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AEROSPACE ENGINEERING
LABORATORY OF INTEGRATION AND TESTS FOR NANOSATELLITES – LITN–CRS/COCRE/INPE-MCTIC

NANOSATC-BR2 - ASSEMBLY, INTEGRATION AND TESTS

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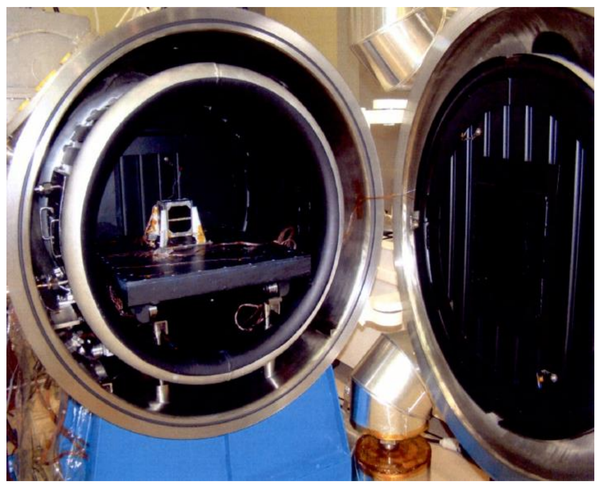
OBJECTIVES

This poster has the main objective of presenting the development of INPE-UFSM' NANOSATC-BR: CubeSats Development Program, at A. I. & T. (Assembly, Integration and Tests) of Nanosatellites. NANOSATC-BR1 – 1U CubeSat, the very first Brazilian nanosatellite [2], was the initial contact of the group with A. I. & T. procedures, and its Engineering Model is available at the recently opened LITN (Laboratory of Integration and Tests for Nanosatellites) at CRS/COCRE/INPE-MCTIC. This Laboratory turns possible for students to practice integration of CubeSat Structures and perform basic electronic tests using its subsystems. NANOSATC-BR2 - 2U CubeSat (10 x 10 x 22.6 cm), the second nanosatellite of the Program, is under development and its A. I & T. will occur within the next few months. Up to now, some payloads such as the Langmuir Probe have passed through Thermal Vacuum tests at the Laboratory of Integration and Tests at São José dos Campos (LIT/INPE-MCTIC).

METHODOLOGY

NANOSATC-BR1 Thermo Vacuum, Vibration and Mass Property tests [4] were performed at LIT/INPE-MCTIC. The Thermo Vacuum test (Figure 1) has the objective of thermally validating the satellite for flight by simulating the space environment in vacuum chambers. Throughout the period of 48 hours, the nanosatelite was exposed to thermal cycling, obtaining a range of temperatures that varied from - 30ºC to + 32ºC. After finishing the process, functional tests were performed with the objective of verifying its functionalities and properties, thus, validating the nanosatellite thermally. Vibration test was performed to validate the satellite structurally, in order to prove that the spacecraft was able to withstand the dynamic conditions that it was exposed to, especially during launch. The test was performed with the nanosatellite already positioned in the test POD (Mechanical structure that encloses the CubeSat) (Figure 2). During the test, frequencies used for random and sinusoidal tests that reached up to 2000hz were applied on the three Cartesian coordinates of the satellite. Mass Property was performed in order to determine the moment of inertia and center of gravity of the CubeSat.



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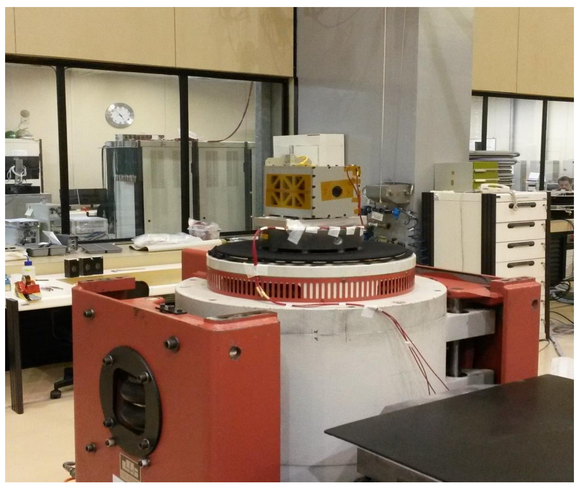
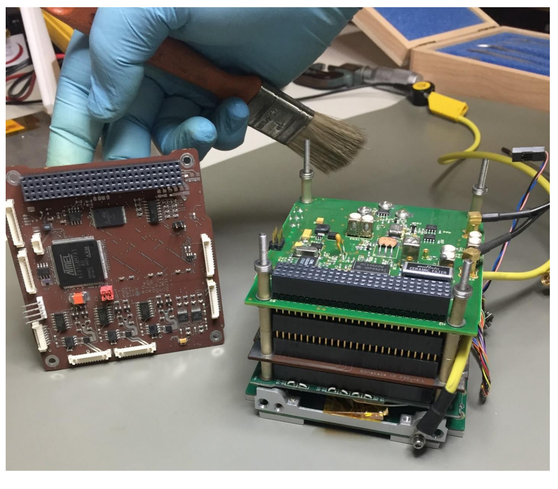


