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Comparison of mechanical properties of heat-treated components made by the WAAM from Inconel 718 alloy

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Inconel 718 is a precipitation-hardenable superalloy that was developed in the 1950s. Due to its exceptional creep resistance, corrosion resistance and ability to maintain its mechanical properties at elevated temperatures of up to 700°C, it is used in the chemical, energy and aerospace industries. The mechanical properties of the Inconel 718 alloy are not only determined by the chemical composition, but also by the processing of the alloy itself. Segregation of refractory elements such as niobium and molybdenum often occurs with Inconel 718 nickel alloy. The result is a hard yet brittle intermetallic compound called the Laves phase, which forms in the interdendritic regions due to thermal cycling during deposition. Its presence consequently worsens the mechanical properties and helps the initiation and propagation of cracks. Homogenization annealing after deposition is currently the most viable way of controlling the appearance of the Laves phase in the microstructure of a component made by the WAAM. The paper compares three regimes of heat treatment (annealing temperature of 980 °C and a holding time of 30, 90 and 120 minutes) in terms of the resulting ultimate tensile strength, yield strength, ductility and impact energy, while the results are also evaluated statistically.