial data logging for coefficient of drag.
- Required video-based logging of air brake state.
- Rocket must have $1 \leq$ static margin ≤ 5 at all times on ascent.
- Points based on percentage difference (vs target %) between max altitude with and without drag system deployed.

*Challenge: Student teams will design and construct a high-power rocket with an **active drag system** that will reach an apogee of at least 3000 ft above ground level and be recovered safely and in flyable condition, predict its flight performance (both with and without the drag system engaged), and construct a non-commercial on-board data collection package for the rocket that will characterize its coefficient of drag over time and use an on-board video camera to document the state of the drag system (e.g. engaged/deployed, disengaged/retracted etc.). Modest bonus for going above 3000 ft. Stiff penalties for not reaching 3000 ft.*

Pre-Competition Requirements

Educational Outreach

- Validated by each State's Space Grant
- State Space Grant Notifies Technical Advisor
- Must be completed and submitted no later than May 6, 2016
- Failure to Complete on time: 10% Score Reduction

Pre-Competition Requirements

Model Rocket Demonstration Flight

- **Purpose**
  - Demonstrate a minimum knowledge of rocketry
- **How to do it**
  - Purchase a model rocket flight kit
  - Assemble
  - Successfully fly and recover the rocket
  - Document the flight with before and after photos of the rocket and the team "in the field"
  - E-mail photos to the MN Space Grant along with flight date and location no later than March 18, 2016 (PDR due date)
- **Potential Waivers**
  - If your whole team has high-power rocketry experience, you may request of Gary Stroick a waiver from this requirement
  - If you prefer to build and fly a standard (non-competition) high-power rocket instead of a model rocket, that is acceptable

Graded Aspects of the Competition

- Preliminary Design (Written) Report (30%)
- Flight Readiness (Written) Report (15%)
- Flight Readiness (Oral) Presentation (15%)
- Competition Flight Performance (20%)
- Post-Flight Performance Report (20%)

Note 1 – There is a 10% overall reduction if you do not complete the Educational Outreach component of this program.

Note 2 – Written reports are due by e-mail to the Technical Advisor by 5:00 p.m. Central Time on the dates specified in the schedule. Scores for late reports will be reduced by 20% for each portion of a day that they are late.

Five Aspects to the Competition

Preliminary Design (Written) Report (30%)

- Communicate the engineering and design effort
  - Provide detailed design and diagrams
  - Analysis of predicted performance
  - Analysis of non-“pre-qualified” components
- Estimated Budget
- 25 pages MAX
- Due March 18, 2016

Five Aspects to the Competition

Flight Readiness (Written) Report (15%)

- SHOW the construction and completed rocket
  - Construction Pictures, diagrams, etc.
- Test Flight (using H or larger motor)
  - Flight Performance Analysis
  - Flight Results Discussion
  - Improvements planned prior to competition
- Actual Budget
- 25 pages MAX
- Due May 6, 2016

Five Aspects to the Competition

Flight Readiness (Oral) Presentation (15%)

- Communicate the design and engineering effort
- Organization and presentation
- Rocket Construction
- VISUAL AIDS
- 10 minutes for presentation plus 3 for Q&A
- Sunday afternoon or evening before the launch (May 15, 2016)

Five Aspects to the Competition

Competition Flight (20%)

- Each successful flight requires:
  - Launch
  - Rocket flies vertically and stably
  - Recovery system(s) successfully deployed
  - Safely land all parts of rocket under 24 ft/sec
  - Recover in re-flyable condition
- Flight Scoring:
  - Successful flight (see above)
  - Timely prep of rocket for both flights (no more than 1 hour each time)
  - How close is the drag-system-engaged apogee divided by the no-drag-system apogee to the target of 75%?
  - See handbook p. 23 for the detailed scoring formula
  - Modest bonus for going over 3000 ft and stiff deductions for not going at least 3000 ft (on the no-drag-system flight)

Five Aspects to the Competition

Post-Flight Performance (Written) Report (20%)

- Flight Performance Comparison
  - Actual vs simulated flight performance analysis
  - Graphs, charts, stills from video, etc.
  - Results and discrepancy discussion
- 15 pages MAX
- Due May 27, 2016

Safety Reviews

- Each team must go through a safety review in their home state prior to coming to the competition launch
- Each team will go through a safety review with Tripoli MN the evening of their oral presentation
- On the day of the launch:
  - Each rocket must be examined for flight safety by the Range Safety Officer (RSO)
  - **The Tripoli RSO has the final word on flight safety!**

Judging

- Separate from safety checks by Tripoli, MN, the written and oral reports and the performance in the competition flight itself will be evaluated according to the rubrics in the handbook by a panel of judges from industry and/or academia.
- **Each Space Grant sponsoring more than one rocket will be expected to provide <u>one</u> judge.** If you don't have someone from your state you'd like to send to MN for the competition dates, contact Gary Stroick about possibly retaining someone from Tripoli to serve as "your" judge. Typically judges' travel expenses are reimbursed (at least). Please identify your judge no later than January 31, 2016.

Schedule Summary

- Oct 1, 2015 – Notice of Intent to Compete (non-binding)
- Jan 29, 2016 – Formal Team Registration (pay $)
- Jan 31, 2016 – All state's judges identified
- Feb 12, 2016 – Declaration of Comp. Attendance
- Mar 18, 2016 – Preliminary Design (Written) Report (PDR)
- April 25, 2016 – Test Flight(s) done no later than this date
- May 6, 2016 – Flight Readiness (Written) Report (FRR)
- May 15-16, 2016 – Competition (incl. Oral FRR)
- May 27, 2016 – Post Flight Performance Report (PCPR)
- June 10, 2016 – Competition Results Announced

$$v_x = v\cos\theta$$

$$v_y = v\sin\theta$$

$$x = v\cos\theta \cdot t$$

$$y = \left(v\sin\theta - \frac{g}{2}t\right) \cdot t$$

Comments or Questions?