

2019-2020 Hybrid Motor High Powered Rocket Competition

Sponsored by the NASA Florida Space Grant Consortium (FSGC) and the
Spaceport Rocketry Association, Inc. (SRA)

I. Introduction

The objective of the competition is to build and launch a hybrid powered rocket with a hybrid motor rated “G” or from a lower class (160 Newton seconds or less). The competition has **two categories**. The **first category** consists of launching a hybrid rocket to the maximum altitude. The **second category** challenges the teams to fly their rocket closest to 2,000 feet in altitude. There must be at least two teams competing in each category. If there is only one team competing in a specific category, that team will have to wait for at least one other team to enter that category. Barring that, the team will either be forced to withdraw, or will have to move to the other category.

- This competition is open to any university, college, or community college team in Florida, both public and private.
- The rocket can be built from scratch or from a kit.
- The motor must be a hybrid motor rated “G” or from a lower class. The motor can be built from scratch or purchased from a company.
 1. If the motor is built from scratch or a standard motor is modified in **anyway** (including motor case, nozzles or grains), the motor becomes **non-standard**.
 2. Any team using a non-standard motor would make the project “research” and would require a mentor. The team must identify a “mentor” by the first report due date of the competition. A mentor is defined as an adult who is included as a team member, who will be supporting the team (or multiple teams) throughout the project year, and may or may not be affiliated with the school, institution, or organization. The mentor must maintain a current Level 2

certification, and be in good standing, through the Tripoli Rocketry Association (TRA). **The mentor is designated as the individual owner of the rocket for liability purposes and must travel with the team to launch week**

3. If using a “research” motor the following is required:
 - a. A minimum of two documented motor tests must be done to demonstrate the safety, quality, and performance of the motor. Documentation must be prepared and submitted to FSGC two-weeks before launch and must show thrust curves, impulse, burn-time, etc. from the two tests.
 - b. Additionally, modified motors fall under Tripoli Experimental rules and must follow the following rules:
 - i. No sugar based propellants.
 - c. Non-Tripoli Members age 18 and over, that are students of an accredited educational institution, may participate in joint projects with Tripoli members. These individuals are allowed in the High Power Launch Area if escorted by an High Power Rocketry (HPR) Flier (An Adult Flier that is certified to fly High Power rockets at their certification level) or Model Rocket Launch Area if escorted by an Adult Flier (An insured TRA member or an insured member of an approved, insured rocketry organization that is 18 years old or older).
 - d. Space Grant will require the name and Tripoli member number of the certified Level 2 overseer within 2 weeks of competition start.
 - e. The maximum number of non-Tripoli member participants shall not exceed five (5) per supervising flier.
 - f. On Launch Day Pre-launch prep in the “prep area” and going to the launch pad area and activity in the pad area will require the presence of a Tripoli certified Level 2 individual.

4. Any team using all certified (purchased) hardware and propellant and following manufacturer configuration requirements will not need a Tripoli certified Level 2 participation or oversight.
 - a. No one on the team needs to be TRA member
 - b. When purchasing the motor, refer to the section where it lists Tripoli certified motors, tube, grain and nozzle combinations. NOTE: certified (purchased) fast nozzle could not be coupled with a slow propellant formulation (unless the manufacturer would permit it). If any team does this, the team would fall under the rules of 1. above.

II. Proposal

The **Faculty Advisor** of the university, college, or community college team must submit a two-page proposal with a budget of up to \$600.00. **If a faculty advisor is requesting funds for more than 1 team, then the maximum funding request for 2 teams is \$1000, for 3 teams, \$1400 and 4 teams, \$1700.** The proposal must be submitted by the Faculty Advisor through that institution's Sponsored Research Office – otherwise the proposal will not be accepted. If a team is planning to enter both categories, please submit separate proposals (maximum two- pages each).

The proposal will include:

1. 2019-20 Hybrid Rocket Proposal Cover Page with Signatures.
2. Faculty Advisor's email address and contact information.
3. The team name.
4. Which category is the team competing in (Maximum Altitude or Closest to 2,000ft).

5. Answer the following questions: Why does your team want to compete in this competition? How do you think your team can meet the objective of building and launching a hybrid powered rocket?
6. A Detailed Budget (**Please note that indirect costs are limited to 5%**). The budget should only include items that are needed for the construction of the hybrid rocket. Stipends to students are disallowed. Travel costs to the launch site can be included.
7. Student Project Manager, Student Project Alternate Manager, and all Team Members:
 - Name and email address.
 - Status (Freshman, Sophomore, Junior, Senior etc.)
 - Subject major enrolled
 - Hometown
 - Gender
 - Race (Needed for Reporting to Funding Authority - Please Choose: Native American, Pacific Islander, African American, Hispanic, Caucasian, Other, Asian)

Please note that the starting date is **October 7, 2019**. This date is just the award date for funding purposes. Teams can begin their work from the **September 24, 2019** announcement date for the selected teams.

