Standardisation of mechanical testing for metal AM:

Load bearing area determination using surface texture correction for PBF-LB tensile specimens

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Abstract

Additive manufacturing (AM) has revolutionized the production of complex metal components, with laser-based powder bed fusion (PBF-LB) being one of the most popular and extensively researched processes. However, the mechanical testing of these components often relies on traditional standards that do not adequately consider the unique surface characteristics inherent to AM. A critical challenge in accurately characterising a part's mechanical performance is determining the true load-bearing area, which is significantly influenced by the process-specific as-built surface texture. Current mechanical testing standards typically assume uniform surface conditions, failing to account for the irregularities and features produced in AM processes.

This misalignment can lead to inaccurate assessments of mechanical properties, compromising the reliability and safety of AM parts in critical applications. Therefore, it is essential to develop standardised approaches that incorporate surface texture corrections to enhance the accuracy of load-bearing area determinations for PBF-LB tensile specimens.

This study proposes a methodology that addresses these challenges by integrating load-bearing area corrections based on areal and profile surface texture parameters. Both, areal (ISO 21920) and profile (ISO25178) parameters are included to ensure broad accessibility and applicability of the proposed correction and are included in an international interlaboratory study (ILS). The research is conducted in consultation with ASTM F42 and ISO/TC 261 to align with ongoing efforts in standardisation.

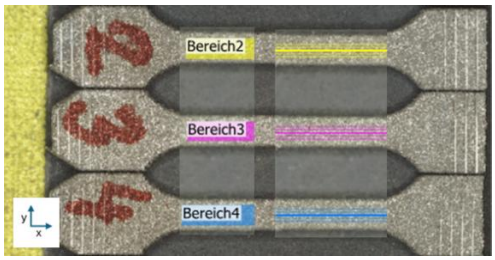

Figure 1: Tensile specimens with areal and profile surface texture measurement definitions for ILS study.