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QUALIFICATION TEST RESULTS OF LE-9 ENGINE FOR H3 LAUNCH VEHICLE

Abstract

The H3 Launch Vehicle, Japanese new mainstay launch vehicle, has been developed since 2015 and its maiden flight was successfully completed in Feb. 2023. Key concepts of H3 are reliability, affordability, and high performance to become more competitive in the international launch market than Japanese current mainstay launch vehicles, H-IIA and H-IIB. Booster engine of H3, called LE-9, is based on Japanese technological heritages: high thrust engine technologies of LE-7A, current booster engine, and expander cycle technologies of LE-5B, their upper stage engine. Based on these technologies LE-9 achieves the first high thrust expander cycle engines in the world. Expander cycle is simple and robust cycle, so it has potential of low cost and high reliability, but it is usually difficult to apply expander cycle to high thrust engines because expander cycle is relatively powerless. LE-9 solves this problem by adopting expander “bleed” cycle. Expander bleed cycle is Japanese unique technology now realized only in LE-5B; current Japanese upper stage engine. Some key features of LE-9 engine were demonstrated through LE-X technology demonstration program (2008 - 2014). After this program development of LE-9 engine started in 2015. In Bread Board Model (BBM) phase, failure modes and risks were identified and mitigated by elementary tests and full-scale components tests. In Engineering Model (EM) phase, Four EM engines were produced for firing tests to validate start sequence, engine performance, durability, and others in a wide range of operations. In the latter part of EM phase, additively manufactured components, e.g. injector, pipes and valve casing, were tested, and its feasibilities were confirmed. In Qualification Model (QM) phase, two engines have been tested to verify and certify all engine specifications. After QM phase, a static firing test with flight engines for maiden flight was conducted at launch pad to comprehensively verify vehicle and grand facility. Finally maiden flight of H3 launch vehicle with LE-9 engines is scheduled in Feb. 2023. In the congress qualification test results will be presented and engine characteristics obtained in the development will be discussed.