Type: Presentation Only (I will have a presentation/video already pre-recorded)

Title: Development of a Passive Thermal Control Valve for 3D-Printed Loop Heat Pipes

Description, Uniqueness, & Assessment: As the capabilities of extended-duration science payloads on the Lunar surface increase, so do the thermal control requirements. The primary power source for near-term Lunar surface science missions is a combination of solar photovoltaic arrays and batteries. A thermal control system that rejects daytime heat efficiently and conserves energy through the night is essential to keep the payloads, batteries, and other critical components at suitable temperatures. Conventional loop heat pipes (LHPs) provide very efficient heat transfer between electronics and spacecraft radiators when necessary but require 2-3 W of power continuously to shut down and minimize heat transfer through the night. This can increase battery mass substantially if applied for the entire Lunar night. The focus of this work is the development of a passive thermal control valve (TCV) integrated with the design of a 3D-Printed LHP evaporator. In this study, it was demonstrated that an on/off TCV is sufficient to shut down an LHP quickly and is much less expensive than currently used proportional valves. Three different designs are demonstrated for the TCV: “open when cold”, “closed when cold”, and a 3D-printed integral (also “open when cold”). Benchtop testing demonstrated the functionality and feasibility of using an on/off TCV in an LHP system. Results for the two subtractive manufactured TCV designs, tested with an additively manufactured capillary pump, show that it is feasible to maintain a tight seal and passively shut down the LHP at a cold temperature setpoint. Additional progress is required to refine the additively manufactured TCV design to create a sufficiently tight seal.

Status: Phase I SBIR (completed); further work is pending additional funding

Topic Area: Passive Thermal