



romanian space agency

Romania



# CANSAT

Romanian Competition GUIDELINES

2022



# → INTRODUCTION

CanSat activities across its Member States (including Canada, Latvia, Slovenia and Malta), all leading to a European final event – the European CanSat Competition. The CanSat project, aimed at secondary school students, mainly addresses Technology, Physics, and programming curricular subjects. By offering the practical experience of working on a small-scale space project, CanSat makes use of these subjects in an interdisciplinary manner, and promotes collaboration and teamwork.

In Romania the organiser of the competition is the European Space Education Resource Office (ESERO) Romania synergy with the Romanian Space Agency (ROSA).

## **What is a CanSat?**

A CanSat is a simulation of a real satellite, integrated within the volume and shape of a soft drinks can. The challenge for the students is to fit all the major subsystems found in a satellite, such as power, sensors and a communication system, into this minimal volume. The CanSat is then launched by a rocket up to an altitude of approximately one kilometre, or dropped from a platform, drone or captive balloon. Then its mission begins. This involves carrying out a scientific experiment and/or a technology demonstration, achieving a safe landing, and analysing the data collected.

Educational value of the CanSat project

Through the CanSat project, the participating student teams experience all the phases of a real space project, from selecting the mission objectives, designing their CanSat, integrating the components, testing the system, preparing for launch, and analysing the scientific data obtained. Throughout this process the students:

- learn by doing,
- get acquainted with the inquiry-based methodology that is typical of real-life scientific and technical professions,
- acquire and/or reinforce fundamental Technology, Physics, and programming curricular concepts,
- understand the importance of coordination and teamwork,
- enhance their communication skills.
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# → PROJECT PHASES

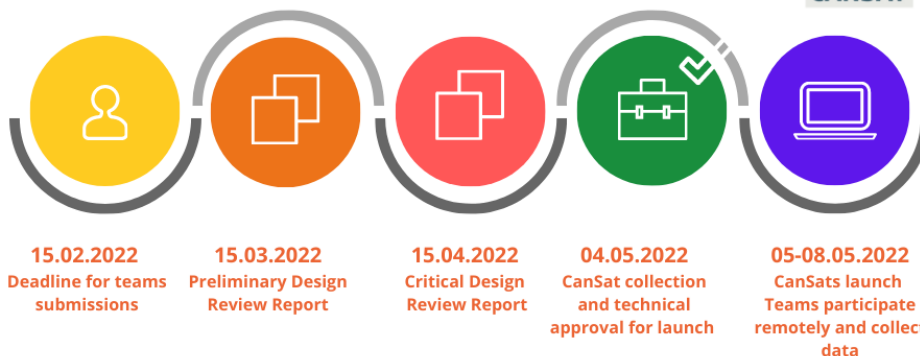
The phases of the European CanSat Competition reflect and take into account the set of national CanSat activities – mostly national competitions – which lead to the selection of one national team that will participate in the European competition. Only one team per participating country (ESA Member States<sup>1</sup>, Latvia, Slovenia, Canada and any guest competitor) is admitted to the European competition.

The European CanSat Competition 2022 consists of five phases:

1. **Phase 1** – Imagine your CanSat
2. **Phase 2** – Build your CanSat
3. **Phase 3** – Launch your CanSat: *National Launch Campaigns* (See calendar below)
4. **Phase 4** – Launch your CanSat: *European CanSat Launch Campaign*
5. **Phase 5** – Write your final report

## Calendar

### Romanian CanSat competition 2022



romanian space agency



<sup>1</sup> ESA Member States in 2020: Austria, Belgium, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Ireland, Italy, Luxembourg, the Netherlands, Norway, Poland, Portugal, Romania, Spain, Sweden, Switzerland, United Kingdom.

In the framework of the current collaboration agreement between ESA and the Republic of Malta, teams from Malta can also participate in the European CanSat Competition as guest competitors. Teams from other countries may also participate in the European CanSat Competition as guest competitors if approved by ESA (see Annex 1).

# → PROJECT PHASES

Phases 1 -2-3 are considered National and are managed by ESERO Romania.

Phase 4 onwards the CanSat competition is managed by the ESA Education Office.

