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ADVANCES IN THE DEVELOPMENT OF A LOW MASS LOW POWER HIGH-FLOW REGULATION VALVE FOR SATELLITE ELECTRIC PROPULSION

Abstract

Electric propulsion for satellites is a major breakthrough in platform architecture. Compared to chemical propulsion, it offers propellant mass savings and higher thrust efficiency resulting in a significant reduction of the satellite mass and size, hence of the satellite costs. Most small satellites constellations in Low Earth Orbiting launched or planned have already chosen to be equipped with electric thrusters with a system power of 10 to 100 W. Recently, more powerful thrusters ranging from 1kW to 5kW are in development to equip larger satellites for Medium and Geostationary Earth Orbits. Therefore larger flow management systems are required to feed the thrusters at high mass flow rate, while maintaining mass, encumbrance and costs as low as possible.

In this challenging context, Air Liquide Advanced Technologies (ALAT) is developing a new miniaturized high-flow regulating valve compatible with Xenon, Krypton and cold gas. This new regulating valve based on thermal expansion, called High-Flow Multi-Function Valve (HF-MFV), inherits from the past developpements with the French Space Agency CNES support. This new HF-MFV is being designed to deliver an accurate operating range of mass flow rate [0-25] mg/s Xenon mass flow rate at the lowest End Of Life Pressure tank pressure possible. Enabling a large mass flow rate at a very low upstream pressure is one of the most critical operating points, which is required for the satellite deorbiting.

First, this paper describes the development process of the miniaturized Xenon Krypton high-flow regulating valve valve, focusing on its robustness, miniaturization, tightness, very-low power and performance. Then, results of preliminary performance and environment tests will be detailed in order to emphasize the main advantages of the new high-flow valve. Finally, we will address the remaining development steps required to achieve a Technology Readiness Level 6.