

## CRYOGENIC PROPULSION SYSTEMS FOR ISRO'S LAUNCH VEHICLES

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### Abstract

Cryogenic propulsion system using Liquid Hydrogen (Normal boiling point 20K) and Liquid Oxygen (Normal boiling point 90K) as propellant combination is used in Satellite Launch Vehicles in view of the higher Specific Impulse (ISP). The specific impulse of Cryogenic propulsion is 450-460s as compared with 260-275s of solid propulsion, 280-315s of earth storable liquid propulsion and 300-350s of semi-Cryo propulsion systems. Due to extreme low temperature of Cryogenic propellant and low density and explosive nature of LH<sub>2</sub>, the development of Cryo propulsion system is very complex. In ISRO, after a detailed study phase, experimental studies were carried out using GO<sub>2</sub>-GH<sub>2</sub>, LOX-GH<sub>2</sub> and LOX-LH<sub>2</sub> propellant combination. To meet the initial requirements of GSLV Mk II vehicle, Cryogenic Stages (CS) were procured from Russia and for the continued self reliant operation of the vehicle. Indigenous Cryogenic Upper Stage (CUS) powered by an engine developing a thrust of 73.5 kN with a propellant loading of 12.8 tonnes is developed and successfully flight tested. The C25 stage for the GSLV Mk III vehicle with a propellant loading of 27 tonnes powered by a 186 kN thrust CE20 engine is also in the advance stage of development. A Semi-Cryogenic engine working on LOX and Kerosene propellant combination and capable of developing 2000 kN thrust level is also currently under development for application in future Launch Vehicles of ISRO. This article titled "Cryogenic Propulsion Systems Development in ISRO" gives the overall development details of Cryogenic Propulsion Systems in ISRO.