

## ***Progress Towards a High-Capacity 90 K Turbo-Brayton Cryocooler***

***A.L. Niblick, K.J. Cragin, M.V. Zagarola, Creare LLC,  
Hanover, NH***

Creare is developing for NASA a high-capacity turbo-Brayton cryocooler to support their initiatives for space-borne zero-boil-off storage and liquefaction of oxygen and methane. The cooler is optimized to provide more than 150 W of refrigeration at temperatures from 90 K to 120 K for compatibility with a broad range of storage pressures for both cryogenes. The cryocooler is a scaled-up version of the 20 W at 90 K cryocooler that Creare delivered to NASA in 2012 and was used in NASA's seminal demonstrations of reduced boil-off hydrogen storage and zero-boil-off oxygen storage. The cryocooler includes 1) a new 2 kW-class permanent magnet compressor that incorporates efficiency improvements demonstrated in other Creare turbomachines over the last 10 years, 2) a micro-tube recuperator that is a larger version of the unit developed for our high-capacity 20 K cryocooler, and 3) a high-capacity turboalternator that was based on our prior 500 W-class compressor with materials updated for operation at cryogenic temperatures and optimized aerodynamics. The cryocooler will utilize these components in two development and test cycles. In the first cycle, we will integrate the components in a brassboard configuration to obtain initial performance data before committing to a flight-like configuration. In the second cycle, we will integrate the cryocooler in a flight-like configuration and perform qualification tests including thermodynamic performance and launch vibration testing. This paper reviews the component testing and initial testing of the brassboard cryocooler.