

CanSat Competition Guide 2014

**Mission:
Environmentally Powered
Atmospheric Probe
Version 1.0**

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1. Introduction

The CanSat competition is a design-build-fly competition that provides teams with an opportunity to experience the design life-cycle of an aerospace system. The CanSat competition is designed to reflect a typical aerospace program on a small scale and includes all aspects of an aerospace program from the preliminary design review to post mission review. The mission and its requirements are designed to reflect various aspects of real world missions including telemetry requirements, communications, and autonomous operations. Each team is scored throughout the competition on real-world deliverables such as schedules, design review presentations, and demonstration flights.

2. Mission Overview

The 2014 mission simulates a sensor payload traveling through a planetary atmosphere sampling the atmospheric composition during descent.

The overall CanSat system is composed of two primary components, a science payload and a re-entry container that protects the payload during ascent, "near-apogee" deployment and initial re-entry/descent.

Once the deployed container/payload system reaches a specified altitude the payload is released from the container to gently descend and safely land. All operations are to be autonomous. "Near apogee" deployment will occur at an altitude of approximately 670 meters or higher. Upon deployment from the rocket the container and payload shall descend at 12 meters per second using any passive descent control system. At an altitude of 500 meters the payload shall be released from the container and descend under its own control to a safe landing. The safe landing of the payload shall be accomplished without using a parachute, para-foil, streamer, or any similar device to reduce its speed. The payload descent rate shall be 10 m/s or less. After release, the descent rate of the container shall not be maintained. The payload will send telemetry during descent and not use any batteries. All power must be harnessed from the environment. The payload shall safely carry one raw hen's egg, which simulates delicate payload instrumentation.

Telemetry shall be collected at a minimum 1 Hz rate. The payload must transmit as much data as possible during descent. Telemetry can be sent continuously or in bursts. Once the payload lands, data transmission must stop. Points are awarded for each 1Hz data sample collected from payload deployment from the container through landing. Judges will review data submitted and only count the data during active descent of the payload.

3. Requirements

3.1 Base Requirements

Requirement Number	Requirement
1	Total mass of the CanSat (container and payload) shall be 600 grams +/- 10 grams without the egg.
2	The payload shall contain and protect the egg from cracking or breaking during flight through landing. The egg will weigh not more than 67 grams.
3	The payload shall be completely contained in the container. No part of the payload may extend beyond the container.
4	Container shall fit in the envelope of 125 mm x 310 mm including the container passive descent control system. Tolerances are to be included to facilitate container deployment from the rocket fairing.
5	The container shall use a passive descent control system. It cannot free fall.
6	The container shall not have any sharp edges to cause it to get stuck in the rocket fairing section.
7	The container shall be a florescent color, pink or orange.
8	The rocket airframe shall not be used to restrain any deployable parts of the CanSat.
9	The rocket airframe shall not be used as part of the CanSat operations.
10	The CanSat (container and payload) shall deploy from the rocket fairing section.
11	The descent control systems shall not use any flammable or pyrotechnic devices.
12	The descent rate of the CanSat shall be 12 m/s above 500 meters.
13	When the CanSat reaches 500 meters, the payload shall be released from the container.
14	When released, the payload shall have a descent rate of less than 10 m/s.
15	All descent control device attachments shall survive 30 Gs of shock.
16	All descent control devices shall survive 30 Gs of shock.
17	All electronic components shall be enclosed and shielded from the environment with the exception of sensors.
18	All structures shall be built to survive 15 Gs acceleration.
19	All structures shall be built to survive 30 Gs of shock.

