

Unsettled Topics on Surface Finishing of Metallic Powder Bed Fusion Parts in the Mobility Industry

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Kevin T. Slattery, DSc—Kevin is a Principal ADDvisor® at The Barnes Global Advisors (formerly The Barnes Group Advisors). His primary expertise is in Metallic Additive and Metals Manufacturing, focusing on test program development and process and product verification, qualification, and certification. He has supported over 25 clients on five continents throughout the entire additive manufacturing value chain—from raw material to finished components. He is a 2020 Ambassador for America Makes and was part of the Materials Challenge Silver Medal team in the United States (US) Air Force Rapid Sustainment Office Additive Manufacturing Olympics.

Kevin was previously the Chief Scientist for Additive Manufacturing at Boeing Research and Technology (BR&T). He was responsible for developing and integrating the technology roadmaps and development plans for metallics additive manufacturing for the entire company, along with building and leading a multiskilled team to execute and deliver the technology throughout the enterprise. Prior to that, he was the Chief Scientist for Metals, Ceramics, and Mechanical Systems at BR&T, with the responsibility for portfolio development and coordination, while executing the additive manufacturing portion.

He served as the division chief engineer for the US Navy and US Air Force fighter aircraft and US Army rotorcraft in Boeing's Military Sustainment organization. From 1997 to 2012, he was on the BR&T Metals Team as a researcher and senior manager, where he primarily developed advanced low-cost titanium

processing technologies supporting all Boeing products. He was the technical and programmatic lead in implementing the first aerospace metal-additive manufactured structural aircraft components for both spares and production, with five other first-in-the industry technology implementations.

He began his career at McDonnell Douglas (now Boeing) as a nondestructive testing engineer, where he developed inspection technologies for metallic and composite components, along with integrating the impact of discontinuities with the acceptance criteria for carbon/epoxy composites.

Dr. Slattery holds BS and MS degrees in Metallurgical Engineering from the University of Missouri-Rolla (now Missouri S&T) and a DSc in Material Science and Engineering from Washington University in St. Louis. He currently holds 36 US patents, with another 15 applications pending, along with 36 significant publications and conference presentations.

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Abstract

Laser (L-PBF) and electron-beam powder bed fusion (EB-PBF) additive manufacturing (AM) technology, or “3D printing,” has transitioned from prototypes and tooling to production components of geometries that can only be made using AM in demanding fields such as medicine and aerospace. These initial applications either

- Take advantage of the relatively high surface roughness of the process
- Are in fatigue, corrosion, or flow environments where surface roughness—higher than that found in cast, machined, or sheet metal products—does not impose performance penalties

To move to the next levels of performance, the surfaces of components made by L-PBF and EB-PBF will need to be smoother than the current as-printed surfaces and will have to achieve this on increasingly more complex geometries. Finally, these surfaces will need to be produced without significantly increasing the cost of the final component.

In this third part of an ongoing series on AM, the challenges, technologies, and opportunities for surface finishing of L-PBF and EB-PBF metallic parts are discussed.

NOTE: SAE EDGE Research Reports are intended to identify and illuminate key issues in emerging, but still unsettled, technologies of interest to the mobility industry. The goal of SAE EDGE Research Reports is to stimulate discussion and work in the hope of promoting and speeding the resolution of identified issues. These reports are not intended to resolve the challenges they identify or close any topic to further scrutiny.

Notes on terminology:

- **Surface Finishing** refers to the use of in-situ processing or post-processing to smooth the surface of a part made using PBF. A primary example is sanding.
- **Surface Improvement** refers to the use of in-situ processing or post-processing to impart compressive residual stresses on the surface of a part to improve fatigue properties. A primary example is shot peening.

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