OVERVIEW OF THE 6 METER HIAD INFLATABLE STRUCTURE AND FLEXIBLE TPS STATIC LOAD TEST SERIES. G. T. Swanson[1], C. D. Kazemba[2], R. K. Johnson[3], S. J. Hughes[3], A. M. Calomino[3], F. M. Cheatwood[3], A. M. Cassell[4], [1]ERC Incorporated, NASA Ames Research Center, Moffett Field, CA 94035 USA, [2]Science and Technology Corporation, NASA Ames Research Center, Moffett Field, CA 94035 USA, [3]NASA Langley Research Center, Hampton, VA, 23681, USA, [4]NASA Ames Research Center, Moffett Field, CA 94035 USA

Introduction: To support NASA's long term goal of landing humans on Mars, technologies which enable the landing of heavy payloads are being developed. Current entry, decent, and landing technologies are not practical for this class of payloads due to geometric constraints dictated by current launch vehicle fairing limitations. Therefore, past and present technologies are now being explored to provide a mass and volume efficient solution to atmospheric entry, including Hypersonic Inflatable Aerodynamic Decelerators (HIADs).

At the beginning of 2014, a 6m HIAD inflatable structure with an integrated flexible thermal protection system (TPS) was subjected to a static load test series to verify the design's structural performance. The 6m HIAD structure was constructed in a stacked toroid configuration using nine inflatable torus segments composed of fiber reinforced thin films, which were joined together using adhesives and high strength textile woven structural straps to help distribute the loads throughout the inflatable structure. The 6m flexible TPS was constructed using multiple layers of high performance materials to protect the inflatable structure from heat loads that would be seen during atmospheric entry. To perform the static load test series, a custom test fixture was constructed. The fixture consisted of a structural tub rim with enough height to allow for displacement of the inflatable structure as loads were applied. The bottom of the tub rim had an airtight seal with the floor. The centerbody of the inflatable structure was attached to a pedestal mount as seen in Figure 1. Using an impermeable membrane seal draped over the test article, partial vacuum was pulled beneath the HIAD, resulting in a uniform static pressure load applied to the outer surface. During the test series an extensive amount of instrumentation was used to provide many data sets including: deformed shape, shoulder deflection, strap loads, cord loads, inflation pressures, and applied static load.

In this overview, the 6m HIAD static load test series will be discussed in detail, including the 6m HIAD inflatable structure and flexible TPS design, test setup and execution, and finally initial results and conclusions from the test series.

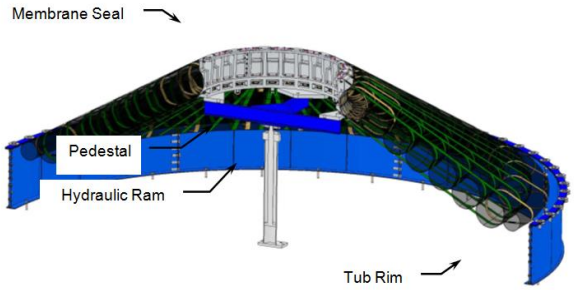

Figure 1. Cutaway view of the 6m HIAD static load test fixture

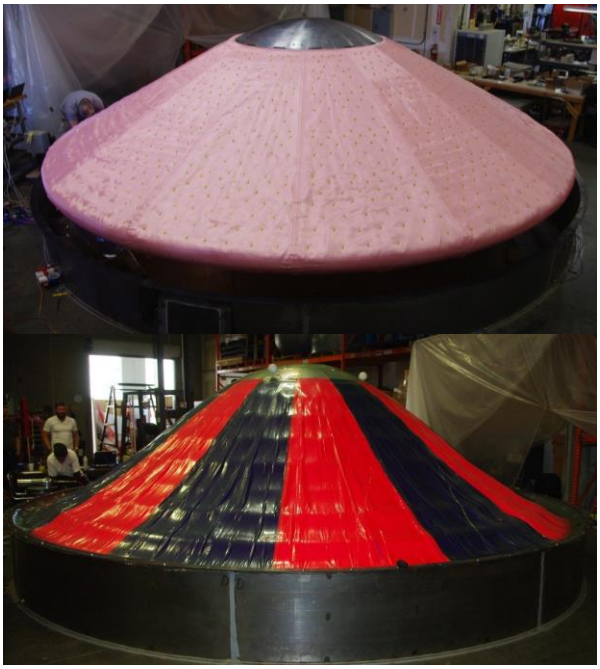

Figure 2. 6m HIAD with TPS (top), under 50,000 lbs of static load (bottom)