IAF SPACE PROPULSION SYMPOSIUM (C4)
Propulsion Technology (3) (10)

Author: Mr. Felipe Juan Dengra Moya
ArianeGroup, Germany

FLPP3: TEST RESULTS OF FULL ELECTRICALLY ACTUATED ENGINE VALVES

Abstract

Future designs of launchers ask for an electrification of their components, especially valves. Direct advantages of the use of full electrically actuated valves at launcher level are:

- a more optimized engine tuning management all along the flight - a decrease of the amount of unburned propellants - very low thrust phases - smoother transient behaviors of engines - extended life cycles and higher reliability - the removal of the complete helium command system

In the frame of FLPP3, a new LOx/LH2 expander closed cycle upper stage engine is currently being developed: ETID (Expander Technologies Integrated Demonstrator). ETID delivers 115 kN of vacuum thrust and is performing with a vacuum Isp of 457 seconds in its reference point. Thrust regulation spans from 95The flow control management of this engine relies on a set of 6 electrically actuated valves, which were designed until a PDR maturity level. Two of them, the OCV (Oxygen Chamber Valve) and the TCV (Thrust Control Valve) were chosen to be further developed. They have been manufactured and have undergone a development test phase. With this choice, a representative shut-off valve (OCV) and a representative regulation valve (TCV) were made available for the verification of the complete set of technological requirements of all six valves at engine level. The valves' principle of operation is based on the use of a fully redundant brushless motors fed by a DC (Direct Current) voltage level of 55 Volts, which is the level available at launcher level. Advanced technology materials for the main seat, the dynamic seals, the rotational-to-translational movement transmission element and for the bearings have been used. The development of these valves have led to an important reduction of mass and recurring time with respect to the engine valves currently being flown in European upper stage engines thanks to the use of ALM (Additive Laser Manufacturing) parts and the compact coaxial valve design using a high integration of mechanical and electrical parts.

The final paper will show the results of the development tests performed for these two valves. The complete test campaign included pressure tests, internal and external leakage tests, thermal cycling, functional tests, vibration tests and redundancy/failure management tests. Very stringent requirements were set on the mass flow accuracy conditions, failure modes management and safety conditions.