MICROGRAVITY SCIENCES AND PROCESSES SYMPOSIUM (A2)
Microgravity Sciences Onboard the International Space Station and Beyond (6)

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THERMAL EXCHANGE: A PAYLOAD FOR TECHNOLOGICAL EXPERIMENTS ON-BOARD THE INTERNATIONAL SPACE STATION

Abstract

The International Space Station was mainly thought as an orbiting research laboratory and, as such, it comprises several resources to test and validate new technologies to be used in future space missions. This paper presents the progresses in the design and development process of Thermal Exchange, a microgravity experiment that aims at on-orbit validation of low-toxicity heat pipe performance for thermal control of future spacecraft, both manned and unmanned. Tendency for future space systems points towards simplicity, limited maintenance needs and high reliability. In particular, vehicle thermal control should be based on passive systems, requiring low maintenance and very limited remote control. Accordingly, heat-pipes are good candidates for future spacecraft thermal control, due to their low complexity and maintenance requirement, as well as their high reliability. In this scenario, Thermal Exchange aims at the development of a payload for the demonstration, in microgravity conditions, of heat pipes and low toxicity working fluids, which would make it compatible with human applications (habitable modules) as well. Thermal Exchange is a sub-rack payload that will be operated inside the Microgravity Science Glovebox (MSG) on-board the International Space Station (ISS). Thermal Exchange consists of a main housing that accommodates the experiment and the avionics containers: the experiment container includes four axially

grooved heat pipes filled with low-toxicity working fluids and mixtures, whereas the avionics container encloses three electronic boards to perform power management and distribution, health management and on-board data handling autonomously once on-board the ISS. Thermal Exchange will be launched with Space-X 9 launch vehicle inside an half CTB (Cargo Transfer Bag). Thermal Exchange will be uninstalled and stowed at the end of the on-orbit operations and will re-entry on Earth with Space-X 10 launch vehicle. This paper first provides a general overview of Thermal Exchange and the project schedule, including the operations to be carried out on the ISS. Then, it deals with the development of the ground and flight models, highlighting first the differences between the models and then focusing on the assembly integration and test of both models. Main results are presented and discussed. Eventually main conclusions are drawn.