ManTech Project Advances Knowledge on Improving Additive Manufacturing of Metal Electronics Chassis

Status: Technical Success

PROBLEM / OBJECTIVE

The production of monolithic aluminum alloy chassis (or frames) for electronic applications poses several manufacturing challenges. Traditional (subtractive) manufacturing and joining processes (e.g., vacuum brazing), as applied to electronics chassis, typically result in high part count, long lead times, and significant manufacturing costs. Additionally, such techniques are not amenable to rapid design modification, testing, and production. Additive manufacturing (AM) has been proposed as an effective means to meet those challenges, but AM is subject to dimensional distortion during manufacture of the expansive, thin walls needed for the electronic chassis. To address that challenge, the Navy Metalworking Center conducted a project to quantify the efficacy of various dimensional distortion mitigation approaches. An Integrated Project Team (IPT) evaluated factors such as chassis dimensions, alloy selection, process parameter manipulation, and post-build heat treatment to improve the manufacturability of electronic chassis using AM technologies.

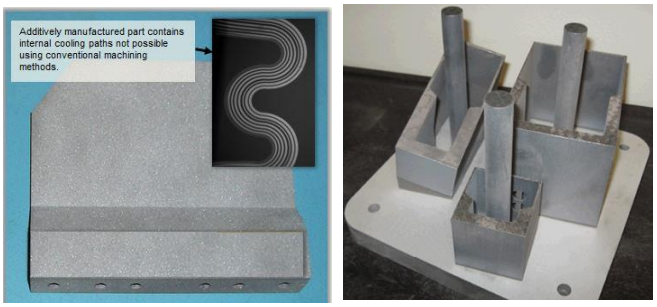
ACCOMPLISHMENTS / PAYOFF

Process Improvement:

Using a design of experiment developed for this process, the IPT investigated the impact of 14 variables on distortion and mechanical properties of aluminum electronics chassis. Three rounds of testing were completed on sub-sized, geometrically simplified chassis leading to empirically derived mathematical models for use in predicting the performance of full-size chassis. The results will be used to identify physical build shapes and processing to yield dimensionally accurate chassis with desired mechanical and thermal properties.

Implementation and Technology Transfer:

This project was terminated early due to an unfavorable return on investment for the targeted application, the Navy's Next Generation Jammer. Despite the project ending early, Raytheon is committed to applying the technical lessons learned from this project to support implementation of AM on future Navy and other Department of Defense platforms. The project's technical findings are part of the evolving, broadly applicable academic and industrial knowledge of distortion in laser powder bed fusion produced parts.



Maturing additive manufacturing (AM) technologies to produce metal electronics chassis for Navy platforms is being considered for cost, schedule, and performance benefits. (Left) internal conformal cooling channels in an AM prototype. (Right) an experimental AM build. Raytheon images.

Expected Benefits and Warfighter Impact:

Project team members from Raytheon believe that the technical knowledge gained from this project could benefit other electronic chassis manufacturing applications in the future. If implemented, they anticipate a potential reduction in lead time and part count, as well as performance improvements such as decreased weight and increased cooling efficiency.

TIME LINE / MILESTONE

Start Date:	April 2015
End Date:	May 2017

FUNDING

Navy ManTech Investment:	$690K

PARTICIPANTS

Raytheon
North Carolina State University
NMC
ONR Navy ManTech

This article was prepared by the Navy Metalworking Center, operated by Concurrent Technologies Corporation, under Contract N00014-10-D-0062 (CDRL A00002/Task Order 0013) to the Office of Naval Research as part of the Navy ManTech Program. Approved for public release; distribution is unlimited.