RockSat-C
Payload Canister
User’s Guide

The Next Step In Low Cost
Student Access To Space

Colorado Space Grant Consortium
Discovery Learning Center Room 270
520 UCB
Boulder, Colorado 80309-0520

Wallops Flight Facility
Wallop Island, Virginia
0.0 APPROVALS AND TRACKING

0.1. Signatures

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COSGC Boulder Director

Concurrence: _______________________________ 10-10-2012
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Sounding Rockets Program Office
# 0.2. Revisions

<table>
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<tr>
<th>Revision</th>
<th>Description</th>
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<tr>
<td>DRAFT</td>
<td>Initial release</td>
<td>7/31/2009</td>
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<tr>
<td>1</td>
<td>Power section updated to reflect command line and RockOn requirements. References to Shawn Carroll and 2010 dates highlighted or changed to reflect changes for 2011.</td>
<td>7/1/2010</td>
<td>SMC</td>
</tr>
<tr>
<td>2</td>
<td>Updated for 2010-2011 program, including dates, electrical requirements, images, appendices, and addition of Visual Inspection Procedure</td>
<td>8/3/2010</td>
<td>EML</td>
</tr>
<tr>
<td>3</td>
<td>Updates for the 2011-2012 program: dates, clarification on electrical systems, updating the Visual Inspection Procedure, addition of dimensions of optical port, rocket skin thickness</td>
<td>8/8/2011</td>
<td>EML</td>
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<tr>
<td>4</td>
<td>Updates for the 2012-2013 program: dates, clarification on U.S. Person restrictions, Export Control, and ITAR language, details on required plumbing for atmospheric ports and various other minor updates.</td>
<td>10/10/12</td>
<td>EML</td>
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1.0 INTRODUCTION

1.1. RockSat Program
RockSat-C is a follow-up program to the RockOn Workshop, where customers design their own sounding rocket payload and compete for a spot on the launch vehicle. The RockOn Workshop teaches participants how to build a sounding rocket payload in three days. The goal is that participants will take what they learn during the workshop and return the next year with an original payload to fly with RockSat-C or RockSat-X programs. The RockSat-C program is designed to provide students with access to low-cost flight opportunities and further develop their engineering skills. The RockSat-C flight is made possible through significant cost sharing provided by Wallops Flight Facility (WFF) and the launch fees paid by RockSat-C teams. A portion of the RockSat-C launch fees are invested back into the RockOn Workshop. RockSat-C and the RockOn Workshop canisters fly on the same rocket each year. The program uses a modular canister system to allow for simple integration to the WFF Sub-SEM ring assembly. This standardized approach simplifies final integration and allows for more focus on the design of the payload. The organizers of the RockSat-C program guide the RockSat-C customers through the design process in the fall with multiple design reviews, leading projects to a Critical Design Review level design in December. Based on available space in the rocket, the most developed and capable projects are selected for flight in January. These projects then make their first payment and begin building. The projects continue to have subsystem and system testing reviews with the RockSat-C program manager through May. Any special requirements that arise for payloads are communicated to WFF through the RockSat program manager. The program culminates in June when the teams travel to WFF in Virginia for inspection, integration to the rocket, launch and recovery.

1.2. Participant Eligibility and Responsibility
The intent of the RockSat-C program is to provide hands-on experiences to students and faculty advisors to better equip them for supporting the future technical workforce needs of the United States and/or helping those students and faculty advisors become principle investigators on future NASA science missions. Therefore, RockSat-C is limited to U.S. educational institutions; only payloads from U.S. educational institutions are eligible to participate in the RockSat-C program. For the purpose of the RockSat-C, ‘educational institution’ is defined broadly and includes, but is not limited to, the following: universities, colleges, technical schools, public and private high school, middle school and grade school, science museums, etc. Organizations, which are not included in the above listing, are encouraged to contact Colorado Space Grant Consortium (COSGC) to clarify their eligibility in the program. In addition, U.S. entities (e.g. industry, research institutions, etc.) that fall outside of the eligibility conditions listed above, but who are interested in participating in the program, are encouraged to team with
Participation in the RockSat-C program includes teleconferences with WFF employees and contractors as well as all integration, testing, launch, and recovery operations take place at WFF. Normal access to WFF facilities and personnel is limited to U.S. persons only. Therefore, individuals participating in the RockSat-X program must be a U.S. Person. U.S. federal law defines a U.S. Person as: a citizen of the United States, an alien lawfully admitted for permanent residence, or a corporation that is incorporated in the U.S. (22 CFR 120.14, 15 – and by 8 U.S.C. 1101(a)(20)).

Additionally, participants in the RockSat-C program shall comply with export regulations in regards to disclosures of technical data. All participants warrant and represent that they will limit disclosure of any technical data contained in, made available, or generated in the performance of their participation in the RockSat-C program in accordance with export restrictions imposed by the U.S. Export Administration Regulations, 15 C.F.R. Parts 768 et seq. and the International Traffic in Arms Regulation, 22 C.F. R. Part 120 et seq. This applies to all parties involved (such as an industrial partners to an educational institution).

1.3. Purpose

The purpose of this document is to identify the interfaces, requirements and logistics pertaining to the University of Colorado at Boulder (CU-Boulder) Colorado Space Grant Consortium’s (COSGC) RockSat Payload Canister Program. This document also establishes the guidelines and requirements for qualifying a payload for selection to be flown in June, along with the review and integration schedule. Payloads shall be student based with faculty and/or industry involvement only. The RockSat-C flight opportunity is not available to payloads that are profit-related endeavors and/or industry research and development. Students must be actively engaged and involved.

1.4. Getting Involved (Intent to Fly Form—IFF)

Interested institutions will need to submit an Intent to Fly Form (IFF) no later than September 17, 2012 at 5:00 PM MDT. No later than October 17, 2012, each initially selected institution will make a $1,000 earnest deposit. This deposit is fully refundable until the customer has been down selected as a finalist in the month of January. Further details on the selection process can be found in Section 8.

1.5. Canister Space

Customers have a choice of whether to use an entire canister or use part of canister. Those that wish to share a RockSat-C Payload Canister shall indicate this on the submitted Intent to Fly Form (IFF). In the event that a sharing customer does not specify the fraction of the canister’s volume and allowed mass required, COSGC will assume that the customer needs one-half of the usable...
space and one-half of the allowed mass. Customers may use as much as an entire can, half of a can, or as little as one third of a can as long as their payloads still meet the weight and center of gravity requirements.

Customers are encouraged to collaborate and pair prior to the submittal of the Intent to Fly Form. In the event that shared customers cannot fill a canister, COSGC will pair the remaining customers to fill each canister. Final customer pairings shall be released with initial selections. It is each customer’s responsibility to review the list and request changes in pairing assignments within two weeks of being initially selected, if desired.

Two weeks after initial selections, all pairings, mass allotments, and volume allotments are final and cannot be changed without written consent of COSGC. In the event that a subset of customers would like to redistribute allotments, all customers of the subset must contact COSGC, and changes will only be made with written approval of all parties involved and COSGC. Cost sharing is covered in Section 1.6.

Customers that share a canister are responsible for interfacing to each other. It is required that all sharing customers assigned to a canister collaborate and create specific interfacing slides for all design reviews. Interfacing across state lines can be extremely challenging but is a realistic challenge that many aerospace projects must overcome.

1.6. Cost

The cost of the RockSat-C flight opportunity is contingent upon the fraction of the canister being utilized. This cost covers the following expenses: launch costs, one (1) RockSat-C payload canister, mission management support, and other amenities supplied during the week of launch.

During the week of launch, the cost will also provide the following amenities for four team members: lunch on the first Friday integration, tentatively June 14th, breakfast and lunch on the following Monday through Wednesday (17th-19th), a hot breakfast the day of launch, tentatively June 20th, lunch on launch day, and a final celebration dinner on the evening of launch. Additionally, each of the four members will receive a RockSat-C t-shirt. The cost will NOT cover travel to and from Wallops Flight Facility, lodging, or other expenses incurred. In the event that a team would like to bring more than four team members, additional meals and t-shirts can be purchased in advance. Additional details will be provided closer to launch for those wishing to send more than four participants. Please notify Emily or Chris as soon as possible if extra shirts and/or meals are required.
A table summarizing the cost of participation in the RockSat-C program is shown in Table 1. *These costs include the earnest deposit of $1,000*.

<table>
<thead>
<tr>
<th>Canister Costs</th>
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<tbody>
<tr>
<td><strong>Fraction</strong></td>
</tr>
<tr>
<td>Whole</td>
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<tr>
<td>1/2</td>
</tr>
</tbody>
</table>

1.6.1. Dedicated Customers

A dedicated customer is an institution whose payload will occupy an entire canister. If a dedicated customer’s payload is chosen to fly at final down select (January), he/she will then make two additional equal payments of $5,500 on 02/18/2013 and 04/08/2013. *After receipt of the first installment of $5,500, each customer will be sent one RockSat-C payload canister contingent upon machining completion, and all deposits/payments shall become non-refundable.* All payments must be made in the form of a check made payable to: University of Colorado. Payments should be sent to:

Colorado Space Grant Consortium  
Discovery Learning Center Room 270  
520 UCB  
Boulder, Colorado 80309-0520

1.6.2. Share Customers

A share customer is an institution whose payload will occupy only a fraction of a canister. Share customers only have the option to occupy one-half of a canister; no other fractions will be allowed due to the added complexity of pairing. The assigned fraction sets the maximum volume and mass that the shared customer can occupy from the available mass and volume. How each shared customer occupies his/her territory is the business of the sharing customers in the specific canister. Table 1 summarizes the total cost for each shared customer payload.

