CANSAT – FRANCE

Competition design guide

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1 Introduction

This document provides the design guide for the Cansat competition organised by CNES and Planete Sciences, in France.

This document and the mission guide are also available on the web site

http://www.planete-sciences.org/espace

2 Definition:

Cansat: a mini « space probe », with a volume between 33cl and 1 litter and having a « Can » shape.

Organisation: composed from CNES and Planete Sciences members. Management of the competition.

Technical committee: composed from CNES and Planete Science Experts. In charge of the Cansat projects follow on. Managed by a Planète Sciences member.

Board: examiners, from CNES, Space industry and Planète Sciences. Present during the competition itself.

3 Document changes:

Edition 01: initial document

Edition 02: Document for 2009 competition

Edition 03: Document for 2010 competition

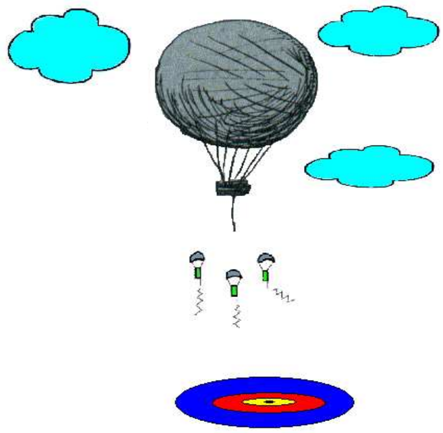
Addition of chapter 3
Addition of 2 notes page 15 on cansat release position and weather conditions
Addition of a note on meteo
Updating PLA001, PLA002, PLA004, PLA005, PLA006, PLA009
Creation of PLA004
Correction CDC003: high is 115 mm and not 150 mm
Updating CDC016, CDC017, CDC018
Correction O002, OP003, OP005, OP006

4 Presentation:

The competition is open to student (18 years old and more)

The competition is open to both:

- open class (Cansat volume = 33cl) and
- International class (Cansat Volume 1 litter)



The Cansat is released by a tethered balloon at a certain altitude and should carry out a scientific mission, (to simulate the space mission of a probe). One ambitious option is to realise the come back mission, whose goal is to reach dedicated GPS coordinates on the ground, after landing.

The competition will be hold in a dedicated area, during 3 days.

All information will be updated on the Cansat dedicated Site.
http://www.planete-sciences.org/espace/spip.php?article239

The notation will be done accordingly the different phases, as described in annex of the mission document.

5 *Teams composition:*

[EQU001] Each team will include at least 3 students.

There is no limit on the number of participants.
One student can not belong to 2 different teams.

The rules for each student in the project will be described in the mission plan. Each team will send its registration form (web) to the organisation. A dedicated student will be in contact with the organisation.

[EQU002] All team members should be student or young professional (less than one year).

The person who do not fulfil this rule could send a proposal to the organisation and they may be accepted to take part as a free team (not part of the competition)

[EQU003] In a same team, the students could come from different universities.

The participation of more than one team from a same university is allowed, in case the relevant projects are different.

[EQU004] The team, which receives the help of a professional person, should include this information in the registration form.

The professional person is invited to the competition.

6 Phases of the competition

PLA 001
To take part to the competition, each team should send its registration form to the organisation (web site). There will be no selection at this step.

This Cansat competition will illustrate a real development program of a space project so it will include the relevant phases: conception / realisation / flight demonstration and lesson learned from the experience.

All deliverable documents will be written on a Power Point format or equivalent, to be sent to:

cansat@planete-sciences.org

Phase 1: Conception

PLA002
Delivery of the *intermediate conception report:*

- 10 slides (power point format) maximum
- Technical presentation of the project
- Proposed mission
- Budget
- Proposed RF channels and associated power (CDC017 radio frequencies).

To be sent by e mail to cansat@planete-sciences.org

The selection of the project is based on the intermediate conception report.

PLA003: delivery of the final conception report, also on PowerPoint format, on the basis of the updated intermediate conception report.

To be sent by e mail to cansat@planete-sciences.org

PLA004: intentionally left blank

Phase 2: Development

PLA005 All physical data collected by the Cansat will have to be transmitted to the ground by telemetry and recorded by the team.

PLA006 The Cansat will have to fulfil all the requirement of the §7. Dedicated controls will be done before the flight demonstration, to check the conformity of the Cansat with the specifications of §8.

Phase 3: Presentation of the project

PLA007 Each team will do a 10' presentation (power point format) in front of the Cansat Board • 10' maximum followed by 5' questions. • Presentation of the teams and the rules of each student • Mission objective and technical presentation of the Cansat • Cost and Planning

Phase 4: Flight demonstration

The Cansat will be released from a tethered balloon. The released altitude will be communicated to the team, 2 hours before the launch period.

