DESIGN CASE STUDY

Pulsating Heat Pipe for Micro-Gravity Application

PROJECT DETAILS

Customer: **European Space Agency (ESA)**

Application: **Micro-gravity application**

Technology: **Pulsating Heat Pipe**

Industry: **Aerospace**

Location: **Bologna**

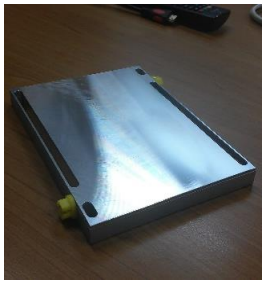
THE DESIGN CHALLENGE

The European Space Agency partnered with The European Design Engineering team of Aavid, Thermal division of Boyd Corporation, for its INWIP project: Innovative Wickless Heat Pipe Systems. The purpose of the project was to study the behaviour of a Wickless Pulsating Heat Pipe System in micro-gravity conditions. The extreme conditions and complexity of the technology.

The project was divided into two parts:

- **REXUS:** A pulsating heat pipe system surrounded by metal foam and inserted into a metal box filled with paraffin wax. The heat, carried by the vapour bullets, flows into the metal foam, melting the paraffin wax.

- **ISS:** A pulsating heat pipe system connected to 8 Peltier cells. The heat carried by the vapour bullets warms one side of the Peltier cells and a liquid cold plate cools the other side.



In cooperation with the University of Pisa, Aavid designed and manufactured the prototypes for both parts of the project.

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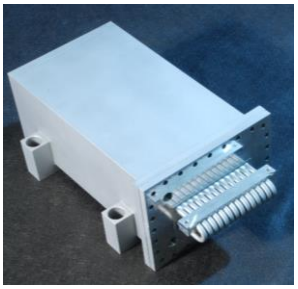
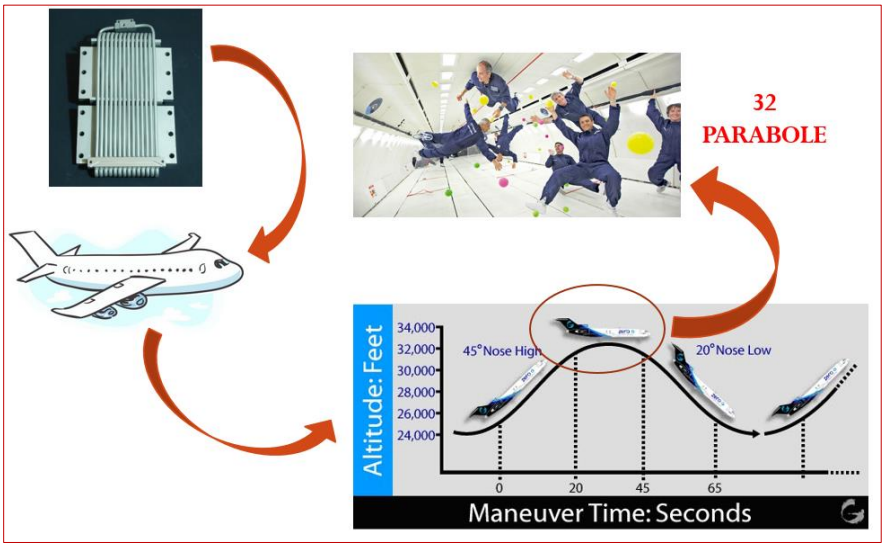
THE TEST EVIRONMENTS

ROCKET REXUS 22: In March 2017, the prototype was launched from the Esrange Space Center in Kiruna, North Sweden, aboard the rocket Rexus 22, to be tested in zero gravity. The rocket followed a parabolic trajectory up to an altitude of 90 km and fell to the ground.



ISS ZERO-GRAVITY PARABOLIC FLIGHT: The cooling system will be installed on a plane which will run along 32 parabolas on a future test flight. In correspondence to the peak of each parabola, the force of gravity will be balanced by vertical traction, creating a transient state of 22 seconds of micro-gravity. During this time, we will be able to monitor the behaviour of the pulsating heat pipe.



A goal of this research is to properly prepare for systematic experimentation on the Thermal Platform1 (TP1) aboard the International Space Station and to investigate the performances of cooling systems with ordinary and innovative working fluids.

> A further aim of the research is the preparation of systematic experimentation on the Thermal Platform1 (TP1) on board the International Space Station

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