

2012 EUROPEAN CANSAT COMPETITION

GUIDELINES



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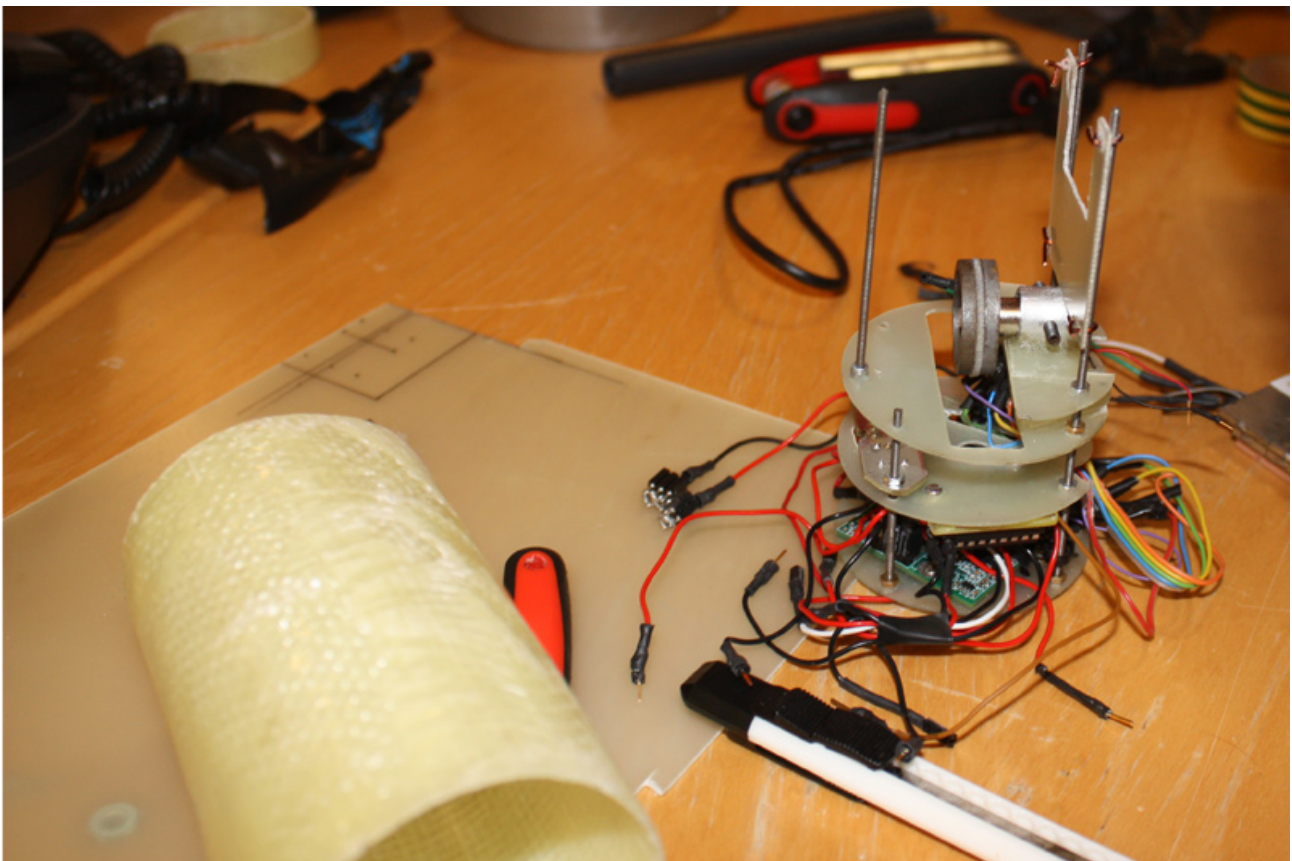


1 INTRODUCTION

ESA wishes to foster and support 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. Following the success of the 1st European CanSat competition in 2010, the Education Office is organising the 2012 European CanSat competition in collaboration with NAROM (the Norwegian Center for Space-related Education).

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 metres 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 analysing the data.



The DeSoto CanSat from the 2010 European CanSat competition
© DeSoto team

2 COMPETITION OVERVIEW

The 2011-2012 European 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 ESA Education Portal at www.esa.int/education and on the CanSats in Europe website at www.cansat.eu. The deadline for proposals is Sunday 16 October 2011 at 24:00 CEST. A complete proposal form must be submitted to ESA before the deadline, i.e. all team members and the teacher/tutor must be registered on the ESA Education Office's project portal (www.joinspace.org) and a completed copy of the official proposal form must be uploaded.

