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NASA TECH BRIEF

Weld Microfissuring in Inconel 718 Minimized by Minor Elements

Inconel 718 is a commercial precipitation-hardenable nickel-base alloy having good strength and ductility over a wide temperature range (−423° to > 1300°F). Because of these properties and its superior weldability and high resistance to strain-age cracking (compared to René 41) Inconel 718 has been used for parts requiring high strength at both cryogenic and elevated temperatures, particularly those which are machined and welded and then heat treated to develop required properties.

Intergranular microfissures have been detected in the weld heat-affected zone of Inconel 718 forgings and plate by refined dye-penetrant and X-ray inspection techniques. Such microfissures have not been uncommon in other precipitation-hardenable nickel-base alloys and were shown to be measurably influenced by specific trace elements. An investigation was therefore undertaken to identify and establish the concentrations of trace (minor) elements which would minimize weld microfissuring in Inconel 718. The results of this investigation thus far show that a manganese content in excess of 0.20 percent combined with a silicon content greater than 0.25 percent markedly reduces the tendency of Inconel 718 to weld microfissuring. Experiments have also shown that the addition of 20 ppm of magnesium significantly decreases weld microfissuring in the standard alloy. A 2100°F solution anneal, known to severely degrade standard Inconel 718 weldability, had no appreciable effect on the weldability of the alloy with the added magnesium. Only electron-beam welding, a most severe test of fissuring tendency, could cause the magnesium-modified alloy to fissure measurably.

Note:

Pertinent information on Inconel 718 is also contained in Tech Briefs 67-10049 and 67-10282. Inquiries on the microfissuring investigation may be directed to:

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Patent status:

No patent action is contemplated by NASA.

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