

# INROC-2023

## International Rocket Competition

### 2023- India Rulebook



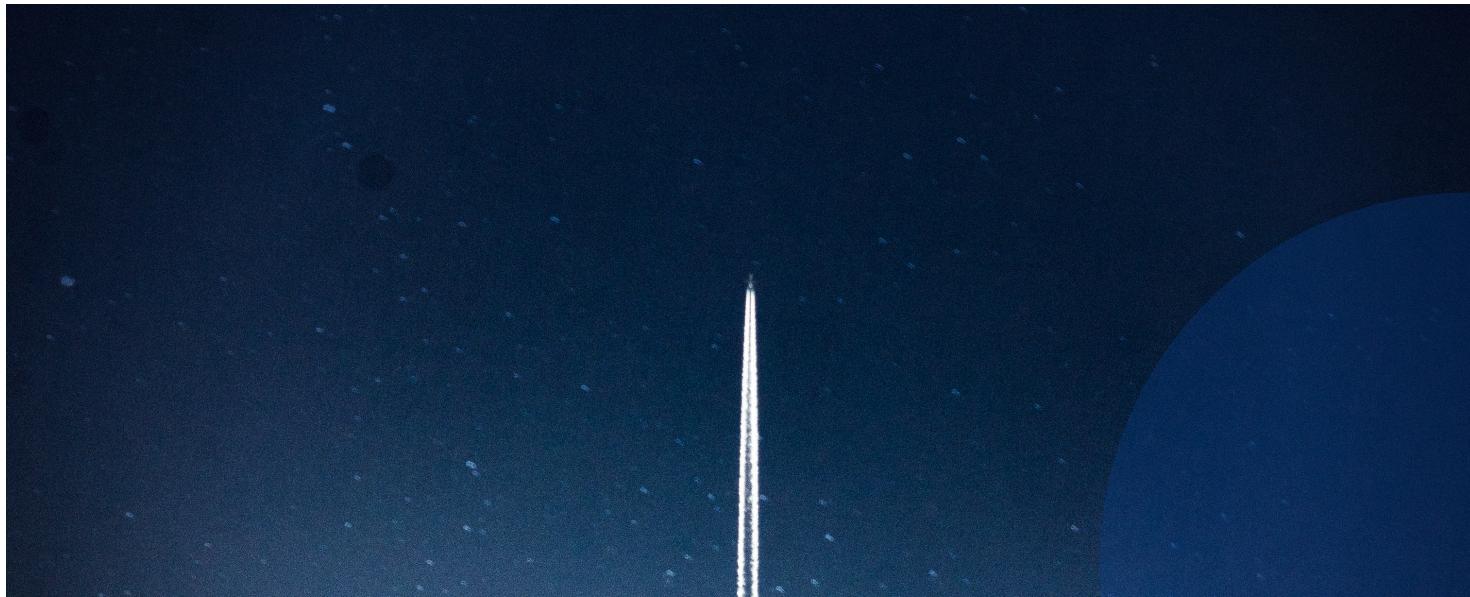
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[indoplanetxsvr.com](http://indoplanetxsvr.com)



# **International Rocket Competition - 2023**

## **Introduction**

Indoplanetx Space Vault Research Pvt. Ltd and Aero.in is organizing INROC - International Rocket Competition with the help of TIDES Business Incubator in IIT ROORKEE, in which our lab is incubated as well. The ISVR-Aero.in sponsors the INROC - International Rocket Competition , which is held and aims to encourage university-level students to fly sounding rockets by having the rockets built and designed by them. It is well known that these contests encourage creativity, inspire students to go outside the classroom, teach them how to collaborate with one another, and prepare them for the challenges of the real world and their future employment. The guidelines for taking part INROC are laid forth in this document. This document will be completely reissued after major improvements have been made. Minor changes will be noted by the revision number and updated in the document's effective date. ISVR-Aero.in has the power to review, approve, and publish updated versions of this document.