Eligibility

The following conditions should be fulfilled, in order for a proposal to be considered as eligible:

- The team should comprise between 4 and 10 high school students (aged 16+), assisted by a teacher or tutor.
- The team members must be enrolled as full-time students at a school in an ESA Member State.
- The majority of team members must hold the nationality of an ESA Member State.
- A complete application must be submitted to ESA before 24:00 CEST on Sunday 16 October 2011, i.e. all team members and the teacher/tutor must be registered in the online system and a completed copy of the official proposal form must be uploaded.

Responsibility for leading the team

Each team must have a teacher or tutor responsible for monitoring the team's technical progress, available to offer help and advice, and acting as the point-of-contact between the ESA Education Office and the student team. The teacher/tutor must be available to attend the teachers' introductory workshop and to accompany the team to the competition launch campaign.

Team selection

There are 12 CanSat launch slots available in the competition launch campaign. It is possible for one of these launch slots to be reserved by the organisers of a national or regional CanSat activity (see below).

The remaining slots will be filled through a central selection process, organised by ESA's Education Office. A panel of experts will consider all proposals on the basis of their scientific merit, team organisation and outreach plans. The final selection will be communicated to the teams and published on the CanSats in Europe website on Monday 24 October 2011.

Reserving a launch slot

Organisers of a national or regional CanSat activity can apply to reserve one of the 12 launch slots available in the competition launch campaign, for example, for a winning or high-scoring team from a national competition.

The following aspects will be considered by ESA and NAROM when evaluating the applications:

- The nature and schedule of the activity
- The number of schools and students involved in the activity
- The outreach value of the activity
- The prospects for continuation of the activity in future
- The nature of the CanSat that is proposed for the launch slot (how and when the team will be chosen, which CanSat activities will have already been completed, information available about the team or mission, etc.)

National organisers should send their applications to cansat@esa.int no later than Sunday 28 August 2011 at 24:00 CEST, although early applications are encouraged. There is no specific template – all information should be included in the email and attachments. A decision will be made within 3 weeks of receipt of an application and a list of reserved slots will be regularly updated on the 'CanSats in Europe' website.

2.2 Teachers' introductory workshop

A teachers' introductory workshop will take place at ESA/ESTEC on 2-3 December 2011, run jointly by ESA's Education Office and NAROM. The aim is to ensure that all teams have the necessary equipment and expertise to proceed with their CanSat project. The teacher or tutor of each selected team must be present.

During the workshop, each teacher will receive a CanSat kit and there will be lectures and training sessions on several topics, including: sensors and signal analysis; data handling and data transmission; software installation and programming. A tour of the ESA/ESTEC facilities is included and there will be ample opportunity for questions and discussion.

2.3 CanSat construction and test activities

Between December 2011 and March 2012, 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
- Finalisation of the CanSat design
- Building the CanSat
- Integrating the components and sensors
- Programming the software
- Testing all the systems
- Preparing for the launch campaign
- Updating a website/blog
- Other outreach activities, e.g. presentations, videoclips, media coverage, etc.

In order to ensure that all projects are on track, a total of three brief progress reports are due at six week intervals.

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 is available throughout this phase: questions can be posted on an open forum, so that information is available to all teams.

2.4 Competition launch campaign

The highlight of the competition will be the competition launch campaign to be held at Andøya Rocket Range in Norway, where each CanSat will be launched in a rocket up to an altitude of 1 km. The CanSats will then separate from the rocket, 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:

Sun 22 Apr	Teams arrive in Andenes
Mon 23 Apr	Welcome and introduction Presentations of projects by CanSat teams Final integration and technical inspection of the CanSats
Tues 24 Apr	CanSat launch day
Wed 25 Apr	Presentation of results by CanSat teams Competition prize ceremony (Back-up launch day)
Thurs 26 Apr	Evaluation and closing Optional cultural activities
Fri 27 Apr	Teams depart from Andenes

N.B. Due to limitations at the rocket range, a maximum of 4 students and 1 teacher per team can attend the competition launch campaign.

2.5 Key Dates

Phase 1: Call for proposals and team selection	
Activity	Deadline
Call for proposals opens	22 June 2011
Deadline for national / regional organisers to reserve a launch slot	28 August 2011
Deadline for proposals	16 October 2011
Announcement of selected teams	24 October 2011
Phase 2: Teachers' introductory workshop	
Activity	Deadline
Teachers' introductory workshop at ESA/ESTEC	02-03 December 2011
Phase 3: CanSat construction and test activities	
Activity	Deadline
Progress report 1	20 January 2012
Progress report 2	2 March 2012
Progress report 3 (as-built documentation)	13 April 2012



Phase 4: Competition launch campaign and post-flight activities

Activity	Deadline
Competition launch campaign at Andøya Rocket Range	22-26 April 2012
Final report	18 May 2012

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.

