**Ultrasonic Additive Manufacturing (UAM) of Liquid Cold Plate Heat Exchangers for NASA Thermal Management Applications**

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**Abstract**

There is a need for high performance thermal management devices that can pull heat out of smaller and smaller areas at higher and higher rates. This push for increased efficiency of traditional thermal management devices has brought forth the need for designs only possible through 3D printing. Ultrasonic Additive Manufacturing (UAM) is a technology in the 3D metal printing toolbox that allows complex fluid path designs, multi-metal designs, traditional aluminum alloys, and smooth internal contours. Previous work with NASA JPL has demonstrated UAM’s ability to build internal cooling channels in a variety of materials such as copper and aluminum. Channels have been built with sizes ranging from .005” up to 1” in width. NASA’s partnership has enabled higher technology readiness levels for UAM space based thermal devices. Metrics include, burst pressure over 2500 PSI in aluminum 6061, hermeticity of better than 1E-8 scc/s GHe, rocket launch vibration testing, thermal cycling from -120°C to +120°C.

The team has demonstrated the technology on a cold plate design originally meant for the Mars Rover. In this project, the team built several prototypes that were successfully tested. Additionally, the parts went through extensive NDE including x-ray computed tomography demonstrating the printed parts were free of discontinuities. A subsequent program has printed a radiator and cryogenic cooler mount scheduled for flight in late 2022.

The team will present an overview of developments in 3D printed heat exchanger starting in 2014 through present. This will include design guidelines developed along the way, testing performed, and results from NDE.