## Objectives

Indoplanetx Space Vault Research Pvt. Ltd and Aero.in comes here to organize International Rocket Competition - 2023. The main objective of the rocket competition is to make space for everyone & space for all . The vision of this competition is to engage the space enthusiasts to involve in rocket science.



## **Who we are ?**

Indoplanetx Space Vault Research Pvt. Ltd, India hereinafter referred to as ISVR of the first part and Aero. in, the second part, strongly believe that the Global Space Sector is rising and with that, a giant wave of new opportunities is about to strike the nation. All the developing countries need an entirely new type of workforce to serve their space industry and there is an immediate need for many Space Research and Training Platforms to provide the necessary skills to the young minds of the country. To achieve this goal, the value of interaction and cooperation between the two organizations/institutions can strengthen their individual and collective programs and further develop important friendships between them and their respective constituents as they work more closely together. ISVR and Aero.in comes here to host India's first International Rocket Competition.

## **Competition Overview**

Student teams competing in the INROC must design, build, and launch a rocket With a parachute ejection system. The team needs to attain a target apogee between 2800m and 3500m Above Ground Level (AGL). Team Projects will be divided into one of the following categories based on the type of project attempted. Teams are permitted to switch categories if required, prior to submitting their final Project Technical Report.

- 2800M to 3500m AGL apogee with solid or hybrid propulsion.
- Parachute ejection system after reaching the apogee
- Sensors like GPS, Pressure sensors, and Altimeters must be attached
- Should not cross the required apogee
- Every participating team should make the Project Technical Report, which as attached the format below

## PROJECT TECHNICAL REPORT

Each team shall submit a Project Technical Report which overviews their project for the judging panel and other competition officials.

### ABSTRACT

The Project Technical Report shall contain an Abstract. At a minimum, the abstract shall identify the launch vehicle's mission/category in which the team is competing, identify any unique/defining design characteristics of launch vehicle, define the payload's mission (if applicable), and provide whatever additional information may be necessary to convey any other high-level project or program goals & objectives.

### INTRODUCTION

The Project Technical Report shall contain an Introduction. This section provides an overview of the academic program, stakeholders, team structure, and team management strategies. The introduction may repeat some of the content included in the abstract because the abstract is intended to act as a standalone synopsis if necessary.

### SYSTEM ARCHITECTURE OVERVIEW

The Project Technical Report shall contain a System Architecture overview. This section shall begin with a top-level overview of the integrated system, including a cutaway figure depicting the fully integrated launch vehicle and its major subsystems – configured for the mission being flown in the competition. This description shall be followed by the following subsections. Each subsection shall include detailed descriptions of each subsystem, and reflect the technical analyses used to support design and manufacturing decisions. The Project Technical Report should not just discuss what the team did, but the reasoning for their choices. These may include but are not limited to, design goals, limitations, potential trade-offs, anticipated component loads along with safety factors.

## **MISSION CONCEPT OF OPERATIONS OVERVIEW**

The Project Technical Report shall contain a Mission Concept of Operations Overview. This section shall identify the mission phases, include a figure, and describe the nominal operation of all subsystems during each phase (e.g., a description of what is supposed to be occurring in each phase, and what subsystem[s] are responsible for accomplishing this). Furthermore, this section shall define what mission events signify a phase transition has occurred (e.g., "Ignition" may begin when a FIRE signal is sent to the igniter and conclude when the propulsion system comes up to chamber pressure. Similarly, "Liftoff" may begin at vehicle's first motion, and conclude when the vehicle is free of the launch rail). Phases and phase transitions are expected to vary from system to system based on specific design implementations and mission goals & objectives. No matter how a team defines these mission phases and phase transitions, they will be used to help organize failure modes identified in a Risk Assessment Appendix .

## **CONCLUSIONS**

The Project Technical Report shall contain Conclusions and Lessons Learned. This section shall include the lessons learned during the design, manufacture, and testing of the project, both from a team management and technical development perspective. If you had failures, what did you learn from them? Furthermore, this section should include strategies for corporate knowledge transfer from senior student team members to the rising underclassmen who will soon take their place.

