MediaBackground

National Aeronautics and
Space Administration

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Moffett Field, California 94035

NASA Engineers Test New Reentry Vehicle Shape

Early in the development of rockets and space vehicles, the conventional wisdom was to design sharp reentry vehicles to reduce atmospheric friction. This thinking changed in the 1950s when a NASA engineer, H. Julian Allen, theorized that a blunt body design would better survive reentry by creating a shock wave in front of a vehicle's heat shield, thereby reducing heat on the vehicle. Since then, every major reentry vehicle has employed Allen's design concept.

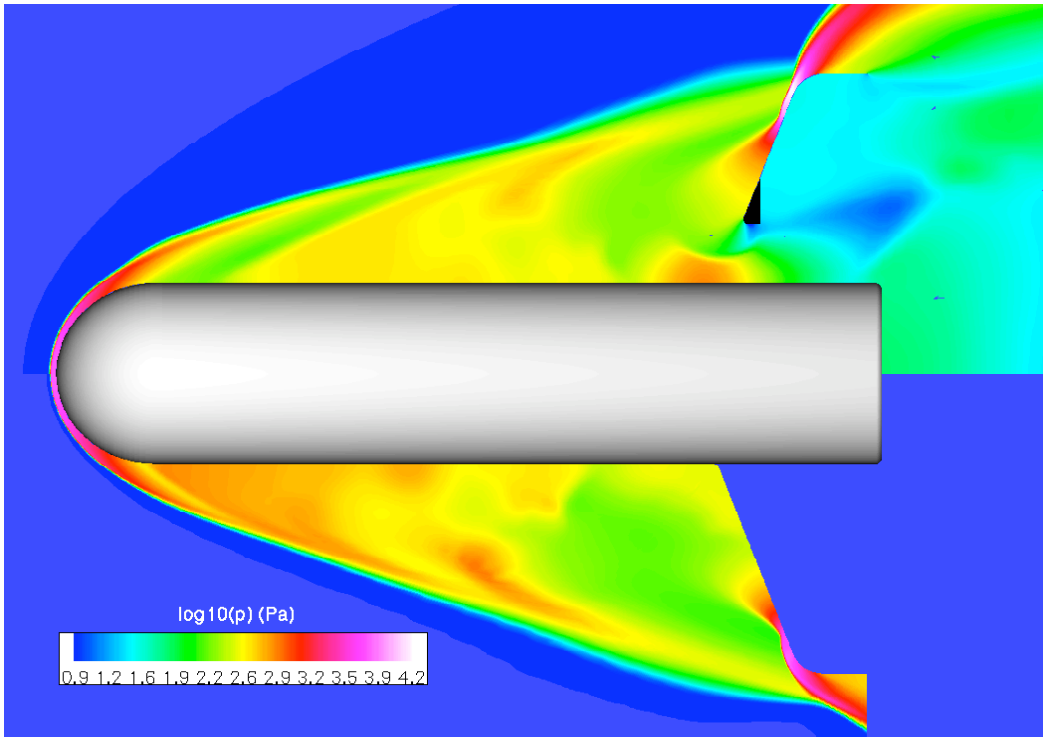
NASA is challenging the conventional wisdom again with a new reentry vehicle design that could lead to the development of lightweight, self-orienting, super-stable reentry probes. This Slotted Compression Ramp, or SCRAMP, design concept situates the payload in front of the heat shield. The concept originated with the Sub-Orbital Aerodynamic Reentry Experiments, or SOAREX, Project.

SOAREX is a multi-year hypersonic flight test development project at NASA's Ames Research Center at Moffett Field, Calif. It is funded by the Fundamental Aeronautics Program of NASA's Aeronautics Research Mission Directorate in Washington.

Image of the SOAREX SCRAMP probe. Credit: NASA

Hypersonic Badminton Birdie

The SCRAMP probe is analogous in design to a badminton birdie, with a slotted flare skirt attached to a spherical or blunt-nosed cylinder. This serves to push the center of gravity forward, providing nose-forward stability. The diameter of the flare skirt is larger than the diameter of the cylinder nose. During reentry, both the flare skirt and the cylinder nose will produce shock waves. The bow wave produced by the cylinder nose will collide with a larger, stronger wave produced by the flare-



Computational Fluid Analysis of the flow around the SCRAMP probe with and without a slot in the flare. The top half of the image shows the flow with a slot, and the bottom half shows it without. Blue indicates lower temperatures and pressures. Credit: M. Wright

skirt. A slot around the inner circumference of the skirt will permit the thin layer of air next to the vehicle -- called the boundary layer -- to be swallowed, leading to the interaction between the shock waves. This interaction and resulting redirection of energy creates sufficient drag to slow down and stabilize the vehicle during reentry.

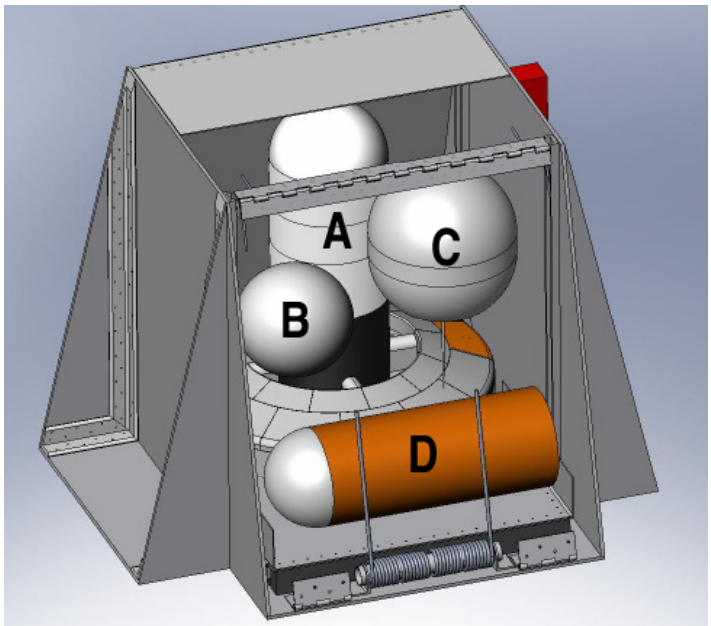


Illustration of the SOAREX Payload Ejection System. A: SCRAMP Probe, B: Atmospheric Calibration Probe, C: Naval Research Lab Probe, D: Ballast. Credit: NASA

Hot Flight Test

SCRAMP's launch will be the first hot flight test of the design. Overlapping heat shields, new flush-mounted sensors and small inexpensive transmitters will be tested in conditions that approximate atmospheric entry from orbit around Mars. This design could be used in the future for small Mars science missions that can take advantage of excess payload capacity in a launch vehicle.

The probe will be launched atop the Alliant Techsystems, or ATK, ALV X-1 suborbital rocket, along with NASA's Hypersonic Boundary Layer Transition, or HYBOLT, experiment, and a payload designed by the U.S. Naval Research Laboratory.

HYBOLT will operate for approximately 75 seconds after liftoff, then detach from the rocket to expose the SOAREX experiment complement. A payload ejection system will deploy SCRAMP, an instrumented sphere that will take atmospheric measurements at the time of release, and the Navy experiment.

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