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C3Or3C-02: ABI life test cryocooler system 2025 update

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The Advanced Baseline Imager (ABI) Pulse Tube Cryocooler System is a two-stage pulse tube cryocooler designed to service space applications requiring simultaneous cooling of two separate optical assemblies at different temperatures, ultra-high reliability, and long lifetime. The mechanical cryocooler is a two-stage variant of the Northrop Grumman HEC (High Efficiency Cryocooler), consisting of an integral linear coldhead and a remote coaxial cold head. This two-stage HEC was designed to provide simultaneous cooling power of 2.27W at 53K at the linear stage and 5.14W at 183K at the remote stage. The ABI Cryocooler System was designed to meet 10-year lifetime requirements –to characterize long-term operation, a life test has been underway since 2009 under the supervision of L3Harris. From inception of the test, the total uptime has been 122,480.90 hours and achieved over 6.7 years of stable performance prior to launch on GOES-R. From June 2018, the life test has been operating at an elevated rejection temperature. The ABI Cooler System performance has remained anchored long past mission requirement life with no degradation in cooling performance. As presented in this paper, the test has shown that there is some performance variation in beginning of life to end of life, however data indicates this variation is predictable. This paper presents the performance data collected on the cooler during acceptance testing and over the course of the cooler's life test and analyzes the relevant performance parameters against predicted performance.

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