Requirement Number	Requirement
20	All electronics shall be hard mounted using proper mounts such as standoffs, screws, or high performance adhesives.
21	All mechanisms shall be capable of maintaining their configuration or states under all forces.
22	Mechanisms shall not use pyrotechnics or chemicals.
23	Mechanisms that use heat (e.g., nichrome wire) shall not be exposed to the outside environment to reduce potential risk of setting vegetation on fire.
24	No batteries shall be allowed in the payload. Batteries are allowed only in the container to support releasing the payload.
25	The container shall only use alkaline type batteries.
26	The container shall collect and store altitude data at a 1 Hz rate from launch to the moment of landing.
27	The container shall transmit its altitude data at a 1 Hz rate during from launch time to landing.
28	The payload shall harvest energy from the environment during descent.
29	During descent, the payload shall collect air pressure, air temperature and power source voltage once per second.
30	During descent, the payload shall transmit all telemetry. The number of telemetry data transmitted shall be scored. The payload shall not generate telemetry at greater than 1 Hz rate.
31	Telemetry shall include payload mission time with one second or better resolution, which begins when the payload is powered on. Mission time shall be maintained in the event of a processor reset during the launch and mission.
32	XBEE radios shall be used for telemetry. 2.4 GHz Series 1 and 2 radios are allowed. 900 MHz XBEE Pro radios are also allowed.
33	XBEE radios shall have their NETID/PANID set to their team number.
34	XBEE radios shall not use broadcast mode.
35	Both the container radio and payload radio shall use the same NETID/PANID. Teams are allowed to determine how to coordinate communications between the container, payload and ground station.
36	The payload shall include an external umbilical power connection to allow for testing and safety checks when not harvesting energy.
37	The external power connection shall be a sturdy connector that is easily accessible when the payload is stowed in the container. Loose wires are not allowed.
38	Cost of the CanSat shall be under \$1000. Ground support and analysis

Requirement Number	Requirement
	tools are not included in the cost.
39	Each team shall develop their own ground station.
40	All telemetry shall be displayed in real time during descent.
41	All telemetry shall be displayed in engineering units (meters, meters/sec, Celsius, etc.)
42	Teams shall plot data in real time during flight.
43	The ground station shall include an antenna mast of 3.5 meters height, which is to be measured from the ground to the tip of the antenna structure.
44	The ground station mast shall be free standing. The antenna mast cannot be attached to provided tent or other structures.
45	The ground station mast shall be properly secured as to not fall over under any conditions with surface winds up to 30 mph.
46	If guy wires are used to support the ground station antenna mast, the guy wires shall be made visible for safety.
47	Both the container and payload shall be labeled with team contact information including email address.
48	The flight software shall maintain a count of packets transmitted, which shall increment with each packet transmission throughout the mission. The value shall be maintained through processor resets.
49	The container and payload shall maintain a mission time which is the number of seconds since each vehicle is powered on. The mission time shall be maintained in the event of a power loss or processor reset. The time may be maintained by software or by hardware real-time clock. If a hardware real-time clock is used, a separate, dedicated power source may be used to power the clock; however, this power source may not be used to power any other vehicle functions.

3.2 Selectable Bonus Objectives

Only one bonus objective can be selected. The points for the bonus objective will only be awarded if the egg in the payload is returned intact.

1. Use a three-axis accelerometer to measure the stability and angle of descent of the payload during descent. Sample at appropriate rate and store data for later retrieval.
2. Measure light intensity in the infrared and visible spectrum and include with the required telemetry.

3.3 Telemetry Requirements

Upon powering up, the CanSat payload shall collect the required telemetry at a 1 Hz sample rate. The telemetry data shall be transmitted with ASCII comma separated fields followed by a carriage return in the following format:

<TEAM ID>,<PACKET COUNT>,<MISSION_TIME>,<ALT SENSOR>,<TEMP>,<VOLTAGE>,
[<BONUS>]

1. **The payload telemetry for the entire mission shall be saved on the ground station computer as a comma separated value (.csv) file that will be examined by the competition judges in Excel. Teams will provide the file to the judges after the launch operations via USB drive or CD.**
2. The telemetry data file shall be named as follows:
CANSAT2013_TLM_<TEAM_ID>_<TEAM_NAME>.csv
where the team_id is the four digit team id number and <team_name> is to be selected by each team (using underscores instead of spaces in the file name).
3. <TEAM ID> is the assigned team identification
4. <PACKET COUNT> is the count of transmitted packets, which is to be maintained through processor reset.
5. <MISSION_TIME> is the time in seconds since the payload was powered on for the telemetry data being transmitted (which is not necessarily the transmission time, if data was saved for burst transmission).
6. <ALT SENSOR> is the altitude with one meter resolution
7. <TEMP> is the sensed temperature in degrees C with one degree resolution
8. <VOLTAGE> is the voltage of the CanSat power bus, which is powered by a non-battery source
9. <BONUS> is free-form bonus objective data
10. Additional data fields may be appended after the required fields as determined necessary by the team's design

The container shall collect altitude data at a 1 Hz rate from launch to the time of landing and store it in internal memory. The data shall be in the following format:

<TEAM ID>,<PACKET COUNT>,<MISSION_TIME>,<ALT SENSOR>

The container telemetry data file shall be named as follows:

CANSAT2013_CAN_<TEAM_ID>_<TEAM_NAME>.csv

where the team_id is the four digit team id number and <team_name> is to be selected by each team (using underscores instead of spaces in the file name).

