

# CENTRE FOR JOINT WARFARE STUDIES



## CENJOWS

### CHINESE MARS MISSION: TIANWEN-1

1. **Significance of Upcoming Chinese Mars Mission TIANWEN-1<sup>1</sup>**. The mission is planned to be launched in July 2020 with a Long March 5, the heavy lift rocket. Its stated objectives are to search for evidence of both current and past life, and to assess the Mars environment. With a similar natural environment to Earth, Mars has become a hot destination of deep space exploration.
2. Among the over 40 Mars exploration missions since 1961, only about half succeeded. China aims to become only the second country to land and operate a spacecraft on the surface of Mars.
3. This would be first independent Chinese mission in which will have orbiter, lander and rover all in one mission. Its earlier mission Yinghuo-1, Mars exploration space probe was launched in 2011 with the intention to orbit the Mars, on a Russian Fobos-Grunt mission to one the moons of the Mars, Fobos, aboard a Russian Zenit rocket. But the Zenit never made it out of Earth orbit and the mission failed.<sup>2</sup>
4. The new Chinese Mars spacecraft is developed by the China Aerospace Science and Technology Corporation (CASC), and managed by the National Space Science Centre (NSSC) in Beijing. The lander carrying the rover will use a parachute, retrorockets, and an airbag to achieve landing.

<sup>1</sup><https://spectrum.ieee.org/tech-talk/aerospace/robotic-exploration/where-how-china-mars-mission-news>

<sup>2</sup><https://www.space.com/coronavirus-china-mars-mission.html>

5. The 5-metric-ton spacecraft consists of an orbiter and the landing segment for the rover. It's expected that the spacecraft will remain coupled in orbit until April. The orbiter will employ a pair of cameras to image the preselected landing sites, before attempting to set down the 240-kilogram rover on the surface.

6. The rover will be powered by solar panels, probe the ground with radar, perform chemical analyses on the soil, and look for biomolecules and biosignatures.

7. Simulated landings have been performed for the mission preparations by the Beijing Institute of Space Mechanics and Electricity.

8. Long March 5 rocket will send the Chinese spacecraft on a journey for about seven months, after which it will fire rockets in order to enter orbit around Mars in February 2021.<sup>3</sup>



9. Earth and Mars will be around 150 million kilometers apart when the orbiter arrives, so it will take eight minutes for communications signals to travel each way. Therefore, the spacecraft's guidance, navigation, and control, or GNC, for the landing process will be fully autonomous. This system will be based on the GNC of Chang'e-4, which autonomously achieved the first landing on the far side of the moon in 2019.

10. The Chinese are moving forward with their experience of moon missions Change-3 and Change 4 and the lunar lander. The lander will employ a laser range finder and a microwave ranging velocity sensor to gain navigation data—technology that was also developed initially for China's moon missions.

11. The blunt body aerodynamics of the entry capsule's heating shield, which is shaped like a spherical cone whose tip forms a 70-degree angle, will provide the first deceleration as it hits the Martian atmosphere. Next, while traveling at supersonic speeds, a disk-gap-band parachute will deploy to further slow the spacecraft, and then be discarded. For this, China has drawn on technology and experience from its Shenzhou crewed spacecraft, which has allowed astronauts to re-enter Earth's atmosphere and safely land, for these phases.

12. Retro-propulsion will be responsible for slowing the spacecraft during its final descent. Most of this will be provided by a 7,500-Newton variable thrust engine, like the main engine used by China's Chang'e-3 and -4 lunar landers.

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13. The lander will employ a laser range finder and a microwave ranging velocity sensor to gain navigation data—technology that was also developed initially for China's moon missions.

14. Other necessary pieces of China's mission are also in place. Tracking stations are now operating across China, as well as in Namibia and Argentina.

15. China is constructing the largest steerable radio telescope in Asia with a 70-meter-diameter antenna to receive data from its first Mars exploration mission which is expected to be launched this year. After completion, the telescope will greatly improve China's ability to receive deep space exploration data and will lay a foundation for China's future asteroid and comet probing and other planetary exploration missions.<sup>4</sup>

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<sup>4</sup>Source: *Xinhua News Agency*