

OVERVIEW OF THE ORION THERMAL PROTECTION SYSTEM

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ABSTRACT

The Orion spacecraft is being developed as part of the Constellation Exploration Program and will serve as the United States' crewed transportation system to the International Space Station after the retirement of the Space Shuttle in 2010 and as the eventual means to return U.S. astronauts to the Moon. Therefore, Orion is being designed for reentry missions from both low Earth orbit and from Lunar-return trajectories.

This presentation will provide an overview of the development of the Orion TPS, a critical component in the development of the spacecraft. The thermal protection system (TPS) that protects the crew module from the extreme environments associated with Earth atmospheric reentry consists of a forward heatshield and an aft backshell. The requirements that drive the design of the TPS will be discussed, including several key requirements that establish a precedent for U.S. human-rated spacecraft. For the first time in U.S. human spaceflight, a vehicle's TPS is being designed with a specific, derived requirement for reliability. Also, due to the increased presence of spacecraft in Earth's orbit in recent decades, requirements for micro-meteoroid/orbital debris damage tolerance are also a driving requirement that has affected the selection of portions of the TPS.

The efforts to select materials and to define a preliminary design for both the heatshield and the backshell will be described. This will include a discussion of the design challenges presented by the numerous penetrations on both the backshell and the heatshield. Finally, the verification and validation plan which is currently under development to certify the TPS for human-rated missions will be outlined. To support the execution of this plan, a ground test campaign for both thermal and structural performance is being designed. This test campaign will directly support thermal and thermal/structural analyses that also are fundamental to the certification effort.