

SPACE TRANSPORTATION SOLUTIONS AND INNOVATIONS SYMPOSIUM (D2)
Future Space Transportation Systems Technologies (5)

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TECHNOLOGIES AND VERIFICATIONS FOR REUSABLE SOUNDING ROCKET SYSTEM

Abstract

In order to make the access to space for scientific researches much easier and make the opportunities of the rocket launches much frequent, a fully reusable sounding rocket is proposed in ISAS/JAXA, and its preliminary system design study is underway. A target of flight performance of the reusable sounding rocket is equivalent to S-310 rocket of the present sounding rocket in ISAS, that is, a flight up to 100km in altitude with 100 kg payload. Reusable sounding rocket is different from the present expendable rockets in 1) repeated operations, 2) returning flight / re-ignition of engine / vertical landing, 3) fault tolerant / health management. Some key and critical technologies related to these characteristics of reusable system must be verified to design an operative reusable sounding rocket in phase-A. Technologies with respect to the reusable vehicle are 1) reusable engine development and repeated operations, 2) reusable insulation development for cryogenic tank, 3) aerodynamic design and model flight demonstration for returning flight, 4) cryogenic liquid propellant management demonstration, 5) landing gear development and 6) health management system construction. Presently, technical demonstrations for these key technologies are in progress. Moreover, System and subsystem designs such as aerodynamics, propulsion systems, structures, etc. are also conducted, respectively. Aerodynamics of the vehicle is designed to minimize the drag in ascent phase, maximize the lift to drag ration in returning flight. A vertical take-off and vertical landing (VTVL) is adopted for this system. So this system has a slender body shape without large wings, that is, with only minimizing control surface for guidance and control in returning flight. The vehicle is designed as a fault tolerant system for one engine fail in its flight. The concepts and system requirement for full time abort is considered. As a main engine of the reusable sounding rocket, it is aimed to develop a reusable engine which can be repeatedly operated 100 times. Life-controlled design is important technique for the development of reusable engine. For the VTVL system, main engines require not only reusability but also a wide range of throttling level and high response performance in order to achieve vertical landing capability. In order to develop such reusable engine, repeated ground firing tests of engine system were conducted for the verification of life control engine design. In this paper, system design and verifications for key technologies of reusable sounding rocket are introduced