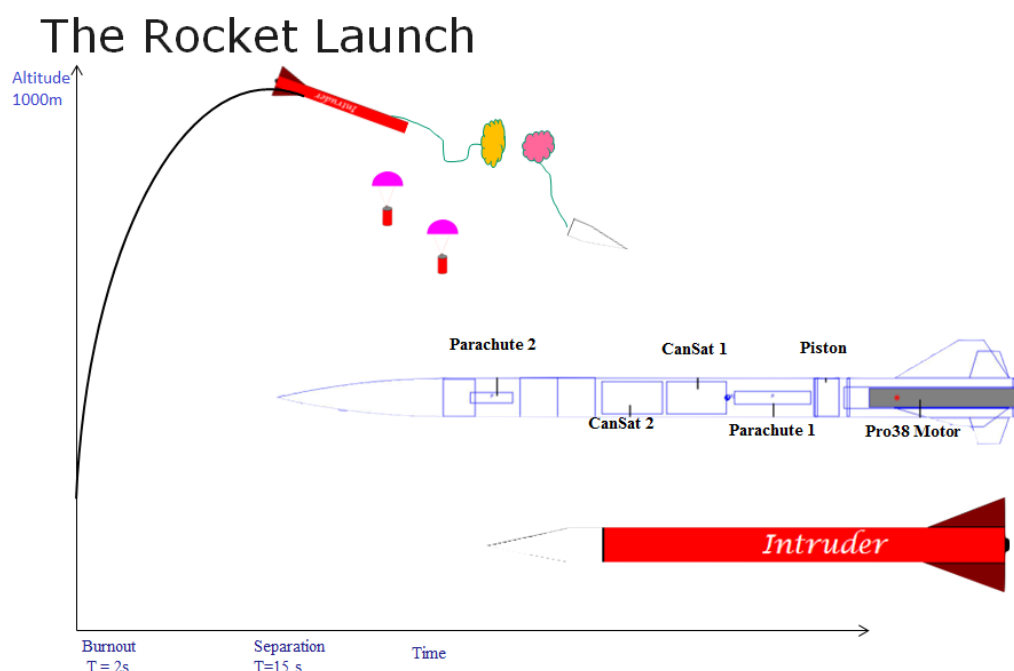
3.1 The rocket launch

A commercial model rocket kit, the Intruder, will be used to launch the CanSats. Six rockets will be launched, each with 2 CanSats on board. The rocket has the following characteristics:

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

The rocket will deploy its parachute at apogee, together with two CanSats. These will descend on separate parachutes and are collected after launch. The CanSats are usually found within 200m of the launch site.

During the flight, the rocket can reach a maximum acceleration of 11g in the vertical direction and a maximum velocity of 550 km/h.



3.2 Primary and secondary CanSat missions

3.2.1 Primary mission

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

After release and during descent, the CanSat shall measure the following parameters and transmit the data as telemetry 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).

3.2.2 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 example 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. **Telecommand**
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 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/telecommand 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.).

3.3 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 radio antennas and GPS antennas, which can be mounted externally.
- [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 maximum mass of the CanSat is limited to 350 g.
- [4] Explosives, detonators, pyrotechnics, and flammable or dangerous materials are strictly forbidden. All materials used must be safe for the personnel, the equipment and the environment. Material Safety Data Sheets (MSDS) will be requested in case of doubt.
- [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 three continuous hours.
- [6] The battery must be easily accessible, in case it has to be replaced or recharged in the field.
- [7] The CanSat should have a recovery system, such as a parachute, which is able to be 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 1000N of force. The strength of the parachute must be tested, to give confidence that the system will operate nominally.
- [9] The flight time is limited to 120 sec.
- [10] The descent rate must be between 8 m/s and 11m/s.
- [11] The CanSat must be able to withstand an acceleration of up to 20g.
- [12] The total budget of the CanSat should not exceed €500.



4 EVALUATION AND SCORING

The teams will be evaluated on an ongoing basis, 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%
TOTAL	100%



5 FUNDING

All costs related to the teachers' introductory workshop at ESA/ESTEC on 2-3 December 2011 will be sponsored by ESA and NAROM. This includes travel expenses, accommodation, meals, training material and the provision of a CanSat kit for each team.

For the competition launch campaign at Andøya Rocket Range in Norway on 22-26 April 2012, ESA and NAROM will sponsor the accommodation, meals and local transportation, as well as all costs for the rocket launches and related flight activities.

Teams are responsible for obtaining alternative sponsorship for any additional CanSat hardware (beyond the kit supplied), as well as the team's travel expenses to and from the competition launch campaign in Norway.

6 CONTACT

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