At the time that earnest deposits are due, all share customers shall still pay the earnest deposit of $1,000 made payable in the same method as described in Section 1.6.1. *After receipt of the first installment (February), all deposits shall become non-refundable.* In the event that a subset of sharing customers is chosen at final down select, the remaining cost to each customer in the canister will be broken into two equal payments. These payments will be made on the dates indicated in the schedule (02/18/13 and 04/08/13) (see Section 9.0). The RockSat-C payload canister for a sharing subset will be given to the customers on the night of arrival in Virginia for fit checks.
1.7. Points of Contact

Program points of contact (POC’s) are as follows:

| Colorado Space Grant Director | Chris Koehler  
<table>
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<tr>
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<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>303-492-4750</td>
</tr>
</tbody>
</table>
| Colorado Space Grant RockSat-C  
| Student Program Manager       | Emily Logan  
|                               | 720-341-3552             | rocksatprogram@gmail.com |

1.8. Applicable Documents and Links

- Colorado Space Grant Consortium RockSat website:  
- Colorado Space Grant Consortium RockOn Workshop website:  
  [http://spacegrant.colorado.edu/rockon/](http://spacegrant.colorado.edu/rockon/)
- NASA Wallops Flight Facility:  
  [http://www.nasa.gov/centers/wallops/home/index.html](http://www.nasa.gov/centers/wallops/home/index.html)

2.0 ROCKSAT OVERVIEW

The RockSat payload canister is a modular system of canisters designed for suborbital flights with Wallops Flight Facility’s (WFF) Sub-SEM ring assembly (Figures 4 and 5). Images and solid models are also given below in Figures 1-3, 6, and Appendix A. The objective of the RockSat-C payload canister is to give customers a design envelope to build around that will allow easy integration to any WFF rocket using the Sub-SEM ring assembly. This standardized approach provides customers low-cost access to space. The RockSat-C payload canister was successfully tested in June of 2008 through the RockOn Workshop when five RockSat-C payload canisters carried payloads to an altitude of greater than 40 miles on WFF’s improved Orion rocket.

The second iteration of the RockOn Workshop took place June 21-26, 2009. The first iteration of RockSat-C flew with the workshop on June 26, 2009 when four customer cans carrying ten experiments soared to an altitude of greater than 72 miles (117 km) on Wallops Flight Facility Terrier-Improved Orion rocket.

The third RockOn Workshop was held June 19-24, 2010, and the second set of RockSat-C experiments was launched on June 24, 2010. Five customer cans...
containing experiments from ten universities reached an altitude of 72.7 miles (117 km) on a WFF Terrier-Improved Orion rocket.

RockOn 2011, held June 18\textsuperscript{th}-23\textsuperscript{rd} 2011, had teams from multiple universities for a total of 27 participants. The RockSat-C 2011 program had nine teams from 8 schools to fill a total of seven canisters on the Terrier-Improved Orion launch vehicle. A total of 45 students and faculty mentors came to Virginia to support their payload’s launch. The flight reached 74.3 miles (119.6 km) and was once again successfully recovered.

In 2012, RockOn and RockSat-C had close to 100 participants, with 43 participants attending the workshop. Ten university teams attended to support their RockSat-C payloads. The workshop was held June 16\textsuperscript{th}-21\textsuperscript{st}, with another successful launch carrying the payloads to over 100 km. This year was also the first year in which RockOn Workshop payloads were combined in a canister with a RockSat-C university payload. This collaboration was very successful. In the event that a selected RockSat-C payload canister cannot fly on launch day, there shall be back up mass simulators present and ready to fill the vacant spot.
2.1. **RockSat Payload Canister Images**

**Figure 1: RockSat Payload Canister**

**Figure 2: RockSat Payload Canister**

**Figure 3: RockSat Payload Canister**

**Makrolon plates visible in the picture and SolidWorks model are part of the RockOn workshop and are not required or included.**

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3.0 **ROCKET DESCRIPTION AND CAPABILITIES**

This section covers key interfacing and launch vehicle capabilities that customers should be aware of for the design of his/her payload.

3.1. **RockSat Payload Canister Interface General Description**

Each RockSat payload canister will be attached to the Sub-SEM ring assembly in a stacked configuration (Figure 4). The Sub-SEM rings are further attached to longerons that span the entire length of the experiment section (Figures 4 and 5). With 9 RockSat canisters flying (3 RockOn, 6 RockSat-C customers), the
RockSat Payload Wallops Check-In Procedure

Terrier-Orion is estimated to reach an altitude of approximately 68-72 miles (110-120 km).

The selected RockSat-C payload canisters will be flying with three (3) other RockSat payload canisters that will contain payloads of RockOn 2013 workshop participants. The RockSat-C payload canisters shall use the five (5) top bulkhead bolts and five (5) bottom bulkhead bolts to secure the payload to both the canister lid and base. Further details on these bolts and dimensions are discussed in Section 5.2.

In addition to meeting the bolt interface requirements, each payload shall conform to the activation requirements set forth in Section 5.2.2. A compliance test shall be performed before integration. **Payloads that do not meet these requirements shall be removed from the flight.** The payload activation system shall be designed such that the wires pass through the designated wire-way. Further details on the dimensions and location of the wire-way can be viewed in Section 5.1.5 and Appendix A.

The RockSat payload canister is cylindrical in shape. The useable payload space has diameter of approximately 9.3 inches and an approximate height of 9.5 inches; see Figure 6 and mechanical drawings in Appendix A for exact dimensions. Each RockSat payload canister weighs approximately 7.2 pounds without the caphead screws. The total weight of the integrated RockSat-C payload canister, complete with customer hardware, shall be 20±0.2 lbf. No modifications shall be made to the RockSat payload canister. **Violation of this rule will result in the customer being removed from the flight.**
3.1.1. Modular Structure, Sub-SEM, and Payload Space Images

Figure 5: Modular Stacked Assembly

Figure 5: Longerons and Sub-SEM Ring

RBF connections to Terrier-Orion shorting plug run down the side of the cans and through the inner diameter of the sub-SEM ring assembly

Figure 6: RockSat Payload Canister Volume Constraints

Diameter: 9.3 inches

Height: 9.5 inches
3.2. Rocket Key Performance Parameters

Table 2: Key Performance Parameters

<table>
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<th>Value</th>
<th>Notes</th>
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<td>Apogee (miles)</td>
<td>≈72 miles</td>
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</tr>
<tr>
<td>Spin Rate (Hz)</td>
<td>≈1.3 Hz at Terrier burn out; ≈5.6 Hz at Orion burn out</td>
<td>1,2</td>
</tr>
<tr>
<td>Maximum Ascent G-Load</td>
<td>25 G</td>
<td>1,2</td>
</tr>
<tr>
<td>Rocket Sequence (Burn Timing)</td>
<td>5.2 s Terrier burn—9.8 s coast—25.4 s Orion burn</td>
<td>1,2</td>
</tr>
<tr>
<td>Chute Deploy (seconds)</td>
<td>489.2 s</td>
<td>1,2</td>
</tr>
<tr>
<td>Splash Down (seconds)</td>
<td>933 s</td>
<td>1,2</td>
</tr>
</tbody>
</table>

Notes:

1. All parameters are subject to change, but all customers will be notified of any changes.
2. Data from 2009 Terrier Improved Orion launch.

3.3. Flight Environment Conditions

The biggest environmental factor to consider for WFF flights will be G-loading. During the 2008 RockOn workshop, participants recorded sustained G-loads of approximately 25 Gs during ascent on the improved Orion rocket. Payloads shall be designed to withstand 25 Gs of quasi-static loading in all three axes with possible impulses of approximately 50 Gs in the Z (longitudinal) axis. Three-axis vibration testing will be conducted by WFF before flight. **Payloads that do not pass the vibration test will be removed from the flight at WFF’s discretion.**

Temperatures in the experiment section began at ambient (72° F for RockOn 2008), and climbed to a maximum of 90° F during the ascent of the improved Orion.

In most orbital and suborbital flights, outgassing is an important consideration. Wallops Flight Facility pressurizes its experiment sections with oxygen-less air, so this should not be an issue. In the event that the seal is lost, it is best to use low outgassing materials in payload design. Outgassing properties for most materials can be found at: [http://outgassing.nasa.gov/](http://outgassing.nasa.gov/).

3.4. Disclaimer

Recovery of payloads is not guaranteed. As with any flight, there are possible anomalies that can occur during the flight or recovery that can severely damage
or destroy flight hardware. All selected teams should consider this and understand that space flight involves risks that neither COSGC nor WFF can plan for. Selected payloads assume all risks, and neither of the said institutions shall be held responsible in event of an anomaly and/or unrecoverable payload.

4.0 ORGANIZATIONAL RESPONSIBILITIES

4.1 Hardware and Interface Responsibilities
Component and functional design responsibilities are listed below.

RockSat-C Payload Customer
- Payload experiment and support system
  - Support system includes:
    - Power to operate payload
    - Data storage
    - Thermal system (if desired)
    - Internal structure to RockSat payload canister
    - All environmental sensors (if desired)
    - Activation system at launch (in accordance with Section 5.2.2.)
- Mechanical interface to the ten (10) bulk head screws outlined in Section 5.2.1.
- Safety features for experiment-related hazards
- Activation wires of at least 4 feet exiting the canister for each payload
- All required ground side data analysis equipment (computers not provided)
- Required interfacing between sharing customers

COSGC and WFF
- Terrier-Orion rocket, range safety, launch support, recovery and tracking
- One (1) RockSat payload canister
- Ten (10) 8-32 Black Oxide Alloy Steel Socket Head Cap Screws (to bulk heads)
- Pressure and vibration testing and integration onto rocket

4.2 Ground Control
After the RockSat-C payload canisters have been integrated onto the sub-SEM ring assembly three days prior to launch, the customer will have very limited access to the payload, if any. WFF will handle all activities pertaining to payload preparation, launch, and recovery. Customers will not have access to the payload after integration until the rocket has been recovered and the payload section is de-integrated.
5.0 PAYLOAD DESIGN REQUIREMENTS

5.1 Payload Physical Envelope, Mass, and Center of Gravity Requirements

The following subsections outline the physical requirements and constraints of the RockSat-C payload canister.

5.1.1. Constraints on Payload Types

The purpose or mission of a payload is open to the customer. The customer shall design a payload that by all standards (engineering and laymen) would be considered safe and practical. Experiments shall not put other payloads, WFF employees, COSGC employees, or the launch vehicle at risk. All payloads shall be formally selected before the customer can become a contender for flight. This approval will come with signatures on the Intent to Fly Form (IFF) that shall be submitted no later than September 17, 2012 at 5:00 PM MDT. The RockSat-C payload canister can be sub-divided between other customers to share space and costs. If two customers choose to share payload space, this should be documented on the IFF.

