GUIDELINES

Dutch CanSat Competition 2022-2023

The Netherlands esero

Contents

What is CanSat?

In the CanSat competition, SE-students lead their own space mission - with a satellite the size of a soft drinks can. Together with a group of fellow students, they compete against teams from all over the country.

CanSats are small satellites that contain the same essential subsystems as a real satellite, such as power, sensors and a communication system. But CanSats are different - they fit into a 330ml soft drinks can! CanSats do not go into space, but are launched with a rocket and then released at an altitude of about 1 kilometer. CanSats have to perform two missions on their way back to the ground, and land safely.

The **primary mission** is the same for all participating teams: to measure the air temperature and air pressure on their return journey to Earth. The data must be transmitted by radio to the team's ground station at least once every second during the flight. After flight, teams make an analysis of the data obtained and present this in a graph.

The **secondary mission** is determined by each team itself. 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.

The best CanSats will be selected to have their Cansat launched with a real rocket. The winning team will automatically be entered into the ESA European CanSat Competition 2023.

Educational value of the CanSat competition

The CanSat competition provides the participating teams with the opportunity to experience all the phases typical of a real space project, from selecting the mission objectives, designing the CanSat, integrating the components, testing the system, preparing for launch to analysing the scientific data obtained. Through this process the students:

- learn by doing;
- get acquainted with the inquiry-based methodology typical of real-life scientific and technical work;
- acquire and/or reinforce fundamental technology, physics and programming curricular concepts;
- understand the importance of coordination and teamwork;
- enhance their communication skills.

COMPETITION OVERVIEW

Phase 1: Call for proposal and team selection	
13 September 2021	Call for proposals open
14 October 2022	Deadline proposals
30 October 2022	Announcement of selected teams
Phase 2: CanSat Design and construction	
Start November	Selected teams receive CanSat Starter kit
12 and 19 November 2023	Online teacher workshop (2x 3hrs)
13 January 2023	Deadline Progress Report
1 or 2 February 2023* (back up day 8 or 9 February)*	CanSat Test Day
Phase 3: Selection Top 10	
17 February 2023	Final design deadline
3 March 2023	Announcement 10 teams selected for Launch event
Phase 4: Launch	
16 March 2023* (back-up date: 23 March)*	CanSat Launch Event
Phase 5: Post-flight activities	
14 April 2023	Final Paper deadline
20 April 2023*	Award Ceremony
End June 2023*	European Competition

* **Final dates have yet to be confirmed**. In case of bad weather, the test day and launch event will be moved to the backup date. If for any reason, an event cannot go ahead or not in the planned manner, we will try our best to find a suitable alternative. However, events may be cancelled if necessary. ESERO NL will inform all participating teams with changes.

Phase 1: Call for proposal and team selection

To participate in the CanSat Competition, teams have to submit an application. An application consists of the following document. All forms can be found at www.esero.nl/cansat

- Proposal
- Personal Detail form
- Photography and Filming Consent Forms

All required documents should be mailed toinfo@esero.nl Please use the subject line: "[SEASON] CanSat Competition Proposal NAME TEAM".

Eligibility and team selection

A maximum of 40 teams will be admitted to the competition. Teams will be selected based on the quality of the research proposal and technical feasibility of their idea. Per school, a maximum of 2 teams may participate in the competition.

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

- The team should comprise between four and six (aged 14-20) full-time secondary school students, assisted by a teacher.
- A complete proposal is submitted before the deadline (see table on page 4).
- The proposal is written in English.
- For each team member a (scan of a) signed photography & filming consent form is submitted
- The team has a team leader, who has to be teacher (or TOA). The team leader monitors the teams progress, is available to offer help and advice acts as the point of contact between the organisers of the competition and the team. The team leader must be available to accompany the team to the test and launch events
- If more than half of the team members have participated in previous CanSat competitions, the team is eligible only if it meets the following conditions: the team members have never won the competition, and the secondary mission of the team is completely new. If there are more than 40 teams, teams with fewer members that already participated will be preferred.

When a proposal has been accepted, the team will receive a confirmation of their entry. The confirmation will include an invitation for the teacher to attend the teachers' workshops in November.

Phase 2: CanSat Design and construction

See competition overview for exact dates!

November	Selected teams receive CanSat Starter kit Online teacher workshop (2x 3hrs)
Halfway January	Deadline Progress Report
End January/Begin Feb	CanSat Test Day

Starting the project

All selected teams will receive a CanSat starter kit. This kit contains all elements needed to assemble a basic CanSat, including the sensors for the primary mission. All materials needed for the secondary mission must be obtained by the team.

The CanSat Book, which can be downloaded from the website, will provide the teams with the basic information required to start their CanSat project.

The teacher workshop

If the team is admitted to the competition, the team leader will receive an invitation to attend the online teacher workshops covering the basics of building a CanSat.