1. <TEAM ID> is the assigned team identification
2. <PACKET COUNT> is the count of transmitted packets, which is to be maintained

through processor reset.

3. <MISSION_TIME> is the time in seconds since the container was powered on
4. <ALT SENSOR> is the altitude with one meter resolution

4. Team Composition

Students currently enrolled in undergraduate degree programs, or students having graduated from such programs since the start of the current competition cycle, are counted as undergraduate students.

Students currently enrolled in post-graduate degree programs (MS, PhD), or students having entered such programs since the start of the current competition cycle, are counted as graduate students.

4.1 Team Size

Each team shall consist of between 3 and 10 students (undergrad teams) from an accredited college or university. Teams may consist entirely of undergraduate students (undergrad teams), entirely of graduate students (grad teams), or a combination of the two (mixed teams). Graduate teams shall consist of no more than 5 students. Mixed teams shall consist of no more than 7 undergraduate students and 3 graduate students.

4.2 Faculty Advisor

Each team must have a faculty advisor. The role of the faculty advisor is to:

- Provide a point of contact for the team, both with the university and the competition.
- Aid teams with logistics such as arranging conference rooms, laboratory resources, etc.
- Providing general guidance throughout the competition.

The faculty advisor shall not:

- Make design decisions or direct recommendations.
- Participate in more than an oversight role during reviews.

4.3 Team Mentors

Each team will be assigned a competition mentor who acts as a liaison between the team and the competition committee. The mentor will be responsible for scheduling all competition reviews and coordinating all communications with the team. Mentors are also responsible for tracking the team's progress throughout the competition.

Team mentors are available to answer questions and provide general guidance. The mentor shall not provide design recommendations.

5. Deliverable Items

Teams will be evaluated based on a series of deliverable items provided at various stages of the development. The deliverable items are selected to provide representative real-world milestones for tracking the CanSat development and ensuring team success.

5.1 Preliminary Design Review

The PDR is a “multi-disciplined technical review to ensure that the system under review can proceed into detailed design, and can meet the stated performance requirements within cost (program budget), schedule (program schedule), risk, and other system constraints”. The CanSat PDR shall demonstrate:

- An understanding of the CanSat mission requirements
- Allocation and derivation of system and subsystem requirements
- Definition of the CanSat concept of operations
- Overview of preliminary design that meets specified requirements
- Results of, or identification of, necessary trades to support preliminary design. While it is ideal to have completed trades prior to the preliminary design, it is not necessary.
- Results of, or identification of, necessary prototyping or testing efforts necessary to support or finalize the preliminary design.
- Preliminary budget
- Detailed development schedule

Preliminary design reviews shall be conducted via teleconference coordinated by the team lead(s) and mentors. The PDR presentations shall be less than 30 minutes in duration including time for questions. Presentation reviewers shall be permitted to ask questions during the presentation (i.e., questions are not held until the end of the presentation).

The PDR shall follow the presentation outline posted on the CanSat Competition website.

5.2 Critical Design Review

The CDR is “a multi-disciplined technical review to ensure that the system under review can proceed into system fabrication, demonstration, and test; and can meet the stated performance requirements within cost (program budget), schedule (program schedule), risk, and other system constraints”. The CDR shall demonstrate:

- All PDR level requirement TBDs and TBRs shall be resolved
- Refinement of the CanSat CONOP
- Results of detailed design and analysis for each subsystem
- Verification that detailed design meets system and subsystem level requirements
- Identification of subsystem and system level tests necessary for requirements verification

- Results of requirements verification tests completed to date
- Overview of mission operations
- Preliminary launch day sequence of events
- Revised budget
- Updated development schedule

Critical design reviews shall be conducted via teleconference coordinated by the team lead(s) and mentors. The CDR presentations shall be less than 30 minutes in duration including time for questions. Presentation reviewers shall be permitted to ask questions during the presentation (i.e., questions are not held until the end of the presentation).