5.1.2. Physical Envelope

All payloads must be contained within the RockSat-C payload canister. The canister is cylindrical in shape with a diameter of 9.3 inches and a height of 9.5 inches. The payload may occupy as much or as little of this space as desired. Mechanical drawings of the RockSat payload canister are contained in Appendix A.

5.1.3. Mass Properties

The entire RockSat payload canister and payload shall weigh 20±0.2 lbf (9.07 kg). RockSat-C payload canister will be weighed prior to integration. Cans not conforming to the weight constraints will be removed from the flight.

5.1.4. Center of Gravity

All payloads shall be designed to have a center of gravity (CG) that lies within a 1 x 1 x 1 inch envelope of the geometric centroid of the integrated RockSat-C payload canister. To ensure stable flight, WFF may require a moment of inertia (MOI) test prior launch. This test will confirm that the CG of the payload and RockSat payload canister lie within the one inch cube envelope discussed above. Payloads that do not meet WFF’s CG requirements will be removed from the flight.

5.1.5. Payload Access Openings and Wire-Way

The RockSat-C payload canister has two (2) payload access openings that are separated by 180 degrees. These openings have approximate dimensions of 3.5 inches wide by 4.5 inches tall. The wire-way is offset 90 degrees from these
windows. The wire-way consists of a notch on the bottom and top bulkheads that allow the Remove Before Flight (RBF) and other necessary wires to pass down the payload section. In addition to the notches, the RockSat-C payload canister skin has a cut-away for running wires. Mechanical drawings of the locations and dimensions of the windows and wire-way can be found in Appendix A.

COSGC and WFF require that each RockSat payload canister pass down one (1) set of two (2) wires that WFF personnel will connect to the launch vehicle shorting plug and/or relay (see Section 5.2.2 for more information on electrical interfaces). Each experiment shall have one (1) set of RBF wires of no shorter than 4 feet. These wires will be trimmed and will have Winchester connectors added at WFF. There shall be no current passing through these wires until the payload is activated at launch. If other wires need to be passed to other payloads or to WFF, a formal variance request should be submitted to Chris Koehler and Emily Logan.

5.1.6. Optical and Atmospheric Ports

Unless indicated otherwise on the IFF, all payloads are assumed to be contained within the experiment section and will not have access to an optical or atmospheric access port. If a port is desired, this needs to be explicitly stated on the IFF. Not every payload can be granted access to these ports due to limitations of the rocket skin..

For the RockSat-C flight, the customer payload section will have access to two static pressure ports, two dynamic pressure ports, and four optical ports. As previously stated, not all payloads can be granted access to these ports, and any desired ports shall be indicated in the IFF. When choosing sharing partners, it should be noted that each of the four available canisters will be granted one optical port. The optical ports have a diameter of 1.5 inches and are made of quartz.

If a customer is granted access to an atmospheric port, he/she must provide the drop down tubing to interface to WFF. The customer end shall terminate with a male ¼” NPT connector. Tube lengths will be determined once placement in the payload section has been established. All customers shall use PFA tubing and tube fittings from Swagelok for all connections between port and payload. More details are included in Appendix B. In addition to providing the drop down tubing, customers using an atmospheric port shall also design in a redundant valve to close prior to splash down to ensure that no water will enter the payload section in the event of a WFF shut off valve failure. WFF valves are designed to open at 5,000 feet on ascent and close at 5,000 feet during ascent.

Port options for the June launch are TBD at this time.
5.1.7. Summary of Key Constraints

Table 3: Summary of Key Constraints

<table>
<thead>
<tr>
<th>Type</th>
<th>Quantitative Constraint</th>
</tr>
</thead>
<tbody>
<tr>
<td>Physical Envelope</td>
<td>Cylindrical:</td>
</tr>
<tr>
<td></td>
<td>Diameter: 9.3 inches</td>
</tr>
<tr>
<td></td>
<td>Height: 9.5 inches</td>
</tr>
<tr>
<td>Mass</td>
<td>Canister + Payload = 20±0.2 lbf</td>
</tr>
<tr>
<td>Center of Gravity</td>
<td>Lies within a 1x1x1 inch envelope of the RockSat payload canister’s geometric centroid.</td>
</tr>
<tr>
<td>Ports – optical or atmospheric</td>
<td>Customer shall provide drop down tubing for atmospheric plumbing. Plumbing must terminate with a male ¼” NPT connector. Additionally, the customer shall design in a redundant valve to protect the payload at splash down.</td>
</tr>
</tbody>
</table>

5.2. Payload Interfaces

The main interfaces the customer must consider to integrate to the launch vehicle are mechanical and electrical. The following sections discuss the requirements for each interface type.

5.2.1. Mechanical Interfaces

The payload shall be contained within the RockSat-C payload canister. The restrictions on volume, mass, and CG can be found above in Section 5.1. In addition to the above restrictions, each payload shall be designed such that its internal structure mounts to both the top and bottom bulkheads of the RockSat payload canister. The top and bottom bulkheads each have holes for five (5) 8-32 black oxide alloy steel socket head cap screws. This means that the customer’s payload must mount to ten (10) of the said bolts. This requirement will ensure that the top and bottom bulkheads are secured to the payload. These bolts can be ordered in various lengths and shall be provided by COSGC and WFF. This interface must be addressed in all design reviews.

No payload may alter or modify the RockSat-C payload canister in any way. The RockSat-C payload canister shall remain in the same state that it was issued in, and no part of the internal payload shall be mounted to any other part of the RockSat-C payload canister but the bulkheads as described above. RockSat-C canisters remain the property of COSGC and WFF after flight and recovery and must be returned to COSGC.
5.2.2. Electrical Interfaces

Each payload shall be electrically self-contained. No power will be provided by WFF or the launch vehicle. It is highly recommended that all payloads use rechargeable batteries, **rechargeable lithium ion batteries may not be recharged while payload is at WFF**. Other types of rechargeable batteries may be used and recharged at WFF, such as NiMH. Non-rechargeable lithium ions are allowed. It is recommended that all payloads get their batteries approved by COSGC before purchasing them.

In addition to providing power, the customer must ensure that the payload is **completely isolated from the canister**. Their payload electronics must not be shorted or connected to the canister in any way. More information about this requirement can be found in section 5.2.2.2.

5.2.2.1. Payload Activation

Payload activation can occur in multiple ways. There are a total of twelve activation connectors for the six RockSat-C canisters. The electrical system contains four (4) relays capable of providing connections for up to three (3) pairs of shorting wires. Each payload should strive to minimize the number of required activation lines and shall not exceed two (2). Payloads can choose how to activate, but for safety reasons all payloads must conform to either Requirement 1.SYS.1 or 1.SYS.2, whose parent is 0.SYS.1:

0.SYS.1 All payloads shall be designed such that Wallops will always know its status as active or inactive (current flowing/not flowing).

- **1.SYS.1** Payloads wishing to activate early shall be designed such that Wallops can activate and deactivate the payload or subsections of the payload via a single set of shorting wires.

- **1.SYS.2** Payloads wishing to activate at launch shall be designed with two opens in the system such that activation occurs if and only if Wallops has shorted the connection and the G switch has been depressed.

Typically, RockOn and RockSat-C payloads activate using the 1.SYS.2 configuration, with a g-switch. An example schematic is provided in the 1.SYS.2 section to demonstrate this activation scheme.

5.2.2.1.1. Requirement 1.SYS.1 – Early Activation

Requirement 0.SYS.1 is the parent requirement mandated by Wallops Flight Facility. Because each payload provides its own power, Wallops must be able to verify that current cannot flow anywhere in your payload during the arming procedure, which could result in prematurely igniting the rocket motor.

A payload designed to conform to 1.SYS.1 will activate/deactivate at Wallops’ command. This system is likened to a light switch, where Wallops can inhibit the
flow of current via a relay. *This type of activation shall not latch*, meaning that when power is turned on, it can still be turned off. WFF must have full control of activating and deactivating the payload. A pictorial representation of this activation scheme is given in Figure 7. This activation is the simpler of the two options, but is typically reserved for teams that require an early activation. The diagram shows that the wires presented as the open can be the wires directly connected to the power on the payload.

Be advised that this system will be checked by COSGC and WFF to ensure compliance. This means that the payload will be powered on and off during inspection. Be sure to design the system so that any data collection occurring will be able to either reset or that there is enough memory space to account for the power-on during inspections. Any sensors that activate or deploy upon payload power on will also need to be retracted/de-activated upon payload power-down.

**Each set of wires conforming to 1.SYS.1 shall not exceed a peak current of 750 mA**

![Figure 7: 1.SYS.1 Activation Diagram](image)

The advantage of 1.SYS.1 is that Wallops can activate these payloads up to 10 minutes prior to launch. Of the twelve activation lines available, four of the lines will be designated to activate with a 1.SYS.1 activation type. This means that the early activation times can be chosen and must be agreed upon by all RockSat-C customers. The circuit provided by the relays will remain closed during the duration of the flight and well after landing.

5.2.2.1.2. Requirement 1.SYS.2 – G-switch Activation

Requirement 1.SYS.2 is based off of the RockOn activation system. The system shall be constructed such that there are two “opens” in the activation system before the shorting wires are closed, a remove-before-flight (RBF) connection and a G-switch. Once WFF closes the RBF connection via a relay, this will leave only one open in the system, the mechanically activated G-switch. No current
shall flow through any portion of the payload until both opens have been closed at launch. The G-switch is internal to each payload and is not activated by WFF.

** Each set of wires conforming to 1.SYS.1 shall not exceed a peak current of 750 mA **

It is HIGHLY recommended that 1.SYS.2 payloads latch in a manner similar to the RockOn AVR board. Diagrams of an acceptable 1.SYS.2 activation system and the three key states are shown below.

