



# STIC Note

## 3D Metal Printer



### BACKGROUND/PROBLEM

One of United States Coast Guard (USCG) Aviation Logistics Center (ALC) responsibilities is to overhaul Coast Guard Aircraft, which may require the manufacture of prototype and replacement parts. Creating tooling to make parts is a critical part of this process. Many parts are no longer available. Even if the parts are available, they may have long lead times for delivery, leaving gaps in mission support.



Figure 1. MH-65 Dolphin being refurbished. (Source: USCG)

### METHODS

ALC manufactures prototype components and parts to test feasibility of use (form, fit and function).

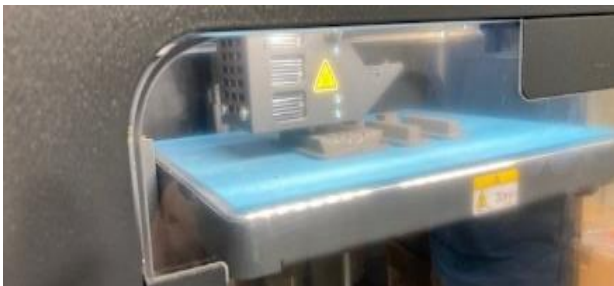


Figure 2. Part printed using the 3D Metal Printer. (Source: USCG)

The 3D Metal Printer selected must be capable of producing the needed tooling or prototype parts within a build envelope of 9.8" x 7.2" x 5.9". The fabrication method was an Additive Manufacturing Process. Market research found that there are many printers that met ALC requirements. An RFQ resulted in three machines that fit the requirements. The Markforged 3D Metal X Printer was selected because it met the most USCG requirements and had the lowest submission bid. To meet the required safety standards, installation of the machine required a new ventilation system and rewiring of the electrical system at ALC. These safety measures had to be tested to verify they met the required levels for occupation of the manufacturing space.



Figure 3. 3D Metal Printer includes three core equipment components. From left to right: Dryer, Sinter Machine, 3D Printer. (Source: USCG)

## EVALUATION

The Printer was set up to fabricate “dog bone” test samples. In addition, the printer was used to fabricate a part currently produced by existing manufacturing methods for comparison.

The parts were then evaluated for “fit and finish” to determine usability. The dog bones tested show that the samples are within the accepted strength of conventionally manufactured 17/4P H Stainless Steel (as compared to the published standards; ASTM A564, for example).

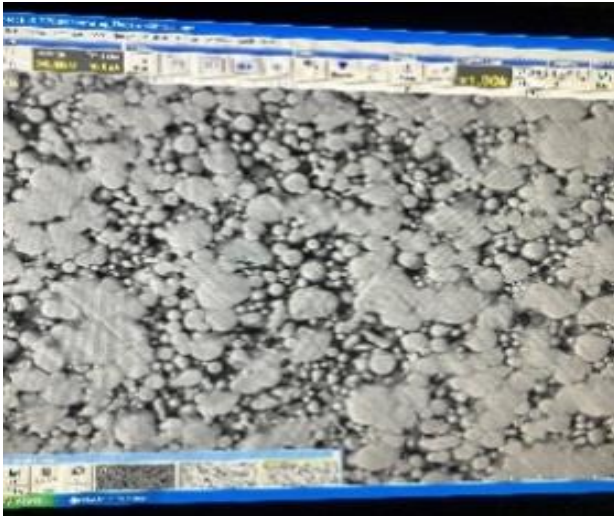


Figure 4. Test Sample of prewashed part magnified 1000x. (Source: USCG)

## CONCLUSIONS

The printer’s use has been limited to testing parts and some tooling. Reconciliation of some initial kinks with the Argon gas sintering process allowed evaluation of the various materials the machine is capable of printing. Certifying parts for aircraft use is a rigorous and lengthy process. The process at this stage of development does not guarantee that each and every part is the same. The process is susceptible to many

uncontrolled variables. However, some can be controlled with design changes. With more experience and testing, there is high confidence that 3D Metal Printing will be a very valuable asset (mostly for tool making). Experience gained from learning how the variables influence part-making as well as how the different materials perform in the process will increase its utility.

### Cons for 3D Metal Printing Methods:

- Each part will be somewhat different.
- Orientation of print layer is crucial.
- Requires new high cost equipment.
- Needs pressurized Argon gas to purge Oxygen in the sintering process.
- Getting testing authorization is likely to be cost-prohibitive to replace aircraft parts.
- An array of durability testing is required.

### Pros for 3D Metal Printing Methods:

- Considerable potential for making tools to aid in the manufacturing of conventional parts.
- Very effective to prove fit and function when prototyping or manufacturing parts no longer available from the manufacturer.
- Can print many types of metal.
- Operator training of actual machine is not as involved as conventional manufacturing.
- Less waste material.

## FUTURE WORK

Different materials and designs will likely bring about alternate uses for the machine. The CG Additive Manufacturing working group at ALC will address alternate uses as they emerge.

The Science and Technology Innovation Center (STIC) is a DHS S&T and USCG collaboration.