

Space Launch System Base Heat Shield Thermal Protection System Performance

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NASA Space Launch System (SLS) Core Stage base heat shield had experienced the highest heating environments on the entire launch vehicle during Artemis I flight as predicted. The base heat shield experiences P50 cork combustion dynamics at low altitudes, plume-induced recirculation at moderate altitudes and then in-space base flow physics out to Main Engine Cut-Off (MECO). The base heat shield thermal protection system (TPS) is composed of an ablator P50 cork which is bonded to a substrate. The heat shield protects plume-induced heating environments from the gimbal actuation system, RS-25 turbomachinery systems and other aft section sensitive components during ascent. This paper estimates the base heat shield TPS performance from Artemis I using flight data from the NASA Langley Research Center's Science Calibrated Flight Imagery (SCIFLI), development flight instrumentation (DFI) and other TPS recession flight measurements. Predictions from computational and ground test-derived engineering ablation models and observations are also applied. Since no base heat shield substrate thermocouple data were obtained for Artemis I, an estimate of the TPS performance data is derived here. This best available data provides thermal margin of the SLS Core Stage base heat shield to inform the Artemis II Crewed mission to the moon.

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