

NASA's Space Launch System: Secondary Payload Accommodations in Block 1 and Beyond

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Launching from pad 39B at Kennedy Space Center no earlier than December 2019, NASA's Space Launch System (SLS) will send the Orion crew vehicle to a distant retrograde lunar orbit in order to test and validate the new systems developed for SLS, Orion and Kennedy Space Center's Exploration Ground Systems (EGS). In addition to these primary mission objectives, the first integrated flight of NASA's new deep space exploration system, Exploration Mission-1 (EM-1), offers accommodations for 13 6U CubeSats, which will be deployed in deep space after Orion separates from the SLS Interim Cryogenic Propulsion Stage (ICPS). In 2017, the SLS Program, managed by NASA's Marshall Space Flight Center (MSFC) in Huntsville, Alabama, completed the ICPS and delivered it to the EGS Program, which has responsibility for stacking and launch operations. The 13 EM-1 secondary payloads will reside in the Orion Stage Adapter (OSA), which connects the ICPS to Orion's spacecraft adapter. The OSA is essentially complete with preparations being made for transporting the hardware to Kennedy Space Center with accommodations for secondary payload dispensers and with the secondary payload avionics unit installed.

The rest of the Block 1 SLS vehicle has completed manufacturing and is being outfitted for flight, including the 212-foot core stage. Boeing is building the core stage at Michoud Assembly Facility near New Orleans, Louisiana. Propulsion for the heavy-lift vehicle is supplied by twin five-segment solid rocket boosters, being built by Orbital ATK, and four RS-25 engines supplied by Aerojet Rocketdyne. The four RS-25 main engines, and their new computerized controllers are complete for EM-1. Those engines will be integrated into the completed core stage and fired simultaneously at NASA's Stennis Space Center during a "green run" test, scheduled for 2019. The Block 1 vehicle will have the capability to launch at least 70 metric tons (t) of payload. A more powerful configuration, Block 1B, will be available in the 2020s, and will provide incremental performance improvements that will boost the vehicle's capabilities to at least 32 t to trans-lunar injection (TLI) in the crew configuration and at least 37 t to TLI in the cargo configuration. Block 1B will offer an 8.4 m fairing; other fairing sizes are being studied. Block 1B will offer more accommodations for smallsats on a payload adapter than Block 1 provides in the OSA. A variety of CubeSat sizes from 6U to 27U may be accommodated in Block 1B.

The smallsat payloads selected for EM-1 include NASA research experiments and spacecraft developed by industry, international partners and academia. The payloads are: Near Earth Asteroid (NEA) Scout, Lunar Flashlight, BioSentinel, Lunar Icecube, LunIR, the CubeSat

Mission to Study Solar Particles (CuSP), LunaH-Map, ArgoMoon, the EQUilibriUm Lunar-Earth point 6U Spacecraft (EQUULEUS), and the Outstanding MOon exploration TEchnologies demonstrated by Nano Semi-Hard Impactor (OMOTENASHI). In addition, three CubeSat payloads that have completed the final ground tournament of NASA's Cube Quest Challenge and are now competing for further prizes are manifested on EM-1: Cislunar Explorers, from Cornell University in Ithaca, New York; the University of Colorado-Earth Escape Explorer (CU³) and Team Miles, of Tampa, Florida.

This paper will provide an overview of the status of the SLS Block 1 launch vehicle and an overview of the 13 EM-1 6U payloads. Work on the Block 1B vehicle is already underway, which will offer more space for smallsats; those planned accommodations will also be discussed.