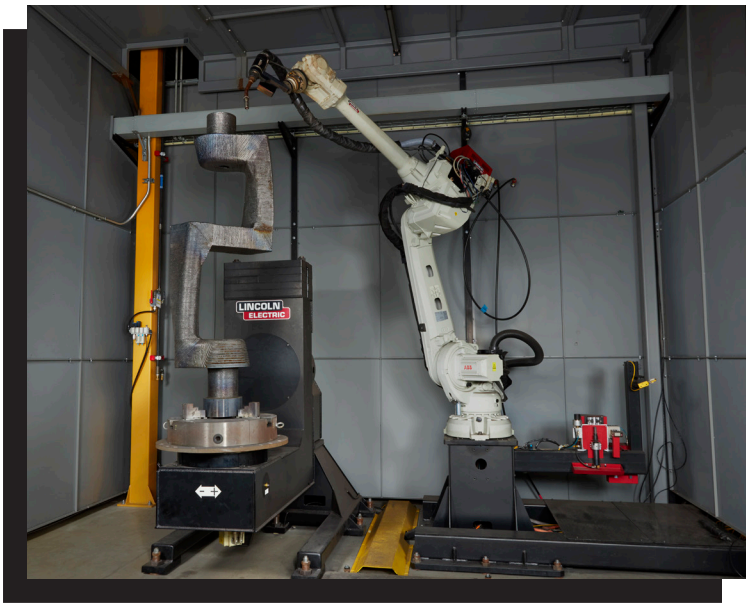
3D METAL PRINTING REDUCES MAINTENANCE COST AND STRUGGLES OF REPLACING LEGACY EQUIPMENT

CASE STUDY

The Challenge



Stick electrodes are a significant part of Lincoln Electric's consumables business, and large mixers are a key piece of production equipment for manufacturing the stick electrode flux. Lincoln Electric's stick electrode plant in Cleveland, Ohio has seven flux mixers, with six in continuous production and a seventh rotated out of production for rebuild. The flux mixers are pre-World War II machinery which means rebuilding and repair is challenging as spare parts are not readily available.

In 2018 a program was initiated to redesign the flux mixer to make it easier and less time consuming to rebuild and to ensure Lincoln Electric could produce in-house all the spare parts needed for rebuilding. Individual parts were redesigned for ease of machining, fabrication and assembly. However, while effective for most components, the redesign program was unable to address the manufacturing or sourcing of six large, steel castings: two each of a bearing housing, mixer blade, and side cover. If these parts need to be replaced they would have to be sourced either from the secondary market, an outside foundry, or machined from billet or bar stock. The latter two options have very high costs with long lead times, and it is increasingly difficult to locate components on the secondary market.

The mixer blade is a casting that Lincoln Electric sources from a foundry once every ten years. Given the infrequency of orders, casting patterns are often lost or damaged and if a new pattern needs to be manufactured, Lincoln Electric incurs a substantial cost and the lead time stretches out. Even if the pattern exists, the lead time for mixer blade castings is considerable: approximately three months.

In addition, the mixer blades experience a significant amount of heat during flux production and require cooling. The blades are cooled via internal cooling channels created by gun drilling and plugging. Not only are gun drilling and plugging difficult and time consuming, but the cooling effectiveness is limited by the relatively small size of the channels compared to the mass of the blade.

LINCOLN ELECTRIC

3D METAL PRINTING FACTORY FOR LARGE PARTS – REPLACING LEGACY PARTS

CASE STUDY

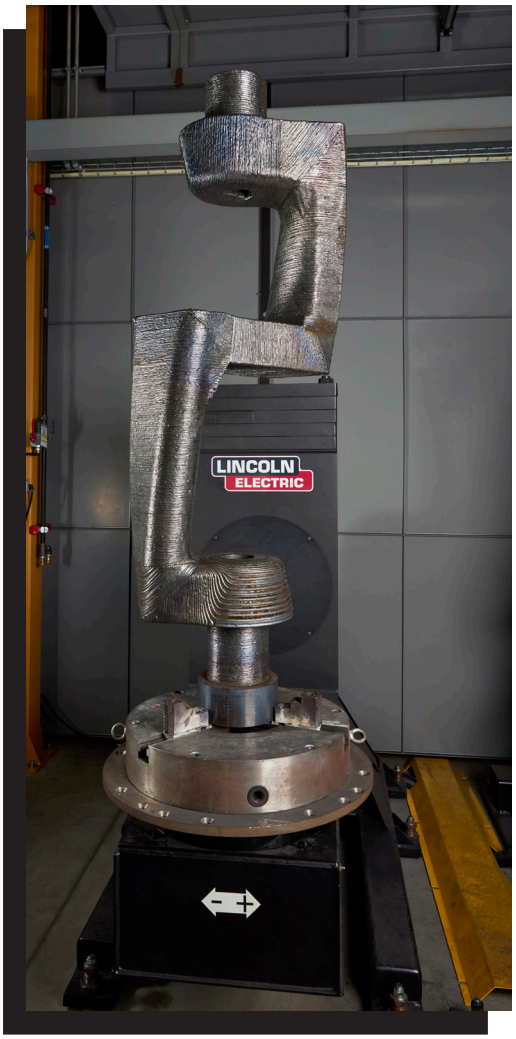
The Solution: Lincoln Electric Additive Solutions

Lincoln Electric addressed many of the challenges and costs associated with cast mixer blades through its 3D metal printing solution. Unlike castings, 3D metal printing does not require the production, inventory, or maintenance cost of patterns and molds. This saves a considerable amount of time and money for low volume or one-off parts. By utilizing North America's largest production capacity for both welding wire and 3D metal printing of large parts, Lincoln Electric Additive Solutions was able to 3D print a mixer blade in just under two weeks. Not only was there an 80% drop in delivery time, but the printed material is stronger and tougher than the original cast iron material.

The maintenance engineering team responsible for the flux mixers also took advantage of the design flexibility afforded by 3D metal printing to substantially increase the cooling capacity of the blades. The team redesigned the cooling channels in CAD to conform more closely to the part geometry — minimizing distance from the blade surface. In addition, the cross sectional area of the channels was increased substantially compared to the gun drilled holes.

Lincoln Electric can now maintain a "digital inventory" rather than a physical inventory of patterns and parts. With a digital file on hand, a mixer blade can be quickly 3D printed anytime it is needed, and there is no longer a need to warehouse a casting pattern.

In all, this project was considered a resounding success for 3D metal printing: Additive Solutions' delivered its internal customer 3D printed mixer blades at a lower cost and substantially shorter delivery time — parts which are expected to outlast the cast mixer blades due to the enhanced material properties and improved cooling.



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