Development and Validation of Design Tools for Advanced, Two-Phase, Space Heat Exchangers

Problem Statement

- Single phase heat exchangers are currently used for cooling on ISS and other space platforms, but questions regarding the effect of gravity on two-phase heat exchanger performance prevent their use.
- This flight will allow for collection of two-phase heat transfer data so that the phenomena can be better understood and applied.
- NASA, DOD, other private space contractors

Technology Development Team

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Proposed Flight Experiment

Experiment Readiness:

- The experiment is currently in working order and ready to fly.

Test Vehicles:

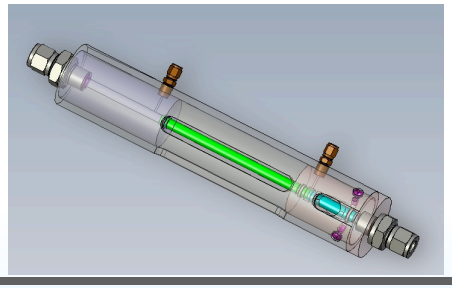
- Parabolic flight is requested in the Zero-G 727

Test Environment:

- The test rig has in the past flown up to 40, 0.01g parabolas per day for 4 days. On upcoming flights, both 0.01g and Lunar/Martian gravity are requested for at least one 40 parabola day.

Test Apparatus Description:

- A closed flow loop has been constructed whereby flow boiling measurements can be made in low-g environments. The experiment is contained within a single test rack (100 cm wide x 750 cm high x 650 cm deep) bolted to the floor of the aircraft. The mass of the apparatus is about 118 kg.



Technology Maturation

- The current TRL is estimated to be between 4-5 since operation of the test apparatus in low-g has been demonstrated for limited conditions
- To reach TRL level of 6, heat transfer data is needed to determine the threshold velocity between the 1-g and low-g regimes. The upcoming tests are designed to obtain this data.
- It is estimated that perhaps 3-5 more flight weeks will be needed to obtained the data needed to properly design space two-phase heat exchangers.

Objective of Proposed Experiment

- We wish to determine the effect of gravity and flow rate on flow boiling heat transfer within a cylindrical heat exchanger
- The current experiment allows the local temperatures and heat transfer to be measured with unprecedented spatial and temporal resolution, allowing flow boiling models to be verified.

TA03 Space Power and Energy Storage, TA14 Thermal Management Systems