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Six-Tube Freezable Radiator Testing and Model Correlation

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ABSTRACT

Freezable radiators offer an attractive solution to the issue of thermal control system scalability. As thermal environments change, a freezable radiator will effectively scale the total heat rejection it is capable of as a function of the thermal environment and flow rate through the radiator. Scalable thermal control systems are a critical technology for spacecraft that will endure missions with widely varying thermal requirements. These changing requirements are a result of the spacecraft's surroundings and because of different thermal loads rejected during different mission phases.

However, freezing and thawing (recovering) a freezable radiator is a process that has historically proven very difficult to predict through modeling, resulting in highly inaccurate predictions of recovery time. These predictions are a critical step in gaining the capability to quickly design and produce optimized freezable radiators for a range of mission requirements. This paper builds upon previous efforts made to correlate a Thermal Desktop™ model with empirical testing data from two test articles, with additional model modifications and empirical data from a sub-component radiator for a full scale design. Two working fluids were tested, namely MultiTherm WB-58 and a 50-50 mixture of DI water and Amsoil ANT.