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KEYNOTE: DEVELOPMENT STATUS OF THE CRYOGENIC OXYGEN/HYDROGEN YF -77 ENGINE FOR LONG-MARCH 5

Abstract

Long-March 5 (CZ-5) is the next generation of China's Long-March launcher family. CZ-5 is the first launcher utilizing cryogenic and nontoxic propellants (LOX/liquid hydrogen, and LOX/ Kerosene) in China, which is entirely clean and environmentally friendly. CZ-5 is powered by four Oxygen/Kerosene boosters, two high-thrust LOX/LH2 YF-77 engines on the core stage, and two LOX/LH2 expender cycle YF-75D engines on the second stage. Compare to the former Long-March launcher, CZ-5 has significantly more lift capability which can deliver a payload of 14,000 kg to Geosynchronous Transfer Orbit (GTO) and 25,000 kg to Low Earth Orbit (LEO). The YF-77 engine is the first booster rocket engine in China with cryogenic Oxygen/Hydrogen. The YF-77 engine utilizes a gas generator cycle and each engine has a thrust rating of 700-kN in vacuum at an oxidizer-to-fuel mixture ration (O/F) of 5.5. The YF-77 engine is the first high-thrust cryogenic engine developed in China, which presented a big challenge. It takes a big technological step with respect to previous Chinese cryogenic Oxygen/Hydrogen engine, such as YF-75 which powers CZ-3A/3B's upper stage, with a factor of 9 on thrust, a factor of 2.7 on pressure, a factor of 9 on mass-flow rate, and a major increase in scale. The YF-77 engine is based on China's 40-year cryogenic engine development legacy and makes use of the technical experiences acquired through prior engines. Furthermore, three-dimensional modeling and a wide array of numerical analysis and design tools are implemented, which progressing the development project and shortening the development time. The YF-77 provides both high performance and high reliability to meet the requirements of launcher. In January 2002, The Commission of Science, Technology and Industry for National Defense (COSTIND) approved the development of a new cryogenic engine—the YF-77, which was the most powerful cryogenic LOX/LH2 engine ever developed in China. The engine development program is under responsibility of Beijing Aerospace Propulsion Institute (BAPI), a division of the Academy of Aerospace Launch Propulsion Technology (AALPT).