## GENERAL GUIDELINES

INROC propulsion systems are defined as those designed by and manufactured by a team. However, due to constraints such as budget, lack of technical skills, tooling, or finances, student teams may work with 3rd parties to assist in the manufacturing of some components. Under no circumstances are the propellant components to be manufactured by a third party. This includes solid propellant grains

## FLIGHT CATEGORIES

Teams competing in INROC must create a rocket that can reach an apogee of either 2800 m or 3500 m above sea level while carrying no less than 1 kg of cargo (AGL). Teams may use either commercial off-the-shelf (COTS) or student-researched and developed (SRAD) propulsion systems. SRAD propulsion systems are defined as those designed by students, including student-designed modifications of COTS systems, whether students conduct fabrication directly or by a third party working to student-supplied specifications. There are no restrictions on multistage or clustered launch vehicles.

The propulsion system (solid [S], hybrid [H], or liquid [L]) and target apogee will be used to categorize projects (2800 m to 3500 m). S3, H3, L3, S9, H9, and L9 are the six flight categories as a result. The origin of the propulsion will be specified in the COTS scenario by the addition of the suffix [-c], but SRAD systems will not have a suffix, allowing for differentiation between COTS and SRAD systems. No matter where they come from, propulsion systems of the same sort will compete in the same category.

Before submitting their final Project Technical Report, teams may change categories, as necessary. e.g., they may switch from the 3000m or vice versa. INROC reserves the right to change the category in which a project is initially entered based on the design presented (from COTS to SRAD, or between S/H/L).

## **TEAM COMPOSITION AND ELIGIBILITY**

INROC teams shall consist of members who are currently enrolled in a Bachelor's or Master's degree or were matriculated undergraduate or graduate students (i.e., Masters) during the previous academic year (e.g., former students who graduated shortly before the competition remain eligible), & Companies and team, anyone can participate . Each team is limited to 10 members max & Min of 6. Teams may integrate advisory members (e.g., doctorate students, professors and mentors),. Please note that advisors are considered team members and will count for the 10 members limit.

The limitation in the number of team members only applies to the number of team members to be present at the event, and not to the constitution of the team itself.

Each team shall assign a team leader when applying to INROC. The team leader must be the point of contact with INROC for all matters, meaning that INROC organisation will always and only directly contact the team leader, and that the team leader must be the only one contacting the INROC organisation.

Furthermore, the team leader should be responsible for disclosing and sharing all the information provided by INROC to the remaining team (e.g., by having access to the teams' reserved area in the INROC

The number of teams at INROC 2023 edition will be limited. National rules regarding Covid-19 in place at the time of the event will apply.

## **LIMITATIONS ON SUBMISSIONS**

The project report must be submitted to INROC by each team, organization, or group. There is a limit of one project per category. Any deviation from this rule will need to be discussed with the event organizers individually. Every team must submit the appropriate document to the INROC team, which was have attached the format above.

## **PROCESSES FOR APPLICATION AND REGISTRATION**

Although the organizers hope to accept all applicants, a procedure to narrow the field of potential participants from all applicants must be in place. Teams will be chosen as part of a process that aims to include a variety of young rocket teams. Applications received throughout the whole application time will be taken into consideration; this approach will not be first-come, first-served.

## **PARTICIPATION LETTER FOR ACADEMIC INSTITUTION**

Each team must request that the academic institution(s) where its members are enrolled send a letter to INROC, recognizing that the team is the institution's representative and stating that the team intends to take part in the competition. Senior academic or senior staff representative must be the signatory (e.g., professor). Academic institutions sending several teams to the INROC only need to prepare one participation letter for the entire group; however, each participating team must submit a separate copy of that letter. Each associated university must send the team its own letter that has been signed, in the case of a combined team made up of students from different academic institutions, must have proper document individually.

## **PURPOSE**

The ISVR - Aero.in would like to explain and define the fee structure for the International Rocket Competition (INROC). There is a separate fees that make up the entire "INROC Registration Fee"- the Entry Fee, Rocket Fee, and Rocketeer Fee .

