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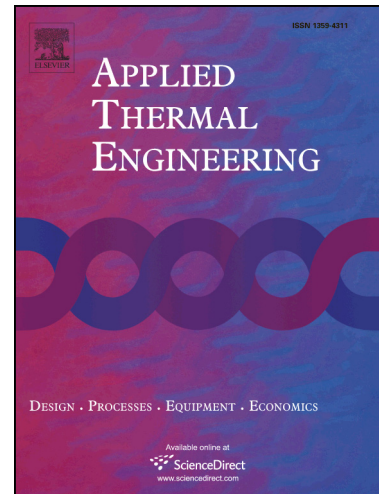
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## Hybrid Pulsating Heat Pipe for Space Applications with Non-Uniform Heating Patterns: Ground and Microgravity Experiments

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### ABSTRACT

A hybrid Closed Loop Thermosyphon/Pulsating Heat Pipe with an inner diameter bigger than the capillary threshold is tested both on ground and in hyper/microgravity conditions. The device, partially filled up with FC-72, consists of an aluminum tube (inner diameter: 3 mm) bent into a planar serpentine with five curves at the evaporator. A transparent section closes the loop in the condenser zone, allowing fluid flow visualization. Five heaters are mounted alternatively on the branches, just above the turns and controlled independently, in order to investigate the effect of non-uniform heating configurations. On ground, where the device works as a thermosyphon, the non-uniform heating configurations promote the fluid net circulation in a preferential direction, increasing the thermal performance with respect to the homogeneous heating. Parabolic flights point out that during the 20 seconds of microgravity, the sudden absence of the buoyancy force activates an oscillating slug/plug flow regime, typical of the Pulsating Heat Pipes, allowing the device to work also without the assistance of gravity. Furthermore, peculiar heating configurations can shorten the stop-over periods and stabilize the pulsating two-phase flow motion.

*Keywords:* Thermosyphon; Pulsating Heat Pipe; Microgravity; Non-Uniform Heating.

### NOMENCLATURE

*BHM*: Bottom Heated Mode [-]

*Bo* : Bond Number [-]

*CHF*: Critical Heat Flux [ $\text{W}/\text{cm}^2$ ]

*CPL*: Capillary Pumped Loop [-]

*d* : Diameter [m]

FPGA: Field Programmable Gate Array [-]

*FR* : Filling Ratio [-]

*g* : Gravity acceleration [ $\text{m}/\text{s}^2$ ]

*Ga* : Garimella Number [-]

*LHP*: Loop Heat Pipe [-]

*PFC*: Parabolic Flight Campaign [-]

*PHP*: Pulsating Heat Pipe [-]

*SPHP*: Space Pulsating Heat Pipe [-]

*T* : Absolute temperature [ $^{\circ}\text{C}$ ]

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