Under Pressure: The Artemis I Heatshield Char Loss Investigation and Artemis II's Successful Entry

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Abstract

Following the successful Artemis I skip reentry on December 11, 2022, unexpected char liberation from the Orion heatshield prompted formation of an Anomaly Response Team to determine root cause and establish flight rationale and corrective actions for subsequent missions. Through a comprehensive investigation including detailed hardware analysis, modeling & simulation, and ground testing, the team determined that the low permeability Avcoat experienced extreme internal gas pressure buildup during the skip entry that could not adequately outgas, leading to crack formation and char liberation. Key discoveries included significant performance differences between permeable and impermeable heatshield regions and successful replication of the anomaly through ground testing. Based on extensive ground testing and analysis, Artemis II flew a modified trajectory without the skip entry to minimize crack-inducing conditions, and successfully splashed down on April 10, 2026 with significantly reduced char loss. For Artemis III and beyond, a corrective action was implemented to produce a more permeable version of Avcoat that will substantially reduce internal pressure accumulation during entry.

Keywords: Orion Heatshield, Avcoat, Thermal Protection Systems, Char Loss

References

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