

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

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DEVELOPMENT STATUS OF THE HYPERSONIC TURBOJET ENGINE FOR MACH 5 FLIGHT IN
JAXA**Abstract**

Development of the hypersonic turbojet engine with air-precooling system has been conducted in JAXA since 2004. This engine can protect its turbo-machinery from aerodynamic heat during hypersonic flight owing to liquid hydrogen coolant supplied in the air precooler. The latest model of the hypersonic turbojet engine assembled in 2007 has 0.225 by 0.225 meters square cross section, a total length of 2.67m. We have a phased plan for making Mach 5 flight test of the hypersonic turbojet engine by 2015.

Our first target velocity of flight experiment is Mach 2. In 2009 we successfully conducted pre-flight verification tests in an altitude testing facility of Akiruno Research Center. In September 2010 the first Mach 2 flight was conducted in Taiki Aerospace Research Field. The Mach 2 flight experimental vehicle carried the engine and propellant system supplying gaseous hydrogen as a fuel and liquid nitrogen as a coolant of the precooler. The engine was ignited at Mach 2 and operated for 20 seconds in supersonic flight environment. The flight experiment was successfully excluding parachute deployment failure.

In order to conduct the next Mach 5 flight we must verify the air precooling system with liquid hydrogen in ground test facilities. Direct connected wind tunnel test of the engine is to be conducted in 2011 in Noshiro Testing Center, where free jet wind tunnel test at Mach 5 condition in Kakuda Space Center is scheduled in 2013. Difficulties on these experiments are concerning with quickly changing environmental conditions (inlet pressure and temperature). Testing duration is less than 1 minute due to limited amount of heated air supplied from the ground test facilities or hydrogen fuel in the vehicle. Therefore dynamic simulator of the engine is indispensable in designing engine controller scheduling liquid hydrogen flow rate.

In this paper we introduce the Mach 5 flight test plan including pre-flight ground tests as well as dynamic simulation of the engine and liquid hydrogen propellant system.