## Phase 3: Launch your CanSat – National Competitions

Activity	Date
National competitions take place	Up to 8 May 2022
Deadline for national competition organisers to communicate name of winning teams to ESA	9 May 2022

## Phase 4: Launch your CanSat – European CanSat Launch Campaign

Activity	Date
Student teams submit their Pre-launch Report to ESA	10 June 2022
European launch campaign	20-25 June 2022

## Phase 5: Write your final report

Activity	Date
Student teams submit their CanSat Final Report to ESA	29 July 2022



# → Phase 1 - Imagine your CanSat

## Primary and secondary CanSat missions

### 1. Primary mission

The team must build a CanSat and program it to accomplish the following compulsory primary mission:

To measure, after release and during descent, the following parameters:

- Air temperature
- Air pressure

For the Romanian CanSat Competition 2022 launch campaign, this data must be **stored at least every second in an on-board removable memory card and the CanSat must send over IP also its last known location in order to be recuperated**. For the European CanSat Competition 2022 launch campaign, this data must be **stored at least every second in an on-board removable memory card<sup>2</sup> ..**

The jury will conduct the launches without the presence of the student teams (rather like a satellite launch campaign), therefore no live radio frequency reception is possible this year as this is normally done by the student teams. Teams are encouraged to send data over IP. Alternate communication solutions can be proposed and discussed with the jury members, implementation of such solutions has to be agreed by the jury members before the launch.

During the post-flight analysis, it must be possible for the team to analyse the data obtained (for example, make a calculation of altitude) and display it in graphs (for example, altitude vs. time and temperature vs. altitude).

The secondary mission of the CanSat must be selected by the team. Teams can take ideas from real satellite missions or collect scientific data for a specific project, make a technology demonstration for a student-designed component, or any other mission that would fit inside the CanSat and show its capabilities.

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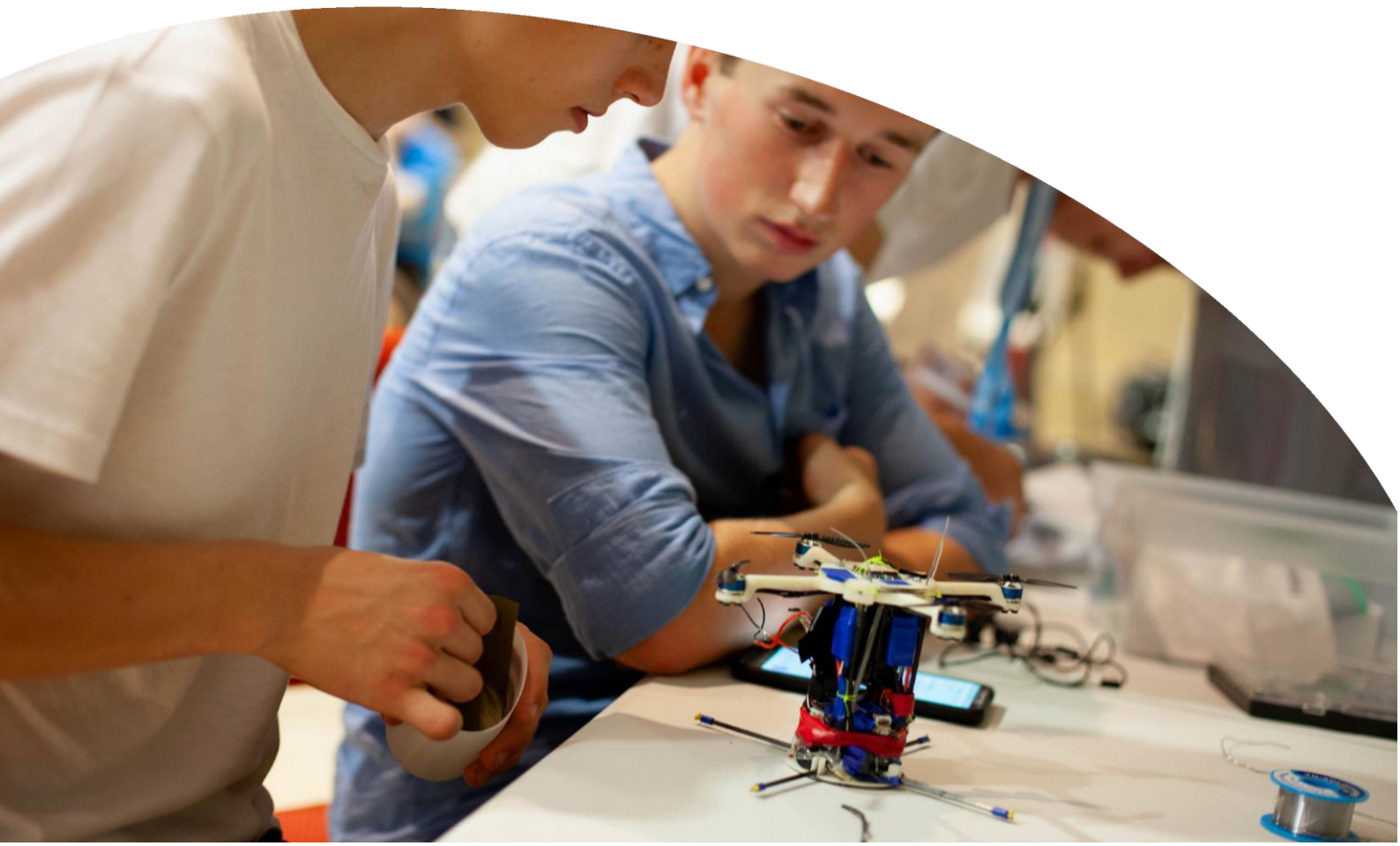
<sup>2</sup> Due to the current COVID-19 travel restrictions, the European CanSat Competition 2020-21 Launch Campaign will be run by ESA and followed remotely by the winning teams. It has therefore been decided to remove the requirement of transmission to a ground station in order to ease the execution of the European Launch Campaign. See also page 10.

