

THE SOLAR SIMULATION TEST OF THE ITALSAT THERMAL STRUCTURAL MODEL

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ABSTRACT

ITALSAT is a three axis stabilized communication satellite. It is the main program presently under development in Italy as part of the Italian Space Plan sponsored by the government through the National Research Council (CNR).

The spacecraft embarks three payloads: two for telecommunication at 20/30 GHz and one for a propagation experiment at 40/50 GHz. The antenna farm consists of five antennas: three of them are mounted on the earth facing platform while the other two are located on the east and west panels.

The overall spacecraft thermal design is SELENIA SPAZIO responsibility while the body thermal control has been subcontracted to AERITALIA.

The thermal control is achieved by means of the following techniques:

1. thermistors to control heaters located on the batteries and Antenna Pointing Mechanism (APM). The controls are achieved by a Thermal Control Unit (TCU) which processes the temperatures and commands the heaters;
2. thermostats to automatically control heaters located on the Reaction Control Thrusters (RCT) and earth sensors;
3. high dissipating units are located on the north and south radiators;
4. second surface mirrors (SSM) bonded on the external surface of radiator panels to minimize solar energy absorption and to increase the heat rejection;
5. all other spacecraft surfaces covered with thermal blankets to reduce the solar effects and to minimize thermal gradients.

The ITALSAT structural/thermal model (STM) has been submitted to a solar simulation test in order to verify the spacecraft thermal design and the thermal mathematical model which will be used to predict the "on orbit" temperatures. The test was performed, by SELENIA SPAZIO, in the INTESPACE SIMLES solar simulator (Toulouse, France) in November 1987.

The STM was representative of the flight model in terms of configuration, structure, appendages and thermal hardware; dissipating dummy units have been used to simulate the electronic units.

The test consisted of three main phases: on station (begin of life), on station (end of Life), transfer orbit.

The end of life condition has been simulated by applying a certain quantity of kapton tape on the north radiator SSM in order to increase its solar absorptance up to the end of life expected value.

Different seasonal conditions (i.e. solar fluxes cases) and diurnal transient have been properly simulated throughout the test in order to verify the spacecraft thermal control performances.

The STM was mounted on the SIMLES gymbal system via a test adaptor designed to minimize heat fluxes with the spacecraft. 436 thermocouples have been used to monitor the spacecraft temperatures during the test. 51 heater circuits provided the simulation of the heat dissipation in the various operative modes.

Test Results are currently under evaluation; on the basis of a preliminary analysis it is possible to say that:

- test performances have been satisfactory; test conditions had small and reckonable influence on the spacecraft temperatures;
- spacecraft measured temperatures were up to 15°C higher than the predicted ones. This imposes a careful correlation analysis in order to have a reliable flight temperature predictions.

The paper will describe the tested spacecraft model and the test approach. Finally test results, correlation with predicted temperatures as well as influences of test conditions on the spacecraft test temperatures will be extensively presented and discussed.