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THERMAL VACUUM TESTS CAMPAIGN FOR THE SPORT CUBESAT QUALIFICATION AND
VALIDATION

Abstract

This work presents the thermal vacuum qualification and validation tests for the Scintillation Prediction Observation Research Task (SPORT) components and models, from the engineering model to the CubeSat flight model. All stages of the tests campaign are described, as well as lessons learned. The SPORT science mission, which aims to understand the preconditions that lead to the formation of equatorial plasma bubbles, is an international partnership between NASA, the Brazilian National Institute for Space Research (INPE), the Aeronautics Institute of Technology of the Brazilian Department of Aerospace Science and Technology (DCTA/ITA), and U.S. universities. The first test (in May 2020) was the Thermal Vacuum Test (TVT) to qualify a Hold Down Release Mechanisms (HDRM) for booms (Electric Field, Impedance and Langmuir Probes), and consists of applying qualification temperature cycles (hot and cold dwell) under a high vacuum environment, while functional tests are carried out. The objective was to demonstrate the capabilities of the HDRM to meet the functional requirements under these conditions. The Thermal Balance Test (TBT) of the qualification model (QM) was performed in March 2021. The test philosophy was the simulation of the heat flux incident on the satellite made by film heaters installed on the external surfaces. In addition, film heaters installed on the internal dummies simulated the power dissipation of electronics and equipment. The main objectives of the TBT were to verify the performance of the SPORT QM thermal design under flight conditions and to generate useful information to adjust and refine the thermal mathematical model. The TVT and Bakeout test for the protoflight models of the mechanical structure and electronics were realized in August 2021. The purpose of the test was to demonstrate the ability of the electronics to comply with the functional requirements when subjected to the temperature and pressure acceptance level. Three more TVTs combined with Bakeout were dedicated to special functional tests of the reaction wheel, power conditioning and distribution unit and batteries, including the flight model battery. All these tests were successfully conducted at the Integration and Testing Laboratory (LIT/INPE) using the 1x1m and 250L2 Thermal Vacuum Chambers, with the following specifications: 785 and 250 liters of volume, respectively; temperature range from -180°C to $+150^{\circ}\text{C}$; and cryogenics pumps for the high vacuum conditions. In each test, a set of thermocouples was used to the temperature monitoring at different points of the satellite.