## 2. Secondary mission

Teams should brainstorm their own mission objectives, ideas and constraints in order to try to define their mission. The student teams are free to design a mission of their choice, as long as they can demonstrate to have some scientific, technological or innovative value. Teams should also keep in mind the limitations and requirements of the CanSat mission, and consider the feasibility (both technical and administrative in terms of time and budget) of their chosen mission.

Teams are invited to take inspiration from **ESA's missions** for designing their own secondary missions, which could form the basis of a real space mission!

In this phase, the applicants will need to present their investigation plan by answering a series of questions in the registration form regarding their CanSat project. Teams will be judged according to the clarity and quality of their proposals. Student teams must submit their project by completing this form <https://tinyurl.com/cansatRo2022> by 14 February 2022, 22:00 .



## → Phase 2 – Build your CanSat

Under the supervision of their teacher/mentor, all the teams participating in CanSat will have to carry out technical work on their CanSats, applying the procedures used in the typical lifecycle of a real space project, which are:

- Selection of mission objectives;
- Definition of technical requirements necessary to achieve these objectives;
- Design of hardware and software;
- Reporting;
- Design of ground station/ground telecommunication system;
- Integration and testing of the CanSat before the European launch campaign starts.

### Support throughout the development phase

Teachers/mentors participating in National Competitions may be offered support from their National Organisers, such as<sup>3</sup>:

- CanSat Teacher's workshop for mentors
- CanSat Webinars with space experts
- Supporting learning materials (e.g., the [ESA CanSat resources](#) or national resources)
- Individual recommendations/help throughout the project
- Reviewed versions of submitted documents

### Reporting

If a team is participating through their own National Competition, they may need to submit different reports to their national organisers for them to track the team's progress. These reports are typically:

- Preliminary Design Review (PLR)
- Critical Design Review (CDR)
- Final Design Review (FDR-as bulit)

The Preliminary Design Review (PDR) /Critical Design Review (CDR), is a technical document that ensures the design can meet the stated performance requirements, taking into account all the system constraints.

Compiling the PDR/CDR allows student teams to detail and evaluate the design effort, determine readiness for hardware fabrication and for software coding, and establish the final configuration of the secondary mission.

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<sup>3</sup> This offer will vary depending on the National Organiser, please consult this with your contact point.