![Figure 8: Initial State of RBF System (Safe)](image)

![Figure 9: RBF System After WFF Shorting Plug Added (Armed)](image)
Payloads utilizing an activation system conforming to 1.SYS.2 are proven and have worked well in previous missions. Unless the payload must activate early for calibration or other purposes, it is recommended that all payloads design to 1.SYS.2. Activation systems conforming to 1.SYS.2 will also be connected to one of the twelve available relays. Payloads correctly designed to meet 1.SYS.2 should have the ability to connect to an early activating relay in the event that there are not enough designated RBF lines. This will not change the operation of the activation, since the system shall not activate until the mechanical g-switch is activated. The following figure is the RockOn g-switch activation, and can be used as an example when designing the 1.SYS.2 activation.

![Activation Schematic with G-Switch Implementation (RockOn Workshop Design)]
Note that the RDY LED must be excluded in the final design, as this is solely and indicator, and will cause an unpermitted current draw when the payload is off. It can simply be removed from the circuit, leaving that wire open.

5.2.2.2. Can Shorts and Voltage Checks
To ensure the safety of Wallops personnel, the potential of payload ground and all shorting wires will be measured relative to the RockSat-C Canister. The potential between the canister and all shorting/ground wires shall be 0 V and source no current, or the customer will be removed from the flight at Wallops’ discretion. This DOES NOT mean the payload ground should be shorted to the canister to ensure 0V potential between them. The canister must be fully isolated from the payload. The customer must ensure that no power sources are shorted to the canister in any way (through heat-sinks, accidental battery shorts, etc.). The procedure used to check this requirement is fully explained in the Visual Inspection Procedure (Appendix D) and must be checked prior to arriving at Wallops to ensure compliance.

5.2.2.3. High Voltage Requirements
WFF pressurizes the experiment sections on the rocket, but in the event that the seal is broken, the payloads will experience near vacuum conditions at apogee. To mitigate risk, no high voltage experiments will be allowed without a formal variance request. This variance must be in written form and approved by Chris Koehler and Emily Logan.

5.2.3. Telemetry Tracking and Control
Wallops Flight Facility will not provide real-time telemetry. No payload shall transmit data of any kind. Communication systems are strictly prohibited; there will be no exceptions unless approval is sought and approved by Wallops before the Mission Initiation Conference (MIC).

All data should be stored on on-board memory. Using on-board memory alleviates the complexity of a communication system, and has been proven to be extremely effective for the RockOn workshop and other COSGC rocket payloads.

Post flight radar tracking of the rocket will be made available. In the event that radar skin tracking data is provided from Wallops Flight Facility, COSGC will provide the data to teams that request a copy.

5.3. Structural Design Requirements
Each payload will experience extreme and varying G-loads during the course of flight. Workshop participants from RockOn 2008 experienced up to 25 Gs in the positive Z (longitudinal) direction during ascent and experienced about +/- 10 Gs in the X and Y (lateral) axes. In the event of a parachute failure, there would be more extreme loading in all three axes.
5.3.1. Material Selection

When designing the structure for the payload, materials with high resistance to stress corrosion cracking (SCC) are recommended. Materials that have worked well in the past have been aluminum (6061), steel, and Makrolon. Makrolon is used for all RockOn Workshop payload decks and has worked well for other COSGC rocket payloads. Plastics or other petroleum based materials shall be used sparingly. In the event of a pressure loss, outgassing could fog optics or sensors on other RockSat-C payloads.

5.4. Lasers and Liquids

More information to come. Lasers will require possible training and completion of safety forms. Liquids will require accompanying MSDS sheets. All use of these items will be contingent upon Wallops approval.

5.5. Thermal Design Requirements

The customer is responsible for thermal control of his/her payload. Due to the short duration of the flight and the closed experiment section, thermal systems may not be required. The RockOn workshop of 2008 saw an increase in temperature of 18 degrees Fahrenheit during the flight. RockOn workshop payloads do not use thermal control, but the choice to use a thermal control system will be left to the customer.

5.6. Electrical Design Requirements

Payload electronics shall be designed to be safe and practical. Each payload is required to have a 1.SYS.1 or 1.SYS.2 activation system described in Section 5.2.2. It is highly recommended that a latching relay system be used with 1.SYS.2 where the shorting connection allows a mechanical G-switch to complete the circuit and activate the payload upon ascent.

Any payload that uses alternating current or circuitry with substantial switching (relays) shall notify COSGC as soon as possible during the design phase. Fast switching can induce magnetic interference that must be approved by WFF.

5.7. Electrical Harnessing and Staking

All payloads shall harness wires with a nylon lacing tape or the equivalent. Wire harnesses that are excessively long should be staked to the structure to mitigate the risk of disconnects during flight. It is also highly recommended that all connectors and IC sockets be tied and staked in place using aerospace grade Room Temperature Vulcanizing (RTV) sealant, or at minimum, hot glue. An example of a well-harnessed and staked payload can be seen below in Figure 11.
6.0 PAYLOAD HARDWARE INTEGRATION

The customer shall furnish a complete, functional, and fully integrated payload to COSGC and WFF on the day of visual inspections, tentatively June 13, 2013, that meets all of the requirements of this document. The customer’s payload shall pass pre-flight inspections by members of both COSGC and WFF to ensure compliance with the requirements of this document. A Launch Readiness Review (LRR) will be held two (2) weeks before launch via teleconference. Integrated payloads shall be delivered to WFF no later than six (6) days before launch (Friday, June 14th at 8:00 AM). Wallops Flight Facility may require Moment of Inertia and/or vibration testing prior to integration to the sub-SEM ring assembly. Final integration of the customer’s RockSat payload canister to the sub-SEM ring assembly will occur three days prior to launch. After the customer’s RockSat-C payload canister has been integrated to the sub-SEM ring assembly, there will be limited access to the payload.

7.0 PAYLOAD TEST REQUIREMENTS

Testing of the payload shall be performed by the customer to ensure payload functionality and survivability. All tests shall be documented and/or recorded for the testing reviews, whose dates are established in Section 9.

7.1. Structural Testing

The customer shall perform any testing that he/she sees fit to ensure that his/her payload will survive the launch environment. In addition to the testing completed by the customer, WFF will perform a three axes vibration test the week before launch.
7.2. Environmental Testing

It is not required but highly recommended that the customer run a full mission simulation in a vacuum chamber.

7.3. Day in the Life Testing (DITL)

The customer is required to run two (2) full mission simulations to demonstrate functionality of the payload. This test should consist of the payload being operated on the bench as an integrated payload for the entire mission life (less than 30 minutes). The results of these tests will be presented at the weekly teleconferences as indicated on the schedule.

7.4. Visual Inspection Testing

The customer is required to fully integrate the payload and perform a visual inspection using the same procedure as that being followed when the payload is checked at the Refuge Inn on June 13th, 2013. This test ensures that payloads interface with the canister correctly and that there are no shorts between the canister and the payload (requirement discussed in Section 5.2.2.2.). The procedure is included in Appendix D, and a completed and initialed copy must be sent to COSGC before June 6, 2013. This copy will be used at the Refuge Inn for the official inspection on Thursday, June 13th, 2013. Wallops Flight Facility has strict requirements and due to the tight schedule of events, payloads must be completely ready for inspection upon arrival at the facility. Having the payloads pre-checked allows for safer, quicker integration for both the vibe test and flight integration.

8.0 SELECTION PROCESS

Any educational institution wanting to fly shall submit the IFF either via email or by fax no later than September 17, 2012 at 5:00 PM MDT. The IFF will be emailed along with this document upon its release.

The IFFs will be reviewed, and initial selections will be made by September 24, 2012. Initially selected candidates will be chosen based on responses to the questions on the IFF. Institutions that submit an IFF will be expected to pay a refundable earnest deposit of $1,000 no later than October 17, 2012. All payments must be in the form of a check made payable to the University of Colorado (Section 1.6.1). At this point in the selection process, there will be more candidates than available positions. Over the next three months, candidates will refine their mission and complete three (3) design reviews. The first review is the Conceptual Design Review (CoDR), which will mature to a Preliminary Design Review (PDR), with a Critical Design Review (CDR) used as a final design review before down-selects for a spot on the June 2013 flight. In addition to these reviews, candidates will submit monthly, online progress reports. Each of these presentations and online progress reports will be reviewed and used to determine the flight worthiness of all initially selected candidates.
No later than January 18, 2013, COSGC and WFF will award flight opportunities to the six RockSat-C payload canisters that are the most mature and ready to continue in the engineering process. Up to two canisters of customers may be kept as reserve payloads, and will continue in the design process.

If an institution is NOT selected at final down select, their earnest deposit will be refunded in full. Those institutions that are awarded flights will continue to the next step of the engineering process. The six selected canisters and the reserve customer(s) will make the first non-refundable installment on February 18, 2013. *Once the initial payment is received, the customer’s space has been reserved and no refunds will be issued for any reason; this includes but is not limited to failing to complete the payload before launch or being removed from flight by either Wallops Flight Facility or COSGC.* The final non-refundable installment will be due April 8, 2013. For further details concerning the engineering/design process after final down select, please see the schedule in Section 9.

In the event that a customer cannot complete his/her payload or does not follow requirements set forth in this document, a reserve customer will become a primary customer, and the primary customer will not be refunded or compensated in any way. In the event that the six finalists all launch, the reserve customer(s) will be refunded the cost of flight, but will NOT be compensated for any hardware, travel, or miscellaneous expenses incurred in the engineering process.

### 9.0 SCHEDULE

The following table is a schedule with key deadlines and reviews that the customer should be aware of. Please note due dates for presentations and plan accordingly, because some fall on test weeks or times when other activities may be going on (especially Spring Break since schools tend to stagger that vacation). Being on time is a critical part of successful participation in the RockSat-C program. The RockSat-C website will have the most up-to-date schedule; the following schedule is subject to change. A breakdown of the events for the week preceding the launch is shown in Appendix C.

