

Exploration Helmet Permanent Anti-fog Study

Kristine Davis¹

Greg Trude²

¹NASA Johnson Space Center

²Air-lock Inc.

For the current Extravehicular Mobility Unit (EMU) spacesuit, an astronaut applies an anti-fog solution to the interior of the helmet bubble before each EVA. However, the anti-fog solution has been reported to cause eye discomfort during at least seven EMU EVAs when the anti-fog solution contacted the crew member's eyes. During STS-100, astronaut Chris Hadfield reported the eye irritation temporarily blinded him during his spacewalk. In addition, the wipe on anti-fog solution is a consumable that needs to be accounted for and a supply launched for missions.

To solve this, the Exploration EMU (xEMU) pressure bubble investigated using a permanent anti-fog coating during Design Verification and Test (DVT) human in the loop (HITL) events. Chosen for previous use in Constellation Space Suit develop, HTAF-601, a water based permanent anti-fog solution, was tested. However, major issues have arisen with further HITL testing with the coating. Cleaning the helmet has been a challenge to avoid damaging the permanent anti-fog coating. NASA has completed a set of different methods for cleaning the anti-fog to try to document a preferred method. It was found isopropyl alcohol (IPA) cannot be used to clean the interior of the helmet because it will strip and delaminate the permanent anti-fog coating. Even with using a very gentle cleaning method of flushing with distilled or DI water and dabbing at facial oils, the permanent anti-fog starts to delaminate consistently after 50 hours manned pressurized time (MPT). Finally, the HTAF-601 coating is being discontinued by the vendor.

Due to these issues, further investigation is being completed evaluating two solvent based anti-fog solutions: Exxene's HCF-100 and FSI's Visgard 106-94. Each coating will be evaluated on polycarbonate samples for application consistency, steam cycles (mimicking breath cycles), cleaning durability, haze, and light transmission. This study will determine if either coating is a viable option to pursue as a permanent anti-fog for spacesuit helmet applications.