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THERMAL BALANCE TESTING THE TM OF THE CHINA-BRAZIL REMOTE SENSING SATELLITE

Abstract

Following the cooperation between Brazil and China on space activities, CBERS 3 – China-Brazil Earth Resources Satellite, is the fourth spacecraft under design and construction by the two nations and to be put into orbit by the Chinese launcher Long March 4. Measuring approximately 3.2 x 1.8 x 3.1m and weighting more than 1.5 ton, this spacecraft will carry four cameras for remote sensing purposes. Considering some modifications on the design of this particular spacecraft, a Thermal Model (TM) was built and was submitted to extensive thermal vacuum tests at the Integration and Testing Laboratory - LIT, from the Brazilian National Institute for Space Research - INPE, in Sao Jose dos Campos, Sao Paulo. On the specification and design of this particular thermal-vacuum test, the skin-heaters technique was adopted as an economical and efficient alternative to solar simulation. So, skin-heaters were used to simulate heat flux on external surfaces of the TM, including the multi-layer insulation and thermal radiators. In addition, more than 120 dummy boxes simulating the actual spacecraft subsystems were instrumented with skin-heaters providing the expected thermal dissipation during the selected orbital and electronic operating phases. Tapes and paints with special surface thermal optical properties were also used on the structure and boxes. For thermal monitoring purposes, more than 370 temperature sensors were installed on selected points of the spacecraft TM so their data could be recorded during the execution of the whole test. Particularly for this campaign, a technique for the application of radiative heat flux was developed at LIT-INPE enabling to simulate the thermal radiation absorbed by the remote sensing cameras in a non-contact mode. Radiometers were used to measure the radiative heat flux at the level of the camera inlet optical surface. Making good use of the recently built 6m x 8m Space Simulation Chamber, the CBERS Thermal Model was submitted to high-vacuum environment and then thermally conditioned to a series of six cases including hot and cold soaks, in order to verify the computing thermal modeling and the results of the techniques adopted for the heat transfer among the subsystems, the structure and between the spacecraft and the space. Details and the main results from this thermal balance tests are presented in this paper.