

The Mars Pathfinder System Level Solar Thermal Vacuum Test

Jacqueline C. Lyra & Keith S. Novak

**Thermal and Propulsion Engineering Section
Jet Propulsion Laboratory, Pasadena, California**

Abstract

The Mars Pathfinder mission, scheduled to be launched in 1 December 1996, is the second launch in NASA's 1 Discovery Program. The mission is primarily an engineering demonstration of key technologies and concepts for eventual use in future missions to Mars. As part of the 1 Discovery Program this mission is the first to be implemented with a cost cap of \$150M (FY 92) and with a maximum three year development cycle.

The Mars Pathfinder flight system consists of three essential elements: a Cruise Stage, that houses the solar panels and the Propulsion subsystem among others; an Aeroshell and Deceleration Module; and a Lander that carries the Sojourner microrover. The Lander c. K10SCC1 in the aeroshell separates from the a cruise stage just prior to entering the Martian atmosphere.

Restricted budget and schedule reduced the thermal verification test program to only two thermal tests: (a) a thermal characterization test of a development Lander and the Heat Rejection System, and (b) a full-up flight system solar thermal vacuum test. Since the first test covered only the lander thermal design verification we were forced to rely solely on the system level test to verify the thermal design of the spacecraft cruise stage and cruise stage components.

One of the main challenges of the thermal environment test program was the need to design a program that would represent the three mission phases: (a) cruise, (b) entry and descent and (c) Martian surface landed operations, each with different thermal environments.

Many other challenges were encountered during the design phase of the test program. The cruise phase of the test had to be designed to simulate the solar loads on a spin balanced spacecraft that cruises at off-Sun angles varying from 0° to 60°. A novel approach of using a combination of infrared lamps and a solar simulator was implemented for that purpose. During the landed phase, the Martian atmosphere had to be simulated for the first time in the JPL 25-foot Space Simulation Facility. Designed as a vacuum chamber, the combination of an atmosphere and cold shrouds was a potential concern for the structural integrity of the chamber,

This paper concentrates on the first part of the system level solar thermal vacuum test for the Mars Pathfinder Flight System, that includes the cruise and entry/descent/landing phases of the mission. It will also cover the pre-test design and mapping of the infrared lamps system, the proof of concept test for an accelerated cooldown and test results.