

## ENGINEERING KNOWLEDGE REQUIREMENTS FOR SAND AND DUST ON MARS

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The successful landing of human beings on Mars and the establishment of a permanent outpost there will require an understanding of the martian environment by the engineers. A key feature of the martian environment is the nearly ubiquitous presence of sand and dust.

The engineering community will be tasked to perform many critical functions at Mars. Each of these functions will certainly be influenced by the sand and dust in the environment. For example, safe landing (entry, descent, and touchdown) will require good visibility, knowledge of atmospheric density, and an aeroshell which will not be critically eroded. Habitat emplacement will require appropriate site selection, site preparation, actual emplacement of the habitat, and emplacement of radiation protection around the habitat. Surface operations will require surface mobility and mining (including the location of resources as well as excavation). The effects of sand and dust on equipment will be of great importance to many scientific and engineering functions.

The engineering teams will begin with the best understanding of sand and dust from the scientific community, and they will evaluate the sensitivities of their engineering designs and operations to that knowledge. In some areas, a broad range of possible sand and dust values will have little effect on outpost or vehicle designs. In other areas, knowledge which is lacking, or uncertainties which are high, may potentially have a huge influence on the designs and operations. For these latter cases, the mission planners of the Space Exploration Initiative (SEI) will need to evaluate the advantages of acquiring precise martian environmental data through the flights of robotic precursor missions.

The paper will focus on the process which the engineering community will undertake to determine the sensitivities of their designs to the current level of knowledge about Mars sand and dust. It will also describe the interaction of the engineering community with the SEI mission planners and management.