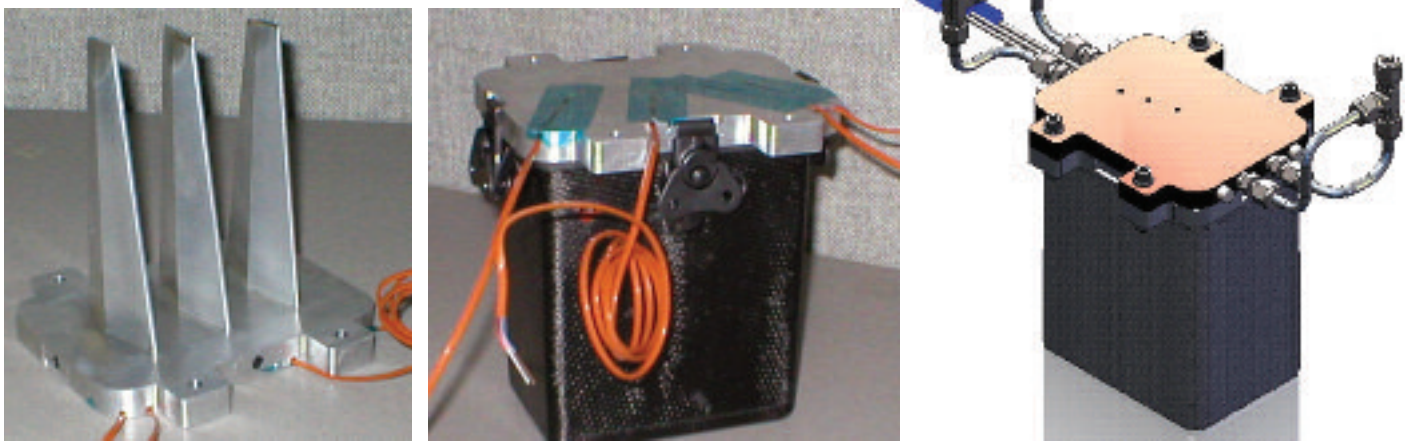


Representative SuperCool Phase I SBIR hardware and CAD model

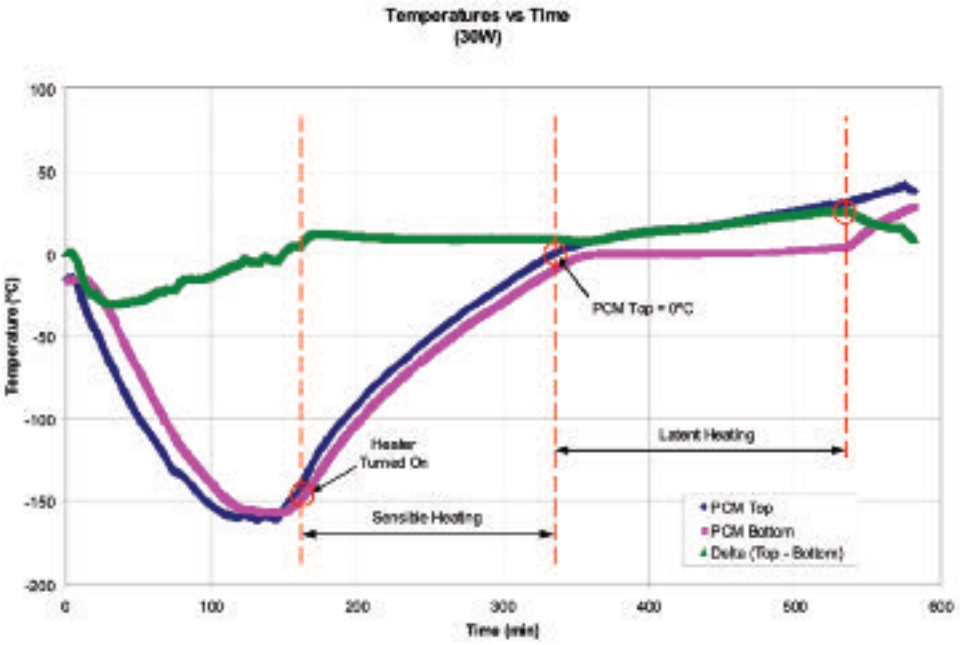
SuperCool
Phase Change Heat Sink

SuperCool phase change heat sinks are being developed by Paragon for Portable Life Support Systems (PLSS) for Extravehicular Activity (EVA) spacesuits. SuperCool technology uses super-cooled ice to provide a non-toxic and non-flammable phase change material (PCM) heat sink that can be used for microgravity EVA's as well as surface EVA's on the Moon or Mars.

On-back weight for the astronaut is minimized by using water as the PCM is 70% more efficient, by weight, than other PCM's. Further reduction in on-back weight is achieved by super cooling the ice for additional sensible heat storage capacity. No consumable is needed and therefore the large resupply mass required by sublimators and evaporators is eliminated. Additionally, since no water is vented, SuperCool can be used for Mars spacesuits without contaminating the environment. Unlike a radiator, SuperCool operates independent of the local thermal environment.

Simply freezing the water provides 92.5 Watt-hours of latent cooling capacity per kilogram of water. Super cooling the water to as low as -150ºC increases the total cooling capacity by over 70% to nearly 160 Watt-hours per kilogram of water.

While currently being developed for PLSS applications, SuperCool can also be adapted to provide a lower mass alternative to replace other PCM heat sinks on Altair, the Lunar Electric Rover and Surface Habitats. Almost any flight vehicle or surface systems application that experiences cyclical heating and cooling can benefit from SuperCool Phase change technology. Properly integrated into vehicle and habitat structures, the SuperCool heat sink can also function as primary or secondary radiation shields for the crew.



Supercooling the ice to below -150 ºC increases cooling capacity by over 70% compared to just melting (latent heating).

As part of NASA's Small Business Innovative Research (SBIR) program, Paragon has designed, built, and tested a SuperCool demonstrator unit. The design incorporates patent-pending features to internally accommodate the expansion and contraction of the water as it freezes and thaws. Testing during the Phase I SBIR program demonstrated the robustness of the design with no damage occurring to the demonstrator unit during multiple super cool/warming/melting cycles.