

Development of Additively Manufactured INCONEL 718 for Oil and Gas Applications

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The Ni-Fe-base superalloy INCONEL 718 (IN718) has seen widespread adoption in additive manufacturing due to its high strength and corrosion resistance. The material has been used for a wide range of applications, especially for high temperature structural components in the aerospace industry.

In conventionally manufactured form, however, IN718 is also widely used in the oil and gas industry, where service requirements are drastically different from aerospace. The alloy is used in very low temperatures, where toughness and ductility are paramount, in combination with resistance to environmentally assisted cracking and corrosion. IN718 for oil and gas therefore has a different property profile, and resultantly different microstructure and mechanical properties compared to the aerospace grade. These characteristics of oil and gas IN718 are governed by industry specific standards, to which conformance must be proven for material qualification, due to regulatory requirements in the oil and gas industry.

This presentation describes the development of a specialized heat treatment to enable LPBF IN718 to achieve the required material properties (strength, ductility, hardness, and microstructure) required by oil and gas standards. Iterative tests on the solution and ageing heat treatments were performed to achieve properties in the narrow range allowed by oil and gas standard API 6ACRA. An example of an application of LPBF IN718 in fluid separation at offshore oil wells is also presented.

Keywords: laser powder bed fusion; superalloy; nickel; heat treatment; oil and gas; mechanical properties; microstructure.