

India's Mars Mission: a Fact File

India made history by successfully placing its spacecraft in orbit around Mars on 24th September, 2014. It became the first country in the world to succeed in such an inter-planetary mission in the maiden attempt itself. In the early hours ISRO's Mars Orbiter Mission (MOM) spacecraft was successfully slowed down to be captured by the Red Planet's gravity. Earlier on September 22, 2014, 440 Newton Liquid Apogee Motor (LAM) was successfully test fired. Only the US, Europe and Russia have previously sent missions to Mars, but India is the first country to succeed on its first attempt.

ISRO's Mars Orbiter Mission is India's first interplanetary mission to planet Mars with an orbiter craft designed to orbit Mars in an elliptical orbit. The Mission is primarily a *technological mission* involves in the capability to survive and perform Earth bound manoeuvres, cruise phase of 300 days, MARS orbit insertion and capture and on-orbit around MARS, Deep space mission planning and communication management.

Exploration of Mar's surface features; morphology, mineralogy and Martian atmosphere by indigenous scientific instruments are the major objectives of the mission.

The Mars orbiter satellite consists of the following payloads.

Payloads of the Mars Orbiter Satellite

Lyman Alpha Photometer (LAP)

Lyman-alpha Photometer (LAP) measures deuterium and hydrogen from lyman-alpha emission in the Martian upper atmosphere. Measurement of D/H (Deuterium to Hydrogen abundance Ratio) allows us to understand especially the *loss process* of water from the planet.

Methane Sensor for Mars (MSM)

MSM is designed to measure Methane in the Martian atmosphere and map its sources. Data is acquired only over illuminated scene as the sensor measures reflected solar radiation. Methane concentration in the Martian atmosphere undergoes spatial and temporal variations.

Mars Exospheric Neutral Composition Analyser (MENCA)

MENCA is a quadruple mass spectrometer capable of analyzing the neutral composition in the range of 1 to 300 amu with unit mass resolution. The heritage of this payload is from Chandrayaan Altitudinal Composition Explorer (CHACE) payload. MENCA is a quadrupole mass spectrometer based scientific payload, capable of measuring relative abundances of neutral constituents in the mass range of 1 to 300 amu, with a unit mass resolution.

Mars Colour Camera (MCC)

This Mars colour camera gives images & information about the surface features and composition of Martian surface. They are useful to monitor the dynamic events and weather of Mars. MCC will also be used for probing the two satellites of Mars-Phobos & Deimos. It also provides the context information for other science payloads.

Thermal Infrared Imaging Spectrometer (TIS)

TIS measure the thermal emission and can be operated during both day and night. Temperature and emissivity are the two basic physical parameters estimated from thermal emission measurement. Many minerals and soil types have characteristic spectra in TIR region. TIS can map surface composition and mineralogy of Mars.

Important Terminologies in the Mars Mission

Hohmann Transfer Orbit – or a Minimum Energy Transfer Orbit – to send a spacecraft from Earth to Mars with the least amount of fuel possible. In orbital mechanics, the Hohmann transfer orbit is an elliptical

orbit used to transfer between two circular orbits of different radii in the same plane. The orbital manoeuvre to perform the Hohmann transfer uses two engine impulses, one to move a spacecraft onto the transfer orbit and a second to move *off* it. This manoeuvre was named after Walter Hohmann, the German scientist who published a description in it.

Sphere of Influence (SOI) is the oblate-spheroid-shaped region around a celestial body where the primary gravitational influence on an orbiting object is that body. This is usually used to describe the areas in the Solar System where planets dominate the orbits of surrounding objects (such as moons), despite the presence of the much more massive (but distant) Sun.

Parking Orbit is a temporary orbit used during the launch of a satellite or other space probe. A launch vehicle boosts into the parking orbit, and then coasts for a while, then fires again to enter the final desired trajectory. The alternative to a parking orbit is direct injection, where the rocket fires continuously (except during staging) until its fuel is exhausted, ending with the payload on the final trajectory.

Liquid Apogee Motor (LAM) refers to a liquid fuelled rocket motor that is regularly employed on artificial satellites destined for a geostationary orbit. In Mangalyan mission 440 Newton Liquid Apogee Motor was used to give thrust to the satellite to place itself into orbit of Mars from the heliocentric orbit.

Lyman-alpha Emission is the result of the series of transitions and resulting ultraviolet emission lines of the hydrogen atom as an electron goes from higher energy level to the lowest energy level ($n=1$) of the electron. The transitions are named sequentially by Greek letters, from $n=2$ to $n=1$ is called Lyman-alpha, 3 to 1 is Lyman-beta, 4 to 1 is Lyman-gamma, etc.

Methane and Life

Scientists are of the view that presence of Methane in Mars's atmosphere can be an indicator of life. Methanogenesis (production of methane) is the final step in the decay of organic matter. It occurs in the guts of humans and other animals, especially ruminants. The useful products of methanogenesis are absorbed by the alimentary canal, but methane is released from the animal mainly by belching. The average cow emits around 250 litres of methane per day.

Methane has a chemical lifetime of about 300-600 years, which is very short on geological time scales. This implies that the methane that is observed today cannot have been produced 4.5 billion years ago, when the planets formed. The one possibility as the scientists argue could be biological.

(Source: ISRO)