Proposals without the team member information (see item 7) will not be accepted. Teams can always change the composition of the team. If the team members differ from the original proposal, please email the relevant student information (see item 7) to the FSGC office. **We require the student demographic information as NASA requires us to report the data. We only submit aggregate numbers. Individual information is never released.**

All teams that submit a proposal, and are accepted, will be eligible to take part in the competition and compete for additional funding. At least a total of 4 teams (from both categories) will be selected and awarded up to **\$600 (1 team) or \$1000 (2**

teams), or \$1400 (3 teams) and \$1700 (4 teams) to build the rocket (detailed budget must be provided in the proposal). For teams that design their own motors, static testing and data from two test launches is expected. **The funds will be provided as a cost reimbursable grant to the Faculty Advisor.** The funds can be used for supplies, motors, kits and travel. Salary and capital expenditure is not allowed. Indirect costs are limited to 5%.

Submit Proposal via email to: Dr. Jaydeep Mukherjee
jaydeep.mukherjee@ucf.edu

Submit Technical Questions via email to: Robert Eppig, beppig@cfl.rr.com

Proposals, with the signed cover page, must be emailed to Dr. Jaydeep Mukherjee (jaydeep.mukherjee@ucf.edu) by 5pm on **September 20, 2019.**

Inquiries: Financial and Other

All financial inquiries must come from the **Faculty Advisor and/or that institution's Sponsored Research Office.** We will **not** entertain any award related and/or financial inquiries from the Student Project Manager, Student Project Alternate Manager, or Team Members.

All other inquiries must come from the Student Project Manager or the Student Project Alternate Manager. FSGC will not entertain any inquiries from other Team Members.

III. Reports and Flight

Teams will build and test their rockets for flight and will be required to submit an engineering notebook due approximately two-weeks before the launch. Also, the Student Project Manager or the Student Project Alternate Manager from each team will be required to submit, every two-weeks, a "Progress and Accomplishment Report" (P&A report) of no more than 3/4 page text to the **PBWorks website:** <http://hybridrocket.pbworks.com/>

The first of the 2 weeks report is due on **October 11, 2019.**

On **September 27, 2019 the Faculty Advisor, the Student Project Manager, and the Student Project Alternate Manager for each team will be given access to the PBWorks website (via an email account and password log-in).**

P&A reports should include work done plus attachments including parts lists, photos, etc. NOTE: There are no points awarded for submitting the Progress and Accomplishment Reports, however, points will be deducted for non-submittal and late reports.

Also, each team will be required to submit to the **PBWorks website a Hazard Analysis and a Failure Modes & Effects Analysis (FMEA)** report by **November 15, 2019.** The Hazard Analysis should focus on the handling and use of the nitrous oxide and any pyrotechnic systems or materials. The Failure Modes & Effects Analysis should focus on what kinds of things could go wrong with your launch equipment and rocket, as well as, what you have done to mitigate or reduce the identified failure modes. These reports should be no more than four text pages in length, tables and graphs are not included in page count. They should be updated and resubmitted as your designs evolve. The reports are to show that you are ready to test and fly your rockets and motors safely. Failure to submit these reports may result in your being removed from the competition.

IV. Launch Day (March 22, 2020); Alternate Launch Date (April 19, 2020)

Spaceport Rocketry Association will sponsor the launch at the club site in Palm Bay in Brevard County Florida. Results of launch must be in to the judge by 3:50 pm when the field closes on the day of the launch; judge will leave site at 4:00 pm.

General Timeline at Launch Site:

9:00 am – people start to arrive

10:00 am – After a mandatory flyers meeting the field opens for launching rockets

≈3:00 pm – the field closes for launching rockets

4:00 pm – everyone leaves the field

NOTE: We are not responsible for problems at the launch site. Be there early. Don't wait until it is too late to launch. To be awarded points for flight you must have a successful flight; i.e. launch, deployment of recovery system, and controlled landing. All other flights will be judged on a case-by-case base.

Spaceport Rocketry Association, Inc. (SRA) Website:

<http://www.spaceportrocketry.org>

Launch Procedure:

1 – Fill out a Flight Card

2 – When ready to launch only one team member will report to the contest coordinator (Bob Eppig) with Flight Card and a way to communicate with the other team members (phone, walkie talkie or other means).

3 – Contest Coordinator (Bob Eppig) will coordinate countdown and launch with the Spaceport Rocketry Clubs Launch Control Officer.

4 – Multiple teams can meet with contest coordinator (Bob Eppig) at the same time but only one member from each team

a. Altimeters

A recording barometric altimeter must be used to record data for competition. The launch site should be considered zero altitude and the altimeter should be calibrated to zero, it is up to flier to provide proof of a properly calibrated altimeter to the Judge upon request. Acceptable altimeters are PerfectFlite Stratologger or PerfectFlight Firefly. Bob Eppig must approve any others on a case-by-case basis.

