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IN-FLIGHT PERFORMANCE OF THE SUPERSONIC PARACHUTE EXPERIMENT ABOARD
REXUS (SPEAR) VEHICLE**Abstract**

The primary objective of the Supersonic Parachute Experiment Aboard REXUS (SPEAR) was to fly and collect in-flight data of a Hemisflo ribbon parachute at supersonic conditions. In November 2022, the SPEAR vehicle was successfully launched on top of the REXUS 28 sounding rocket from Esrange in Sweden. Shortly after the REXUS 28 apogee at 95.7 km, the SPEAR vehicle was ejected from the rocket. During descent, the Hemisflo ribbon drogue parachute was deployed near Mach 3 and successfully decelerated the free-falling unit to a subsonic velocity. An anomalous main parachute deployment resulted in a hard landing, however the vehicle was successfully retrieved, along with the onboard data. The SPEAR vehicle was equipped with several instruments: an inertial measurement unit, a static pressure sensor, an upward looking camera, and three load cells. The data from these four instruments allows for a reconstruction of the flight events and performance evaluation of each subsystem. This paper provides an overview of the SPEAR flight results, a discussion on the performance of the different subsystems, and finally an analysis of the measurements taken during flight. Thereby this paper aims to expand on the little literature available on the design of free-falling vehicles for supersonic parachute testing. From these results, several conclusions and recommendations are made for the design and operation of future parachute test vehicles or free-falling units in general.