

SPACE PROPULSION SYMPOSIUM (C4)
New Missions Enabled by New Propulsion Technology and Systems (6)

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TEST ACTIVITIES ON HYBRID MOTOR DEMONSTRATOR FOR LANDER MODULE SYSTEM

Abstract

In order to support and promote the consolidation and the evolution of competences in the field of propulsion disciplines by the national scientific and industrial community, ASI has structured a national program of research and development activities named THESEUS (Thruster Evolution for Space Exploration and Upper Stages) for the development of technologies that could have their application in the field of traditional launchers or in the frame of space exploration. The line that is going to be presented in this paper is the one aimed to realize a highly throtttable and re-ignitable engine demonstrator in the class of 10kN of thrust, having its possible application as lander module thruster for moon or planetary exploration. In particular, the motor demonstrator adopts hybrid propulsion (solid fuel and liquid oxidizer) in order to advance to TRL = 4 its technological status, acquiring at the same time knowledge about all main technical aspects of this type of propulsion. To achieve the objective, the following high level main reference goals have been selected: N₂O-HTPB as oxidizer-fuel combination, thrust range 10 kN, re-ignition capability, modular thrust ratio 1:5. AVIO designed the Hybrid Motor Demonstrator (HMD) basing on propaedeutic test campaigns for oxidizer-fuel and thermal protection materials characterizations performed by AVIO and DIAS – University of Naples. The resulting motor is mainly constituted by Loaded Motor Case, injection system, ignition system, nozzle assy and ancillaries interface elements. In summer 2015, AVIO has performed the HMD test campaign in the test stand expressly realized for it. The HMD development included: Injector functional test, Injection System leak and cold test, Combustion Chamber proof test, Ignition System firing test. HMD Hot Firing Test plan was articulated in three nominal phases: short and long duration tests with nominal thrust, and test with reduced (1:5) thrust. First two tests were performed cumulating 28 second of combustion firing time. The data acquired with these tests were sufficient to verify: the re-ignition capability, the motor performance, the regression rate of fuel grain, the behavior of N₂O oxidant, the stable combustion of HTPB-N₂O propellant combination. After the second firing test, a major defect was revealed during nominal HMD inspection: even if no external damage has been found on HMD metallic part nor on test stand, a consumption of motor thermal protection strongly higher than expected was detected. Due to the impossibility to perform in safe conditions the last tests scheduled, the campaign was interrupted.