FABRICATION OF THE HIAD LARGE-SCALE DEMONSTRATION ASSEMBLY AND UPCOMING MISSION APPLICATIONS. G. T. Swanson[1], R. K. Johnson[2], S. J. Hughes[2], J. M. DiNonno[2], F. M. Cheatwood[2], [1]AMA Incorporated, NASA Ames Research Center, Moffett Field, CA 94035 USA, g.swanson@nasa.gov, [2]NASA Langley Research Center

Abstract: Over a decade of work has been conducted in the development of NASA's Hypersonic Inflatable Aerodynamic Decelerator (HIAD) technology. This effort has included multiple ground test campaigns and flight tests culminating in the HIAD project's second generation (Gen-2) deployable aeroshell system and associated analytical tools. NASA's HIAD project team has developed, fabricated, and tested inflatable structures (IS) integrated with flexible thermal protection system (F-TPS), ranging in diameters from 3-6m, with cone angles of 60 and 70 deg.

In 2015, United Launch Alliance (ULA) announced that they will use a HIAD (10-12m) as part of their Sensible, Modular, Autonomous Return Technology (SMART) for their upcoming Vulcan rocket. ULA expects SMART reusability, coupled with other advancements for Vulcan, will substantially reduce the cost of access to space. The first booster engine recovery via HIAD is scheduled for 2024. To meet this near-term need, as well as future NASA applications, the HIAD team is investigating taking the technology to the 10-15m diameter scale.

In the last year, many significant development and fabrication efforts have been accomplished, culminating in the construction of a large-scale inflatable structure demonstration assembly. This assembly incorporated the first three tori for a 12m Mars Human-Scale Pathfinder HIAD conceptual design that was constructed with the current state of the art material set. Numerous design trades and torus fabrication demonstrations preceded this effort. In 2016, three large-scale tori (0.61m cross-section) and six subscale tori (0.25m cross-section) were manufactured to demonstrate fabrication techniques using the newest candidate material sets. These tori were tested to evaluate durability and load capacity. This work led to the selection of the inflatable structure's third generation (Gen-3) structural liner. In late 2016, the three tori required for the large-scale demonstration assembly were fabricated, and then integrated in early 2017. The design includes provisions to add the remaining four tori necessary to complete the assembly of the 12m Human-Scale Pathfinder HIAD in the event future project funding becomes available.

This presentation will discuss the HIAD large-scale demonstration assembly design and fabrication performed in the last year including the precursor tori development and the partial-stack fabrication. Potential near-term and future 10-15m HIAD applications will also be discussed.

Figure 1. Large-Scale (top) and Subscale (bottom) HIAD Inflatable Structure Tori During Fabrication