Day 1, 9-12 hrs: working with Arduino and sensors
Day 2, 9-12 hrs: radio communication and assembling

Progress Report

The progress report provides the organisers with an update of the status of you CanSat in preparation for the CanSat test day. It includes all the discrepancies from the proposal and an assessment of the progress of technical performance measures. Based on their Progress Report, the teams will receive feedback on the technical aspects of their CanSat project to prepare them for the CanSat test day.

A format for the Progress Report is included in the team portfolio, which can be found at www.esero.nl/cansat

The completed Progress Report must be e-mailed before the deadline (see above) to info@esero.nl. Please use the subject line: “CanSat Progress Report [team name]”.

CanSat test day

All teams will have the opportunity to drop their CanSat with a drone to check if all components of their CanSat are working. The teams will then be allowed to make final changes to their design. The test day is not compulsory, although attendance is highly recommended as testing is an important part of the CanSat design process.

Please note: The CanSat test day will ***not*** be part of any assessment or review of team performance. However, it is important to show in your Final Design how you tested your CanSat design and how you used the test results.

Phase 3: Selection Top 10

See competition overview for exact dates!

Halfway February	Final design deadline
March	Announcement 10 teams selected for Launch event

Final Design

The Final Design is the last report that has to be submitted before the launch. This report will contain all the alterations made to the CanSat design and summarises all the work performed to date. This document should accurately record all the details of the completed CanSat prototype and provide a full description of the CanSat system and its functionalities. Based on the Final Design, the work and performance of each team will be reviewed. The 10 best teams will be selected. They will get the opportunity to have their CanSat launched with the CanSat rocket at the launch event.

the Final Design, must be e-mailed before the deadline (see above) to info@esero.nl. Please use the subject line: “CanSat Final Design [team name]”

Team selection

On the launch day, 10 launch slots will be available. The organisers will make a selection of teams that may launch their CanSat. Teams that cannot prove that their CanSat meets the technical requirements (see page 10) will not be selected. From the teams that do meet the requirements, the best 10 teams will be selected following the selection criteria on page 11. The final selection will be communicated to the team leaders two weeks after the deadline for the final design (see above).

Phase 4: Launch

See competition overview for exact dates!

Halfway March	CanSat Launch Event

CanSat launch event

The highlight of the competition will be the launch event, at which the selected CanSats will be launched in a rocket up to an altitude of approximately 1 km. The CanSats will then separate from the rocket, conduct their missions, and land safely on the ground to be recovered by authorised personnel. The CanSats must be flight-ready upon arrival at the launch event.

Phase 5: Post Flight Activities

See competition overview for exact dates!

Beginning of april	Final Paper deadline
End of April	Final and Award Ceremony
End June	European Competition

Final Paper

After the launch event, the teams will be requested to submit a Final Paper and a CanSat log, The Final paper follows the standards of a scientific paper including an abstract and a manuscript of the project. The CanSat log describes your CanSat project's process and outreach activities. The Final Report must be e-mailed before the deadline (see page above) to info@esero.nl. Please use the subject line: "CanSat Final Report [team name]". A template will be sent to participating teams after launch selection.

Final and Award Ceremony

All teams that were present on the CanSat launch day will be invited for an oline final. Each teams presents their project. A jury of experts will interview and evaluate the teams and their work, and select the winner and two runner ups, based on the final reports and the presentation.

European Competition

The winner of the Dutch CanSat Competition will be automatically entered as a participant for the European Competition, organised by ESA. Information on the European Competition and the European Competition Guidelines from ESA can be downloaded here: www.esa.int/Education/CanSat/.

For the European competition launch campaign, ESA will sponsor the accommodation, meals and local transport expenses for one teacher and a maximum of six students per national team, as well as all costs for the rocket launches and related flight activities. All teams will be responsible for travel arrangements and expenses from their hometowns to and from the main airport/railway station to the launch campaign location and for the costs of their CanSat hardware and tools.

MISSION OVERVIEW

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

The rocket launch

The launch campaign will be organised in cooperation with DARE. DARE will also build the rocket: the CanSat Launcher V7. This rocket will deploy its parachute at apogee (about 900 – 1000 meter), reached at around 12 to 13 seconds after take-off. Just after the apogee (0 to 2 seconds later), the CanSats will separate from the rocket and descend on their own parachutes. The CanSats are usually found within 1 km of the launch site. However, recovery cannot be guaranteed. During the flight, the rocket can reach a maximum acceleration of 10 G in the vertical direction and a maximum velocity of 550 km/h.

Primary and secondary CanSat missions

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 must 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 (e.g. make an altitude calculation) and display it on graphs (e.g. altitude versus time and temperature versus altitude). This analysis can be performed in a post-flight analysis.

Secondary mission

The secondary mission for the CanSat is determined by the team itself. 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 fits 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 they can demonstrate that their mission has some scientific, technological or innovative value and as long as it fits the technical and other requirements.

Some secondary mission examples. Please note that the coice of you secondary mission is not limited to these subjects

1. *Advanced telemetry*

After release and during descent, the CanSat measures and transmits additional telemetry 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 wing or an airbag.

