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TEST RESULTS FROM THE ALL ADDITIVELY MANUFACTURED PROMETHEUS TURBINE

Abstract

The Prometheus program aims at breaking new ground for turbine design and manufacturing. The use of additive manufacturing (AM) technology is identified as a key technology and will for the first time be used for a European turbine in a hot fire engine test. The Prometheus program includes design, manufacturing and testing of a fully AM manufactured turbine for space application using selective laser melting (SLM) in alloy 718. The Prometheus program also include technology activities supported in part by ESAs FLPP program, which are aiming at preparing this technology step, run in parallel to the turbine design and manufacturing. Such activities include material characterization testing, manufacturing process development, test builds, material cut-up and post build process evaluations. The Prometheus engine is new ultra low cost engine of gas generator (GG) type driven by liquid methane (CH4) as fuel and with liquid oxygen (LOX) as oxidizer. The turbine and pumps are all mounted on one shaft in a vertical configuration. The paper aims to show and discuss the results from material testing (tensile, fatigue and crack propagation) and component burst testing (rotor spin and manifold pressure). The turbine design is based on existing material data from traditional material forms and it is herein discussed the accuracy of predictions of burst levels and the expected part life is impacted by the results from material testing. The Paper will report on the following activities: • Results of material test • Evaluation of impact from material test • Results from spin burst test • Results from pressure burst test • Evaluation of accuracy of burst test