<table>
<thead>
<tr>
<th>Date</th>
<th>Event Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>9/4/2012</td>
<td>RockSat Payload User’s Guide Released</td>
</tr>
<tr>
<td>9/17/2012</td>
<td>Deadline to submit Intent to Fly Form</td>
</tr>
<tr>
<td>9/24/2012</td>
<td>Initial Down Selections Made</td>
</tr>
<tr>
<td>10/5/2012</td>
<td>Conceptual Design Review (CoDR) Due</td>
</tr>
<tr>
<td>10/5/2012</td>
<td>Conceptual Design Review (CoDR) Teleconference</td>
</tr>
<tr>
<td>10/17/2012</td>
<td>Earnest Payment of $1,000 Due</td>
</tr>
<tr>
<td>10/17/2012</td>
<td>Online Progress Report 1 Due</td>
</tr>
<tr>
<td>10/26/2012</td>
<td>Preliminary Design Review (PDR) Due</td>
</tr>
<tr>
<td>10/26/2012</td>
<td>Preliminary Design Review (PDR) Teleconference</td>
</tr>
<tr>
<td>Date</td>
<td>Description</td>
</tr>
<tr>
<td>---------------</td>
<td>-----------------------------------------------------------------------------</td>
</tr>
<tr>
<td>11/9/2012</td>
<td>Online Progress Report 2 Due</td>
</tr>
<tr>
<td>11/28/2012</td>
<td>Critical Design Review (CDR) Due — Discuss with teams based on finals schedules</td>
</tr>
<tr>
<td>1/18/2013</td>
<td>Final Down Select—Flights Awarded</td>
</tr>
<tr>
<td>1/25/2013</td>
<td>Online Progress Report 1 Due</td>
</tr>
<tr>
<td>2/15/2013</td>
<td>Individual Subsystem Testing Reports Due</td>
</tr>
<tr>
<td>2/15/2013</td>
<td>Individual Subsystem Testing Reports Teleconference</td>
</tr>
<tr>
<td>02/18/2013</td>
<td>First payment due</td>
</tr>
<tr>
<td>3/12/2013</td>
<td>Online Progress Report 2 Due</td>
</tr>
<tr>
<td>3/29/2013</td>
<td>Payload Subsystem Integration and Testing Report Due</td>
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<tr>
<td>4/1/2013</td>
<td>Payload Subsystem Integration and Testing Report Teleconference</td>
</tr>
<tr>
<td>4/08/2013</td>
<td>Final payment due</td>
</tr>
<tr>
<td>4/15/2013</td>
<td>RockSat Payload Canisters sent to customers <em>pending receipt of final payment</em></td>
</tr>
<tr>
<td>4/26/2013</td>
<td>First Full Mission Simulation Test Report Presentation Due</td>
</tr>
<tr>
<td>4/26/2013</td>
<td>First Full Mission Simulation Test Report Presentation Telecon</td>
</tr>
<tr>
<td>5/8/2013</td>
<td>Weekly Teleconference 4</td>
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<tr>
<td>5/15/2013</td>
<td>Weekly Teleconference 5</td>
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<tr>
<td>5/29/2013</td>
<td>Weekly Teleconference 6</td>
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<td>5/29/2013</td>
<td>Weekly Teleconference 7 (FMSTR 2)</td>
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<tr>
<td>6/3/2013</td>
<td>Launch Readiness Review Presentations</td>
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<tr>
<td>6/12/2013</td>
<td>Travel to Wallops Flight Facility</td>
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<tr>
<td>6/13/2013</td>
<td>Visual Inspections at Refuge Inn</td>
</tr>
<tr>
<td>6/19/2013</td>
<td>Presentations to next year’s RockSat</td>
</tr>
<tr>
<td>6/20/2013</td>
<td>Launch Day</td>
</tr>
</tbody>
</table>
10.0 Appendix A: Structural Drawings

Figure 12: Lower End Cap Mechanical Drawing
Figure 13: Upper End Cap Mechanical Drawing
Figure 14: RockSat Canister Skin Mechanical Drawing
Figure 15: RockSat Skin Mechanical Drawing – 0.125” thick
11.0 Appendix B: PFA Tubing and Tube Connections

- Temperatures from 70 to 400°F (20 to 204°C)
- Working pressure up to 275 psi (18.9 bar)
- Sizes from 1/8 to 1/2 in.
2  PFA Tube Fittings

Features
- Audible click ensures tubing is inserted properly.
- Visual indication of proper pull-up:
  - no gap between body hex and hex nut
  - hex flat alignment.
- Smooth, molded internal wetted surfaces reduce potential for system contamination.
- Grooved tubing allows for higher working pressure.
- Wrench assembly avoids the potentially unsafe practices of hand assembly and disassembly.

Materials
- Fittings—Molded PFA/ASTM D3307 Type I

Pressure-Temperature Ratings
Pressure ratings are for Swagelok® PFA tube fittings used with properly grooved Swagelok PFA tubing.

<table>
<thead>
<tr>
<th>Tube Wall, in.</th>
<th>0.000</th>
<th>0.047</th>
<th>0.062</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tube Size, in.</td>
<td>1/4</td>
<td>1/4</td>
<td>3/8</td>
</tr>
<tr>
<td>Temperature, °F (°C)</td>
<td>Working Pressure, psi (kPa)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>70 (21)</td>
<td>275 (19.9)</td>
<td>200 (13.7)</td>
<td>275 (19.9)</td>
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<tr>
<td>100 (38)</td>
<td>245 (17.0)</td>
<td>180 (12.4)</td>
<td>245 (17.0)</td>
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<td>200 (93)</td>
<td>145 (10.0)</td>
<td>110 (7.6)</td>
<td>145 (10.0)</td>
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<tr>
<td>300 (143)</td>
<td>87 (6.1)</td>
<td>64 (4.4)</td>
<td>87 (6.1)</td>
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<tr>
<td>400 (203)</td>
<td>47 (3.3)</td>
<td>34 (2.3)</td>
<td>47 (3.3)</td>
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Ordering Information and Dimensions
Dimensions, in inches (millimeters), are for reference only and are subject to change. Dimensions shown with Swagelok nuts finger-tight. E dimensions refer to the minimum opening.

Unions

<table>
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<tr>
<th>Tube Size, in.</th>
<th>Ordering Number</th>
<th>Dimensions, in. (mm)</th>
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<th>D</th>
<th>E</th>
<th>F</th>
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<tbody>
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<td>1/8</td>
<td>PFA-220-6</td>
<td>1.43 (36.9)</td>
<td>0.50 (12.7)</td>
<td>0.59 (15.0)</td>
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<td>PFA-420-6</td>
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<td>0.60 (15.2)</td>
<td>0.19 (4.8)</td>
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<td>3/8</td>
<td>PFA-620-6</td>
<td>1.89 (48.0)</td>
<td>0.67 (17.0)</td>
<td>0.28 (7.1)</td>
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<td>1/2</td>
<td>PFA-820-6</td>
<td>2.03 (51.5)</td>
<td>0.80 (20.3)</td>
<td>0.41 (10.4)</td>
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Bulkhead Unions

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<th>Dimensions, in. (mm)</th>
<th>A</th>
<th>Ax</th>
<th>D</th>
<th>E</th>
<th>F</th>
</tr>
</thead>
<tbody>
<tr>
<td>1/4</td>
<td>PFA-420-81</td>
<td>2.42 (61.5)</td>
<td>1.41 (35.8)</td>
<td>0.60 (15.2)</td>
<td>0.19 (4.8)</td>
<td>7/8</td>
<td></td>
</tr>
</tbody>
</table>

Panel bore size is 0.030 in. (0.78 mm); maximum panel thickness is 0.046 in. (1.17 mm).

Reducing Unions

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<th>Tube Size</th>
<th>Ordering Number</th>
<th>Dimensions, in. (mm)</th>
<th>A</th>
<th>D</th>
<th>Dx</th>
<th>E</th>
<th>F</th>
</tr>
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<tbody>
<tr>
<td>3/8 to 1/4</td>
<td>PFA-220-4-4</td>
<td>1.77 (45.0)</td>
<td>0.67 (17.0)</td>
<td>0.33 (8.3)</td>
<td>0.19 (4.8)</td>
<td>13/10</td>
<td></td>
</tr>
<tr>
<td>1/2 to 1/4</td>
<td>PFA-820-4-4</td>
<td>1.91 (48.5)</td>
<td>0.80 (20.3)</td>
<td>0.05 (1.3)</td>
<td>0.19 (4.8)</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>1/2 to 3/8</td>
<td>PFA-820-6-4</td>
<td>1.94 (49.3)</td>
<td>0.90 (22.9)</td>
<td>0.67 (17.0)</td>
<td>0.28 (7.1)</td>
<td>1</td>
<td></td>
</tr>
</tbody>
</table>
Ordering Information and Dimensions
Dimensions, in inches (millimeters), are for reference only and are subject to change. Dimensions shown with Swagelok nuts finger-tight. E dimensions refer to the minimum opening.

### Union Elbows

<table>
<thead>
<tr>
<th>Tube Size</th>
<th>Ordering Number</th>
<th>A (in)</th>
<th>D (mm)</th>
<th>E (mm)</th>
<th>F (mm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1/8</td>
<td>PFA-220-8</td>
<td>0.91</td>
<td>0.55</td>
<td>0.09</td>
<td>0.23</td>
</tr>
<tr>
<td>1/4</td>
<td>PFA-620-8</td>
<td>1.13</td>
<td>0.80</td>
<td>0.14</td>
<td>0.39</td>
</tr>
<tr>
<td>3/8</td>
<td>PFA-620-8</td>
<td>1.23</td>
<td>0.97</td>
<td>0.28</td>
<td>0.39</td>
</tr>
<tr>
<td>1/2</td>
<td>PFA-820-8</td>
<td>1.45</td>
<td>0.98</td>
<td>0.41</td>
<td>0.46</td>
</tr>
</tbody>
</table>

### Union Tees

<table>
<thead>
<tr>
<th>Tube Size</th>
<th>Ordering Number</th>
<th>A (in)</th>
<th>Ax (mm)</th>
<th>D (mm)</th>
<th>E (mm)</th>
<th>F (mm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1/8</td>
<td>PFA-220-3</td>
<td>1.82</td>
<td>0.91</td>
<td>0.50</td>
<td>0.09</td>
<td></td>
</tr>
<tr>
<td>1/4</td>
<td>PFA-420-3</td>
<td>2.26</td>
<td>1.13</td>
<td>0.60</td>
<td>0.19</td>
<td></td>
</tr>
<tr>
<td>3/8</td>
<td>PFA-620-3</td>
<td>2.46</td>
<td>1.23</td>
<td>0.76</td>
<td>0.25</td>
<td></td>
</tr>
<tr>
<td>1/2</td>
<td>PFA-820-3</td>
<td>2.90</td>
<td>1.45</td>
<td>0.96</td>
<td>0.41</td>
<td></td>
</tr>
</tbody>
</table>

