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OVERVIEW OF VALVE DEVELOPMENTS AT ŁUKASIEWICZ-ILOT

Abstract

In recent years, Łukasiewicz Research Network - Institute of Aviation (Łukasiewicz- ILOT) has successfully completed two projects regarding the development of thruster valves and a latch valve, funded by ESA. Within the two projects, total of three valves were designed and tested, bringing the technology for each valve up to TRL 4. The following paper aims to provide an overview of the designs, performance, testing capabilities, and further activities.

The projects were initiated by ESA and ILOT to develop cost-effective valves with robust performance, capable of operating with both standard and green propellants. Additionally, it was of prime interest to design valves that are not subject to International Traffic in Arms Regulations (ITAR-free), making them easily accessible to all integrators around the world.

The first project, called 1N Monopropellant & 10N Bipropellant Dual Seat Thruster Valve Development (DSVD), involved the design and testing of two valves. The engineering effort focused on the design of solenoid valves with a PTFE seal offering great compatibility with a wide range of propellants (both standard and green) and with a non-sliding fit armature to ensure reliable operation for a vast number of cycles (over one million were proven).

Simultaneously, the Dual Flow Bipropellant Latching Valve Development project (DLVD) was being carried out. In principle, it involved the design and testing of a solenoid valve, where two separate lines (for fuel and oxidiser) are operated by a common actuator. The development process led to a construction with slightly pressure unbalanced poppets, a PTFE seal, and a 300-series stainless steel interior, offering back pressure relief capabilities through the main seats and enhanced compatibility.

Eventually, the three valves were manufactured in the form of breadboard models with representative functionality and were subjected to extensive test campaigns to confirm their performance and capabilities over a wide range of operating parameters. The test campaign included thorough characterisation of functional parameters under different operating conditions as well as resilience to extensive cycling, dynamic pressure conditions, vibration loads, and non-operating temperatures. Ultimately, the achievement of TRL4 for all three valves was confirmed as robust functional performance had been proven.

Currently, ILOT is planning to increase the technology level to the TRL 6 for DSVD and DLVD valves. Extensive efforts regarding design optimisation, manufacturing qualification, and full qualification test campaigns at the component level are foreseen.