The CanSat PDR/CDR must contain:

- A demonstration that all the requirements stated in the guidelines for the European CanSat Competition have been fulfilled;
- The design specifications needed to fulfil the secondary mission;
- Results of the completed requirements verification tests; • Overview of mission operations; • Detailed budget.

The CDR must be submitted to ESERO via email ([cansat@rosa.ro](mailto:cansat@rosa.ro)) no later than the dates specified in the calendar on page 3 of this document, with the name of the team and name of the document submitted clearly written in the subject line (e.g. "Team X Preliminary/Critical Design Review").

ESERO Romania will provide guidelines as well as templates for the required reports to each participating team.

## → Phase 3 – Launch your CanSat

### *National Launch Campaigns*

In order for a National CanSat Competition to be recognised by ESA (and, as a consequence, for the national winning team to be automatically accepted into the European CanSat Competition):

- Student teams must comply with the European competition student team eligibility criteria stated above.
- The national organisers have to guarantee a fair geographical distribution and participation of teams from across their country.





- The national organisers are requested to organise their national competitions between January and 8 May 2022 to allow teams sufficient preparation time for the European final launch campaign. **Only national winning teams with a physical CanSat ready and delivered to ESA by the end of May 2022 are eligible for the European CanSat Competition 2022.**
- The national organisers do not necessarily have to follow the exact same rules and conditions as the European CanSat Competition, but must make sure that the participating teams are aware of the European CanSat Competition eligibility criteria and technical requirements. ESA will not make exceptions if any requirement is not met at the European launch campaign, regardless of whether any exceptions were made in the National Competitions.
- The Romanian CanSat Campaign will take place on an aerodrome and the CanSats will be launched by helicopter from an altitude of 1000m. Teams will be in contact with the jury members and will make themselves available to be contacted online at the appropriate times.

## → **Phase 4 - *European CanSat Launch Campaign***

For further details regarding the organisation of the European CanSat Launch Campaign, please refer to the European CanSat Guidelines available on the esa.int website at this address.

<https://cansat.esa.int/guidelines/>

## → ELIGIBILITY CONDITIONS

In order for a student team to be accepted into the European competition, the following conditions have to be fulfilled:

1. Each student team must comprise a minimum of 4<sup>4</sup> up to a maximum of 6 students (aged 14 – 19 years old) resident in an ESA Member State<sup>5</sup>, Latvia, Slovenia or Canada, respecting one of the following conditions:
  - Team of students enrolled full-time in a secondary school;
  - Team of students in home schooling condition (certified by the National Ministry of Education or delegated authority);
  - Team of members of a social club enrolled full-time in secondary schools;
2. At least 50% of the students included in a team must be nationals of an ESA Member State, Slovenia, Latvia or Canada.
3. University/higher education students cannot participate in this competition.
4. Each team needs to be supervised by a teacher or mentor responsible for monitoring the team's technical progress, offering help and advice, and acting as the team's point of contact with ESA's Education Office.
5. It is forbidden for a team to participate in the European CanSat Competition more than once, with the exception of the teacher/mentor and up to one student from any former team.

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<sup>4</sup> A minimum of 4 students per team is required in order to guarantee proper team interaction and collaboration.

<sup>5</sup> ESA Member States in 2020: Austria, Belgium, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Ireland, Italy, Luxembourg, the Netherlands, Norway, Poland, Portugal, Romania, Spain, Sweden, Switzerland, United Kingdom.

In the framework of the current collaboration agreement between ESA and the Republic of Malta, teams from Malta can also participate in the European CanSat Competition as guest competitors. Teams from other countries may also participate in the European CanSat Competition as guest competitors if approved by ESA (see Annex 1).

# → TECHNICAL REQUIREMENTS

The CanSat competition is designed to simulate all aspects of a real satellite mission including design, development, testing, launch, operations, and data analysis, by means of teamwork.

