SUCCESS STORY 3004

Project assessed feasibility of AlSi10Mg 40mm grenade launcher components

Hands-on learning provided critical understanding for distributed manufacturing of systems for DoD needs

CAD renders of each of the 3 specific parts printed: projectiles, receivers, and barrels.

PROBLEM

More research is needed to determine if additive-manufactured munitions are viable for the Department of Defense. Demonstration is needed to prove the capability of aluminum parts utilizing the powder bed fusion method of manufacturing. The specific problem the team is facing is understanding, defining, and replicating the parameters necessary to produce high-performing, user-friendly, and safe man-launch projectiles for combat missions.

OBJECTIVE

The main objective of this project was to demonstrate, using the 40mm platform, that additive manufacturing (AM) processes were applicable to Armament products. The goal was to create and demonstrate an AM printed 40mm low-velocity training round munition and a 40mm grenade launcher. The demonstration showcased the AM capabilities of the U.S. Army Armament Research Development and Engineering Center (ARDEC) and their application in the manufacturing of armaments.

AMERICA MAKES TECHNOLOGY DEVELOPMENT ROADMAP

This project aligns to: MATERIAL

ASTM PROCESS CATEGORY: Powder Bed Fusion

EQUIPMENT: L3DSystems PoX320, Twin Laser SLM 280

MATERIAL: AlSi10Mg

TECHNICAL APPROACH

Prior to producing the parts using AM, coupled thermal-mechanical simulations were conducted using AutoDesk Project Pan software by Penn State. Simulations were utilized to ascertain thermally induced distortion and to identify potential corrective measures for the AM process. After analyzing the simulation and introduction of corrective measures, the grenade bodies were produced using AlSi10Mg powder by Penn State. Penn State produced parts using a 3DSystems ProX320 powder bed system and CalRAM used a twin laser SLM 280 powder bed system.

Video footage captured the AM build process for the grenade bodies, receivers, and barrels. Video footage was also taken during the post-process machining and was edited not to exceed 4 minutes. The part drawings representing the grenade body, receiver, and barrel were revised based on the information gained during the manufacturing demonstration.

ACCOMPLISHMENTS

The project team successfully met the project objectives. In total, 20 projectile bodies, 3 barrels, and 3 receivers were printed using the additive manufacturing method of powder bed fusion. Optimization of processing parameters for the ProX320 for AlSi10Mg was vital to the success of printing these parts. The team used the Netfaab Simulation software to obtain fast and accurate physics-based simulations used to predict thermal distortion, which led to a reduction in build failures. Optical comparator analysis was completed by slicing barrels from early builds to check for surface defects. In a comparison of 3D Systems and SLM parameters, it was found that 3D Systems had better internal quality, while SLM had better surface quality. Video footage of the printing and post-processing steps was obtained to be inserted in an ARDEC Project Video.

PROJECT END DATE

April 2017

DELIVERABLES

- Twenty (20) 40 mm projectile bodies
- Three (3) barrels
- Three (3) receivers
- Video footage of AM production
- Revised part drawing
- Documented process data

FUNDING

$187,352 total project budget

PROJECT PARTICIPANTS

Project Principal:
Penn State University Applied Research Lab (PSU ARL)

Other Project Participants:
CalRAM
NCDMM/America Makes

Public Participants:
U.S. Department of Defense