GUIDELINES

Dutch CanSat Competition 2019-2020

The Netherlands esero

Inhoud

INTRODUCTION

During the CanSat competition, teams consisting of four to six pupils from 4th to 6th grade of HAVO/VWO design and build 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 teams devise a mission, draw up a research proposal, and design, build and test a satellite. The CanSat is then launched to an altitude of about one kilometer by a rocket and its mission begins: to carry out a scientific experiment, achieve a safe landing and analyse the data collected. During the flight, radio contact is maintained with the ground station to transmit telemetry and other signals. The pupils work together and gain experience in building a complex system in which various disciplines play a role.

All elements of a real space flight project are involved. For example: writing a proposal, system design, documentation, programming, building and testing the system and the launch, but also the communication via social media and the press. The multidisciplinary nature of the competition means that the teams can consist of a wide range of students with different interests and talents.. The participants will be introduced to working in a team, which is a vital skill with a view to their studies and a professional career.

And last but not least, the winning team will participate in the European CanSat Competition, organised by ESA. See www.cansat.eu.

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;
- become acquainted with the enquiry-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; and
- enhance their communication skills.

COMPETITION OVERVIEW

The CanSat Competition has the following timeline. The timeline is tight and firm. If the team submits any of the required documents beyond the deadline, we cannot guarantee further participation and support.

1 September 2019	Call for proposals online
10 October 2019, 3PM	Research proposals submission deadline
28 October 2019	Team selection announcement
9 November 2019	Teacher workshop
8 January 2020, 4PM	Progress report deadline
28 January 2020*	CanSat Test Day (back-up date: 5 February)*
18 February 2020, 12PM	Final design deadline
2 March 2020	Announcing team selection Launch Event
20 March 2020*	CanSat Launch Event (back-up date: 29 March)*
9 April 2020	Final report deadline
17 April 2020	Award Ceremony
22 – 26 June 2020	European Competition

*Please note that the dates for the test day and launch have yet to be confirmed. In case of bad weather, there is a back-up date. The exact dates and any changes will be communicated to the team leaders and will be announced on the website www.cansat.nl.

Call for proposal

To participate in the CanSat Competition, a team has to submit a research proposal. The call for proposals is published on the CanSat website www.cansat.nl. . The team leader must e-mail the required documents: the Team Portfolio with the completed proposal form, a Personal Detail form, and a signed photography & filming consent form for each team member before the deadline (see above) to info@esero.nl. Please use the subject line: “CanSat Competition Proposal by [team name]”.

Eligibility and team selection

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

- The team should comprise between four and maximum of six (aged 14-20) full-time secondary school students, assisted by a teacher.
- A complete research proposal must be submitted before the deadline (see table on page 4).
- The research proposal is written in English.
- For each team member a (scan of a) signed photography & filming consent form is submitted
- Each team must have a teacher, the team leader, responsible for monitoring the team’s technical progress, who is available to offer help and advice and who 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 if it meets the following conditions: the team members have never won before, the secondary mission of the team is completely new, and the team must show significant progress in comparison with previous competitions in which the members participated.

The teacher workshop

If the team is admitted to the competition, the team leader will receive an invitation to attend a teacher workshop, where he or she will learn the basics of building a CanSat:

- working with Arduino microprocessors;
- soldering;
- programming;
- radio communication.

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.

Reporting – Team Portfolio

In order to monitor the progress of each team, two reports have to be submitted during the competition: the Progress Report and Final Design. For the research proposal, the progress report and the final design report, you will use the same document, which will be your Team Portfolio. This portfolio contains templates for all three reports. The first section, the Research Proposal form, will be completed when applying for the CanSat Competition. When you wish to submit your Progress Report, you will use the same document you submitted for application and complete the next section with the Progress Report form. Please note that you cannot change the original proposal. If you have changed your original idea, you should describe that in your progress report and explain why you have made these changes. You will complete your portfolio in the same way by adding the last section for the Final Design report, without changing the previous sections..
The CanSat Team Portfolio with reporting templates can be found on the CanSat website www.cansat.nl.

Progress Report

The progress report provides the organisers with a status update on your CanSat project and mission in preparation for the CanSat test day and ultimately the CanSat launch event. The Progress Report will be an amended version of the research proposal and will include 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.
The Team Portfolio together with the completed Progress Report must be e-mailed before the deadline (see page 4) to info@esero.nl. Please use the subject line: “CanSat Progress Report [team name]”.

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 best ten teams will be selected. They will get the opportunity to have their CanSat launched with the CanSat rocket at the launch event.

The completed Team Portfolio, including the Final Design, must be e-mailed before the deadline (see page 4) to info@esero.nl. Please use the subject line: “CanSat Final Design [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.

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.

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 9) 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 timeline on page 4 for the exact date).

Post-flight activities

Final Report and Award Ceremony

After the launch event, the teams will be requested to submit the CanSat Final Report, which contains the *Final Paper* and the *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 (template to be downloaded from the website) must be e-mailed before the deadline (see page 4) to info@esero.nl. Please use the subject line: "CanSat Final Report [team name]".

All teams that were present on the CanSat launch day will be invited for the Award Ceremony at NEMO Science Museum. These teams present a project poster on which they show the highlights of their project. A jury of experts will interview and evaluate the teams and their work, and select the three best teams based on the final reports and the posters. These three teams will present their results to the jury and the public. After these presentations, the jury will select the winner of the Dutch CanSat competition.

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. Teams should also take account of the limitations of the CanSat mission profile and focus on the technical and administrative feasibility of their chosen mission.

Some secondary mission examples:

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 you should make an outreach programme to involve your classmates, family, friends, the rest of the school, and your community. You can use your own media and materials, and/or involve other media such as (local) newspapers, websites and/or television.

CANSAT TECHNICAL 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 have to be able to demonstrate how you have met these criteria, e.g. with measurements, calculations, pictures, or other evidence.

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. 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 1,000 N of force. The strength of the parachute must be tested to ensure that the system will operate normally. This force may be applied to the parachute if the CanSat is deployed at the rockets top speed of 550 km/h
6. For safety reasons, a maximum flight time of 90 seconds is mandatory. This is the total flight time including lift-off to 1 km. 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 maximum flight time also applies if attempting a directed landing. This flight time ensures that the CanSat will land close to the launch site.
7. 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.
8. The total budget of the final CanSat model should not exceed €500. Ground stations and any related non-flying items will not be considered in the budget.
9. If items are obtained through sponsorships, they should be specified in the budget with the corresponding current market costs.
10. 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.
11. The CanSat must be powered by a battery and/or solar panels.
12. The CanSat must have an easily accessible master power switch.

The following requirements are not assessed. However, it is highly recommended that the CanSat meets these requirements, otherwise there is a real chance that your mission will fail.

13. 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.
14. Inclusion of a retrieval system (beeper, radio beacon, GPS, etc.) is recommended.
15. The CanSat should have a recovery system, such as a parachute capable of being reused after launch. Bright coloured fabric is recommended.
16. The CanSat must be able to withstand an acceleration of up to 20 G. This force is applied to the CanSat right after launch and/or on the parachute at maximum velocity.

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 school and the local community through different 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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