**The Romanian CanSat competition launch will be made by helicopter from an altitude of 1000m.**

In the European CanSat competition the following rules apply:

## 1. Rocket specifications

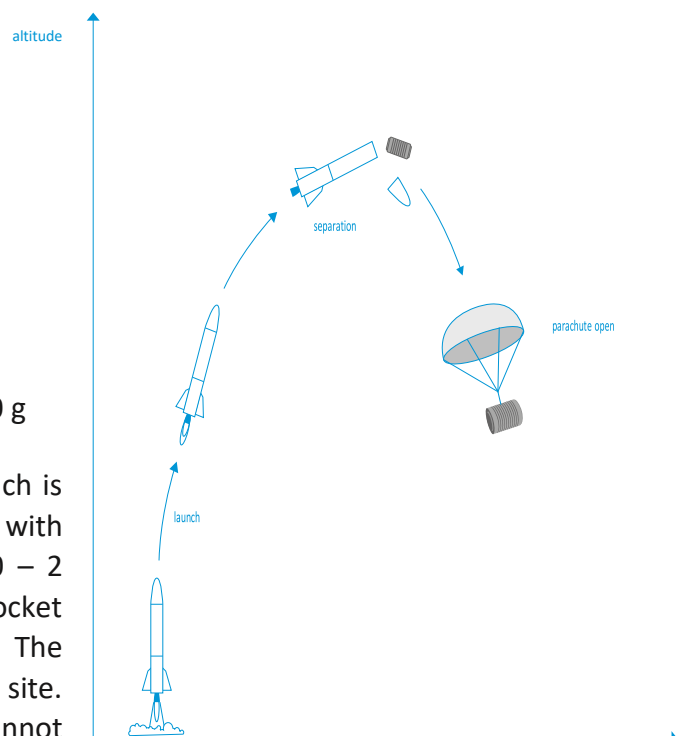
An example of a rocket launch is given below and could differ from the one used in the final launch campaign.

Rockets used for CanSat launches can vary in capacity and specifications. Some of these rockets can launch up to 20 CanSats at a time.

An example of a commercial model rocket kit typically used is the Intruder, or modified versions of this model rocket. Each Intruder rocket can normally host 2 or 3 CanSats with the following characteristics:

<b>Mass:</b>	3 kg
<b>Length:</b>	1.5 m
<b>Diameter:</b>	79.4 mm
<b>Span:</b>	232 mm
<b>Apogee:</b>	approx. 1000 m
<b>Flight time:</b> approx. 140 s	<b>Propellant mass:</b> 280 g

The rocket would deploy its parachute at apogee, which is reached at around 15 seconds after take-off, together with the two/three CanSats. Just after the apogee (0 – 2 seconds later), the CanSats would separate from the rocket and descend individually with their own parachutes. The CanSats are usually found within 1 km of the launch site. However, recovery of the CanSats separation T=15s burnout T=2s time cannot be guaranteed.



## 2. CanSat requirements

### Updated requirements for the European CanSat Competition 2020/21 due to COVID-19

To verify that the CanSats are suitable for launch, a technical inspection and a drop test will take place at the beginning of each European CanSat launch campaign. The way the requirements are evaluated is as follows:

- Air temperature and air pressure must be stored at least every second in an on-board removable memory card. ESA personnel will conduct the launches without the presence of the student teams (rather like a real satellite launch campaign), therefore no live radio frequency reception is possible this year, as this is normally done by the student teams. This card must be easily accessible/removable to the launch operators. For the National Competitions, it is at the discretion of the National Organisers to decide whether the data should be stored in an on-board removable memory card and/or transmitted to ground.
- The CanSat must include a loud audible retrieval system (e.g. beeper, no GPS system) since data will only be stored on-board. This requirement may not be mandatory for the National Competitions.
- The CanSat must include a visual indicator (e.g. LED) to show the power is on. This will help the launch operators to check the CanSat is ready for launch. This requirement may not be mandatory for the National Competitions.

## General requirements

The CanSat hardware and mission must be designed following these requirements and constraints:

