Unibody Composite Pressurized Structure

John H. Glenn Research Center, Cleveland, Ohio

An integrated, generic unibody composite pressurized structure (UCPS) combined with a positive expulsion device (PED), consisting of an elastomeric bladder for monopropellant hydrazine, has been quasi-standardized for spacecraft use. The combination functions as an all-composite, non-metallic, propellant tank with bladder. The integrated UCPS combines several previous innovations — specifically, the linerless, all-composite cryogenic tank technology; all-composite boss; resin formulation; and integrated stringer system. The innovation combines the UCPS with an integrated propellant management device (PMD), the PED or bladder, to create an entirely unique system for in-space use.

The UCPS is a pressure vessel that incorporates skirts, stringers, and other structures so that it is both an in-space hydrazine tank, and also a structural support system for a spacecraft in a single, all-composite unit. This innovation builds on the progress in the development of a previous SBIR (Small Business Innovation Research) Phase I with Glenn Research Center and an SBIR III with Johnson Space Center that included the fabrication of two 42-in. (≈107-cm) diameter all-composite cryogenic (LOX and liquid methane) UCPS test tanks for a lunar lander. This Phase II provides hydrazine compatibility testing of the elastomeric bladder, a see-through PED to validate the expulsion process and model, and a complete UCPS-based PED with stringers and skirts that will be used to conduct initial qualification and expulsion tests. This extends the UCPS technology to include hydrazine-based, in-space propulsion applications and can also be used for electric propulsion.

This innovation creates a system that, in comparison to the traditional approach, is lower in weight, cost, volume, and production time; is stronger; and is capable of much higher pressures. It also has fewer failure modes, and is applicable to both chemical and electric propulsion systems.

This work was done by Markus Rufer, Robert Conger, Thomas Bauer, and John Newman of Microcosm, Inc. for Glenn Research Center. Further information is contained in a TSP (see page 1).

Inquiries concerning rights for the commercial use of this invention should be addressed to NASA Glenn Research Center, Innovative Partnerships Office, Attn: Steven Fedor, Mail Stop 4–8, 21000 Brookpark Road, Cleveland, Ohio 44135. Refer to LEW-19042-1.