

**2018**

**ROMANIAN CANSAT COMPETITION**

**GUIDELINES**



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## 1 INTRODUCTION

The European Space Agency (ESA) supports a broad range of CanSat activities across its Member States, in order to give European high school students their first experience of a real space-related project.

A CanSat is a simulation of a real satellite, integrated within the volume and shape of a soft drink 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 to an altitude of a few hundred meters by a rocket or dropped from a platform or captive balloon and its mission begins: to carry out a scientific experiment and achieve a safe landing.

CanSats offer a unique opportunity for students to have a first practical experience of a real space project. They are responsible for all aspects: selecting the mission objectives, designing the CanSat, integrating the components, testing, preparing for launch and then analyzing the data.



The Flying Dutch Can- CanSat from the 2012 European CanSat competition

## 2 COMPETITION OVERVIEW

The 2018 Romanian CanSat Competition will consist of four phases:

1. Call for proposals and team selection
2. Teachers' introductory workshop
3. CanSat construction and test activities
4. Competition launch campaign

### 2.1 Call for proposals and team selection

The call for proposals is published on the ESERO Romania's website ([www.esero.ro](http://www.esero.ro)) and on the Romanian Space Agency's website at [www.rosa.ro](http://www.rosa.ro). The deadline for proposals is Sunday 28 January 2018 at 22:00 Romanian time. A complete proposal form must be submitted to [cansat@rosa.ro](mailto:cansat@rosa.ro) before the deadline.

#### **Eligibility**

1. Each student team shall comprise a minimum of 4 (required) to a maximum of 6 students (aged 14 - 20) resident in an ESA Member State or Associate State, respecting one of the following conditions:
2. Team of students enrolled full-time in a secondary school.
3. Team of students in home schooling condition (certified by the National Ministry of Education or delegated authority).
4. Team of members of a social club enrolled full-time in a secondary school.
5. At least 50% of the students included in a team must be nationals of an ESA Member or Associate State.
6. The teams will have to be mixed (boys and girls).
7. University/higher education students cannot participate in this competition.
8. Each team needs to be supervised by a teacher or mentor (Team Leader) 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. The Team Leader must be available to accompany the team to the competition launch campaign.
9. One teacher/mentor can be responsible for one team per year only. One teacher/mentor cannot present the same team more than once. One teacher cannot submit more than two applications for the Call for Proposals.
10. Student teams participation in the European CanSat Competition more than once is not allowed (no individual student can participate more than once).
11. Romanian CanSat competition allows former participants to enroll in a team if they have not won the competition in the prior year and the number of former participants that can enroll in a team is limited to half of the total number of team members. Ex: If a team has 5 members (excluding the teacher), the number of former eligible members is 2.
12. A complete application must be submitted to [cansat@rosa.ro](mailto:cansat@rosa.ro) before 24:00



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Bucharest time on Sunday 28 January 2018.

## **Responsibility for leading the team**

Each team must have a teacher responsible for monitoring the team's technical progress, available to offer help and advice, and acting as the point-of-contact between the ESERO Education Office and the student team. The teacher must be available to attend the teachers' introductory workshop and to accompany the team to the competition launch campaign. If the teacher has participated before in a Romanian CanSat training he/she is not required to participate to this training.

## **Team selection**

The competition will have 8 CanSat launch slots available.

A Selection Panel of experts will consider all proposals on the basis of their scientific merit, team organization and outreach plans. The final selection will be communicated to the teams and published on the ESERO website on 31 January 2018.

## **Selection Panel**

Organizers of the Romanian CanSat Competition will appoint a number of experts that shall evaluate the merit of the proposals submitted.

## **Additional terms and conditions**

Team member substitutions are not allowed for the duration of the competition. The complete list of team members must be submitted to the organizers before the **Introductory Teacher Workshop** at the beginning of February.

Students that are enrolled in other school competitions should make a firm commitment for their participation in the Romanian CanSat competition. Teams that retire from the competition because of other scheduling conflicts will be sanctioned with a ban from participating in all ESERO events for two years (teacher and students).

The calendar of the competition is at the discretion of the Organizers.

The official language of the competition is English.

## **2.2 Teachers' introductory workshop**

A teachers' introductory workshop will take place between 8-11 February 2018, during the short inter-semester vacation. The aim is to ensure that all teams have the necessary expertise to proceed with their CanSat project. Teachers that have participated in the past to a similar course will not be invited to participate.

At this workshop additional teachers will be invited to participate based on their submissions to our call.

During the workshop, there will be lectures and training sessions on several topics, including: sensors and signal analysis; data handling and data transmission; software installation and programming. The platforms used will be Arduino and Astro Pi ( Raspberry Pi).

