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DEVELOPMENT OF PROPULSION SYSTEM FOR CHINA CHANG'E 5 LUNAR PROBE

Abstract

After 17 days flight and lunar surface operation, the return module of China Chang'e 5 lunar probe carried with the rare lunar rock and soil landed successfully on the Earth in December 2020. An unprecedented complex propulsion system including three subsystem located in orbiter module, descend module and ascend module respectively was developed for probe to undertake all propulsion function including orbit transfer and adjustment, braking, lunar soft landing, lunar ascending, rendezvous and docking, ejection, etc. The paper discussed the development and key technologies of the propulsion system, the most complicated one of like conduct in China.

To accomplish the challenging mission, high requirements to propulsion system were put forward from probe. Light-weight is essential for probe feasible concept under launch ability restrict. High performance, including impulse specific of main engines and propellant residual, were expected. Besides, the enough reliability also should be ensured for so high-risk mission, although the propulsion system complexity is greatly exceeded the like product, for example the Chang'e 3, and faced with the higher temperature environment in lunar surface than earth orbit ever.

Helium regulated pressured unified Bi-propellant propulsion system with MMH and MON-1 propellant was adopted. Many necessary new products were developed, and many technology improvements were conducted to meet the rigorous requirements. A 3000N main engine with impulse specific above 312s was specially designed for orbiter module and ascend module. The higher impulse specific requirement for 7500N throttling engine mounted in descend module was proposed. A lighter helium bottle was successfully developed with new fiber resin system. Lighter weight surface tension tanks in orbiter module and descend module were developed because the relatively large volume, and higher strength metal was used in ascend module diaphragm tanks shell manufacture. All attitude control engines were designed elaborately based on original product by discarding unnecessary part, and lighter miniaturized solenoid valves were developed. Compared with previous, 15

On the basis of elaborate design and strict quality management, the propulsion system operated perfectly without any malfunction in the whole flight.