CASE STUDY

A 2024 Grand Prize Winner in the Hardware/Appliances category for Metal AM components.

Stator Bore Reaming Tool

Process:
Metal Additive Manufacturing (AM)

Material:
Maraging Steel (18Ni-300), Hardened

Large Diameter:
220 mm

Small Diameter:
140 mm

Cutting Speed:
500–1,000 rpm

End Use and Function

This large AM component is part of a cutting tool for machining stator bore housings for electric vehicle motors. It machines two diameters concurrently in one pass.

Fabrication

The stator tool was built using laser powder-bed-fusion (PBF-LB) with one part per build. The part design allowed large sections of the component to be self-supporting. The part's connection interface was machined to enable assembly of the tool structure. The tool must cut at 500-1,000 rpm while having the cutting diameter accurately adjusted to within 5 μm of the target hole size of 220 mm. The stator tool was built using maraging steel (18Ni-300) and hardened to 43 HRC to facilitate post-machining processes. The larger diameter of 220 mm is supported by six radially extending arms, each holding a four-edged polycrystalline diamond (PCD) insert and guide pad to achieve tolerances of IT7. The smaller diameter of 140 mm features another four cutting inserts.

Results

The AM process allowed the production of a lightweight component, facilitating manual and automated tool handling, as well as enabling faster and more efficient acceleration of the machine spindle. Providing coolant to the cutting edges was a challenge because the customer required minimum quantity lubrication (MQL), which involves delivering a mixture of oil and air at low flow rates through the tool. The flow of MQL coolant was optimized by designing an integrated manifold structure to deliver coolant evenly from a central tube to the individual channels that exit at six cutting edges and guide pads on the larger cutting diameter.