

SPACE PROPULSION SYMPOSIUM (C4)
Hypersonic and Combined Cycle Propulsion (5)

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DEVELOPMENT STATUS OF A HYPERSONIC PRECOOLED TURBOJET ENGINE

Abstract

This paper shows the development status of the subscale precooled turbojet engine conducted by JAXA. A turbine-based combined cycle system (TBCC) is one of the promising candidates for the propulsion system for low cost, high reliability and routine access to space. We proposed and developed a precooled-cycle turbojet engines using liquid hydrogen as fuel and coolant for the first stage of the TSTO space plane and the hypersonic cruiser. This engine can operate from take-off to Mach 6 at 26 km of altitude continuously without mode transition.

At present, a subscale engine "S-engine" is under development, which has 23 cm x 23 cm of rectangular cross section, 2.6 m of the overall length and about 100 kg of the target weight employing composite materials for a variable-geometry rectangular inlet and nozzle. The design thrust and specific impulse at SLS are 1.2 kN and 2060 sec respectively. After the system design and component tests, a prototype engine (metal engine) was manufactured and provided for three times of ground firing tests using gaseous and/or liquid hydrogen. The third test series PCTJ-3 was successfully conducted in October 2008 at JAXA Taiki Aerospace Research Field.

Several fundamental studies have also been conducted such as a wind tunnel test of the buzz characteristics on the air inlet, a system optimization of the hypersonic vehicle using the PCTJ and so on.

The flight test of the S-engine is to be conducted by the Balloon-based Operation Vehicle (BOV) in 2010. The vehicle is about 5 m in length, 0.55 m in diameter and 500 kg in weight. Originally, BOV was design as a test bed for micro gravity experiments. Two micro gravity experiments were successfully

conducted in May 2006 and May 2007 respectively. S-engine will be installed and tested on the third one (BOV-3) . The vehicle is dropped from an altitude of 30-40 km by a high altitude balloon. After 40-second free-fall, the vehicle pulls up and S-engine operates for 30 seconds up to Mach 1.8.