

Spacesuit Water Membrane Evaporator; An Enhanced Evaporative Cooling System for the Advanced Extravehicular Mobility Unit Portable Life Support System

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Development of the Advanced Extravehicular Mobility Unit (AEMU) portable life support subsystem (PLSS) is currently under way at NASA Johnson Space Center. The AEMU PLSS features a new evaporative cooling system, the Generation 4 Spacesuit Water Membrane Evaporator (Gen4 SWME). The SWME offers several advantages when compared with prior crewmember cooling technologies, including the ability to reject heat at increased atmospheric pressures, reduced loop infrastructure, and higher tolerance to fouling. Like its predecessors, Gen4 SWME provides nominal crew member and electronics cooling by flowing water through porous hollow fibers. Water vapor escapes through the hollow fiber pores, thereby cooling the liquid water that remains inside of the fibers. This cooled water is then recirculated to remove heat from the crew member and PLSS electronics. Test results from the backup cooling system which is based on a similar design and the subject of a companion paper, suggested that further volume reductions could be achieved through fiber density optimization. Testing was performed with four fiber bundle configurations ranging from 35,850 fibers to 41,180 fibers. The optimal configuration reduced the Gen4 SWME envelope volume by 15% from that of Gen3 while dramatically increasing the performance margin of the system. A rectangular block design was chosen over the Gen3 cylindrical design, for packaging configurations within the AEMU PLSS envelope. Several important innovations were made in the redesign of the backpressure valve which is used to control evaporation. A twin-port pivot concept was selected from among three low profile valve designs for superior robustness, control and packaging. The backpressure valve motor, the thermal control valve, delta pressure sensors and temperature sensors were incorporated into the manifold endcaps, also for packaging considerations. Flight-like materials including a titanium housing were used for all components. Performance testing of the Gen4 SWME is underway.