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REUSABLE ROCKET ENGINE AND IT'S TRIBOLOGICAL SUBJECTS

Abstract

A fully reusable sounding rocket is proposed in JAXA/ISAS to provide frequent opportunities for atmospheric observation mission with low cost and with short turnaround time, and also to improve technology readiness levels for reusable space transportation systems. This rocket will take off vertically, reach to the high altitude more than 100 km, land on the launch site vertically, and be launched again within 24 hours. The main propulsion system is clustered LOX/LH2 engines with full-time abort capability in spite of the one engine fail. In order to realize the reusable sounding rocket, the main propulsion system should have advanced features of high reliability, reusability, maintainability, and survivability. To fulfill those requirements, followings have been considered and reflected in the engine system design, i.e., optimization of design margins among components for high reliability and reusability, deep throttling capability for vertical landing, and health monitoring capability for abort operation, easy inspection and maintenance for short turnaround time. Those functions and performance are going to be verified and demonstrated through ground engineering tests at Kakuda Space Center/JAXA in 2014. This paper shows the design considerations, the engine system and major components design, and the tribological subjects of bearing and seals of turbopumps.

BEARINGS AND SEALS OF THE LH2 AND LOX TURBOPUMPS The element test of the mechanical seal for oxygen turbopump was carried out. Rotational speed is 25,000 rpm and duration time is 120 minute. this seal nose is about 2 mm at the first time, and it is almost wear away after test. Figure five is the resultrs of the element test of the hybrid ceramic bearing for liquid hydrogen turbopump. Rotational speed is 100,000 rpm and duration time is 120 minute. There appare some cracks on the contact surface of the ceramic balls. This cracks are formed by thermal shock, and these cracks are not widen aftersome tests. The operation time of RSR is about three minutes for one flight. 120 minute is just about equivalent to forty times of flight. By this results, we set the replacement condition for mechanical seal of OTP and bearings of FTP as every thirty flight with some margin.