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Air Force Research Laboratory Spacecraft Cryocooler Endurance Evaluation Final Report

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The Air Force Research Laboratory (AFRL) Spacecraft Component Thermal Research Group has been devoted to evaluating lifetime performance of space cryocooler technology for over twenty years. Long-life data is essential for confirming design lifetimes for space cryocoolers. Continuous operation in a simulated space environment is the only accepted method to test for degradation. AFRL has provided raw data and detailed evaluations to cryocooler developers for advancing the technology, correcting discovered deficiencies, and improving cryocooler designs. At AFRL, units of varying design and refrigeration cycles were instrumented in state-of-the-art experiment stands to provide space-like conditions and were equipped with software data acquisition to track critical cryocooler operating parameters. This data allowed an assessment of the technology's ability to meet the desired lifetime and documented any long-term changes in performance. This paper will outline a final report of the various flight cryocoolers tested in our laboratory. The data summarized includes seven cryocoolers with a combined total of 433,326 hours (49.5 years) of operation.

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