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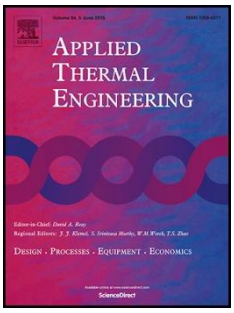

Title: In-flight testing of loop thermosyphons for aircraft cooling

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IN-FLIGHT TESTING OF LOOP THERMOSYPHONS FOR AIRCRAFT COOLING

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Highlights

- A novel cooling system was evaluated in an Embraer test aircraft on ground and during flight
- Flight maneuvers did not affect the thermal performance of the prototype, except the pitch angle
- Heat pipe technology can work in circumstances where freezing of the refrigerant occurs
- Loop thermosyphons can improve the in-flight refrigeration capacity of the aircraft.
- High heat dissipation rates are also possible on ground.

Abstract: A novel design for a heat exchanger was experimentally evaluated in an Embraer test aircraft on the ground and in-flight conditions. The prototype was qualified for flight after constrained acceptance tests. The design consisted of two condensers, linked to one shared evaporator by two parallel loop thermosyphons. Water was used as the working fluid owing to its high figure of merit and because other fluids could represent a hazard in the case of leakage. During the flight, real tests conditions, which could not be set at laboratory, were evaluated. The air stream on the external side of the fuselage and the air conditioning system served as heat sinks. The tests were conducted at flight Mach numbers of around 0.78 and at altitudes of up to 40000 ft. It was shown that the roll angle, angular velocities (pitch, yaw and roll rates) and aircraft accelerations did not affect the thermal performance of the prototype. The pitch angle, however, can affect the prototype performance by avoiding the contact between the working fluid and the heating element. Efficient performance of thermosyphon technology was also shown in freezing conditions. The heat exchanger system allows increasing aircraft refrigeration capacity during flight and on ground.

Keywords: aircraft, thermosyphon, cooling system, fuselage, air conditioning, condenser.

1. INTRODUCTION

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