December 1971 Brief 71-10520

NASA TECH BRIEF

Lewis Research Center

Solid State Welding of Dispersion-Strengthened Nickel Alloys

The problem:

Weld a dispersion-strengthened, nickel-chromium alloy without losing parent-metal strength at the weld joint. Fusion welding and brazing methods result in weldments having approximately 50% of the parent-metal strength. Previously, solid state welds have proven to be weak when tested at elevated temperatures (2000° F).

The solution:

Apply a special two-step, solid state welding cycle to carefully prepared surfaces of the unrecrystallized alloy.

How it's done:

Lap welds were made in a 0.062 in. thick uncrystallized Ni-20Cr-2THO$_2$ sheet obtained from the manufacturer. (Normally, the sheet is recrystallized before shipment.)

The surfaces to be welded were sanded with 600-grit paper, electropolished, and cleaned with trichlorotrifluoroethane. The specimens were stored in this degreasing agent until ready for welding. The prepared specimens were welded in a vacuum hot-press welder evacuated to a pressure of 2×10^{-5} torr. The parameters of the two-step welding cycle were: (1) 1300° F, 30,000 psi, 1 hr; and (2) 2175° F, 2000 psi, 2 hr. All welds were postheated at 2300° F for one hour to achieve stress relief and ensure that recrystallization was complete.

In both short-time shear and over-100-hours creep-rupture tests at 2000° F, the weld joint strength was the same as the strength of the parent material.

Notes:

1. This solid state welding method may be applied to any alloy that undergoes recrystallization upon heating. When recrystallization occurs, the original weld interface is removed by grain growth across it.
2. The method should be applicable, with modifications, to the dispersion-strengthened nickel alloys Ni-ThO$_2$, Ni-Cr-ThO$_2$, Ni-Mo-ThO$_2$, and Ni-Cr-Al-ThO$_2$.
3. The following documentation may be obtained from:

   National Technical Information Service
   Springfield, Virginia 22151
   Single document price: $3.00
   (or microfiche $0.95)

   Reference:
   NASA TN-D-6493 (N71-34470), Enhanced Diffusion Welding of TD-NiCr Sheet
4. Technical questions may be directed to:

   Technology Utilization Officer
   Lewis Research Center
   21000 Brookpark Road
   Cleveland, Ohio 44135
   Reference: B71-10520

Patent status:

Inquiries about obtaining rights for the commercial use of this invention may be made to:

Patent Counsel
Mail Code 500-311
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(LEW-11388)

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