Lunar, Mars, Near-Earth Asteroids, Deep Space Exploration (2)
Lunar, Mars, Near-Earth Asteroids, Deep Space Exploration - IP Session (IP)

Author: Mr. Venkata REDDY
LPSC, ISRO, India

SYSTEM LEVEL GROUND EXPERIMENTAL SIMULATION TESTS ON MOM PROPULSION SYSTEM

Abstract

In Mars Orbiter Mission (MOM), Bipropellant system was adopted to carry MOM from Geo Transfer Orbit through Mars orbit. The MOM propulsion subsystem was designed for attitude and orbit control during the different phases of the Mars Orbiter Mission (MOM) and orbit raising operations such as Transfer orbit corrections, Orbit raising to Mars orbit, Station acquisition, Trans Mars injection, Trajectory correction Maneuever (TCM), Mars Orbit Insertion(MOI) operations etc. The MOM Propulsion system utilizes Mixed Oxides of Nitrogen and Mono Methyl Hydrazine as oxidizer fuel respectively. The propellants were stored in Titanium alloy propellant tanks pressurized with Helium gas. One 440 N Liquid Engine (LAM) and 8 Nos. of 22 N AOCS Reaction Control Thrusters(RCTs) were used. Bi propellant Latch valve (called LVG) isolates the Propellant module from the Pressurant (GHe) gas module. Time duration required for Mars Capture from MOM injection orbit was approx.315 days. In Geocentric phase, Trajectory Correction Maneuvers (TCMs) were carried out prior to the heliocentric phase. The Delta-V required to depart Earth was around 1500 m/s and was split into six burns in the earth orbits. During the Cruise phase of about 300 days, LVG was closed to prevent the possibility of propellants vapour migration to Gas module. The impact of closing LVG on the mission operations were discussed and decided to assess the feasibility of carrying out the further LAM RCTs operations in Mars Orbit Insertion (MOI) burn) in Pressure blow-down mode. To assess the MOM Propulsion capability to meet the mission requirement, various simulation tests in Component level as well as in System level were carried out. Two System level High Altitude Tests were carried out successfully with combined firing of LAM and RCTs simulating the actual MOM Propellant Tank pressures temperatures, Ullage volumes, Test duration with margin etc of Mars Orbit Insertion (MOI) burn. Propulsion System performance was normal during these tests and validated the Propulsion system performance model for MOI burn. A close match exists between the predicted and realized parameters like Propellants consumption, injection pressures etc at the end of tests. This paper explains the details of objective of the System level HAT hot tests, Cold flow system level simulation tests, HAT test plan, Propulsion Parameters predictions, data analysis, comparison with predictions etc and capability of carrying out the Mars Orbit Insertion (MOI) operations of Propulsion system in pressure blow-down with combined firing of LAM and 8 RCTs.