

# 2018-2019 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, they will be asked to move to the other category.

- This competition is open to any university or community college team in Florida, both public and private.
- The rocket can be built from scratch or from a kit.
- The engine must be a hybrid motor rated “G” or from a lower class. The engine can be built from scratch or purchased from a company.
- This competition is open to any university or community college team in Florida, both public and private.
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- The engine must be a hybrid motor rated “G” or from a lower class. The engine 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 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 HPR Flier or Model Rocket Launch Area if escorted by an Adult Flier.
  - 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-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 will require a Tripoli certified Level 2 individual.
4. Any team using all certified (purchased) hardware and propellant and follows manufacturer configuration requirements would 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) a 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 one above.

## II. Proposal

The **Faculty Advisor** of the university 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 three- pages each, except for the student demographic information).

The proposal will include:

1. 2018-19 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? Why do you think your team can actually 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. A spreadsheet showing the following details of each student participating in the project. Please identify the Student Project Manager, Student Project Alternate Manager.
  - Name of Student,
  - Email address,
  - Citizenship (US or non-US),
  - Status (senior, junior etc),
  - Major ( physics, electric engineering, etc),
  - Gender (Male or female)
  - Race (American Indian or Alaska Native, Asian, Black or African American, Native Hawaiian or Other Pacific Islander, White)
  - Ethnicity (Hispanic or Latino, Not Hispanic or Latino)
  - Disability (yes or no)

Please note that the starting date is October 8, 2018. This date is just the award date for funding purposes. Teams can begin their work from September 25, 2018 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 6 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 engines, 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](mailto:jaydeep.mukherjee@ucf.edu)**

**Submit Technical Questions via email to: Robert Eppig, [beppig@cfl.rr.com](mailto:beppig@cfl.rr.com)**

Proposals, with the signed coverpage, must be emailed to Dr. Jaydeep Mukherjee ([jaydeep.mukherjee@ucf.edu](mailto:jaydeep.mukherjee@ucf.edu)) by 5pm on September 21, 2018.

### **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” of no more than 3/4 page text to the **PBWorks website**:

<http://hybridrocket.pbworks.com/>

**On September 28, 2018 the Faculty Advisor, Student Project Manager, and the Student Project Alternate Manager will be given access to the PBWorks website (via an email account and password log-in).**

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 12, 2018.** 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**

Teams will have their rockets and motors inspected for safety by a Spaceport Rocketry Association representative just before launch (TBA). 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 4:00 pm when the field closes

on the day of the launch; judge will leave site at 4:30 pm. 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. NOTE: Rockets deemed unsafe will not be allowed to fly in the competition until fixed and approved.

Spaceport Rocketry Association, Inc. (SRA) Website:

<http://www.spaceportrocketry.org>

### **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.

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 equipment please contact Robert Eppig for our Spaceport Rocketry Association representative contact information – to check if what you need is available. Please check early (at least 2 months in advance) if you wish to use Spaceport Rocketry Association equipment-**THERE IS NO GUARANTEE THAT WHAT YOU NEED IS AVAILABLE.**

#### **d. Static Judging**

For the teams that build their rocket and/or engine from scratch, their scores from the judges will reflect the originality and performance of the rocket and/or the engine.

#### **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 2<sup>nd</sup> highest or closest to altitude
  - 80 pts for 3<sup>rd</sup> highest or closest to altitude
  - 70 pts for 4<sup>th</sup> 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 (30 pts)
  - Engineering Data (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 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) 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).**

## **VI. Additional Funding**

As mentioned earlier in this RFP, at least 6 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.**

Place	Maximum Altitude Category	Closest to 2000 ft. Category
1 <sup>st</sup> Place	\$500.00	\$750.00
2 <sup>nd</sup> Place	\$300.00	\$450.00
3 <sup>rd</sup> 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. 21, 2018: Proposal with Budget and Cover Page with Signatures, Deadline.
- Sept. 25, 2018: Announcement of winners and grant awarded to faculty advisor. Please note that it takes 5 to 7 business days to send the award paperwork to your university.
- Sept. 28, 2018: Participant access given to the PBWorks website via email.
- Oct. 8, 2018: First of the every two week report due and mentor's name submitted.
- Nov. 12, 2018: Hazard Analysis, Failure Modes & Effects Analysis due.
- March 11, 2018: Engineering Notebook due at Florida Space Grant Offices (either hard copy or digital upload to the PBWorks website).
- Launch on Sunday March 17, 2019 (alternate date Sunday April 21, 2019). Launch date is subject to change.