## **2.3 CanSat construction and test activities**

Between February and April 2018, the selected teams will carry out technical work on their CanSats and engage in outreach activities. This work will include the following tasks:

- Detailed definition of the secondary mission
- Finalization of the CanSat design



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- Building the CanSat
  - Integrating the components and sensors
  - Programming the software
  - Testing all the systems
  - Preparing for the launch campaign
  - Updating the team's Facebook page, and additional website/blog
  - Other outreach activities, e.g. presentations, video clips, media coverage, etc.

In order to ensure that all projects are on track, a total of two brief progress reports are due at regular intervals under the supervision of the team's teacher/mentor.

Submission of a **Preliminary Design Review (Report 1)** of a maximum of 30 pages to ROSA by 18 March 2018, 22:00 CET, summarising all the work done (progress report), providing a full description of the CanSat mission, system and functionalities, and indicating the steps, rationale and trouble-shooting which was needed to get to the CanSat design, as well as a detailed budget. This document should accurately record all the details of the completed CanSat prototype. This will be the main document provided to the Jury members upon which the teams will add content for the Critical Design Review (Report 2), who will then be tasked to evaluate the work and performance of each team.

The first Report must be submitted to ROSA at [cansat@rosa.ro](mailto:cansat@rosa.ro) with the name of the team and of the document submitted written in the subject line (e.g. "Team A First Report"). The document should be attached in a word or pdf format with the following file name format: [teamA\\_cansat\\_CDR\\_report.pdf](#).

Guidelines for the activities, as well as templates for the required reports, will be provided to each team that is selected to participate in the competition. Expert advice will be available throughout this phase. The CanSat must be flight-ready upon arrival at the Competition Launch Campaign.

Submission of a **Critical Design Review (Report 2)** of a maximum of 40 pages to ROSA by 22 April 2018, 22:00 CET, summarising all the work done (progress report), providing a full description of the CanSat mission.

The CDR report is a technical document that ensures that the design can meet the stated performance requirements, taking into account all the system constraints. Compiling the CDR report allows student teams to evaluate the detailed design effort, determine readiness for hardware fabrication and for software coding, and establish the final configuration of these secondary mission.

The CanSat CDR report 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 (see 3.2)
- Results of the requirements verification tests completed
- Overview of mission operations
- Detailed budget
- Outline of project schedule

The CDR report must be submitted to ROSA at [cansat@rosa.ro](mailto:cansat@rosa.ro) no later than 22 April 2018, 22:00 CET, with the the name of the team and of the document submitted clearly written

in the subject line (e.g. "TeamA cansat CDR report"). The document should be attached in a word or pdf format with the following file name format: teamA\_cansat CDR report.pdf.

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

Late submission of reports will be penalised.

## **2.4 Competition launch campaign, tentative May 2018**

The highlight of the competition will be the competition launch campaign, where each CanSat will be launched to an altitude of 1 km. The CanSats will conduct their missions, and land safely on the ground to be recovered by the teams.

A report on the results from the launch will be required from each team. The competition winners will then be chosen based on the team's performance throughout the project, as well as the final flight operations and results.

An outline of the programme is as follows:

<b>Day 1</b>	Teams arrive Welcome and introduction Presentations of projects by CanSat teams Final technical inspection of the CanSats
<b>Day 2</b>	CanSat launch day
<b>Day 3</b>	Presentation of results by CanSat teams Jury evaluation & Competition prize ceremony
<b>Day 4</b>	Evaluation & Closing Optional cultural activities Teams depart





## 2.5 Key Dates

Phase 1: Selection	
Activity	Deadline
Call for proposals	21.12.2017
Deadline	28.01.2018
Selected teams announcement	31.01.2018

Phase 2: Introductory Workshop	
Activity	Deadline
Introductory workshop for teachers	08-11.02.2018

Phase 3: CanSat Constructie	
Activity	Deadline
Report 1(Preliminary design review)	18.03.2018
Report 2 (Critical design review)	22.04.2018

Phase 4: Launch Campaign	
Activity	Deadline
Launch Campaign	May 2018



A selection of CanSats from the 2012 European CanSat Competition





## 3 MISSION OVERVIEW

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

### 3.1 Primary and secondary CanSat missions

#### 3.1.1 Primary mission

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

**After release and during descent, the CanSat shall measure the following parameters and transmit the data as telemetry at least once every second to the ground station:**

- **Air temperature**
- **Air pressure**

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).

#### 3.1.2 Secondary mission

The secondary mission for the CanSat must be selected by the team. It can be based on other satellite missions, a perceived need for scientific data for a specific project, a technology demonstration for a student-designed component, or any other mission that would fit the CanSat's capabilities.

