

Mars Surface Tunnel Element Concept

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Abstract

How crews get into or out of their ascent vehicle has profound implications for Mars surface architecture. Extravehicular Activity (EVA) hatches and Airlocks have the benefit of relatively low mass and high Technology Readiness Level (TRL), but waste consumables with a volume depressurization for every ingress/egress. Perhaps the biggest drawback to EVA hatches or Airlocks is that they make it difficult to keep Martian dust from being tracked back into the ascent vehicle, in violation of planetary protection protocols. Suit ports offer the promise of dust mitigation by keeping dusty suits outside the cabin, but require significant cabin real estate, are relatively high mass, and current operational concepts still require an EVA hatch to get the suits outside for the first EVA, and back inside after the final EVA. This is primarily because current designs don't provide enough structural support to protect the suits from ascent/descent loads or potential thruster plume impingement. For architectures involving more than one surface element—such as an ascent vehicle and a rover or surface habitat—a retractable tunnel is an attractive option. By pushing spacesuit don/doff and EVA operations to an element that remains on the surface, ascended vehicle mass and dust can be minimized. What's more, retractable tunnels provide operational flexibility by allowing surface assets to be re-configured or built up over time. Retractable tunnel functional requirements and design concepts being developed as part of the National Aeronautics and Space Administration's (NASA) Evolvable Mars Campaign (EMC) work will add a new ingress/egress option to the surface architecture trade space.