National Aeronautics and Space Administration

Low-Earth Orbit Flight Test of an Inflatable Decelerator (LOFTID)

The Low-Earth Orbit Flight Test of an Inflatable Decelerator (LOFTID), dedicated to the memory of Bernard Kutter, program manager, is a partnership between NASA's Space Technology Mission Directorate and United Launch Alliance (ULA) to demonstrate an inflatable aerodynamic decelerator, or aeroshell, technology that could one day help land humans on Mars.

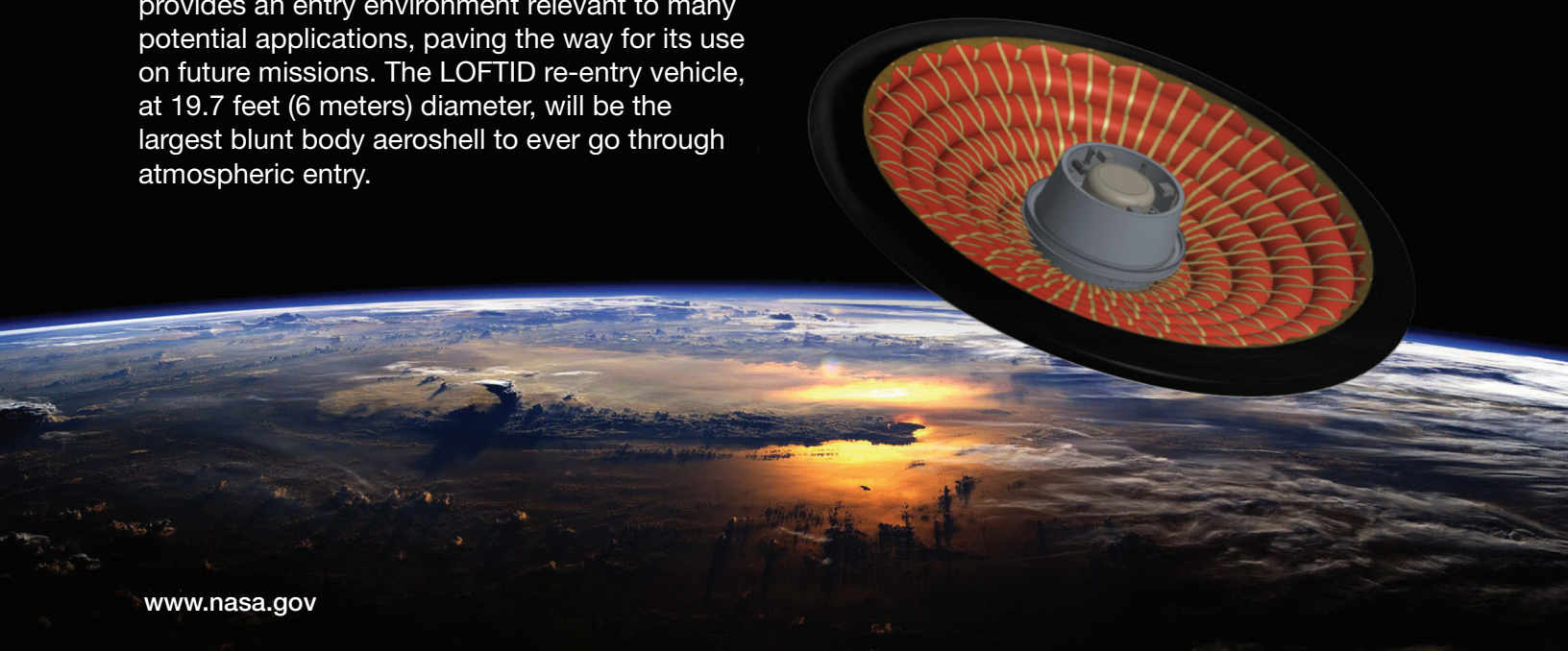
Since NASA's inception in 1958, the agency has relied heavily on rigid aeroshells (a protective shell composed of a heat shield and a back shell), parachutes, and retro-propulsion (rockets) to decelerate people, vehicles, and hardware during orbital entry, descent, and landing operations. The LOFTID demonstration is poised to revolutionize the way NASA and industry deliver payloads to planetary destinations with atmospheres.

