

EUROPEAN HUMAN MISSION TO MARS

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Mission architecture for a European human mission to Mars based on a super heavy Ariane Launcher

Key words: human mission to Mars, Ariane Super Heavy

1. Main principles

This presentation is based on a paper presented at the International Astronautical Congress that took place in Bremen in early October 2018. As suggested by a preliminary study from CNES, a heavy version of the Ariane launcher can be used for a human mission to Mars [1]. This enhanced Ariane has 100 metric tonnes LEO capability and 36 metric tonnes capability for transMars injection (V_{infini}=3.5km/s). In order to simplify the scenario and minimize the costs, it is proposed a pre-deploy semi-direct architecture with several rather small spaceships and the implementation of aerocapture for Mars orbit insertion [2]. There are several advantages: First, as the payload to the Mars surface is split in equal parts between 34 and 36 metric tonnes, the same landing space vehicle can be used with mass and size compatible with the payload capability of the launcher. Second, the choice of relatively small landers allows the use of simple deployable rigid heatshields, which could be used both for aerocapture and entry, descent and landing. The use of small landers also reduces the complexity of the tests for the qualification of the descent and landing systems and procedures, which is a critical aspect of the preparation phase. 5 Ariane are required in this architecture.

2. Architecture

According to our calculations, which are derived from NASA numbers, for a crew of 3 astronauts, this architecture requires only 5 super heavy Ariane launches:

- The first payload is the Mars ascent vehicle that is directly sent to the Martian surface 2 years before the crew. As suggested by NASA, it includes a tank already filled with methane but the oxygen is produced on site exploiting the carbon dioxide of the atmosphere.
- The second payload is a backup habitat with surface vehicles and consumables for 500 days. It is also sent 2 years in advance 2 years before the crew by means of a single super heavy Ariane launcher.
- The third and fourth payload are the two parts of the Earth return vehicle, which are a habitable module with consumables for the return and a propulsion system attached to a Earth reentry capsule. Both are directly sent to Mars orbit separately and fixed together there.
- The fifth payload is the human space vehicle that is directly sent to the surface of Mars.

References

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