

HIGH STRENGTH, DUCTILE WIDE GAP BRAZE JOINTS FOR STATIONARY TURBINE COMPONENT REPAIRS

by

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ABSTRACT

Wide cracks in land-based Ni- or Co-base superalloy turbine components are difficult to repair successfully using conventional welding or brazing techniques. This project examined the feasibility of liquid phase diffusion brazing using novel Ni- and Co-base braze alloys containing Hf or Zr as melt point depressant for the repair of wide cracks in turbine components. An optimized braze cycle was developed and the joints were evaluated using various metallographic techniques and mechanical tests (elevated temperature tensile tests, creep rupture tests and low cycle fatigue tests). Microstructural examination revealed the presence of Hf- or Zr-rich intermetallic phases (most likely Ni_7Hf_2 or Ni_5Zr) in Ni-base braze joints. These intermetallic compounds were, however, observed to be significantly softer than the boride phases routinely found in commercially available braze alloys with boron as melt point depressant. As a result, the novel wide gap brazed joints displayed excellent mechanical properties (ranging from 80% to 100% of the base metal's properties). The low cycle fatigue properties of wide gap braze joints performed using a combination of MarM247 superalloy powder and Ni-Cr-Hf or Ni-Cr-Zr braze filler metals were found to be superior to those of the widely used Ni-Cr-B braze filler metals. Wide gap braze repair of FSX-414 Co-base superalloy using novel MarM509/MarM509B and MarM509/Co-Hf braze alloys resulted in high temperature tensile properties equivalent to those of weld repairs in the same parent material (using Nozzalloy filler metal). The creep rupture and low cycle fatigue (LCF) properties of the braze joints were superior to those of welds performed using MarM918 filler metal.

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