Impact of Powder Variability on the Microstructure and Mechanical Behavior of Selective Laser Melted Alloy 718

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NASA has undertook an intra-agency effort to evaluate, produce and support a NASA standard for safety-critical components for space flight vehicles fabricated from additively manufactured Ni-based superalloy Alloy 718. Superalloy 718 and its derivatives have found wide use in high-temperature aerospace applications (up to 700°C), due to a combination of good mechanical properties, environmental resistance, and workability at moderate cost. Their modest content of refractory elements and intermetallic precipitate produces alloys that are weldable , which makes them promising candidates for selective laser melting (SLM) fabrication and has warranted a number of recent studies on SLM 718 . However, to meet the full potential of AM for safety-critical components for aerospace applications, qualification and certification efforts are necessary. This investigation is a survey of industrial powder feedstock that was readily available commercially to understand the impact of variability on build quality and performance of SLM 718. The survey results will help inform feedstock controls for future updates to the NASA standard, which might include quantities like percentage of fines, chemistry requirements, and/or defect tolerances. This paper will focus on select variables evaluated, including powder chemistry, powder distribution characteristics, grain structure, texture, and build microstructure, and then discuss the relationship of these variables to failure mechanisms observed for the room temperature tensile and fatigue behavior for as-fabricated surface and low stress ground surface conditions. Support of NASA Space Launch System Engine office under Additive Manufacturing Structural Integrity Initiative project is acknowledged.