The CDR shall follow the presentation outline specified in the "CanSat 2013 CDR Outline" document available on the CanSat Competition website. Extra material in the form of backup slides is permitted.

Each section of the CDR shall be scored in accordance with the values listed in the outline. The CDR shall contribute to the total evaluation of the CanSat design according to the values listed the section Evaluation and Scoring.

5.3 Post Flight Review

The PFR provides an assessment of flight operations and results of the demonstration flight. The PFR provides an assessment of successful and unsuccessful flight operations. The PFR shall provide:

- Overview of mission objectives and CanSat design
- Comparison of planned and actual CONOPS and SOE
- Raw and processed data from flight operations
- Failure analysis and assessment (for unsuccessful mission objectives)

Post flight reviews shall be conducted the day following the demonstration flight activities, unless flight operations are canceled due to weather. Presentations shall be limited to 10-15 minutes, including questions, based on the number of teams participating.

Each section of the PFR shall be scored in accordance with the values listed in the outline. The PFR shall contribute to the total evaluation of the CanSat design according to the values listed in the section Evaluation and Scoring.

5.4 Deliverable Submissions and Scheduling

All deliverable items shall be submitted to the team mentor by the dates listed in Table 1. All deliverable items shall be submitted in PDF format using the naming listed in Table 1 where Team_# corresponds to the assigned team number for each team and v# is a unique revision number for the review package that can be used to track revisions. For example, a submission for Team number 1021 of version 2 of the PDR package would be named **Cansat2012_Team_101_PDR_v02.pdf**. Note that adherence to the file name and format

specification is scored during the competition.

All reviews shall be completed within 2 weeks after the “Material Due” dates in Table 1. Teams shall submit to their mentors, a list of 3 date and time choices for each review by the due dates listed in Table 1. These dates and times should provide different opportunities for judges to be scheduled and to avoid conflicts with other reviews – e.g. the date/times should not be 3 different 1-hour slots on the same day that would not provide opportunities to get different judges. Teams will be notified of the final date and time for the review, along with information about the telecon. Reviews not completed within the 2 week time frame risk loss of points for the reviews. Reviews not completed due to competition, mentor, or judge conflicts shall not be penalized.

Teams are encouraged to submit and complete reviews prior to the dates listed if they are prepared to do so.

Table 1: Deliverable item due dates

Deliverable

Material Due	Required Filename Format	Due Date
PDR	Cansat2014_Team_#_PDR_v#.pdf	02/01/14
CDR	Cansat2014_Team_#_CDR_v#.pdf	03/29/14
Launch	NA	06/08/14
PFR	Cansat2014_Team_#_PFR_v#.pdf	06/09/14

At the end of the competition, the PDR, CDR, and PFR packages may be placed on the website for reference in subsequent years.

Post Flight Review packages shall be submitted to the designated competition representative via thumb-drive (not provided by the competition). All presentations shall be submitted at the start of the assigned presentation sessions.

5.5 Slide Format Guidelines

The following guidelines shall be used when developing the presentation material:

- Use the template made available. Failure to do so will result in loss of points.
- All slides shall have simple white backgrounds. This helps reduce the file sizes and makes the slides easier to read.
- All slides shall have pages numbers in the footer. This is to allow for easier referencing of material during the reviews.
- All slides shall list the presenters name in the footer. This provides all the reviewers

with an identity as to who is presenting the material.

- No embedded files or movies shall be included in the presentations. Not all reviewers will be able to access or view movies during the reviews due to network security settings at the various organizations involved.
- Each line-item in the review outlines shall correspond to a dedicated slide. This may result in slides with single bullets on them, however, this makes it easier for the reviewers to follow the presentation.

6. Flight Operations

6.1 Schedule

All times are referenced to central daylight time.

The competition starts Friday at noon and ends Sunday evening.

Flight readiness review and safety inspection and preflight briefing will occur on Friday. The preflight briefing starts 7:30pm.

Saturday will be the launch day unless weather causes a postponement.

Sunday will be post flight presentations.

A detailed schedule will be provided at a later date. Be available Friday at noon until Sunday 6:00pm.