## **STUDENT UNIVERSITY IDENTIFICATION**

Each team must provide copies of the documentation demonstrating that each team member is qualified, i.e., that they are matriculated undergraduate or graduate students from the previous academic year or are presently enrolled in a Bachelor's or master's program.

If the team is from startup's or companies must carry the valid document of your reputed team

The accepted documents as student identification proof are:

- Student card, with valid expiration date or;
- Certificate of enrolment issued by the academic institution or companies, Team
- A print screen of the student personal area from the academic

## **A SYNOPSIS OF THE FEES' HISTORY**

To help provide a fair arrangement for smaller teams and larger teams, as well as for teams with less money and teams with more funding, INROC devised a new price structure. We ensure that smaller teams, which are frequently underfunded, pay less than the larger ones by dividing the cost in this manner.

### **Note to Colleges, Universities, and Organizations Sponsoring Teams:**

ISVR-Aero.in requests that any entity paying for or reimbursing an INROC team's registration fees include the per-person costs as well. Some colleges and universities in the past refused to pay the teams back for the per-student costs. As a result, some teams had insufficient team members and were unable to function properly during the competition. The individual student participation fees are required for a team to compete and for INROC to cover the costs of the event, INROC informs you. ISVR-Aero.in is still and will always be a nonprofit company. We have always worked to keep the costs to teams as low as possible while providing an amazing experience for the students, and the academic institutions they represent.

## SCORING CRITERIA

### **Entry Form and subsequent Progress Updates (60 points - 6% of 1,000 total points).**

The correct, complete, and timely delivery of a team's Entry Form and subsequent Progress Updates is awarded as many as 60 points – 6% of 1,000 total points possible. The Entry Form and subsequent updates are considered correct if they are submitted as specified in this Document. They will be considered complete if they are filled out in accordance with the online form. They will be considered timely if they are received no later than after the deadline specified in the International Rocket Competition (INROC).

The 60 points are divided evenly among the four submissions (i.e., the Entry Form and three subsequent Project Updates), making each submission worth 15 points. The submission is awarded these points on a pass/fail basis and must meet all three criteria – correctness, completeness, and timeliness – in order to “pass.” Although they will not receive points for the submission, teams which miss a submission window are still required to make that submission as soon as possible for administrative purposes – unless that team no longer plans to attend the International Rocket Competition.

### **Technical Report (200 points - 20% of 1,000 points)**

Timely Project Technical Reports will be awarded as many as 200 points – 20% of 1,000 points

possible – for their correctness, completeness, and analysis. Only timely Project Technical Reports will be evaluated and scored. A Project Technical Report is considered timely if it is received no later after the deadline specified in the International Rocket Competition Rulebook. Although they will not receive points for the submission, teams which miss submission window are still required to make that submission as soon as possible for administrative purposes – unless that team no longer plans to attend the International Rocket Competition.

### **Correctness is worth (40 points- 20% of 200 points)**

The Project Technical Report's overall point value. Correctness is defined by its adherence to the format/style guide specified in Rulebook of this competition and upholding of basic technical editing standards. The report's correctness will be rated using the Technical Report template mentioned in Rulebook of competition.

### **Completeness is worth (20 points- 10% of 200 points)**

The Project Technical Report's overall point value. The Project Technical Report is considered complete if it contains all minimally required content defined in the Rulebook of this competition. Points for completeness are awarded on a pass/fail basis, and only minor omissions or ambiguity of required information is tolerated in a passing evaluation.

### **Analysis is worth (140 points – 70% of 200 points)**

The Project Technical Report's overall point value. This constitutes a structured, qualitative assessment by the evaluating competition officials of the analytic rigor demonstrated by the team during the iterative down-selection, refinement, and acceptance of all project aspects. The report's analysis will be rated using the Technical Report using the guideline rulebook of the competition. Note this score may be amended at the International Rocket Competition itself, based on the evaluators' assessment of the team's conceptual understanding during any interactions.

