



## JOINING OF SHAPE-WELDED STELLITE 31 WITH ROLLED NIMONIC 75

### Task

Additive manufacturing processes make it possible to manufacture new geometrically and materially optimized components. Frequently, however, connections to sheets and profiles are necessary in which the welded connection has a decisive influence on the component properties. For the joining of Stellite 31 and Nimonic 75, the strength and the failure behavior of the weld seam were determined by means of suitable test specimens, in order to derive guidelines for the application; Laser Metal Deposition was used as an additive manufacturing technique. The aim was to determine the strength of the bond between dissimilar materials at normal load, as well as to investigate the welding metallurgy and fracture behavior.

### Method

Laser Metal Deposition was used to produce ingots of Stellite 31. The process parameters were adjusted so that the size and frequency of cracks were minimized. After tension annealing, milling, wire-cut EDM and finishing, strips of Stellite 31 were welded onto a test piece out of Nimonic 75 with two seams in a butt joint. Mechanical testing was carried out by transverse tensile tests with and without a thermal cycle up to 750 °C at room temperature and at 750 °C (operating temperature).

### Results

At room temperature, the welded connection reaches strengths which are higher than those of the rolled base materials. An influence of the layer direction on the strength could not be detected. The fracture was mainly found in the cobalt material, to a small extent on the fusion line. One reason for this is microcracking, which occurred during shape welding. At operating temperature, the fracture tests cause all samples to fail in the nickel material outside the welding zone.

### Applications

The tested materials are commonly used in components subjected to high mechanical stress and high-temperature corrosion, such as guide vanes of gas turbines or parts of combustion chambers. Additional applications are possible in the field of power plant technology and chemical equipment construction. Moreover, the combination of Laser Metal Deposition and fusion welding allows a cost-effective production of large components whose production with additive methods alone would be uneconomical.

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4 Macro cut of a broken tensile specimen.

5 Fracture surface in 1.4682.