6.2 Flight Readiness Review and Safety Inspection

Starting at noon, teams are required to have their CanSats inspected for flight worthiness. Each team will be assigned a one half hour time slot to present their CanSat.

All teams shall demonstrate proper operations of their CanSat and ground control station. Each team must demonstrate the capability to transmit commands, obtain and transmit telemetry, and display descent telemetry data to meet base mission requirements. Part of this demonstration ensures that the communications subsystem is properly configured to prevent interference between teams during launch operations.

CanSats will be inspected for safety. The structure will be reviewed and determined if it is flight worthy. The mounting of the electronics and sensors will be reviewed. Mechanisms will be reviewed. Hazards will be identified such as heating elements exposed to the outside, etc.

If any CanSat is determined to not be flight ready, the team has until their flight the next day to make repairs and modifications. This is done to make sure your CanSat is completed before coming to the competition and for the safety of all people on the field.

Safety is highest priority. Any CanSat deemed not flight worthy will not be flown. The team will lose all flight day points.

Crew assignments must be submitted at the flight readiness review in the Mission Operations Manual. The mission control officer will be given an identification so the flight coordinator and launch control officer knows who is the mission control officer.

The missions operations manual will be reviewed at the flight readiness review.

6.3 Team Member Launch Operations Crew Assignments

Crew assignments must be submitted at the flight readiness review. The mission control officer will be given an identification so the flight coordinator and launch control officer knows who is the mission control officer.

The missions operations manual will be reviewed at the flight readiness review.
Team Member Launch Operations Crew Assignments

In order to have a successful launch, teams need to coordinate among themselves and with the flight coordinator. Team members need to be assigned to specific tasks and develop a check list for a successful flight. The following task assignments must be delegated:

Mission Control Officer - This is a single person who is responsible for informing the FLight Coordinator know when the team and their CanSat is ready to be launched.

Ground Station Crew - This is one or more persons who is responsible for monitoring the ground station for telemetry reception and issuing commands to the CanSat.

Recovery Crew - This is one or more persons responsible for tracking the CanSat and going out into the field for recovery and interacting with the field judges. This crew is responsible for making sure all field scores are filled in or loss of points will occur.

CanSat Crew - This is one or more persons responsible for preparing the CanSat ,integrating it into the rocket, and verifying its status.

Team members can take on multiple roles except for the Mission Control Officer. The Mission Control Officer should be coordinating all efforts and interacting with the flight coordinator as needed. It is highly recommended that a check list be developed that steps the crews through the preparation, integration, and flight operations.

Crew assignments must be submitted at the flight readiness review.

6.4 Mission Operations Manual

Each team is required to assemble a mission operations manual. The mission operations manual includes three check lists/operations procedures to be created by the team. The checklists are for configuring the ground station, preparing the CanSat, and integrating the CanSat into the rocket. The launch preparation procedures, launch procedure, and removal procedure are provided and additional steps can be added by the team. The document is available for download and modification. Each section of the mission operations manual must start on its own page. Pages should be numbered and a table of contents to be included.

The team must make at least two copies of the procedures and assembled into three ring binders. One binder will be given to the flight coordinator on launch day.

6.5 Launch Schedule

The launch will start at 1pm. All CanSats are to be submitted at noon. The time period of 8am to 12pm is available for launch preparations, check in, and obtaining the payload egg. This is the time to set up antennas, ground stations, and final CanSat tests and preparations.

The launch will start at 1pm and will be done in groups of five. Each team will be assigned a round which will be scheduled in 1 half hour increments. Be prepared to load rockets toward the end of the previous round.

6.6 Competition Operations and Sequence of Events

Details of flight day operations shall be provided at the Pre-Flight Brief. An overview of the flight day operations include the following activities:

1. Arrive at launch site
2. Check-in with flight line judge. The flight line judge will perform the following tasks:
 1. Perform weight check of completed CanSat.
 2. Perform fit-check of the CanSat using a sample payload section
 3. Perform antenna mast height check
3. Prep and test CanSat for flight.
4. Upon the team round, the team will collect their CanSat and load into a rocket.
5. Flight coordinator will take the team and rocket to launch pad to prepare for flight. At this time, pictures for the competition and team may be taken.
6. The team ground station crew shall check in with a line judge who will witness the command to initiate telemetry transmission which will be displayed on the team ground station computer.
7. The team mission control officer shall confirm with the ground station crew that telemetry reception has been confirmed by line judge before continuing with launch operations.
8. The Mission Control Officer will stand at the launch control table and execute the launch procedures with the flight coordinator.
9. Following separation from rocket, team should monitor telemetry during descent.
10. Once all launches have occurred for the hour, the down range will be opened for access to the recovery crew.
11. The recovery crew will locate a field judge out in the field and provide the field judge with the score card.
12. The field judge will score all flight and landing requirements then give permission for the team to recover their CanSat parts.
13. The ground system crew will deliver the telemetry data file to a line judge for inspection.

Teams shall not touch the CanSat until the field judge verifies all necessary scoring information.

Appendix A Field Safety Rules

1. Consumption of alcohol while rockets are being launched is not allowed.
2. Smoking is only allowed at designated areas. If any one is caught smoking where it is not allowed, the land owner can throw you off the field.
3. Do no catch rockets or CanSats out of the air.
4. Stay behind the designated range line unless the range safety officer (RSO) or launch control officer (LCO) or flight coordinator has given permission to put your rocket on a pad.
5. Pay attention at all times. Every launch is potentially hazardous.
6. If a “heads up” launch is announced, you must be standing and facing the launch pad.
7. Do not retrieve a rocket from the range unless the LCO had given you permission.
8. Everyone must be alert when a “heads up!” is called and be ready to move.
9. Do not litter. Do not throw trash on the ground anywhere on the field. We have been invited to use the land owner's field and should treat it with respect. Any team caught throwing trash on the ground anywhere will be disqualified from the competition and the school will be notified of the disqualification. The land owner can order the team to leave the property and enforce the order.

Appendix B Presentation Recommendations

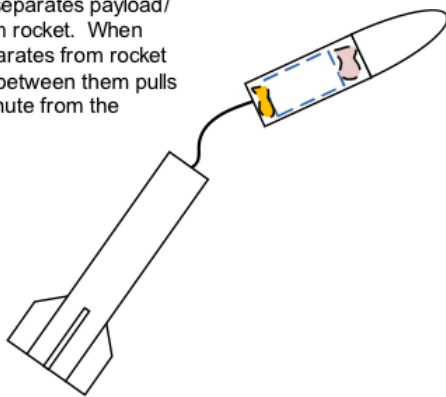
The following recommendations for presentation content and layout are being provided based on past experiences of the judges. These recommendations are not required to be followed but make it easier for the judges to review the material presented.

1. Use a consistent table format throughout the various subsystems when presenting requirements, component trades, and changes since previous reviews. Using a standard table format makes it easier for the judges to find the information in the table quickly since all tables are formatted the same.
2. During the CDR, the Changes Since PDR slides should use a table that contains a discussion of what the state of the design was at PDR, what it is at CDR, and what the rationale of the change was. Details of the change can be discussed in subsequent slides so an in-depth discussion is not always necessary.
3. Include the class year (freshman, sophomore, etc.) and major of each team member for reference. This doesn't play into the scoring of the team, however, it is often nice for the reviewer to know the status of the team members.
4. Be sure to follow the PDR and CDR outlines very carefully. Provide at least one chart for each scored item in the outline; this makes it easier for the judges to follow the presentation and confirm the required information is provided. In the presentation, be sure to address the questions and topics listed in the "description" column of the presentation outline -- those are the key points the judges are looking for.
5. Be clear which optional requirements, if any, are to be included in the design.
6. Be detailed in test descriptions. Identify specific tests, what is going to be done, and the pass/fail criteria.

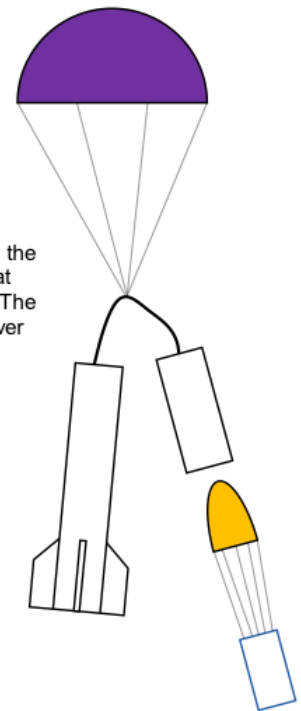
Appendix C Payload Deployment Description

The figure illustrates a typical launch and separation sequence. Due to this nominal deployment sequence, it is recommended that CanSat be integrated with the payload section “upside down” such that the folded CanSat parachute rests on the payload section bulk plate. The CanSat then rests on the parachute and the folded nose cone parachute rests on the CanSat. Once the ejection charge burn is completed, the payload section and nose cone separate from the rocket and tip over. The nose cone slides out of the top of the payload section and the CanSat then falls out of the payload section due to gravity.

