

“Hollow Fiber Flight Prototype Spacesuit Water Membrane Evaporator Design and Testing” by Grant Bue, Matt Vogel, Janice Makinen, Gus Tsioulos, et al.

The spacesuit water membrane evaporator (SWME) is being developed to perform thermal control for advanced spacesuits and to take advantage of recent advances in micropore membrane technology. This results in a robust heat-rejection device that is potentially less sensitive to contamination than is the sublimator. The Membrana Celgard X50-215 microporous hollow-fiber (HoFi) membrane was selected after recent extensive testing as the most suitable candidate among commercial alternatives for continued SWME prototype development. The current design was based on a previous design that grouped the fiber layers into stacks, which were separated by small spaces and packaged into a cylindrical shape. This was developed into a full-scale prototype consisting of 14,300 tube bundled into 30 stacks, each of which is formed into a chevron shape and separated by spacers and organized into three sectors of 10 nested stacks. The new design replaced metal components with plastic ones, and has a custom built flight like backpressure valve mounted on the side of the SWME housing to reduce backpressure when fully open. The spacers that provided separation of the chevron fiber stacks were eliminated. Vacuum chamber testing showed improved heat rejection as a function of inlet water temperature and water vapor backpressure compared with the previous design. Other tests pushed the limits of tolerance to freezing and showed suitability to reject heat in a Mars pressure environment with and without a sweep gas. Tolerance to contamination by constituents expected to be found in potable water produced by distillation processes was tested in a conventional way by allowing constituents to accumulate in the coolant as evaporation occurs. For this purpose, the SWME cartridge has endured an equivalent of 30 EVAs exposure and demonstrated minimal performance decline.