

## ***Space Cryogenic Circulator***

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Circulation of cryogenic fluid is a critical technology for cryogenic propellant storage, where it is important to cool the large surface area of the cryogenic storage tank. Furthermore, cryogenic circulation can enable remote cooling of sensitive instruments with low exported vibration by isolating the instrument from the cryocooler with flexible coolant lines. Lockheed Martin Space has developed a 1.4 kg cryogenic circulator based on a modified pulse tube cryocooler compressor. Lockheed Martin pulse tube compressors have previously operated at cryogenic temperatures as low as 125 K. With Lockheed Martin internal research and development funding, a TRL 6 mini compressor was retrofitted with newly designed check valves which rectify the oscillating flow. This circulator was tested at ambient temperature, and the measured flow is equal to the piston swept volume times the drive frequency, as expected. The measured flow exceeded 3 standard liters per second helium flow with 90% motor efficiency. Testing at cryogenic temperature was also performed, and the circulator performed without problem at 90 K. Quantitative testing was not possible because neither the flow meter nor the piston position sensors work at cryogenic temperatures, but some results will be presented. These results indicate this cryogenic circulator has sufficient flow to provide 50 W of remote cooling at 90 K with reasonably small thermal gradients