### Male Connectors

<table>
<thead>
<tr>
<th>Tube Size</th>
<th>Pipe Size</th>
<th>Ordering Number</th>
<th>A (in)</th>
<th>D (mm)</th>
<th>E (mm)</th>
<th>F (mm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1/8</td>
<td>1/8</td>
<td>PFA-220-1-2</td>
<td>1.21</td>
<td>0.53</td>
<td>0.08</td>
<td></td>
</tr>
<tr>
<td>1/4</td>
<td>1/4</td>
<td>PFA-420-1-2</td>
<td>1.36</td>
<td>0.60</td>
<td>0.10</td>
<td></td>
</tr>
<tr>
<td>3/8</td>
<td>3/8</td>
<td>PFA-620-1-2</td>
<td>1.69</td>
<td>0.67</td>
<td>0.20</td>
<td></td>
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<tr>
<td>1/2</td>
<td>1/2</td>
<td>PFA-820-1-2</td>
<td>1.95</td>
<td>0.90</td>
<td>0.41</td>
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</tr>
</tbody>
</table>

### Male Elbows

<table>
<thead>
<tr>
<th>Tube Size</th>
<th>Pipe Size</th>
<th>Ordering Number</th>
<th>A (in)</th>
<th>D (mm)</th>
<th>E (mm)</th>
<th>F (mm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1/8</td>
<td>1/8</td>
<td>PFA-220-2-2</td>
<td>0.91</td>
<td>0.55</td>
<td>0.09</td>
<td></td>
</tr>
<tr>
<td>1/4</td>
<td>1/4</td>
<td>PFA-420-2-2</td>
<td>1.13</td>
<td>0.80</td>
<td>0.14</td>
<td></td>
</tr>
<tr>
<td>3/8</td>
<td>3/8</td>
<td>PFA-620-2-2</td>
<td>1.23</td>
<td>0.97</td>
<td>0.28</td>
<td></td>
</tr>
<tr>
<td>1/2</td>
<td>1/2</td>
<td>PFA-820-2-2</td>
<td>1.45</td>
<td>0.98</td>
<td>0.41</td>
<td></td>
</tr>
</tbody>
</table>

Swagelok
**Ordering Information and Dimensions**

Dimensions, in inches (millimeters), are for reference only and are subject to change. Dimensions shown with Swagelok nuts: finger-tight. E dimensions refer to the minimum opening.

### Back Ferrules

<table>
<thead>
<tr>
<th>Tube Size</th>
</tr>
</thead>
<tbody>
<tr>
<td>1/4</td>
</tr>
<tr>
<td>3/8</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Ordering Number</th>
</tr>
</thead>
<tbody>
<tr>
<td>PFA-624-1</td>
</tr>
<tr>
<td>PFA-624-3</td>
</tr>
</tbody>
</table>

© PTFE material.

### Front Ferrules

<table>
<thead>
<tr>
<th>Tube Size</th>
</tr>
</thead>
<tbody>
<tr>
<td>1/4</td>
</tr>
<tr>
<td>3/8</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Ordering Number</th>
</tr>
</thead>
<tbody>
<tr>
<td>PFA-623-1</td>
</tr>
<tr>
<td>PFA-623-3</td>
</tr>
</tbody>
</table>

### Plugs

<table>
<thead>
<tr>
<th>Tube Size</th>
</tr>
</thead>
<tbody>
<tr>
<td>1/4</td>
</tr>
<tr>
<td>3/8</td>
</tr>
<tr>
<td>1/2</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Ordering Number</th>
</tr>
</thead>
<tbody>
<tr>
<td>PFA-620-P</td>
</tr>
<tr>
<td>PFA-620-P</td>
</tr>
<tr>
<td>PFA-620-P</td>
</tr>
</tbody>
</table>

### Nuts

<table>
<thead>
<tr>
<th>Tube Size</th>
</tr>
</thead>
<tbody>
<tr>
<td>1/8 in.</td>
</tr>
<tr>
<td>3/16 in.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Ordering Number</th>
</tr>
</thead>
<tbody>
<tr>
<td>PFA-222-2</td>
</tr>
<tr>
<td>PFA-423-3</td>
</tr>
<tr>
<td>PFA-622-3</td>
</tr>
<tr>
<td>PFA-822-3</td>
</tr>
</tbody>
</table>

### Caps

<table>
<thead>
<tr>
<th>Tube Size</th>
</tr>
</thead>
<tbody>
<tr>
<td>1/8 in.</td>
</tr>
<tr>
<td>3/16 in.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Ordering Number</th>
</tr>
</thead>
<tbody>
<tr>
<td>PFA-220-P</td>
</tr>
<tr>
<td>PFA-420-P</td>
</tr>
<tr>
<td>PFA-620-P</td>
</tr>
<tr>
<td>PFA-820-P</td>
</tr>
</tbody>
</table>

### Installation

**WARNING:** PFA tubing MUST be grooved for use with PFA tube fittings. Use the Swagelok groove cutter tool.

1. Insert grooved PFA tubing into the Swagelok PFA tube fitting until a clicking sound is heard.
2. While holding fitting body steady, tighten the blue nut until there is no gap between the nut and body boxes.
3. Continue tightening until the nut and body boxes are aligned.

### PFA Tubing and Tools

For PFA tubing in accordance with ASTM D3539, Type II, in 1/8 to 1 in. and 6 to 12 mm sizes, see the Swagelok Hose and Flexible Tubing catalog, MS-01-180. The catalog also contains ordering information for the Swagelok groove cutter tool.

---

**Safe Product Selection**

When selecting a product, the total system design must be considered to ensure safe, trouble-free performance. Function, material compatibility, adequate ratings, proper installation, operation, and maintenance are the responsibilities of the system designer and user.

**Caution:** Do not mix or interchange parts with those of other manufacturers.

---

**Warranty Information**

Swagelok products are backed by The Swagelok Limited Lifetime Warranty. For a copy, visit swagelok.com or contact your authorized Swagelok representative.
# Appendix C: Launch Week/Integration Agenda

**Day 0, Wednesday (June 12, 2013)**
Recommended day for travel, teams arrive morning and afternoon

**Day 1, Thursday (June 13, 2013)**

<table>
<thead>
<tr>
<th>Time</th>
<th>Activity</th>
<th>Location</th>
</tr>
</thead>
<tbody>
<tr>
<td>9:30 A</td>
<td>Chris and Emily visually inspect payloads</td>
<td>Refuge Inn</td>
</tr>
</tbody>
</table>

**Day 2, Friday (June 14, 2013)**

<table>
<thead>
<tr>
<th>Time</th>
<th>Activity</th>
<th>Location</th>
</tr>
</thead>
<tbody>
<tr>
<td>7:30 A</td>
<td>Arrive at WFF and get through security</td>
<td></td>
</tr>
<tr>
<td>7:45</td>
<td>Safety briefing</td>
<td></td>
</tr>
<tr>
<td>8:15</td>
<td>Walk to F-10 and setup payloads</td>
<td>Building F10</td>
</tr>
<tr>
<td>9:00</td>
<td>Wallops visual inspections and weight check</td>
<td>Building F10</td>
</tr>
<tr>
<td>10:00</td>
<td>Stack integration/vibration/spin testing</td>
<td>Building F10</td>
</tr>
<tr>
<td>12:00 P</td>
<td>Lunch</td>
<td>Williamsburg Room</td>
</tr>
<tr>
<td>1:00</td>
<td>Testing continues</td>
<td>Building F10</td>
</tr>
<tr>
<td>2:00</td>
<td>Stack disassembly and payload inspections</td>
<td>Building F10</td>
</tr>
<tr>
<td>4:30</td>
<td>Action items assigned to teams that didn’t pass testing</td>
<td>Building F10</td>
</tr>
<tr>
<td></td>
<td>Re-vibe discussion</td>
<td></td>
</tr>
<tr>
<td>5:00</td>
<td>Day ends</td>
<td></td>
</tr>
</tbody>
</table>

**Day 3, Saturday (June 15, 2013)**

<table>
<thead>
<tr>
<th>Time</th>
<th>Activity</th>
<th>Location</th>
</tr>
</thead>
<tbody>
<tr>
<td>9:00 A</td>
<td>Refuge Inn Conference room open and available for action items</td>
<td>Refuge Inn</td>
</tr>
<tr>
<td>10:00 P</td>
<td>Refuge Inn Conference room closed for the evening</td>
<td>Refuge Inn</td>
</tr>
</tbody>
</table>

**Day 4, Sunday (June 16, 2013)**

<table>
<thead>
<tr>
<th>Time</th>
<th>Activity</th>
<th>Location</th>
</tr>
</thead>
<tbody>
<tr>
<td>10:00 A</td>
<td>Refuge Inn Conference room open and available for action items</td>
<td>(RockSat)</td>
</tr>
<tr>
<td>3:00 P</td>
<td>Payloads re-inspected for integration Monday</td>
<td>Refuge Inn</td>
</tr>
<tr>
<td>8:00 P</td>
<td>Refuge conference room closed for the evening</td>
<td>(RockSat)</td>
</tr>
</tbody>
</table>
Day 5, Monday (June 17, 2013)

8:00 A  Arrive and get through security  
8:15  Final Wallops inspections  Building F10  
9:00  Integration begins  Building F10  
12:00 P  Lunch  Williamsburg Room  
1:00  Integration continues  Building F10  
5:00  End of the day, integration complete

Day 6, Tuesday (June 18, 2013)

8:30 A  RockOn Workshop integration begins  Building F10  
11:30 A  Arrive and get through security  (RockSat-C)  
12:00 P  Lunch  Williamsburg Room  
12:30 P  RockOn integration continues  Building F10  
3:00  Skin integration  Building F10  
4:00  Pressure test begins  Building F10  
** Afternoon attendance is required for all payloads utilizing ports **

Day 7, Wednesday (June 19, 2013)

9:00 A  RockSat presentations to RockOn 2013 participants  Building F3  
12:00 P  Lunch  Williamsburg Room  
12:30 P  Tours and possible picture with rocket