Some examples of missions are listed below, but teams are free to design a mission of their choice, as long as it can be demonstrated to have some scientific, technological or innovative value. Teams should also keep in mind the limitations of the CanSat mission profile, and focus on the feasibility (both technical and administrative) of their chosen mission.

Some examples of secondary missions:

1. Advanced telemetry

After release and during descent, the CanSat measures and transmits additional telemetry to that required for the primary mission, for example:

- Acceleration
- GPS location
- Radiation levels

2. Remote control

During descent, commands are sent from the ground to the CanSat to perform an action, such as switching a sensor on and off, changing the frequency of measurements, etc.

3. Targeted landing

The CanSat navigates autonomously with a control mechanism such as a parafoil. The



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objective is for the CanSat to land as close as possible to a fixed target point on the ground after it has been released from the rocket. This mission is an advanced telemetry/remote control mission - navigation data is exchanged between the CanSat and a ground station throughout the descent.

4. Landing system

For this mission, an alternative safe landing system for the CanSat would be deployed, such as a bespoke parachute or airbag.

5. Planetary probe

The CanSat simulates an exploration flight to a new planet, taking measurements on the ground after landing. Teams should define their exploration mission and identify the parameters necessary to accomplish it (e.g. pressure, temperature, samples of the terrain, humidity, etc.).

## 3.2 CanSat requirements

The CanSat hardware and missions must be designed to the following requirements and constraints:

1. All the components of the CanSat must fit inside a standard soda 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, but not on the sides), depending on the design.
2. The antennas, transducers and other elements of the CanSat cannot extend beyond the can's diameter until it has left the launch vehicle.
3. The mass of the CanSat must be between 300 and 350 grams. CanSats that are lighter must take additional ballast with them to reach the 300 grams minimum mass limit required.
4. 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, Material Safety Data Sheets (MSDS) will be requested.
5. The CanSat must be powered by a battery and/or solar panels. It must be possible for the systems to be switched on for four continuous hours.
6. The battery must be easily accessible in case it has to be replaced/recharged.
7. The CanSat must have an easily accessible master power switch.
8. Inclusion of a retrieval system (beeper, radio beacon, GPS, etc.) is recommended.
9. 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.
10. The parachute connection must be able to withstand up to 1000 N of force. The strength of the parachute must be tested to ensure that the system will operate nominally.
11. 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.
12. A descent rate between 8 and 11 m/s is recommended for recovery reasons. In case of a directed landing, a lower descent rate of 6m/s is recommended.
13. The CanSat must be able to withstand an acceleration of up to 20 g.
14. 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.
15. In the case of sponsorship, all items obtained should be specified in the budget with the actual corresponding costs on the market.
16. The CanSat must be flight-ready upon arrival at the launch campaign. A final technical inspection of the CanSats will be done by authorised personnel before launch.



## 4 EVALUATION AND SCORING

The teams will be evaluated on an on-going basis based on their reports and performance at the launch campaign, with the following items being taken into account:

### 4.1 Educational value

For this item, the jury will consider the quality of the progress reports and the team presentations, the level of effort made by the team and how much the team appear to have learned throughout the project.

### 4.2 Technical achievement

Innovative aspects of the project will be judged, for example: the mission selected and the hardware/software used. It will be also taken into account how the teams obtained the results, how reliable and robust the CanSat was and how the CanSat performed. If the CanSat did not succeed in accomplishing the missions but the team is able to explain the reasons why and suggest improvements, it will be also taken into account positively.

### 4.3 Teamwork

The jury will assess how well the team worked together on the assignment, the distribution of tasks, the planning and execution of the project and the team's success in obtaining the necessary funding, support and advice.

### 4.4 Outreach

The team will be scored on how well the project was communicated to the school and the local community, taking into account any webpages, blogs, presentations, promotional materials, media coverage, etc.

### 4.5 Marking scheme

1. Educational value	20%
2. Technical achievement	50%
3. Team value	15%
4. Outreach	15%
<b>TOTAL</b>	<b>100%</b>



## 5 FUNDING

All costs related to the teachers' introductory workshop in February 2018 will be sponsored by ESERO Romania. This includes accommodation, meals, training materials. The cost of travel to and from the training location is not funded by ESERO Romania.

For the competition launch campaign, ESERO will sponsor the accommodation, meals as all costs for the launches and related flight activities for one teacher and up to six members of the team. The cost of travel to and from the competition location is not funded by ESERO Romania.

Teams are responsible for obtaining alternative sponsorship for the CanSat hardware, as well as the team's travel expenses to and from the competition launch campaign.

## 6 CONTACT

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Team Alpha's CanSat - winner of the 2012 European CanSat Competition