A New Kind of Heat Shield

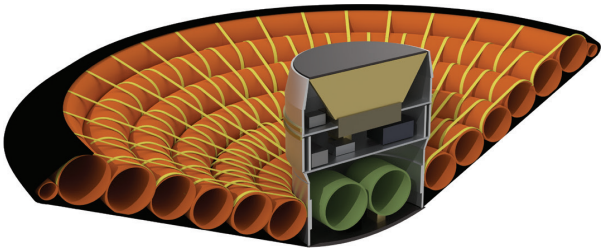
After more than a decade of development of Hypersonic Inflatable Aerodynamic Decelerator (HIAD) technology, including two suborbital flight tests, the LOFTID orbital flight test is the next step. This return from orbit demonstration provides an entry environment relevant to many potential applications, paving the way for its use on future missions. The LOFTID re-entry vehicle, at 19.7 feet (6 meters) diameter, will be the largest blunt body aeroshell to ever go through atmospheric entry.

When a spacecraft enters an atmosphere, aerodynamic forces, like drag, act upon it, slowing it down and converting its kinetic energy into heat. Using atmospheric drag typically is the most mass-efficient method to slow down a spacecraft. Since HIAD technology is larger than traditional aeroshells, it creates more drag and starts the deceleration process in the upper reaches of the atmosphere, allowing not only heavier payloads, but also landing at higher altitudes. It could additionally be used to bring an unprecedented amount of mass back from low Earth orbit, including items from the International Space Station. Another significant potential benefit is enabling the recovery of rocket assets for reuse which can reduce the overall cost of access to space.

The HIAD design consists of an inflatable structure that maintains its shape against the drag forces, and a protective flexible thermal protection system that withstands the heat of reentry. The inflatable structure is constructed with a stack of pressurized concentric rings, or tori, that are strapped together to form an exceptionally strong blunt cone-shaped structure.



The tori are made from braided synthetic fibers that are 15 times stronger than steel. The flexible structure and insulates it from the searing heat of atmospheric entry; it can withstand temperatures in excess of 2900°F (1600°C). It's constructed with three layers: an exterior ceramic fiber cloth



layer to maintain integrity of the surface, a middle layer of insulators to inhibit heat transmission, and an interior layer that prevents hot gas from reaching the inflatable structure. The flexible thermal protection system is also foldable, packable, deployable, and tailorable. Because it is flexible, it takes up less room in the rocket and allows the design to be scalable.

Mission Design

LOFTID is a secondary payload launching on a ULA Atlas V rocket from Vandenberg Space Force Base. After delivery of the primary payload, the National Oceanic and Atmospheric Administration's Joint Polar Satellite System-2 satellite, LOFTID is released and reenters Earth's atmosphere and decelerates from hypersonic, more than 25 times faster than the speed of sound, down to subsonic flight, less than 609 miles per hour. Throughout the flight, a real-time beacon periodically transmits limited data while sensors and cameras acquire a more comprehensive data set that is stored on an internal data recorder and an ejectable data recorder that is jettisoned and recovered after reentry. LOFTID will deploy a parachute to allow a soft splash down and will be retrieved from the Pacific Ocean with support from ULA and the Hawaii Resource Group.

The LOFTID project is sponsored by the Technology Demonstration Missions program within NASA's Space Technology Mission Directorate in partnership with ULA. LOFTID is managed by NASA's Langley Research Center in Hampton, Virginia, with contributions from NASA's Ames Research Center in California's Silicon Valley, NASA's Marshall Space Flight Center in Huntsville, Alabama, and NASA's Armstrong Flight Research Center in Edwards, California.