# VENUS MOBILE EXPLORER (VME): NEAR-SURFACE TRAVERSING WITH METALLIC BELLOWS

**TIBOR BALINT[1], JEFFERY HALL[1], VIKTOR KERZHANOVICH[1], LORI GLAZE[2], CHARLES BAKER[2], MICHAEL ADAMS[2], MICHAEL AMATO[2], ANDREW JONES[2], GABRIEL KARPATI[2]**

*[1]Jet Propulsion Laboratory, California Institute of Technology*
*[2]NASA's Goddard Space Flight Center*
*e-mail: tibor.balint@jpl.nasa.gov*

## ABSTRACT

In support of the National Research Council's (NRC) 2010 Planetary Decadal Survey (DS), NASA Headquarters commissioned the Goddard Space Flight Center (GSFC) to perform a Venus Mobile Explorer (VME) study for the DS Inner Planets Panel. The VME mission concept's science objectives required the characterization of surface composition and mineralogy at two different locations within the highlands region of Venus. The measurements are expected to constrain models of the planet's origin and evolution.

Access to the surface at two locations, separated by several kilometers, is best achieved with an aerial mobility platform that can tolerate the local extreme environmental conditions, where the temperature and pressure of the corrosive supercritical $CO_2$ atmosphere vary from 447°C to 424°C, and 81 bar to 67 bar, respectively, from the surface up to 3 km altitude. Consequently, the study team recommended a metallic bellows system, adopted from the multi-stage balloon concept of a future Venus Surface Sample Return mission. The innovative design of the gondola, surrounded by a toroidal helium tank and capped by the stowed metallic bellows allows for a compact and volume efficient packaging inside the aeroshell. While in situ, the helium inflated metallic bellows system is sized to support the mass of the gondola, which consists of a passive thermal controlled pressure vessel that houses the science payload and subsystems.

From a bellows operational point of view, following atmospheric entry, the VME would descend to the surface in about an hour, with the bellows stowed. At the initial landing location following a 30 minutes science investigation, the bellows would inflate in about 5 minutes and ascend to a float altitude of ~3 km above the surface, leaving the empty helium tank and connected inflation system on the surface. The bellows system would enable high spatial resolution near infrared mapping of the surface over its ~8 to 16 km float path, riding the low altitude winds. The gondola would be released after 220 minutes of traverse over the second landing location, concluding the bellows system's intended functions.

This paper focuses on the design and sizing of the metallic bellows and inflation systems, including the helium tank, pyro and control valves, and fill lines. These are discussed in the context of the key bellows operational phases, from atmospheric entry, through landing, inflation, ascent to float altitude and buoyancy, aerial traverse, to gondola release at the second landing location. The overall mission description will be given in a companion paper.