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USING DEMONSTRATOR HARDWARE TO DEVELOP A FUTURE QUALIFICATION LOGIC FOR ADDITIVE MANUFACTURING PARTS

Abstract

Qualification of components and processes is crucial for implementing additive manufacturing (AM) as part of a company's manufacturing process portfolio. Currently, extensive research is ongoing in industry and academia to understand the capabilities and limitations of AM in order to enable qualification. For critical structural components, understanding the impact of the AM process and material on mechanical properties is essential. While an overall logic for qualification of AM parts is sought for, the complexity of these multidisciplinary end-to-end manufacturing processes requires comprehensive knowledge to be built in the pursuit of such a logic. As part of this work, GKN Aerospace is using demonstrator hardware to mature the AM process. While early expectations on AM often considered it as a universal manufacturing process, the hype has now subdued and it is generally accepted that AM is not suitable for all products. However, in the cases where AM is a good match, it has potential for cost and lead time reduction, while maintaining performance and reliability. GKN has identified liquid rocket engine turbines with highly loaded parts, complex designs, and that are manufactured in low volumes, as a perfect fit for AM. Currently, GKN is designing a new ultra-low-cost turbine demonstrator relying on three objectives; (1) low number of components, suppliers and processes, (2) robust design, and (3) efficient manufacturing. The fully laser powder bed fusion (LPBF) manufactured turbine demonstrator scheduled for engine test in 2020, is an important step in the GKN AM technology demonstration for highly loaded aerospace parts. The verification and demonstration of the AM turbine rests on three pillars; (i) material data, (ii) analysis, and (iii) hardware. Analytical verification using AM material data is the foundation in the verification of the AM turbine. To support this, material testing is an important part of verifying the AM material, as is component testing to check design margins in relation to prediction. Additional testing includes traveler specimens or structures built simultaneously as the full part. Non-destructive inspection of components and travelers verify material quality, and destructive inspections validate the results from non-destructive inspections. This paper presents the use of this verification approach on a LPBF turbine, where correlation of material data, component testing and inspection to analyses are discussed. Furthermore, conclusions are drawn on future needs for the development of a qualification logic for serial production AM hardware.