(2)

Figures 1 & 2: NANOSATC-BR1 inside LIT 250-liter Thermal-Vacuum Chamber &. NANOSATC-BR1 positioned inside the test POD over the Shaker.

With the NANOSATC-BR1 Engineering Model available at LITN, many possibilities of new researches were created. The Laboratory is currently passing through constant evolution, as the students plan solutions for the problems that are found while the development of researches occur. Regarding the A. I. & T. procedures, communication tests were performed. It was possible to receive data from the NANOSATC-BR1 EM in Secure Mode by Morse code, validating its communication with the Ground Station, that is currently located at CRS/COCRE/INPE-MCTIC. Battery tests were performed too, recharging and discharging them completely. Initial Integration of CubeSats are being performed as well, using specific tools and manuals [3] (Figure 3). It is expected that a Hands On Workshop will be available for students from the NANOSATC-BR; CubeSats Development Program in the near future.

On November $8^{th}, 2016$ ILP – Interface Langmuir Probe and SLP – Sensor Langmuir Probe (Figure 4) Thermal Vacuum test were performed [5]. The specimen was mounted in the vacuum chamber in a thermal controlled environment, with thermocouples connected (13 for ILP and 16 for SLP). 4 cycles were performed, hot soak (+50ºC) and cold soak (-10ºC), lasting 30 minutes each. The test had to be done in two parts, because at the end of the first cycle the vacuum chamber presented problems. After the necessary verifications were done, all remaining cycles were performed.



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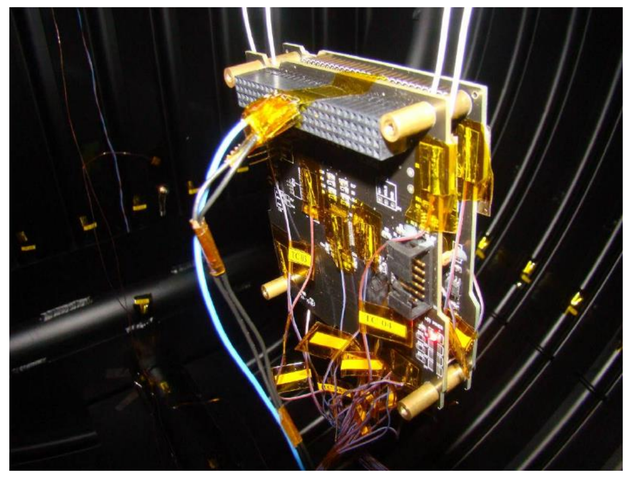

(4)

Figure 3 & 4: NANOSATC-BR1 EM Integration tryout at LITN & ILP - SLP positioned inside the Vacuum Chamber, with thermocouples positioned outside the PCBs.

RESULTS AND DISCUSSIONS

The new LITN laboratory available at CRS/COCRE/NPE-MCTIC is a milestone for the NANOSATC-BR, CubeSats Development Program students group. Integration and Testing courses are in the development phase, with the intention of preparing all members to interpretative and develop further research based on the eminent tests that will be carried out on the NANOSATC-BR2 Flight Model. Another topic to be discussed is the success of the NANOSATC-BR1 FM tests, based on the analysis of the results obtained, the necessary guarantees for validating and launching were presented, allowing the continuity of the project [1]. They were later confirmed with the success of the mission. Despite the damage caused by a magnetic solar storm in September – October 2014, that turned the batteries unable to hold electric charge, all the other subsystems remain functional presently.

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