

OVERVIEW OF THE LOFTID INSTRUMENTATION SUITE. G. T. Swanson¹, C. D. Kazemba¹, R. A. Miller¹, J. D. Williams², S. J. Hughes³, F. M. Cheatwood³. ¹NASA Ames Research Center, ²AMA Incorporated at NASA Ames Research Center, ³NASA 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 Instrumentation Lead for the LOFTID flight demonstration project. He also spends a large part of his time supporting fabrication and testing of the HIAD aeroshell system. Greg received his Bachelor of Science and Master of Science degrees in Electrical Engineering from the University of Idaho.

Introduction: NASA's Hypersonic Inflatable Aerodynamic Decelerator (HIAD) technology has been selected for a Technology Demonstration Mission under the Science and Technology Mission Directorate and is currently scheduled to launch in FY22 [1]. HIAD is an enabling technology that can facilitate atmospheric entry of heavy payloads to planets such as Earth and Mars using a deployable aeroshell. The deployable nature of the HIAD technology allows it to avoid the size constraints imposed on current rigid aeroshell entry systems. This enables use of larger aeroshells resulting in increased entry system performance (e.g. higher payload mass and/or volume, higher landing altitude at Mars) [2].

The Low Earth Orbit Flight Test of an Inflatable Decelerator (LOFTID) will be launched out of Vandenberg Air Force Base as a secondary payload on the NOAA Joint Polar Satellite System-2's Atlas V Launch Vehicle. The flight test features a 6m diameter, 70-deg sphere-cone aeroshell and will provide invaluable high-energy orbital reentry flight data. This data will be essential in supporting the HIAD team to mature the technology to diameters of 10m and greater. Aeroshells of this scale are applicable to potential near-term commercial applications and future NASA missions.

LOFTID will incorporate an extensive instrumentation suite totaling over 150 science measurements. This will include thermocouples, total heat flux sensors, and a radiometer to characterize the aeroheating environment and aeroshell thermal response. An Inertial Measurement Unit (IMU), Global Positioning System (GPS), and flush air data system will be included to allow post-flight reconstruction of the vehicle trajectory including a decoupling of the aerodynamics from the atmospheric density. Loadcells will be used to measure HIAD structural response during entry, and cameras (both visual-spectrum and infrared) will be mounted on the aft segment looking at

the aeroshell to monitor structural deflection and surface temperature distribution. In addition to the primary instrumentation suite, a new Fiber Optic Sensing System (FOSS) will be used to provide global temperature distributions as a technology demonstration. The system will provide over 200 thermal measurements creating a thermal map for the backside of the nose Flexible Thermal Protection System. Another pair of FOSS cables will run along the rigid center structure and measure the temperature response to the vehicle wake environment. The LOFTID instrumentation suite leverages Agency-wide expertise, with hardware development occurring at Ames Research Center, Langley Research Center, Marshall Space Flight Center, and Armstrong Flight Research Center.

This presentation will discuss the instrumentation selected for LOFTID to capture the HIAD performance during the high-energy orbital reentry flight test and provide a current status of the flight instrumentation fabrication and testing.



Fig 1. Thermocouples and Heat Flux Gages Integrated with LOFTID Nose Insulation.



Fig 2. FOSS Installed between Insulation Layers on LOFTID Nose.

References: [1] Hughes S. et al., 16th IPPW, 2019.
[2] Cheatwood F. M. et al., IEEE Aerospace
Conference, 2016