Altimeters with altitude sensors other than barometric sensors, such as accelerometers or magnetic apogee detection, may be used to deploy the recovery systems. However, they are prohibited from use in determining the actual altitude.

b. Determining Actual Altitude

The actual flight profile will be determined by the competition judges. The graph or other flight profile display provided by a recording device will be examined for accuracy. If it is shown that a sudden peak in altitude is attributable to the ejection charge, that peak will not be used to determine the recorded altitude. The altitude just prior to or just after that sudden peak will be the official recorded altitude.

c. Launch Rails & Firing Electronics Requirements

Teams should provide their own launch rails/pads and firing electronics and if requested must be inspected for safety by a Spaceport Rocketry Association representative. **NOTE THIS REQUIREMENT: firing electronics must be at least 300 feet away from launch rails/pads. Firing electronics should incorporate at least one safety switch to prevent accidental ignition of rocket during setup. Please insure that you have enough current available to ignite the motor with 300 foot of cable.** If you wish to use Spaceport Rocketry Association launch pad equipment (not firing electronics), please contact Robert Eppig. He will check to see if what you need is available. Please request equipment 2 months before launch day. Requests closer to launch day than 2 months will not be considered - **THERE IS NO GUARANTEE THAT WHAT YOU NEED IS AVAILABLE.**

Motor Class Total Impulse

G or less: 160 Newton-seconds or less

V. Scoring

Points will be awarded for the phases of the competition. The successful flight is worth 80% of the total points and the teams Engineering Notebook report is worth 20% of the total points. The points for each part are as follows:

1. Points for Flight
 - 100 pts for highest or closest to altitude

- 90 pts for 2nd highest or closest to altitude
 - 80 pts or 3rd highest or closest to altitude
 - 70 pts for 4th highest or closest to altitude
 - 0-10 pts for self-built motor
 - 0-5 pts for self-built rocket
2. Points for Engineering Notebook
 - RockSim or other software simulations (max. 30 pts)
 - Engineering Data (max. 70 pts)
 3. Points for Progress and Accomplishment Report
 - There are no points awarded for submitting the Progress and Accomplishment Reports however, points will be deducted for late and non-submittal reports. For each day late you will lose 1% of your total weighted score (with a maximum of 3% lose for each late report). For each no-submittal report, you will lose 3% of your total weighted score.
 4. Hazard Analysis and a Failure Modes & Effects Analysis Report (FEMA)
 - There are no points awarded for submitting the Hazard Analysis and FEMA reports, however failure to submit these reports will mean loss of points and may result in your team being removed from the competition.

Engineering Notebook - will be a bound notebook (Composition type notebook) which will have all of the team's engineering data, calculations, drawings and sketches, test results, notes, ideas, meeting notes, etc.

NOTE: The notebook is NOT a formal final report. We are looking for your project/laboratory workbook. You will submit the Engineering Notebook to the PBWorks website (digitally scanned) or mail a hard-copy of the report to the NASA FSGC offices (if mailed, the notebook will be returned to the teams on flight day).

[Engineering Notebook is due on March 16, 2010](#)

VI. Additional Funding

As mentioned earlier in this RFP, at least 4 teams (from both categories) will be selected and awarded up to \$600 to build the rocket (detailed budget must be provided in the proposal).

The winning teams from each category will receive additional funding according to the following chart. These additional funds will be provided to the winning team(s) as additional funding to the project award given to them earlier at the start of the program. These funds may be used for supplementing the project costs and/or for expenses incurred for travel to the competition location. **Please note that travel costs can only be provided to US citizens. We may require a revised budget for the additional funding.**

Place	Maximum Altitude Category	Closest to 2000 ft. Category
1 st Place	\$500.00	\$750.00
2 nd Place	\$300.00	\$450.00
3 rd Place	\$100.00	\$200.00

Inquiries: Financial and Other

All financial and award related inquiries must come from the **Faculty Advisor and/or the institution Sponsored Research Office**. We will **not** entertain any financial inquiries from the Student Project Manager, Student Project Alternate Manager, or Team Members.

All other inquiries must come from the Student Project Manager or the Student Project Alternate Manager. FSGC will not entertain any inquiries from other Team Members.

VII. Timeline

- **Sept. 20, 2019:** Proposal with Budget and Cover Page with Signatures, Deadline.
- **Sept. 24, 2019:** Announcement of selected teams.
- **Not before October 7,** grant awarded to faculty advisor.
- **Sept. 27, 2019:** Participant access given to the PBWorks website via email.
- **Oct. 11, 2019:** First of the every two week P&A report due and mentor's name submitted.
- **Nov. 15, 2019:** Hazard Analysis, Failure Modes & Effects Analysis due.
- **March 16, 2020:** Engineering Notebook due at Florida Space Grant Offices (either hard copy or digital upload to the PBWorks website).
- Launch on Sunday **March 22, 2020** (alternate date Sunday April 19, 2020). Launch date is subject to change.

VIII. Relevant Links

1. NASA Florida Space Grant Consortium (www.floridaspacegrant.org)
2. Spaceport Rocketry Association, Inc. (SRA) Website:
(<http://www.spaceportrocketry.org>)
3. Safety Code for High-Power Rocketry Tripoli Rocketry Association
(<http://www.tripoli.org/Portals/1/Documents/Safety%20Code/HighPowerSafetyCode%20-%202017.pdf>)