CRYOGENIC ENGINE REALISATION _ CHALLENGES OVERCOME

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The Cryogenic Rocket Engine using Liquid Hydrogen (LH2) and Liquid Oxygen (LOX) as propellants produces the highest performance in terms of specific impulse amongst the chemical propulsion systems. They reduce the system weight for upper stage because of the propulsive efficiency and help increase the payload which translates into economic benefits. But they are complex due to the intricate design, specialised fabrication requirements and high thermal protection required for the cryo propellants. The engine system comprises of Thrust Chamber, Turbopump, Injector Head Assembly, Gas Generator and Nozzle Divergent Assembly. Cryogenic engines employ wide range of materials, need high heat flux management, have high RPM turbo machinery and handle low temperature propellants. They are all welded, built-up structures and hence a defect at the final stages of realisation forces the entire assembly to be rejected. ISRO has taken enormous efforts to develop and demonstrate this technology for the past 2 decades with strategic creative approach to design and analysis, selection of materials, specialised machining and joining technologies, intricate tooling and fixtures, complicated assembly of subsystems, compliance to high quality standards, elaborate testing at subsystems and integrated levels and observance of strict quality control and safety norms. This technical paper deals with the complexities of the system and the challenges overcome during the realisation of cryogenic engines by ISRO.