PLA008 The mission will start after the release of the Cansat from the Balloon interface.

Phase 5: Outcome

PLA009 The last step will be a presentation of the results of the flight demonstration and conclusion of the project. • 15' maxi • Power point format • Scientific (results of the measurements) and technical (for example what did work and what did not work) interpretation. • Conclusion on the organisation of the project

Technical steps

Calendar	Events	Deliveries	Remark
Before the competition			
T0	Deadline for registration	Registration form	Electronic file to be found on the web site
T1	Conception phase	Intermediate Report	Electronic PPT format *Projects selection*
T2	Conception phase	Final Report	Electronic PPT format: 10 slides max
During the competition			
T3	Presentation of the projects	PPT presentation	10’ max + 5’ questions
T4	Cansat controls		Check list to be delivered to the team, in advance by the organisation
T5	Cansat flight demonstration		
T6	Outcome from the flight demonstration	PPT presentation	15’ max

7 *Missions:*

Preamble: the Cansat missions start from the Cansat release (from the balloon) and can follow on after the landing.

7.1 Missions definition

Scientific mission: the goal is to measure any parameters belonging to the environment of the probe: atmosphere, sun radiation, ground characteristics …This suppose on board transducers and telemetry link with a ground station.
The degree of innovation of the proposed technology will be included in the mark scheme.
The scientific mission is chosen among the organisation proposed missions, described in the annual mission guide.

Come back mission: the cansat has to land on a defined GPS location. The GPS data are provided to the team by the organisation.

Free mission: the mission is proposed by the team.

7.2 Missions to be done

DEF001 The team will choose a scientific mission (from the annual mission guide, see the web site) and a free mission

DEF002 The come back mission is proposed as a bonus and is not mandatory. However, this mission is encouraged.

8 *Specification for the cansat probe*

The requirement for the international class is compatible with other international CANSAT competition guides.

Volume

CDC001 - International class: the volume of the Cansat should not exceed 33 cl - Open Class: the volume is between 33 cl and 1 litter

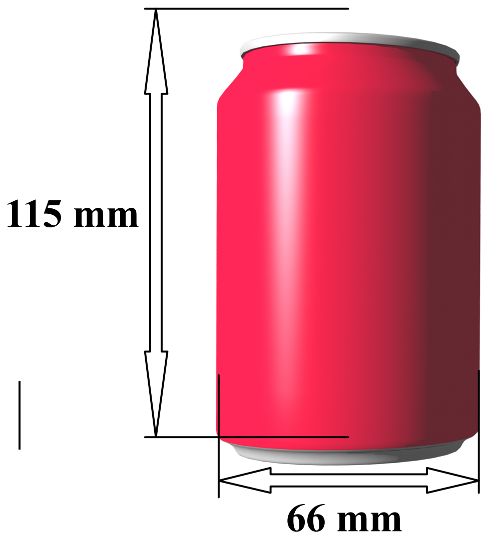
Mass

CDC002 - International class: the mass of the Cansat should not exceed 350 g - Open Class: the volume is less than 1 kg.

Size of the Cansat

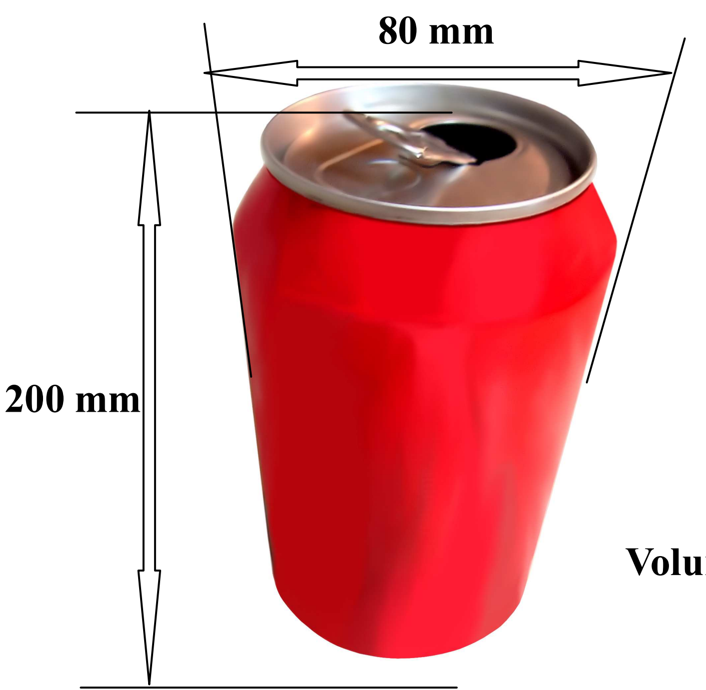
CDC003 -International class: the cansat has to be included in the following cylinder: Diameter= 66mm / Height = 115 mm - Open Class: the cansat has to be included in the following cylinder: Diameter= 80mm / Height = 200 mm

INTERNATIONAL CLASS



Volume : 33cl
Masse : < 350 gr

OPEN CLASS



Volume : 33cl ≤ V CanSat ≤ 1 litre
Masse : ≤ 1 kg

Propulsion

CDC004 Electric / thermal or pyrotechnic propulsion is to be excluded, especially for activating the propellers. Passive propellers (to reduce the descent velocity) are authorized.

