European CanSat competition

Competition guidelines

15th – 19th August 2010

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1. Introduction

The Education Office of the European Space Agency (ESA) and the Norwegian National Centre for Space-related Education (NAROM) are organising the First European CanSat competition from 15th to 19th August 2010 in Norway. This project will provide ten teams of European high school students with their first experience of a real space-related project.

A CanSat is a **"scale satellite"** integrated within the volume and shape of a regular soft drink can. The challenge for the students is to fit all the major subsystems found in a satellite such as power and communications into a soda can of 350ml. The CanSat will be launched from a rocket up to 1km and after release the CanSat has to perform a certain mission, such as altitude control, sending telemetry data or performing an experiment, then land safety on the ground.

The First CanSat competition was held in 1999 in the United States and since then many competitions have taken place around the world and during recent years in Europe, in the following countries:

- **The Netherlands:** A national competition for high school students has been organised by the company Innovative Solutions in Space (ISIS) and the Technical University of Delft every year since 2007. www.cansat.nl
- **Spain:** An international competition was organised by the student association LEEM, with the support of the Universidad Politécnica de Madrid (UPM), in 2008 and this will be repeated in 2010. http://cansat.leem.es/
- **France:** A national competition for university students was established in 2008 by the French Space Agency (CNES) and the educational association Planète Sciences. http://www.planete-sciences.org/espace/Cansat
- **Norway:** NAROM initiated an annual national competition for high school pupils in 2009. http://www.narom.no/artikkel.php?aid=2&bid=56&oid=944

2. Educational value of the competition

The CanSat competition is a very good platform to stimulate interest and enhance understanding, as well as offering a great opportunity for high school students to participate in a hands-on, space-related project. It undergoes the same phases as a real satellite mission at an affordable cost.

CanSats provide an ideal platform, not only for **gaining knowledge** about the composition of a satellite and phases of a space engineering project but also for **developing skills**, both general (e.g. scientific enquiry, technical design, data analysis and presentation, teamwork) and practical (e.g. soldering, building electronics, software programming, testing).

Some of the educational advantages of this activity are:

- Building a CanSat is a practical supplement to school subjects, such as mathematics design & technology and physics.
- Working towards a launch campaign is inspiring and raises enthusiasm amongst the next generation of scientists, engineers and astronauts. It communicates the excitement of space exploration and can encourage the students to pursue a scientific degree and career.
- Students gain the satisfaction of being involved with the end-to-end life cycle of a complex engineering project.
- The activity exposes students to the satellite development process, starting with design, through integration, testing and launching, and finally data analysis and presentation of results.
- CanSats serve as a model to explain the composition of a satellite and functions of the various subsystems.
- Participants learn the importance of teamwork and project planning. They must be organised, respect the role of each team member, set objectives and accomplish them, have meetings and adhere to a schedule.
- Students can develop their technical skills by designing a concept, building it, solving problems and redesigning it if necessary.
- The activity challenges the student's knowledge, encouraging creativity and innovation.
- Students learn how to make presentations and defend their project in front of a jury.

3. The teams

The teams can be composed of three to ten high-school students (aged 16+), but a maximum of four students will be able to represent the school in the competition. The students should be assisted by a teacher or tutor who will be the point of contact between the students and the organisers. All participating students and teachers should hold the nationality of an ESA Member State or Co-operating State[1]. Teams from Cooperating States should have the approval of their country's ESA Delegation.

4. The CanSat Missions

The missions and their requirements are designed to reflect various aspects of real space missions including telemetry, communications and autonomous operations.

1. Primary Mission: Telemetry

The students must build a CanSat and programme 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 and display it in graphs.

2. Secondary Mission: Free choice

The students must develop a secondary mission of their choice. They can be inspired by other real missions of satellites.

Below are some examples of secondary missions, however teams are free to choose or invent another mission that is not covered here, as long as it has some technological, investigative or innovative value:

[1] The 18 ESA Member States are: Austria, Belgium, Czech Republic, Denmark, Finland, France, Germany, Greece, Ireland, Italy, Luxembourg, the Netherlands, Norway, Portugal, Spain, Sweden, Switzerland, and the United Kingdom. Canada, Hungary, Poland and Romania participate in some ESA projects under cooperation agreements.

a) 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

b) 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.

c) Comeback

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.

d) Landing System

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

e) 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.).