### **SCORING DESIGN AND IMPLEMENTATION (240 points – 24% of 1,000 points)**

Teams will be awarded as many as 240 points – 24% of 1,000 points possible – for the overall design quality, strategic design decisions, and build quality exhibited by their work. Competition officials will evaluate these criteria through interactions with the teams and their systems, occurring throughout the INROC and all during the following day – spent making launch preparations in the field.

## **Build quality is worth (120 points - 50% of 240 points)**

The overall value assigned to Design and Implementation. This constitutes a structured qualitative assessment by the competition officials of the team's quality with which that design was constructed (e.g., Is the finished product sufficiently well-constructed to meet the needs of the underlying design and reasonably expected variation in launch conditions

## **FLIGHT PERFORMANCE (500 points - 50% of 1,000 points)**

Team's will be awarded as many as 500 points – 50% of 1,000 points possible – for their project's flight performance during launches at INROC, demonstrated by altitude achieved relative to the target apogee and successful recovery.

### **Accuracy of launch (350 points- 70% of 500 points )**

The accuracy of the launch vehicle's actual apogee achieved relative to the target apogee is worth 70% (350 points) of the overall value assigned to flight performance. Precise Trajectory planning is important. Points will be awarded for apogees within  $\pm 30\%$  of the 3km or 10,000 feet target apogee according to the following formula.

$$\text{Points} = 350 - (350 / 0.3 \times \text{Apogee Target}) \times |\text{Apogee target} - \text{Apogee Actual}|$$

where Apogee Target may be equal to 2800m to 3.5km .Teams shall report in person to competition officials immediately after recovery of their rocket to report the official altitude in accordance with Rulebook. If telemetry data from the official altitude logging system is available, teams may report the apogee revealed in this telemetry to competition officials if a confirmation of nominal ascent and recovery system deployment events is possible. This information will be used for scoring only in the event the launch vehicle is not recovered prior to the end of eligible launch operations on the final scheduled launch day.

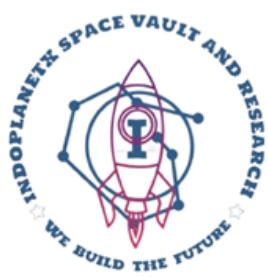
## Recovery (150 points- 30% of 500 points)

The successful recovery of the launch vehicle is worth 30% (150 points) of the overall value assigned to flight performance. A recovery operation is considered successful if it does not result in excessive damage to the launch vehicle. Excessive damage is defined as any damage to the point that, if the systems intended consumables (e.g., propellants, pressurized gasses, energetic devices) were replenished, it could not be launched again safely. At competition officials' discretion, replacement of damaged fins or other airframe components specifically designed for easy, rapid replacement is allowed if such components are on hand and can reasonably be replaced within 30 minutes. Competition officials will visually inspect the launch vehicle upon its return to the designated basecamp area and award these points on a pass/fail basis.

<b>Criteria</b>	<b>Total (1000 Points)</b>
Entry Form and subsequent Progress Updates	<b>60 points</b>
Technical report	<b>200 points</b>
Scoring design & Implementation	<b>240 points</b>
Flight Performance	<b>500 points</b>

## Penalties

Teams will be penalized 20 points off their total earned score for every instance of unsafe or unsportsmanlike and unsafe conduct recorded by competition officials (e.g., judges, volunteers, or staff members).



## INROC FEES

ISVR - Aero.in spends the entire year preparing a world-class event for the students, sponsors, and viewers. Teams will still have an unmatched opportunity to display their work, network with recruiters from the aerospace industry, and advertise their schools even if their rocket isn't ready to launch. The International Rocket Competition offers world-class emergency services, professional event facilities, and an exciting atmosphere for the teams and the audience to enjoy. The following costs are payable by student teams to take part in the International Rocket Competition.

**Entry Fee: Rs. 11,999/-**

Early registration before 11-04-2023

**Entry Fee: Rs. 15000/-**

Regular registration after 11-04-2023

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