Appendices

CDC005 Any appendices should be included in the maximal specified volume, except for parachute.

CDC006 An additional mass of 50 g and an additional volume allocation is offered for the parachute. The supplementary volume allocation is the available place of the interface system provided by the organisation. Any electrical link between the cansat and its parachute is forbidden.

Reference position of the target

CDC007 The GPS coordinates of the target will be provided to the team by the organisation, 2 hours before the flight demonstration. The data's will be given on a NMEA GGA format, the geodic reference is the WGS84 model.

Release altitude of the Cansat

CDC008 The release altitude will be between 100 and 150 m.

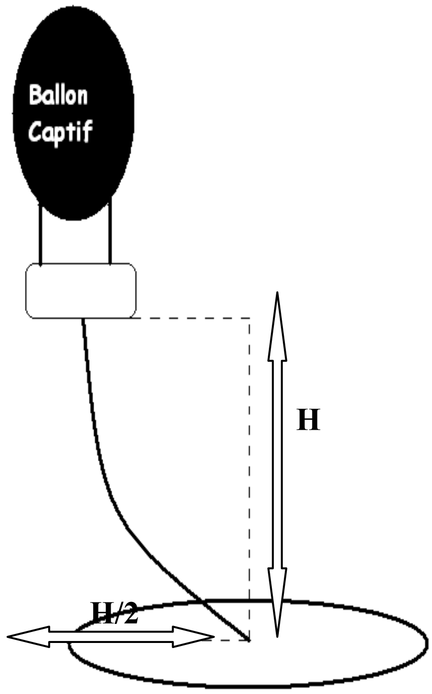
Cansat initial velocity from release system

CDC009 The cansat release velocity is close to zero.

Acceleration

CDC010 During the ascent phase of the balloon, the vertical acceleration for the cansat is less than 2g, including 1g for gravity. The eventual lateral accelerations are due to the wind.

Distance to the target:



[CDC011]
When the cansat is released, the distance of the Cansat and the vertical of the target will be less than H and around H/2, H being the release altitude.

Note: The cansat released point can be moved by the organisation (by moving the attachment point on the ground), depending of weather conditions.

Cansat Carrier

CDC012
The Carrier to transport the Cansat up its release altitude is a tethered balloon, provided by the organisation.

Wind conditions

CDC013
The Cansat release will be authorised, only if the wind velocity is less than 5 m/s.

Note: if the weather conditions do not allow the cansat release, the teams will be judged on their project presentation and a ground demonstration.

Interface between the Balloon ad the Cansat

[CDC014] The release system is based on gravity. The cansat is placed inside a tube. The trap door (lower floor) is opened by a telemetry command from the ground operator.

A ring is available in case the team wishes to attach a separation detector.

Separation balloon / Cansat

CDC015 The release of the cansat is done by the organisation via a telemetry command from the ground.

Cansat / Ground RF link

CDC016 Any RF link between the team station and the cansat is authorised within the rules specified in appendix1. There should be no human intervention on the eventually up links commands during the cansat missions.

CDC017 The team should have its own system of RF telemetry for emission and reception, modulation/ demodulation and coding / decoding. The relevant on board and ground equipment item should be in accordance with the proposed rules in annexe 1 of the present document. The relevant frequencies, channel bandwidths, and associated power will be included in the intermediate report.

The free frequency in the ISM ranges are recommended as described in the annex1.

If required by the team, Planete Sciences can provide a standard RF emitter (Kiwi millennium) which has been developed by CNES and used for stratospheric Balloons and Rocketry. The associated reception stations are also available.
Planete Sciences can also provide FSK modulation (in the range 1200 – 4800 bauds) and decoding for FSK protocol.

CDC018 A manual switch of the emitted RF power is mandatory for each cansat.

Reutilisation

CDC019* The Cansat should be constructed so that a new flight could take place 1h after the previous one.

* Only for international class.

Safety

CDC020 The cansat shall not present any danger for people who work on it.

No pyrotechnics, no dangerous products, no biologic experiments are authorized.

CDC021 Descent velocity shall be in the range [4, 15] m/s.

This will be justified during the presentation of the project to the board.
A calculation method is proposed on htpp://www.planete-sciences.org

Expenses

CDC022 There are no specific requirements.