Day 8, Thursday (June 20, 2013)

4:30  Travel to launch viewing site (own vehicles)  Wallops Island  
5:00  Wait for launch  Wallops Island  
6:00  Launch!  Wallops Island
# RockSat Payload Wallops Check-In Procedure

<table>
<thead>
<tr>
<th>Time</th>
<th>Activity</th>
<th>Location</th>
</tr>
</thead>
<tbody>
<tr>
<td>7:00</td>
<td>Recovery Operations - May return to hotel</td>
<td>Williamsburg Room</td>
</tr>
<tr>
<td></td>
<td>Hot Breakfast Available</td>
<td></td>
</tr>
<tr>
<td>12:00 P</td>
<td>Lunch (Provided)</td>
<td>Williamsburg Room</td>
</tr>
<tr>
<td>12:30</td>
<td>Can / Rocket De-integration</td>
<td>Building F10</td>
</tr>
<tr>
<td>1:30</td>
<td>Can De-integration</td>
<td>Building F10</td>
</tr>
<tr>
<td>5:00</td>
<td>Celebration Dinner</td>
<td>TBD</td>
</tr>
<tr>
<td></td>
<td>- Possible: teams discuss unique results from data and the workshop (learned, liked, disliked, etc)</td>
<td></td>
</tr>
<tr>
<td>7:00</td>
<td>Pack up, clean up and head home!</td>
<td>Refuge Inn</td>
</tr>
</tbody>
</table>
Appendix D: Visual Inspection Procedure

This procedure was used for the RockSat 2011 visual inspections and is subject to change. The most updated version can be found on the website. However this copy can be used as a guide for planning and preparation for the test.

Institution

Environmental Testing

Cleared for Integration

Pass

RockSat 2011 Payload Check-In Procedure

<table>
<thead>
<tr>
<th>Revision</th>
<th>Date</th>
<th>Authored By</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>00</td>
<td>3-09-2010</td>
<td>Shawn M. Carroll</td>
<td>Initial Release</td>
</tr>
<tr>
<td>01</td>
<td>4-26-2010</td>
<td>Shawn M. Carroll</td>
<td>Proofed Prior To Website Release</td>
</tr>
<tr>
<td>02</td>
<td>6-13-2010</td>
<td>Shawn M. Carroll</td>
<td>Added University and Pass Box to Cover Page</td>
</tr>
<tr>
<td>03</td>
<td>4-15-2011</td>
<td>Emily Logan</td>
<td>Update for 2011 launch</td>
</tr>
<tr>
<td>04</td>
<td>5-6-2011</td>
<td>Emily Logan</td>
<td>Check-in schedule updates</td>
</tr>
<tr>
<td>05</td>
<td>5-12-2011</td>
<td>Emily Logan</td>
<td>Check-in schedule updates</td>
</tr>
<tr>
<td>06</td>
<td>6-6-2011</td>
<td>Emily Logan</td>
<td>Modified for integration check-in</td>
</tr>
</tbody>
</table>

Approvals

RockSat Student PM: Emily M. Logan

Date: 6/17/11

Principle Investigator (PI): Chris Koehler

Date: 6/17/11
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1.0 Introduction

1.1. Test Purpose and Objectives
The purpose of this document is to outline the testing procedure needed to verify that the __________________________________________________________________________ payload complies with the requirements of the 2011 RockSat program. Compliance with the below requirements will ensure that the payload is safe and ready for environmental testing at Wallops Flight Facility to take place on 17 June 2011. Payloads that do not pass the checklist below may be removed from the flight if the issue cannot be easily remedied prior to the above said environmental test.

1.2. Team Check-In Schedule
Please note that your payload should be completely integrated as though it were going to check in and go straight to a vibe table. Each check-in is scheduled for a block of 90 minutes. If you have a canister partner, the entire can must be integrated and put together for check-in. Universities will be checked in as canisters, with a separate document for each team to verify electrical compliance.

<table>
<thead>
<tr>
<th>SCHEDULE</th>
<th>University(ies)</th>
</tr>
</thead>
<tbody>
<tr>
<td>9:00 AM</td>
<td>University of Colorado at Boulder</td>
</tr>
<tr>
<td>10:30 AM</td>
<td>Virginia Tech</td>
</tr>
<tr>
<td>12:00 PM</td>
<td>Lunch -- no check-ins</td>
</tr>
<tr>
<td>12:30 PM</td>
<td>Harding University and Temple University RockStars</td>
</tr>
<tr>
<td>2:00 PM</td>
<td>Drexel University and Temple University SAVSS</td>
</tr>
<tr>
<td>3:30 PM</td>
<td>University of Minnesota and Augsburg College</td>
</tr>
<tr>
<td>5:00 PM</td>
<td>Dinner -- no check-ins</td>
</tr>
<tr>
<td>5:30 PM</td>
<td>CSU and WVU</td>
</tr>
<tr>
<td>7:00 PM</td>
<td>Follow-up check-ins begin if necessary</td>
</tr>
<tr>
<td>9:00 PM</td>
<td>Conference room open for general work</td>
</tr>
</tbody>
</table>
Quality Assurance (QA) Precautions

1.3. QA provisions
To ensure a path of compliance, each payload will be subjected to the procedure and testing outlined in this document. Additionally, each payload will have its own Preliminary Payload Check-In document, and results will be directly recorded into it. This check-in test will be performed once by the team for redundancy to ensure the payload is ready for official check in at the Refuge Inn the day before environmental testing.

Please send the completed and signed form to the following address by June 8, 2011.

Colorado Space Grant Consortium
Discovery Learning Center Room 270
520 UCB
Boulder, Colorado 80309-052

Failure to complete this check-in procedure and ensure that it is received by June 8th may result in your payload’s removal from the flight. Please keep a tracking number for the package to make sure it arrives at COSGC. Finally, the payload will be re-checked Sunday, June 19th to ensure weekend work has not created any major changes in the payload. After passing this check, the payload will be sealed in a clear bag and labeled with a sticker. At this point, you will not have access to your payload.
2.0 Test Resources

2.1. Facilities
   • Refuge Inn Conference Room

2.2. Equipment

<table>
<thead>
<tr>
<th>Equipment</th>
<th>Quantity</th>
<th>Needs to be Cleaned (Y/N)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 Scale (accurate to 0.1 lbf)</td>
<td>1</td>
<td>N</td>
</tr>
<tr>
<td>2 Multimeter</td>
<td>1</td>
<td>N</td>
</tr>
<tr>
<td>3 Flash Light</td>
<td>1</td>
<td>N</td>
</tr>
<tr>
<td>4 ¼” Female NPT Connector</td>
<td>1</td>
<td>N</td>
</tr>
<tr>
<td>5 Writing Utensil</td>
<td>1</td>
<td>N</td>
</tr>
<tr>
<td>6 Camera</td>
<td>1</td>
<td>N</td>
</tr>
<tr>
<td>7 Highlighter</td>
<td>1</td>
<td>N</td>
</tr>
<tr>
<td>8 Tape</td>
<td>1 Roll</td>
<td>N</td>
</tr>
<tr>
<td>9 Label Maker</td>
<td>1</td>
<td>N</td>
</tr>
<tr>
<td>10 Calculator</td>
<td>1</td>
<td>N</td>
</tr>
<tr>
<td>11 Stapler with staples</td>
<td>1</td>
<td>N</td>
</tr>
<tr>
<td>12 5 gallon plastic ziplocs and stickers</td>
<td>9</td>
<td>N</td>
</tr>
</tbody>
</table>

2.3. Required Personnel
Emily Logan—RockSat Student PM
Chris Koehler—Principle Investigator (PI)
At least 2 members of the payload team
3.0 Test Procedure

3.1. General Test Concept
The purpose of this check-in is to ensure the customer is in compliance with the requirements set forth by the RockSat-C Program and Wallops Flight Facility. The requirements are listed in the following table.

<table>
<thead>
<tr>
<th>Requirement</th>
<th>Description</th>
<th>Verification</th>
</tr>
</thead>
<tbody>
<tr>
<td>RSC.1 - Weight</td>
<td>RockSat Canister + Payload = 20±0.2 lb</td>
<td>Weighed before MOI and vibe testing.</td>
</tr>
<tr>
<td>RSC.2 - Volume</td>
<td>Contained within RockSat Canister</td>
<td>Constraint in User’s Guide unless pre-approved by RSC manager and WFF. Visual inspection will be completed.</td>
</tr>
<tr>
<td>RSC.3 - CG/MOI</td>
<td>Within 1x1x1” of centroid</td>
<td>Customer responsibility prior to Wallop’s testing. WFF testing determines “go” or “no go.”</td>
</tr>
<tr>
<td>RSC.4 - Electrical</td>
<td>No current flow prior to command line OR g-switch activation</td>
<td>Customer responsibility prior to inspections and Wallops testing. WFF testing determines “go” or “no go.”</td>
</tr>
</tbody>
</table>

This test will first ensure that the required documentation is present. The next phase of testing assumes that the payloads arrive fully integrated and assembled in their respective canisters. The payload will then be visually inspected to ensure that it is contained in the canister. Next, the payload will be massed to ensure that it conforms to the mass requirements. Canisters utilizing an atmospheric port will be checked to make sure that the male ¼” NPT connector on the payload end interfaces to a female ¼” NPT connector. Canisters utilizing a special port will have the port hardware available for inspection to verify the correct interface is on the instrument.

To ensure that the canister is not shorted to the power source, the canister’s skin potential relative to the power supply’s negative terminals will be checked. The next test quantifies the voltage and current on each set of RBF wires. The customer(s) will then be asked to open the canister by removing the top bulkhead and outer skin, which will expose the payloads inside. During the process of removing the top bulkhead and outer skin, it will be verified that the internal structure bolts to 4 out of 5 of the top bulkhead attachments and 4 out of 5 of the bottom bulkhead attachments. Additionally, the general structure of the payload stack and potting will be checked. Finally, it will be verified that rechargeable lithium-ions are not being used.
3.2. Documentation Check
The purpose of the documentation check is to ensure that your payload is well defined and if there are any questions about structures or electronics, the information will be readily available to help integration proceed as smoothly as possible. The documentation must be in a binder.

