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DEVELOPMENT OF LARGE HIGH PRESSURIZED XENON TANK FOR ELECTRICAL PROPULSION SYSTEMS

Abstract

The commercial satellite market is currently experiencing a major upheaval. In that course of, new large satellites in medium and geostationary earth orbits are no longer foreseen with Chemical Propellant Systems but rather with Electric Propulsion (EP). Next generation Satcom platforms, such as Electra and Neosat, are even equipped with full EP systems. As a result, vast amounts of Xenon (up to 1500 kg) must be reliably stored under high pressure and faces to a set of challenging requirements and constrains. In parallel, significant reaction forces and cycling loads acting during launch and in-orbit phases. In order to satisfy these demands, MT-Aerospace has developed a "Large Xenon Tank Assembly" (L-XTA). The L-XTA represents a low-mass, high-performance pressure vessel, which enables a maximum degree of flexibility over a large volume range of 300-900 liters. Conception and verification of the L-XTA has been performed under consideration of all relevant launch vehicles and under close collaboration with multiple European primes as well as satellite operators. Due to the comprehensive relevant heritage and sophistication of the applied fracture mechanics analysis as well as the state-of-the-art non-destructive inspections (NDI) and welding methods, the wall thickness of the titanium liner is minimal. Accordingly, the liner comprises less than 20 percent of the overall tank mass, yet remains compliant with "safe life" requirements as specified in respective international standards. Special feature of the composite over-wrapped metallic liner (COPV) is an integral equatorial composite skirt. It is machined to provide lugs, which enables both high dimensional tolerances as well as ease of integration to the interfacing satellite structure. The paper provides an overview of the tank design with its main functional characteristics, the driving design constrains and requirements as well as the manufacturing approach. It outlines main parts of the development process and the qualification campaign. Finally, significant advantages of this developed one-tank-solution compared to a multi-tank approach are summarized. The L-XTA demonstrates a low-mass COPV for large Xenon amounts and for a wide range of satellite applications. It optimally satisfies the end-user requirements, including both technical and economic aspects, while remaining fully compliant to ECSS guidelines.