5. Planetary probe

A CanSat can simulate 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.).

Outreach programme

An important, but often undervalued aspect of a successful mission is showing other people what you have done. Your project is not only fun and informative for you, but may also be interesting and beneficial for others. Therefore an outreach programme should be designed to involve a carefully chosen target group: for example classmates, family, friends, the rest of the school, the local community. You can use your own media and materials, and/or involve other media such as (local) newspapers, websites and/or television.

CANSAT REQUIREMENTS

Launching a satellite is a complex process in which many things can go wrong, with severe consequences. Therefore each CanSat must meet a set of technical requirements. If your CanSat does not meet these criteria, you will not be selected for the launch event. You must demonstrate how you have met these criteria, e.g. with measurements, calculations, pictures, or any other evidence.

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. An exemption can be made for radio antennas and GPS antennas, which can be mounted externally (on the top or bottom of the can, not on the sides), based on the design. The rocket payload area has a maximum of 4.5 cm of space available per CanSat, along the can's axial dimension (i.e. height), which must accommodate all external elements including the parachute, parachute attachment hardware and any antennas.

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 grams and 350 grams. CanSats that are lighter must take additional ballast with them to reach the 300 grams minimum mass limit required. The rocket is designed to launch a payload with a specific mass. If the payload mass is too high or too low, it will affect the rockets flight path.

4. Explosives, flammable or other hazardous 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 parachute connection must be able to withstand up to 50 N of force, *but we strongly recommend a strength up to 200 N*[1]. The strength of the parachute must be tested to ensure that the system will operate nominal. This force is applied on the parachute right after deployment.

6. The CanSat must be able to withstand vibrations resulting from an acceleration of up to 20 G. This vibrational load is applied to the CanSat during the propelled portion of the launch.

7. The CanSat must land within the security zone designated by the authorities of military terrain 't Harde. For single stage parachutes this means that the maximum flight time is 90 seconds. This is the total flight time including lift-off. This means the CanSat should descend from 1 km to the ground in 77 seconds. This implies an average minimum descent rate of 13 m/s. This flight time ensures that the CanSat will land close to the launch site. When systems other than single stage parachuting are used, exceptions are possible in consultation well in time before Final Design. The systems must be tested to prove that they are safe.

8. In the case you use a larger parachute that is actively deployed at a later point in your CanSat flight, it must be ensured that the parachute stays secured until your moment of deployment. Both in terms of the mechanical system and the electrical/software actuation.

9. The CanSat must be powered by a battery and/or solar panels. The systems must be able to be activated for four hours non-stop without the battery running low. The battery must be easily accessible if it has to be replaced/recharged.

[1] The deployment mechanism in the DARE rocket is slightly different than that of the ESA rocket. The ESA rocket deploys the CanSats at apogee (at v ~ 0 m/s) while the DARE rocket deploys them a few seconds before apogee (at v~100 m/s).

10. The CanSat must have an easily accessible master power switch.
11. The CanSat should have a recovery system, such as a parachute capable of being reused after launch. Bright coloured fabric is recommended.
12. Inclusion of a retrieval system (beeper, radio beacon, GPS, etc.) is recommended.
13. The total budget of the final CanSat model should not exceed €500. This does not include ground support equipment, such as laptops, power supplies, antennas. This does include the cost of the CanSat starter kit received at the start of the competition, unless it is immediately and unopened returned to the organisation upon receipt.
14. If items are obtained through sponsorships, they should be specified in the budget with the corresponding current market costs.
15. The CanSat must be flight-ready upon arrival at the launch event. A final technical inspection of the CanSats will be carried out by authorised personnel before launch.

EVALUATION AND SCORING

Teams will be judged on the following criteria.

Technical achievement

The project has a high degree of technical complexity and originality, and the team has shown their engineering skills by tackling problems and developing innovative solutions. The CanSat performs well in terms of deployment and data collection for both the primary and secondary mission. In the case of malfunction during launch, the team is able to identify the problem and suggest improvements.

Scientific value

The mission has a clear scientific objective. The data collection suits this objective. The team shows that they understand the underlying scientific principles. The team is able to summarize their project with clarity and provide a readable and complete report.

Professional Competences

The team has shown that they were able to complete the tasks as an effective team, with clear roles for each team member, within the available time and budget. The team used self-reflection to identify strengths and flaws and was able to improve their process, and adapt to unexpected changes. The team was able to convincingly conveying the core message of their project to the jury, by making an appealing poster and presentation, and answering critical questions.

Outreach

The project was communicated to the chosen target groups through fitting channels, in an appealing way. The project had a strong (local) media presence.

COSTS

All the events (the teacher workshop, the test day and the launch day) will be completely free of charge, including the CanSat kit for each participating team. This CanSat kit contains all elements needed to assemble a working CanSat, including the primary mission.

Travelling expenses and other CanSat costs are not included.

CONTACT

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