

Transport from Earth to Mars

Jump to: navigation, search

Mars missions require the transport of equipment, material and people from Earth to Mars, and possibly back to Earth. This page wants to clarify the needed transportation volume and the proposed technology.

The Mars mission duration is a factor of the various trajectories possible to reach Mars. Hohmann transfer orbits, low energy trajectories, Mars cyclers are all possible paths to Mars.



A child's fantasy of rockets to Mars

Contents

- 1 Preparatory Explorations
- 2 Settlement Equipment
- 3 People
- 4 Landing on Mars
- 5 Open Issues
- 6 References

Preparatory Explorations

Some explorations are needed prior to the actual start of the colonization. Mostly, this will be probes to collect data, radio-transmitted to Earth. Some may, however, need to bring material from Mars to Earth for deeper analysis.

Settlement Equipment

A Martian settlement requires very much equipment, including energy generators and construction material for habitats and greenhouses. There are a few strategies for shipping:

- Large numbers of conventional rockets are launched from Earth with destination Mars.
- A few big vessels are assembled in Earth's orbit and then started towards Mars. This requires a large number of shuttle starts from Earth's surface, too. The advantage is, those vessels can provide some radiation shielding by an arrangement of equipment around an inner cabin for persons.

Since most material is not prone to radiation damage, the trajectory of pure material transport can be optimized to lowest fuel consumption, helping to save costs.

People

For colonization of Mars the colonists are traveling only one way. The journey takes 6 month or less depending on the transportation system.

During the journey the astronauts are subject to radiation, which requires means to protect them. Cosmic radiation and solar wind cause DNA damage, which increases the risk of cancer significantly. The effect of long term space travel in the interplanetary space is unknown, but scientists estimate up to 19% probability for male persons to die of cancer because of the radiation during the journey to Mars and back to Earth. Together with the base probability of 20% for a male person on Earth to die from cancer this gives a probability of 35%. For women the probability is even higher due to their larger glandular tissues. ^[1]

Good radiation shielding means heavy space ships, and heavy space ships can not be lifted from a planet's surface to an orbit. The only possible way to use such a heavy space ship for more than just a handful of people is to keep it on a cyclic trajectory, commuting between Earth' orbit and Mars' orbit. Legacy rocketry can provide lifting and landing.

People need to eat, drink and breath during the journey. With currently known technology only a few persons can be brought to Mars with a single ship.

Artificial gravity through centrifugal force can be established in order to avoid health damage of the astronauts, although exercise is enough to prevent damage from zero-g.

Landing on Mars

Aerobreaking can be used to decelerate during approach when entering the orbit. Only small probes have touched down on the Martian surface up to now, using parachutes, balloon cushions and rockets.

A space elevator might be a possible solution for large amounts of material as well as for persons. The technology for building such a cable and vehicles to climb the cable has not yet been fully developed.

Open Issues

- How many tonnes per vehicle can be brought to Mars with existing technology?
- How many people per vehicle can be brought to Mars with existing technology?
- What technology is required to land big vessels smoothly on Mars?
- Which technology is good for cargo, which for manned transportation?

References

1. NASA: Space radiation between Earth and Mars poses a hazard to astronauts. (http://science.nasa.gov/headlines/y2004/17feb_radiation.htm)

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