5. The CanSat Requirements

1. All the components of the CanSat must fit inside a European soda can: 115 mm height and 66 mm diameter.

2. The maximum mass of the CanSat is limited to 350 g.

3. The CanSat should have a recovery system, such as a parachute, which is able to be reused after launch.

4. The antennas, transducers and other elements of the CanSat cannot extend beyond the can's diameter until it has left the rocket.

5. The deployable subsystems and recovery system can exceed the length of the primary structure, up to a maximum length of 230 mm.

6. Flight time is limited to 120 sec.

7. The descent rate must be between 8 m/s and 11m/s

8. Explosives, detonators, pyrotechnics, flammable materials, dangerous materials and biological payloads are strictly forbidden. All materials used must be safe for personnel, equipments and the environment. Material Safety Data Sheets (MSDS) will be requested in case of doubt.

9. The CanSat shall operate with a battery or solar panels. It must be possible for the systems to be powered on for three continuous hours.

10. The CanSat must be able to withstand an acceleration of up to 20g.

11. The battery must be easily accessible, in case it has to be replaced or recharged in the field.

12. The total budget of the CanSat should not exceed €1000.

13. It is forbidden to use any kind of camera onboard the CanSat.

6. Evaluation

A jury of experts from NAROM and ESA will follow the projects during their development and evaluate them, taking into account the following aspects:

1. The educational value

a. Did the participants increase their knowledge in relevant fields?

b. What was the quality of the final presentation and report?

2. Technical value

a. What was the technical level of the CanSat?

b. How innovative is the idea?

c. How was the solution implemented?

d. How well did the CanSat comply with the set requirements?

e. Did the CanSat perform as expected?

3. Team value

a. How well did the team work together on the assignment?

b. Was the project well planned and executed?

c. Did the team succeed in obtaining the necessary funding, support and advice?

4. Promotional value

a. Was the project well communicated to the school and the local community? e.g. through posters, presentations, etc.

b. Did the team use the internet to promote their project? E.g. by creating a webpage or blog, posting videos on Youtube, etc.

c. Did they manage to get attention from local or national media?

7. Phases of the project

The project phases are:

Phase 1	4 - 25 Jan	**Registration** at www.joinspace.org and submission of proposals
Phase 2	12 - 13 Feb	**Teachers' Introductory Workshop** at ESA-ESTEC in Noordwijk, The Netherlands
Phase 3	mid Feb – mid March	**Design Phase** – the CanSat design and budget is elaborated by the teams
Phase 4	end March	**Design Review** – the experts review the design and budget and give feedback to the teams
Phase 5	April - June	**Build and Test Phase** – the hardware and software is developed, integrated and tested. Monthly reports are submitted to ESA and NAROM.
Phase 6	June - July	**Campaign Preparation** – final verification of the CanSat is carried out. The teams prepare a document and presentation for the jury about their project.
Phase 7	15-19 Aug	**Launch Campaign** takes place at Andøya Rocket Range in Norway.
Phase 8	mid Sept	**Final Report** – the final design, results and data analysis are submitted.

Experts from ESA, NAROM and other national CanSat competitions will be available throughout all phases to support and advise the teams.

8. Support and Responsibilities

What support is provided to teams participating in the Competition?

- The teachers will be invited to an introductory workshop with experts from ESA and NAROM on 12-13 February 2010 at ESTEC, the technical centre of the European Space Agency. They will learn all the basic steps to build the CanSat and accomplish the missions. They will also have the opportunity to visit the Satellite testing facilities, the Space Expo, etc.
- ESA will sponsor all the costs of launching the completed CanSats in a rocket up to 1 km from Andøya Rocket Range (ARR). ARR, located 2 degrees north of the Arctic Circle on the Norwegian island of Andenes, is a premier launch facility for sounding rockets and balloons.
- Teams will be provided with a manual containing instructions on how to build the CanSat and the guidelines of the competition.
- Support will be available from experts following the teams' progress during the project and answering their questions.
- Participants will gain a unique international experience competing with other teams from across Europe.
- Some funding support will be available towards project costs (e.g. materials, travel and accommodation expenses, etc)
- A ground station will be provided during the campaign for receiving data from the CanSat and sending telecommands.

What are the responsibilities of the schools?

- Initiate the program in their own school and select a group of pupils to present the CanSat in the competition.
- Organise the work and make sure that the students get some time per week to work on the CanSat.
- Finance and provide necessary equipment and components for the project.
- Contact the panel experts if necessary.

9. Contacts

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