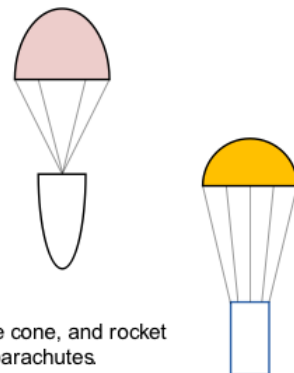
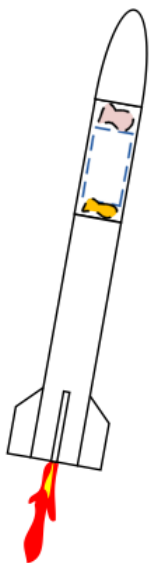
Ejection charge separates payload/nose section from rocket. When front section separates from rocket the shock chord between them pulls the rocket parachute from the rocket.



When the front section tips over, the nose cone falls off and the cansat falls out of the payload section. The cansat parachute now inflates over the cansat.



Cansat rests on its parachute. The nose cone parachute rests on the bottom of the cansat.



The cansat, nose cone, and rocket descend under parachutes.

Appendix D Acronyms

A	Analysis
CDR	Critical Design Review
CONOP	Concept of Operations
D	Demonstration
DCS	Descent Control System
GCS	Ground Control Station
HW	Hardware
HWR	Hardware Review
I	Inspection
LCO	Launch Control Officer
PDR	Preliminary Design Review
PFB	Pre Flight Briefing
PFR	Post Flight Review
RSO	Range Safety Officer
SOE	Sequence of Events
T	Test
TBD	To Be Determined
TBR	To Be Resolved
VM	Verification method

Appendix E Definitions

<i>Analysis</i>	Verification method that utilizes evaluation of data generated by accepted analytical techniques or simulations under defined conditions to show the item will meet the specified requirements.
<i>CDR</i>	A multi-disciplined technical review to ensure that the system under review can proceed into system fabrication, demonstration, and test; and can meet the stated performance requirements within cost (program budget), schedule (program schedule), risk, and other system constraints.
<i>CONOP</i>	Describes what the system will do and the way the system works from the operator's perspective. The CONOP is a high level description that should include a top-level block diagram.
<i>Demonstration</i>	Verification method that utilizes a qualitative exhibition of functional performance, usually accomplished with no or minimal instrumentation.
<i>Inspection</i>	Verification method that utilizes an examination of the item against applicable documentation to confirm compliance with requirements.
<i>Need Date</i>	Latest date a component or element (software, etc.) must be received or completed in order to not impact the end completion date.
<i>PDR</i>	A multi-disciplined technical review to ensure that the system under review can proceed into detailed design, and can meet the stated performance requirements within cost (program budget), schedule (program schedule), risk, and other system constraints.
<i>Shall</i>	Verb used to indicate a requirement is binding. All shall statements require verification.
<i>Should</i>	Verb used to define a goal or non-mandatory provision.
<i>Test</i>	Verification method utilizing operation of all or part of the item under controlled conditions, either real or simulated, to determine that the quantitative design or performance requirements have been met.
<i>To Be Determined</i>	An item or parameter that has not been specified at the time of document release.
<i>To Be Resolved</i>	An item or parameter that is preliminary or uncertain at the time of document release and for which a final value is to be specified at a later time.
<i>Validation</i>	Confirms that the system, as built (or as it will be built), satisfies the user's needs. Confirmation you built the right thing.
<i>Verification</i>	Confirms that the system, its elements, its interfaces, and incremental work products satisfy their requirements. Confirmation you built the system right.

Will

Verb used to reference a binding or hard requirement elsewhere in the document text.