

SPACE TRANSPORTATION SOLUTIONS AND INNOVATIONS (D2)  
Future Space Transportation Systems (4)

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RECENT PROGRESS TOWARD REUSABLE SOUNDING ROCKET

**Abstract**

ISAS activities for reusable rocket technology and architecture including flight demonstration by the RVT (Reusable Vehicle Testing) have shown various progresses in technical areas such as reusable rocket engines, returning flight and vertical landing techniques and demonstrations, composite cryogenic LH2 tank studies, new architectures for reusable and repeated flights with quick turnaround and so on. Following these basic studies of reusable rocket at ISAS, mission definition and system requirement synthesis of the reusable sounding rocket are completed lately. Herewith not only the technical and performance related issues, but also its operational aspects and requirements for the frequent repeated flight were given stressed.

Throughout these studies, readiness in the reusable rocket technique and for the system synthesis for the next vehicle were in progress. The engines for the next vehicle are pump-fed and with wide range of throttling capability, both of which are needed for the powered vertical landing of sounding rocket. A special emphasis is placed in throttling of the engine thrust with "constant rotation number" of the pumps which allow to avoid the critical velocities anticipated in the engine operation for the throttling range of 20 to 100 % of maximum thrust level. The demonstration of the concept was made making use of the existing RVT engine for past years and completed. Also progresses were made in returning flight capability special for the vertical landing aerodynamics and flight mechanics of nose-first entry type of the vehicle. A new composite cryogenic LH2 tank with layered manufacturing technique while the previous ones were that of filament-wound structure for the flexibility in manufacturing. For the sounding rocket's system definition and requirement analysis, research of the flight demand such as the number-of-flight per year and its frequency by the potential user communities. These requirements are from the needs of the middle to upper atmosphere research, studies from micro-gravity community, engineering community which may use frequently this repeated flight opportunity and so on. These updated status in the study and anticipated progress in the coming years are presented.