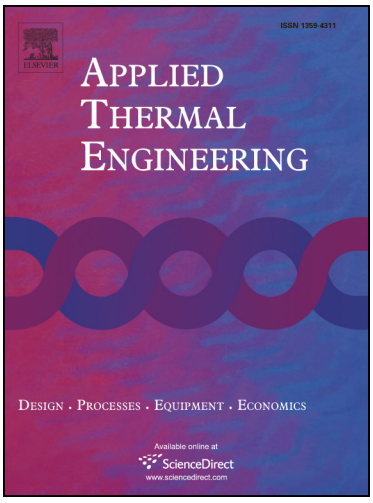

The results of comparative analysis and tests of ammonia loop heat pipes with cylindrical and flat evaporators

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The results of comparative analysis and tests of ammonia loop heat pipes with cylindrical and flat evaporators

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Abstract

Comparative analysis and tests of ammonia loop heat pipes (LHPs) with a flat disk-shaped evaporator 40 mm in diameter and a cylindrical evaporator 10 mm in diameter equipped with a 40 mm × 40 mm × 12.2 mm copper interface were conducted. Both evaporators had the same heated surface 12.56 cm^2 in size. The length and the diameter of the vapor line and the condenser were also equal. Tests of LHPs were conducted at +90°, 0°, -90° angles with respect to gravity and identical condenser cooling conditions at +20 °C heat sink temperature. For the cylindrical evaporator, the maximum heat load of 400 W (31.8 W/cm^2) was reached at a junction temperature of 86.5 °C. For the flat evaporator, the maximum value of heat load was 320 W (25.5 W/cm^2) at a junction temperature of 91 °C. For the cylindrical evaporator, the minimum value of thermal resistance of 0.064 °C/W was reached at maximum heat load. For the flat evaporator, it was 0.067 °C/W at 180 W heat load. As orientation was shifted, the value of the maximum heat load fluctuated by no more than 20-25 % for both devices, while the value of the minimum thermal resistance fluctuated by no more than 4 % for cylindrical evaporator and no more than 12 % for flat one.

Keywords: Loop heat pipe, evaporator, heat load, thermal resistance, heat flux, electronics cooling

1. Introduction

Loop heat pipes (LHPs) are passive heat transfer devices which operate on a looped evaporating-condensing cycle and employ a capillary mechanism for moving the working fluid. These devices were first developed in the 1970s for use in thermal control systems in aerospace applications [1]. The main advantages of LHPs are high heat transfer capacity at any orientation in the gravitational field and in zero-gravity, low thermal resistance, and adaptability for various