1. All the components of the CanSat must fit inside a standard soft drinks can (115 mm height and 66 mm diameter), with the exception of the parachute. Radio antennas and GPS antennas can be mounted externally on the top or bottom of the can, depending on the design, but not on the sides.  
**Note:** The rocket payload area usually has 4.5 cm of space per CanSat available, along the can's axial dimension (i.e. height), which must accommodate all external elements including: parachute, parachute attachment hardware, and any antennas.
2. The mass of the CanSat must be between a minimum of 300 grams and a maximum of 350 grams. CanSats that are lighter must take additional ballast with them to reach the 300 grams minimum mass limit required.
3. Explosives, detonators, pyrotechnics, and inflammable or dangerous materials are strictly forbidden. All materials used must be safe for the personnel, the equipment, and the environment. In case of doubt by ESA, Material Safety Data Sheets (MSDS) may be requested from the teams.
4. The CanSat must be powered by a battery and/or solar panels. It must be possible for the systems to remain switched on for four continuous hours.
5. The battery must be easily accessible in case it has to be replaced/recharged.
6. The CanSat must have an easily accessible master power switch.
7. The CanSat should have a recovery system, such as a parachute, capable of being reused after launch. It is recommended to use bright coloured fabric, which will facilitate recovery of the CanSat after landing.
8. The parachute connection must be able to withstand up to 500 N of force. The strength of the parachute must be tested to ensure that the system will operate nominally.
9. For recovery reasons, a maximum flight time of 120 seconds is recommended. If attempting a directed landing, then a maximum of 170 seconds flight time is recommended.
10. A descent rate between 8 and 11 m/s is recommended for recovery reasons. However, the CanSat's descent speed must not be lower than 5m/s or higher than 12m/s for safety reasons. Additionally, the airfield or weather conditions might determine additional mandatory restrictions on the velocity.
11. The CanSat must be able to withstand an acceleration of up to 20 g.

12. The total budget of the final CanSat model should not exceed 500€. Ground Stations (GS) and any related non-flying item will not be considered in the budget. More information regarding the penalties in case the teams exceed the stated budget can be found in the next section.
13. In the case of sponsorship, all sponsored items should be specified in the budget with the actual corresponding costs on the market.
14. For the Romanian CanSat Competition 2022 launch campaign, the data required for the primary mission must be stored at least every second in an on-board removable memory card and the CanSat must send over IP also its last known location in order to be recuperated.
15. The CanSat must be flight-ready by the deadline specified by the organiser.

### 3. Meeting the requirements for the Romanian and the European Launch Campaign

To verify that the CanSats are suitable for launch, a technical inspection will be made via teleconference with the team for the Romanian CanSat launch campaign.

To verify that the CanSats are suitable for launch, a technical inspection will be made and a drop test will take place at the beginning of each European CanSat launch campaign. The way the requirements are evaluated is as follows:

- **Requirements 1, 2, 6 and 10 will be evaluated** on site by a specially appointed CanSat technical team. If the physical event takes place with online participation from the student teams, these tests will be carried out by ESA and therefore teams will only have 1 chance to pass.
- **Requirements 8 and 11** refer to tests that should be carried out prior to the European CanSat launch campaign and the proof of these tests being successful should be stated in the PLR.
- Replace with: A statement of confirmation that the rest of the requirements are met should be included in the Pre-Launch Report, paying special attention to the COVID-19 requirements and **requirement 12**, which must be stated in the document.

# → EVALUATION AND SCORING

## 1. The jury

The jury, appointed by ROSA, will be composed of CanSat experts, education experts, or engineers and scientists who will evaluate the teams' performances during 'Phases 1-2-3', during Phase 4 the jury will be appointed by ESA, taking into account the CanSat Pre-launch Report. The jury members will score the teams during the launch campaign and announce the results from their scoring in the Closing Ceremony.

The jury will typically have 3-6 members, and their fields of expertise can vary from science to engineering or education. The jury board is usually comprised of:

- Space science/engineering expert(s)
- IT/Electronics expert(s)
- Education expert(s)

## 2. Scoring

Performance in the following areas will be evaluated:

### A. Technical achievement

The jury will take into account how the teams obtained the results, how reliable and robust the CanSat was, and how the CanSat performed. Innovative aspects of the project will be judged (e.g. the tools selected and the hardware/software used).

The aspects evaluated will be:

- **Mission's technical complexity:** The CanSat's technical level, understanding of the technical concepts and the originality of the engineering aspects of the mission.
- **Performance of the Primary mission:** The CanSat's technical performance in terms of deployment and data collection for the Primary Mission.
- **Performance of the Secondary mission:** The CanSat's technical performance in terms of deployment and data collection for the Secondary Mission.

