

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

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DESIGN AND DEVELOPMENT STATUS OF LE-9 ENGINE FOR H3 LAUNCH VEHICLE

Abstract

JAXA is developing H3 launch vehicle for next Japanese flagship rocket since 2014. The concepts of H3 are less launch price, higher reliability and more flexible launch schedule than the current flagship launch vehicle, H2A and H2B, in order to be more competitive in the international launch market. LE-9 is the first stage engine of H3. LE-9's propellants, thrust, Isp, weight, cost are LOX/LH₂, 1471kN, 425s, 2410kg and half of the current Japanese first stage engine, respectively. To archive the H3 concept, LE-9 has several unique features. The most important feature is engine cycle; expander bleed cycle. Number of components in this engine cycle is less than other cycles, so this cycle can reduce manufacturing cost, enhance intrinsic reliability and simplify checkout procedure before flight. Expander cycle historically can't be adopted to booster engines due to its weaker turbine driving power than other cycle, but expander bleed cycle which is Japanese unique open expander cycle makes it possible. Another feature is electrically actuated valves. Its opening position and engine operating point can be controlled during acceptance firing test. This can reduce number of test comparing with conventional control methods of engine operating points by orifices, and can reduce acceptance test cost. Another feature is new manufacturing technology. Several technologies are applied to LE-9 in order to reduce manufacturing cost, for example HIP brazing for the main combustion chamber and open impellers for the turbopumps. Additive manufacturing technology also is applied for pipes etc. New design approach based on probability design analysis is also applied to LE-9. This approach can enhance reliability in flight and prevent schedule and cost overrun in development phase. LE-9 development was started in 2014 and will be completed in 2020. First firing tests will be conducted at Tanegashima island in this Spring. The manuscript will describe overview of LE-9 design and development status.