The budget allocation has to be presented, including the sponsors contribution, if any.

9 *On the launch area*

Written procedures

OP001 The team shall prepare a procedure describing each operation done on the cansat on the launch site and up to the flight.

A guide will be available on the web site, to help the team. It will also concern the operation linked with the release system.

This procedure will be presented to the controller during the competition. However, it is recommended to include it in the conception report.

Preparation

OP002 The team shall be on the launch area 30' before its flight time slot.

Tables will be available. Electrical supply may be available. However, the Cansat teams are encouraged not to use any energy forms.

Flights planning

OP003 The balloon will be available for the team, 15' before the flight, for cansat integration into the interface tube.

OP004 The cansat shall be ready for flight at least 20' before the flight.

OP005 The access to the safety area will then be available for safety and control people.

Delay and unexpected event

OP006 The cansat shall have a minimum 45' autonomous electrical supply, not including the flight. In case there is more than 45' delay (not team responsibility), the team will have the possibility to change the batteries of its cansat. In case of a delay caused by the team, the possibility to launch may be lost.

10 Logistics:

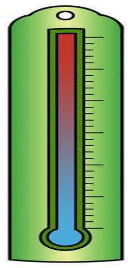
Transport and accommodation near the launch area, will be provided by the organisation. A financial participation of each team will be required.

Table and power supply will be available on the integration hall, the day before the flight.

During the flight, a tent will be available for the team, close to the launch area. There will be a table, where the team could have its reception station. This will be located such that the flight of the cansat could be easily seen.

11 Available informations on the launch area:

Weather conditions



A small weather station will be available on the launch area with temperature / relative humidity / atmospheric pressure/ wind velocity and direction, atmospheric pressure evolution

12 Safety rules of the launch area

The safety rules on the launch site will be given during the competition.

13 Disqualification

The organisation will be free to exclude any team / participant in case of violation of the present guideline, especially the safety aspects.

14 Prizes

Prizes will be given for the first, second and third team. Each team will get a participation certificate.

15 Link with the organisation

All updated information for the annual competition will be put on the web site:

http://www.planete-sciences.org/espace/cansat

The deliverable documents will be transmitted to cansat@planete-sciences.org

16 Appendix 1 – Radiofrequency regulation

The Team is allowed to use their own radiofrequency systems assuming French regulations on the frequencies spectrum are respected (see ANFR website: www.anfr.fr). When the Team purchases RF equipment from France and does not attend to modify any part of them, the national regulation is thus considered as fulfilled.

For downlink (from the Cansat to the ground station) and uplink transmissions (from the ground station to the Cansat), the use of the Industrial Scientific Medical (ISM) frequencies spectrum is recommended (see below for more details). In particular, commercial RF designs should be used on those frequencies.

The recommended ISM frequencies for downlink (Cansat → Ground Station) and uplink (Ground Station → Cansat) transmissions, associated with maximum RF emitting powers and channel bandwidths, are:

Frequency Band	Max. Power	Max. Channel Width
433,05 à 434,79 MHz	10 mW a.r.p. (*)	No restriction
868 à 869,2 MHz	25 mW a.r.p. (*)	No restriction
869,3 à 869,4 MHz	10 mW a.r.p. (*)	25 kHz
869,4 à 869,65 MHz	500 mW a.r.p. (*)	25 kHz
869,7 à 870 MHz	5 mW a.r.p. (*)	No restriction
2400 à 2483,5 MHz	10 mW e.i.r.p. (**)	No restriction

(*) Apparent Radiating Power: ARP(dBW) = 10*log10(Pe) + Ge – 2,14, where Pe(W) is the electrical power from the emitter RF output to the antenna input, Ge(dBi) is the maximum isotropic antenna gain.
(**) Equivalent Isotropic Radiating Power: EIRP(dBW) = 10*log10(Pe) + Ge, where Pe(W) is the electrical power from the emitter RF output to the antenna input, Ge(dBi) is the maximum isotropic antenna gain.

The frequencies delivered for the CNES' "Kiwi Millenium" RF transmitter can be used, considering the following restrictions (emitting power, and channel bandwidth):

Frequency Band	Max. Power	Max. Channel Width
137,95 MHz / 138,50 MHz	500 mW e.i.r.p. (**)	50 kHz

→ Each Team must provide in the Intermediate Design Report their RF design, which must include for each link: RF frequencies with channel bandwidths and max. ARP or EIRP. Each Team will receive a unique frequency by type of link (downlink or uplink).

The Organization defines a Frequencies Allocation Plan in order to mitigate any frequency interferences. When frequency collision appears, the organization may ask to the concerned teams to change their emitting settings (frequencies, emitting power, or channel width).