### B. Scientific value

The scientific value of the teams' missions and the teams' scientific skills will be evaluated. This includes the scientific relevance of the mission, the quality of the technical reporting (both written and oral) and the

team's scientific understanding that will be assessed from the team's ability to analyse and interpret results appropriately.

The aspects evaluated will be:

- **Scientific relevance:** Assessment of whether measurements are done with a clear and well- founded scientific purpose, the extent to which the CanSat is used in an original way and if the data collection is appropriate for reaching the objective.
- **Scientific understanding:** Level of understanding of the scientific principles that underlie the project.
- **Technical reporting:** Ability to summarise with clarity and provide a readable and complete Pre-Launch report, the proper labelling of the graphs and use of the correct units and the ability to present scientifically sound data and interpretations during the launch campaign.

### C. Professional competencies

The Jury will assess the team's collaboration and coordination, adaptability and communication skills. The aspects evaluated will be:

- **Teamwork:** Collaborative effort of the team in order to complete the tasks in the most effective and efficient way.
- **Adaptability:** Attitude towards continual improvement and ability to adapt to new conditions, both from the national competition towards the European Competition (if applicable) and/or as far as ideas for improvement after the European Competition are concerned.
- **Communication:** Oral presentation skills, the ability to provide a captivating presentation involving confident speaking skills and a visually appealing presentation.

### D. Outreach

The team will be awarded points on how the project is communicated to the school and the local community, taking into account web pages, blogs, presentations, promotional material, media coverage etc.

### Marking scheme

The overall balance between the items to be evaluated is as follows:

<b>Technical achievement</b>	35%
<b>Scientific value</b>	35%
<b>Professional competencies</b>	20%
<b>Outreach</b>	10%
<b>TOTAL</b>	<b>100%</b>



### Penalties

Teams' final scores will be penalised with 1% per day of late submission of the CanSat Pre-Launch Report. Similarly, 1% of the final score will be subtracted per 10 euros extra spent over the maximum CanSat budget of 500 euros.

## 3. Prizes

The award scheme is designed to acknowledge teams' strengths in as fair a way as possible. At the Romanian and European CanSat Competition 2022, the prizes will be awarded according to the following categories:

- **Best CanSat Project:** This prize will be awarded to the team with the best overall score.
- **Highest Technical Achievement:** This prize will be awarded to the team with the best score in the 'Technical Achievement' field
- **Outstanding Science Mission:** This prize will be awarded to the team with the best score in the 'Scientific value' field.
- **Most Professional Team:** This prize will be awarded to the team with the best score in the 'Professional competencies' field.
- **Best Outreach prize:** This prize will be awarded to the team with the best score in the 'Outreach' field.

**\*Honorary Prize/Special Mention (optional):** The jury may award an 'honorary prize' in any of the two following scenarios:

- When a guest competitor team has achieved an outstanding performance, by ranking top in one or more of the fields mentioned above (see Annex 1)
- When a team goes 'above and beyond' in a particular area not covered by one of the official prizes.
- A team cannot receive more than one prize.
- The 'Best CanSat Project' prize will always be awarded to the team with the highest overall score.
- If a team is ranked the highest in several categories, priority will be given to the highest weighting prizes (Outstanding Science Mission (35%) or Highest Technical Achievement (35%)); in case a team is ranked the highest both in the Scientific value and Technical Achievement fields, the prize awarded will be for the category in which the team has the highest score margin, ahead of the 2nd ranked team in that field.

## → ANNEX

The following rules will also apply:

For example, if one team has the best scores in both Technical Achievement (scoring 8.5 out of 10) and Outreach (scoring 9.5). They will then be granted the Highest Technical Achievement prize because this category has a higher weighting, and the Best Outreach prize will be granted to the second best score in that field.

In a different scenario, where a team has both the best overall score (scoring 8.5) and the best score in Outreach (scoring 9.5), this team will be awarded the European CanSat 2020 prize instead, as this prize needs to be awarded to the best overall score, and the 2nd ranked team in the 'Outreach' field would receive the respective prize.

## → CONTACT

All questions and expressions of interest should be directed to:

**Email:** [cristina.stancu@rosa.ro](mailto:cristina.stancu@rosa.ro)

