MEDLI2 FLIGHT HEAT FLUX SENSOR ENVIRONMENT AND PLANETARY PROTECTION TESTING.

G. T. Swanson[1], R. A. Miller[2], T. Oishi[3], J. A. Santos[4], G. N. Rutherford[5], K. A. Liles[5], C. A. Kuhl[5] D. E. Schreck[1], T. R. White[1], and H. S. Wright[5], [1]NASA Ames Research Center, [2]AMA Incorporated, NASA ARC, [3]Jacobs, NASA ARC, Sierra Lobo, NASA ARC, [5]NASA Langley Research Center

Brief Presenter Biography: Greg works on a variety of projects as part of the Entry Systems and Vehicle Development Branch at NASA Ames Research Center and is currently the MISP test lead for the MEDLI2 project. Greg received his Bachelors and Masters from the University of Idaho.

Introduction: Mars 2020 will fly the Mars Entry, Descent, and Landing Instrumentation II (MEDLI2) sensor suite consisting of a total of seventeen instrumented thermocouple sensor plugs, eight pressure transducers, two total heat flux sensors, and one radiometer embedded in the thermal protection system (TPS). Of the MEDLI2 instrumentation, eleven instrumented thermocouple plugs and seven pressure transducers will be installed on the heatshield of the Mars 2020 vehicle while the rest will be installed on the backshell. The goal of the MEDLI2 instrumentation is to directly inform the large performance uncertainties that contribute to the design and validation of a Mars entry system. A better understanding of the entry environment and TPS performance could lead to reduced design margins enabling greater payload mass-fraction and smaller landing ellipses.

The MEDLI2 total heat flux sensors and radiometer are new instruments that were not flown on the Mars Science Laboratory mission. These sensors directly measure the surface heat flux and radiation at specific backshell locations. The total heat flux sensors use a Schmidt-Boelter sensing element. The radiometer version uses a sapphire window placed over the Schmidt-Boelter sensing element to separate the radiative component of the total heat flux.

MEDLI2 recently planned and executed protoflight environmental testing as well planetary protection measures on the flight and flight-spare total heat flux sensors and radiometers. This testing is required to provide confidence in the performance of the flight-lot sensors when exposed to flight-like environments, and to reduce the risk of biological contamination on the planet of Mars with microbes from Earth.

The testing began with a pre-test calibration and time constant characterization of each sensor to provide a baseline performance to compare to post-test. After calibration each sensor was exposed to protoflight levels of random vibration and sine burst testing to simulate the launch environment. Next, the sensors were placed in a thermal vacuum chamber to accomplish three tasks; sensor bakeout, thermal cycling, and outgassing certification. Sensor bakeout was conducted to allow the sensors to outgas unwanted materials which reduces the possibility of contaminating other instruments on the spacecraft during flight. A temperature controlled quartz crystal microbalance (TQCM) was used to monitor the rate of outgassing. Once the TQCM reading reached steady-state, indicating that sensors had completed the majority of outgassing, the thermal cycling was begun. The thermal cycling stressed the test articles by cycling them between the maximum and minimum expected flight temperatures, including the protoflight margin specified by Mars 2020. At the end of the thermal cycling an outgassing certification was conducted to demonstrate that the sensors met the contamination control requirements. Finally, after the vacuum chamber testing the sensors underwent dry heat microbial reduction to reduce unwanted microbes and meet Mars 2020 planetary protection requirements. The sensors were then calibrated for comparison with the pre-test data.

This poster will provide an overview of the aforementioned MEDLI2 flight and flight spare sensor testing. Details of the protoflight environmental testing and the planetary protection procedures will be presented, and results of the testing will be discussed.