

Operation of a LHP with Multiple Heat Sources

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Loop Heat Pipes (LHP) are widely used in space applications: deployable radiators, instrument cooling and precise temperature control. These applications utilize classical LHP design with single evaporator and single condenser. Traditionally, a LHP is considered as an ideal solution for the heat sources with concentrated power. The rule of thumb for a thermal control system based on the LHP is: one heat source – one evaporator. It has been demonstrated in the past that the dual evaporator LHP is feasible. However, the volume of the compensation chamber grows dramatically with increasing number of evaporators, therefore it is not practical to make an LHP with more than three evaporators. These restrictions limit the area of LHP applications.

The LHP evaporator generates vapor, which travels through the vapor line toward the condenser. This vapor can be used to pick up some additional power from the heat sources other than the heat source feeding the evaporator. The single-phase heat exchange between these secondary heat sources and the vapor is not very effective, therefore the vapor must be condensed prior to entering the secondary heat source. The condensed vapor with the vapor quality close to zero will absorb significant amount of heat from the secondary source, because the ineffective single phase heat exchange will be substituted by highly effective two-phase one. The chain of the secondary sources can be as long as the capillary pressure of the primary wick can allow. The capillary pressure must support hydraulic losses in the vapor channel and in the secondary source heat exchangers. The driving pump – evaporator must be connected to the heat source with the highest power. The system was successfully tested, demonstrating reliable operation in a wide range of powers and temperatures. This paper describes the test article and discusses the results.