SPACE PROPULSION SYMPOSIUM (C4)
Propulsion Technology (1) (3)

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GROWTH OF SPACECRAFT PROPULSION SYSTEMS IN ISRO

Abstract

The Reaction Control System for the first spacecraft Aaryabhatta built by ISRO and flown in the year 1974 was Nitrogen based cold gas system. This was followed by two more spacecraft Bhaskara I and II. The Apple (Ariane passenger payload experiment) spacecraft, the first venture of ISRO as an experimental communication satellite used an all imported monopropellant system. ISRO conceived the first Spacecraft Propulsion System for the Indian Remote Sensing Satellite – IRS-1A with hydrazine as propellant, 1N thrusters, diaphragm propellant tanks, control valve elements were used in the propulsion system. The IRS-1A with 1 N mono propellant thrusters and diaphragm tanks with 80kg of Hydrazine propellant was successfully launched into orbit in 1988. The propulsion system delivered satisfactory performance for over 8 years in orbit. With already developed flown surface tension based propellant management devices (PMD) and the Iridium catalyst under in-house development for 1N and 11N thrusters, efforts are on to completely indigenize this class of propulsion system for spacecraft control. The growth of propulsion system continued with the development of bi-propellant propulsion systems with Mono-Methy1 Hydrazine (MMH) as fuel and mixed oxides of Nitrogen (MON-3) as oxidizer. Engines of thrust capacity 400N and 22N along with their associated propulsion feed system elements comprising of propellant tanks with surface tension type PMD, gas bottles and control valves were first flown in INSAT-2A in the year 1992. Subsequently, the systems were indigenized after elaborate developmental and qualification testing. Since then, ISRO has flown mono-propellant and bi-propellant propulsion systems successfully in over 50 spacecrafts ranging from remote sensing, navigation and communication to weather monitoring applications. The bi-propellant systems developed indigenously have also been successfully flown in ISRO's prestigious missions like space capsule recovery experiment (SRE-1), Chandrayaan-1 and the recent Mars orbiter mission (MOM). ISRO has now graduated into development of electric propulsion systems having high specific impulse (Isp) with Xenon as the propellant. GSAT-9 and GSAT-19 spacecrafts are being configured with electric propulsion systems. This paper briefly describes the journey traversed by ISRO in the development of spacecraft propulsion systems along with a few in-orbit experiences. Further, the present requirement of realization of such propulsion systems in large numbers in order to cater to the increasing demand is also discussed.