<table>
<thead>
<tr>
<th>Documentation Check</th>
<th>Environmental Initial</th>
<th>Integration Initial</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. The payload notebook contains the original or a copy of the completed check-in procedure turned in 6-8-11</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2. The payload notebook contains a full set of system schematics (computer generated)?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3. The payload notebook contains a full set of mechanical drawings (computer generated)?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4. The payload notebook contains data sheets and mechanical specifications that would be deemed relevant to someone inspecting a payload. Non-essential data sheets and design reviews should at minimum be available in electronic format.</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Action Items:

Notes:
### 3.3. Canister Containment Check

The canister containment check verifies that the customer is in compliance with requirements RSC.2. This section verifies the payload does not extend outside of the canister and that it only connects to the canister through the interfaces designed for that purpose.

<table>
<thead>
<tr>
<th>Canister Containment Check</th>
<th>Environmental Initial</th>
<th>Integration Initial</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>The payload is completely contained within the RockSat canister?</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>The payload is not physically connected to any point on the RockSat canister other than the top and bottom bulkheads?</td>
<td></td>
</tr>
</tbody>
</table>

**Action Items:**

**Notes:**
3.4. Atmospheric Port Interface Check (If Applicable)
The atmospheric port interface check verifies that the customer design for the atmospheric port can be interfaced with the WFF atmospheric port setup.

<table>
<thead>
<tr>
<th>Atmospheric Port Interface Check</th>
<th>Environmental Initial</th>
<th>Integration Initial</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 The payload’s atmospheric tubing fits in the wire-way?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2 The terminating ¼” Male NTP connector interfaces to the provided female ¼” NTP connector?</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Action Items:

Notes:
### 3.5. Weight Check

The weight check verifies requirement RSC.1 from Table 1. The payload is weighed three times and the final weight is an average of the three trials.

<table>
<thead>
<tr>
<th><strong>Weight Check</strong></th>
<th><strong>Environmental Initial</strong></th>
<th><strong>Integration Initial</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>1</strong> Power on the scale (accurate to 0.1 lbf)</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>2</strong> Zero the scale</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>3</strong> Place the integrated canister on the scale and record the weight below: ___ lbf</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>4</strong> Remove the canister from the scale and rezero.</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>5</strong> Place the canister on the scale and record the weight below: ___ lbf</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>6</strong> Remove the canister from the scale and rezero.</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>7</strong> Place the payload on the scale and record the weight below: ___ lbf</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>8</strong> Average the weights and record the value below: ___ lbf</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Action Items:**

**Notes:**

---

**If anything other than 20±0.2 lbf, highlight this section of the document!!**
3.6. **Neutral Canister Potential Check**
The neutral canister potential check verifies requirement RSC.4. The purpose is to ensure that no part of the payload is shorted to the canister, and that there is no voltage potential between the canister and the payload.

<table>
<thead>
<tr>
<th>Neutral Canister Check</th>
<th>Environmental Initial</th>
<th>Integration Initial</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Payload has __________ pairs of at least 3 foot pairs of RBF wires connected.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1. ______ activate at launch.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1. ______ activate ________ minutes prior to launch.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2. Payload has one connector tied directly to payload ground easily accessible when the</td>
<td></td>
<td></td>
</tr>
<tr>
<td>payload is integrated in the canister?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3. Place the multimeter in a mode to measure voltage</td>
<td></td>
<td></td>
</tr>
<tr>
<td>*Range: 0-20V unless customer specifies a different range is required</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4. Place one of the multimeter terminals on the skin of the canister and the other on</td>
<td></td>
<td></td>
</tr>
<tr>
<td>the connection to ground</td>
<td></td>
<td></td>
</tr>
<tr>
<td>5. Record the voltage measured on the multimeter __________ V</td>
<td></td>
<td>-</td>
</tr>
<tr>
<td>** If anything other than 0V, highlight this section of the document!! **</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Action Items:**

**Notes:**
### 3.7. Voltage/Current Check

The purpose of the Voltage and Current check is to record the voltages across each pair of activation lines for WFF reference. The current check makes sure that there is no current flow across activation lines that activate at launch (even with the Wallops short no current should flow until the g-switch has compressed). It also verifies that current flow through the command line activation pairs does not exceed the 1A maximum.

<table>
<thead>
<tr>
<th></th>
<th>Voltage/Current Check</th>
<th>Environmental Initial</th>
<th>Integration Initial</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Place the multimeter on a mode to measure voltage&lt;br&gt;Range: 0-20V unless customer specifies a different range is required</td>
<td></td>
<td>-</td>
</tr>
<tr>
<td>2</td>
<td>Have customer point out which pairs activate at launch and mark with T-0-SCHOOL_NAME using tape or the label maker. If there are multiple lines for launch activation for this payload, add the number of each pair after the school name (1, 2, 3…)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>Have customer point out which pairs activate prior to launch and mark with T-X-SCHOOL_NAME (X = minutes prior to launch, using tape or the label maker. If there are multiple lines for launch activation for this payload, add the number of each pair after the school name (1, 2, 3…)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>Measure the potential between the positive and ground terminals on each T-0 pair for the current payload:&lt;br&gt;T-0-1 ____________ V&lt;br&gt;T-0-2 ____________ V&lt;br&gt;T-0-3 ____________ V&lt;br&gt;T-0-4 ____________ V&lt;br&gt;T-0-5 ____________ V</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

---

Colorado Space Grant Consortium

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Rev. 4
<table>
<thead>
<tr>
<th></th>
<th>Voltage/Current Check</th>
<th>Environmental Initial</th>
<th>Integration Initial</th>
</tr>
</thead>
</table>
| 5 | Measure the potential between the positive and ground terminals on each T-X for the current payload:  
  T- -1 ____________ V  
  T- -2 ____________ V  
  T- -3 ____________ V |                       |                     |
| 6 | Place the multimeter on the appropriate mode to measure current (switch cable config if required as well)  
  *Range: 0 – 0.1A unless customer specifies a different range is required |                       |                     |
| 7 | Measure the current through the positive and ground terminals of each T-0 node for the current payload:  
  T-0-1 ____________ ( mA A ) {Circle one that applies}  
  T-0-2 ____________ ( mA A ) {Circle one that applies}  
  T-0-3 ____________ ( mA A ) {Circle one that applies} |                       |                     |
|   | **If any current exceeds 0.1 A, highlight this section of the document!**           |                       |                     |
| 8 | Place the multimeter on the appropriate mode to measure current (switch cable configuration if required as well) in a range the customer feels will not be exceeded on early activation lines. |                       |                     |
**Voltage/Current Check**

<table>
<thead>
<tr>
<th></th>
<th>Voltage/Current Check</th>
<th>Environmental Initial</th>
<th>Integration Initial</th>
</tr>
</thead>
<tbody>
<tr>
<td>9</td>
<td>Measure the current through the positive and ground terminals on each T-X node for</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>the current payload:</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>T-1 ____________ ( mA A ) {Circle one that applies}</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>T-2 ____________ ( mA A ) {Circle one that applies}</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>T-3 ____________ ( mA A ) {Circle one that applies}</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td><strong>If any current exceeds 1 A, highlight this section of the document!</strong></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Action Items:**

**Notes:**
### 3.8. Internal Inspections

The purpose of internal inspections is to make sure the customer is connected to at least 4 of the 5 bulkhead connection points on both the top and bottom of the canister. It also checks that these are the only points where the payload connects to the canister. Additionally, the visual inspection checks to make sure rechargeable lithium ion batteries are not being used (requirement from User’s Guide). Finally, this check looks at the quality of staking to make sure the payload is prepared for flight conditions.

**NOTE:** This section will be completed after all payloads in a canister pass 3.2 – 3.7.

<table>
<thead>
<tr>
<th>Internal Inspections</th>
<th>Environmental Initial</th>
<th>Integration Initial</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. After ALL payloads in a canister have been checked for compliance with sections 3.2 – 3.7, have one customer remove the top bulkhead.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2. As the customer removes the top bulkhead, verify that the internal structure bolts to 4 out of 5 of the top bulkhead connection points.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3. After the customer removes the skin, verify that the internal structure bolts to 4 out of 5 of the bottom bulkhead connection points.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4. Inspect the payload and ensure that it does not connect to the canister anywhere except the top and bottom bulkheads.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>5. Verify that the payload is NOT utilizing any rechargeable lithium-ion batteries. (Non-rechargeable lithium-ion is permitted) Check compliance below:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Compliant ________ (Check One) Not Compliant ________</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>If not compliant, highlight this section of the document!!</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Internal Inspections</td>
<td>Environmental Initial</td>
<td>Integration Initial</td>
</tr>
<tr>
<td>----------------------</td>
<td>------------------------</td>
<td>---------------------</td>
</tr>
<tr>
<td>Visually inspect the payload’s staking work and rate the quality from 1-10. (1 no staking present; 7 acceptable; 10 consider applying at Wallops)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1 2 3 4 5 6 7 8 9 10 {Circle One}</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Action Items:**

**Notes:**

**4.0 Additional Items for Friday Morning**

**5.0 Major Issues and/or Concerns**
6.0 Signature and Approvals Section: Environmental Testing
Signing below agrees that it has been verified that all highlighted sections of the document have been addressed and resolved, and all action items have been completed for the _______________________________ payload. After signing, the Environmental Testing box on the front of the document may be checked to indicate a pass.

_________________________ Date: 6/17/11
RockSat Student PM: Emily M. Logan

_________________________ Date: 6/17/11
Principle Investigator (PI): Chris Koehler

_________________________ Date: 6/17/11
Payload team representative (please print)

_________________________
Payload team representative signature

7.0 Post-vibe Action Items
8.0 Signature and Approvals Section: Integration
Signing below agrees that it has been verified that all highlighted sections of the document have been addressed and resolved, and all action items have been completed for the __________________________________ payload. After signing, the Integration box on the front of the document may be checked to indicate a pass.

RockSat Student PM: Emily M. Logan  Date: 6/19/11

Principle Investigator (PI): Chris Koehler  Date: 6/19/11

Payload team representative (please print)  Date: 6/19/11

Payload team representative signature