NASAfacts

MEDLI MSL Entry, Descent and Landing Instrumentation

MEDLI — the Mars Science Laboratory Entry, Descent and Landing Instrumentation suite — was embedded in the spacecraft's heatshield to gather data on the aerothermal, thermal protection system, and aerodynamic performance characteristics of the MSL entry vehicle during its entry and descent to the Mars surface, and to help engineers better design future Mars missions.

MEDLI, NASA's first Technology Demonstration Mission to fly, captured a rare and valuable data set. Its innovative Mars Entry Atmospheric Data System (MEADS) pressure sensors gathered information about the aerodynamic characteristics of the entry vehicle as it descended, while also studying the Martian atmosphere itself. The MEDLI Integrated Sensor Plugs (MISP), comprised of thermocouples and isotherm sensors, analyzed the performance of the Mars Science Laboratory's unique tiled thermal protection system.

A challenging mission

Close analysis of the MEDLI flight data is vital to future NASA exploration of the red planet. The Mars Science Laboratory spacecraft entered the Martian atmosphere traveling more than 3.5 miles per second — the second fastest NASA entry to Mars to date, after the Pathfinder mission in 1997. The MSL vehicle's aeroshell also was much larger than Pathfinder's (4.5 meters Vs. 2.65 meters), the craft itself was five times heavier, and its entry included the first-ever guided lifting trajectory attempted at Mars — all conditions expected to result in the highest heat flux and shear stress ever faced by a vehicle's heatshield at Mars. These increases drove MSL to use a heatshield material never before flown to Mars. All of these new vehicle and mission features made MSL's heatshield the perfect one to instrument.

Because the Martian atmosphere is primarily composed of carbon dioxide at about 1⁄100 the pressure of Earth's atmosphere, design and testing of the entry system to withstand such environments relies primarily on simulation tools. As a consequence, the MSL spacecraft was designed with large safety margins at the cost of payload mass. The results of the MEDLI experiment will help NASA ensure these margins are correctly sized on future missions, enabling more robust robotic studies and, in time, human journeys of discovery on Mars.

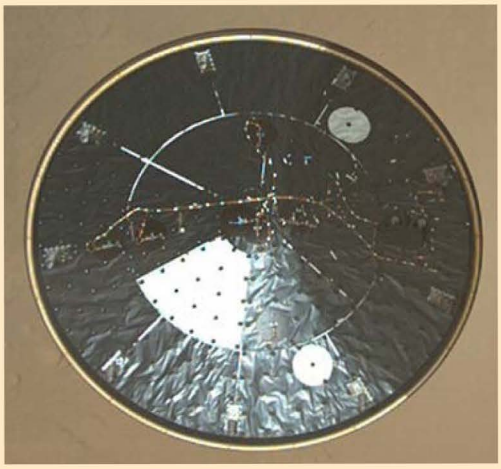
Two types of data

The MEDLI suite included two kinds of instruments, with seven sensors of each kind, in 14 locations on MSL's heat shield. These were all powered by and feeding data to a black box, the Sensor Support Electronics Unit.

One set of sensors, the Mars Entry Atmospheric Data System required seven tenth-inch diameter holes be drilled into the heat shield in a cross pattern. The holes were ports for pressure sensors that measured the atmospheric pressure on the heat shield at the seven MEADS locations during entry and descent.

NASA performed extensive testing in arcjet facilities on Earth to ensure the MEADS pressure ports

See reverse side



A job well done: The MEDLI instruments and wiring harness are clearly visible as the MSL heatshield falls away from the spacecraft after parachute deployment.

Key MEDLI Facts

- The MSL Entry, Descent & Landing Instrument suite was a first-of-its-kind instrumentation system on the Mars Science Laboratory.
- MEDLI measured the temperature and pressure of the spacecraft heatshield as it flew through the Martian atmosphere, delivering unprecedented data that is helping NASA build more efficient robotic and crewed Mars landers in the future.
- About a tenth of MEDLI's data was transmitted during entry and descent; the remainder was stored on the Curiosity rover, and communicated a few days after landing.
- MEDLI data helped generate the "tones" that told the operations team on Earth how the spacecraft was progressing through the Mars atmosphere. These tones would have provided critical forensic information in the event of an entry failure.