

66th International Astronautical Congress 2015

SPACE PROPULSION SYMPOSIUM (C4)
Propulsion System (1) (1)

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RESULTS OF LE-X ENGINE TECHNOLOGY DEMONSTRATION

Abstract

JAXA is now developing next Japanese flagship launch vehicle called as H-X. To mitigate development risks of 1st stage engine, technology demonstration program was conducted from 2010 to 2014. LE-X is the name of technology demonstrator engine. This paper reports LE-X engine design and technology demonstration results. LE-X is expander bleed cycle engine with cryogenic LOX/LH2 propellants. In this cycle, a portion of high pressure hydrogen pumped by fuel turbomachinery is directed to the main combustion chamber cooling channels and then used to drive turbines. This cycle doesn't have gas generator or preburner, so it's simpler than gas generator cycle or staged combustion cycle. This simpleness can provide potential of low manufacturing cost and intrinsic safety. Expander bleed cycle has been applied to 2nd stage engine of current Japanese flagship launch vehicle. But, it has not been applied to 1st stage engine in the world, because turbine driving power is weaker than gas generator cycle or staged combustion cycle. LE-X program was challenge to apply expander bleed cycle to 1st stage engine. The preliminary design of engine system was performed at early phase of LE-X program. Main Combustion Chamber (MCC) and Fuel TurboPump (FTP) were recognized as a potentially high risk component. MCC is the energy source for the turbine drive power, and FTP is one of the main drivers of engine performance. At the middle phase of LE-X, several elementally tests and high fidelity simulation especially on MCC and FTP were performed. At the last phase, full scale MCC firing tests and full scale FTP tests were performed. Based on these tests and simulation results, feasibility of expander bleed cycle for 1st stage engine was confirmed by engine analysis at the end of LE-X program.