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DEVELOPMENT OF A BIPROPELLANT HTP - PROPANE PROPULSION SUBSYSTEM FOR EARS (EUROPEAN ADVANCED REUSABLE SATELLITE) PROGRAM.

Abstract

EARS is a Horizon Europe program funded by the European Commission that lays the basis for a European reusable satellite that carries scientific and commercial payloads to orbit and then safely retrieves them back on Earth. The leading entity is the National Research Council of Italy. The other partners are Kongsberg Nanoavionics, Von Karman Institute, Deimos, the University of Padova and T4i - Technology for Propulsion and Innovation. T4i contribution to the program is the development of a High-Test Peroxide (>90%) and propane propulsion subsystem that de-orbits the spacecraft, using differential steering to keep aligned the thrust with the velocity direction. A gaseous propane fed Roll Control System (RoCS) has been included in the system to account for the roll motion around the principal thrust axis of the satellite, complementing the differential steering work performed by the main thrusters. The propulsion subsystem is composed of 4 identical modules that are installed in the aft section of the satellite. Each of the modules is composed of a propane tank, a HTP tank, one bipropellant thruster, two cold gas nozzles, fluidics, and an electronic board. The propane vapor pressure is used to self-pressurize the whole system, simplifying the architecture and eliminating the use of a third fluid as pressurant. A discharge code was developed to simulate the behavior of the fluidic system from tanks to thruster. Different geometrical and thermophysical aspects have been considered, including pressure losses due to both vaporization of propane and the passage through valves and orifices at different tank starting temperatures and pressures. The key strategy drawn from the simulations is to spill gaseous propane to feed the RoCS nozzles and to spill liquid propane to feed the engines. Employing this solution lowers the amount of power to be given to the propane tank to sustain the whole discharge inside the expected propane temperature range. After considerations on the depth and entity of the fluidic discharges, the physical layout of the propulsion subsystem was drafted, and the fluidic ground support infrastructure was designed, built, and tested to perform the testing campaign of the main thruster.