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How will we keep warm on the red planet?

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Abstract

Among the many challenges that the Mars environment poses for EVA (extravehicular activity) space suit designers, development of an appropriate thermal insulation is one of the most important. The latest in thermal insulation technologies that could be applied or modified for planetary exploration have been reviewed. These include porous and hollow structures, phase change materials, soluble gas elements, as well as vacuum enclosures and fibrous materials. Using current technology, none of these structures offers all of the features needed for Mars exploration, namely lightweight, low bulk, high flexibility, and low thermal insulation. Nonwoven fibrous materials are still the prime design candidates because they are more flexible than other structures while having good resiliency. They are usually safe to use. They are also available in many types of materials, fiber shapes, as well as fabric densities and constructions. However, a recent study conducted at the NASA Johnson Space Center shows clearly that these structures alone are not sufficient to provide effective thermal insulation in the harsh Mars environment. A more promising solution is being developed using aerogel fillers in the nonwoven structures.