SPACE PROPULSION SYMPOSIUM (C4)
Propulsion System (1) (1)

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DEVELOPMENT STATUS OF A 200 KN THRUST CRYOGENIC UPPER STAGE ENGINE FOR ISRO'S NEXT GENERATION LAUNCH VEHICLE

Abstract

ISRO is developing a cryogenic upper stage (C25) for use in the next generation launch vehicle GSLV-Mk3. The stage uses LOX-LH2 propellant combination with a total propellant loading of 27 Tonnes. A 200 kN thrust engine designated as CE20 engine powers the stage. The engine operates on Gas Generator cycle using LOX / LH2 propellant combination delivering a specific impulse of 443 s in vacuum. Gas generator cycle is chosen to facilitate the testing and qualification of all the subsystems independently. The major subsystems of the engine are thrust Chamber (TC), gas generator (GG), LOX and LH2 turbo pumps (TP), igniters, thrust and mixture ratio control systems, stored gas start-up system, control components and pyro valves. The thrust Chamber is regeneratively cooled up to area ratio 10 and dump cooled from area ratio 10 to 100. 169 co-axial swirl type injector elements are brazed together to form the injector head. The Turbopump system consists of independent LH2 and LOX Turbopumps operating in series mode. The Gas Generator generates hot gas using LOX and LH2 tapped from respective pump outlets, for driving the turbines. The hot gas after driving the turbines is expanded through a turbine exhaust gas nozzle. A stored gas start up system using hydrogen is employed to start the turbo pumps. Pyrogen igniters are used in thrust chamber and gas generator to initiate combustion. The engine is gimballed 4 in 2 planes to achieve pitch and yaw control of the vehicle. The engine has passive thrust control and active mixture ratio control (MRC) systems to maintain the required thrust and mixture ratio. The engine has electro pneumatic command valves for supplying helium gas for actuating various engine pneumatic valves. As on date, all the engine subsystems have been independently tested and qualified. These include thrust chamber single element tests, hot tests on gas generator, flow tests and hot tests on LOX and LH2 turbo pumps and hot tests on thrust chamber in the pressure fed mode. Three cold flow trials and two hot tests were done in the integrated GG-TP-start system assembly simulating the thrust chamber flow rates by using control valves. Integrated engines are getting assembled for development tests. It is planned to carry out engine development tests in the sea level facility, HAT facility and integrated with stage before delivering the stage for flight. This paper details the current status of the CE20 engine development.