

Accepted Manuscript

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Authors: O.N. Senkov, D.W. Mahaffey, S.L. Semiatin



PII: S0924-0136(17)30292-3
DOI: <http://dx.doi.org/doi:10.1016/j.jmatprotec.2017.07.020>
Reference: PROTEC 15317

To appear in: *Journal of Materials Processing Technology*

Received date: 3-4-2017
Revised date: 12-7-2017
Accepted date: 13-7-2017

Please cite this article as: Senkov, O.N., Mahaffey, D.W., Semiatin, S.L., Effect of process parameters on process efficiency and inertia friction welding behavior of the superalloys LSHR and Mar-M247. *Journal of Materials Processing Technology* <http://dx.doi.org/10.1016/j.jmatprotec.2017.07.020>

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Effect of process parameters on process efficiency and inertia friction welding behavior of the superalloys LSHR and Mar-M247

O.N. Senkov*, D.W. Mahaffey, S.L. Semiatin

Air Force Research Laboratory, Materials and Manufacturing Directorate, Wright-Patterson AFB, OH 45433, USA

* Corresponding author, Email: oleg.senkov.ctr@us.af.mil; Phone: +1 937-255-4064.

ABSTRACT

The relationships between the inertia friction welding process parameters (initial angular velocity, ω_o , and moment of inertia, I , of the flywheel and the axial compression force, P) and welding behavior (welding time, sample upset and flash formation, efficiency and kinetics of friction-induced sample heating) of dissimilar superalloys were determined. The results showed that the initial kinetic energy of the flywheel, $E_o = I\omega_o^2/2$, should not be considered as a key parameter for the design of the IFW process. Only a fraction of this energy (denoted as 'sample energy', E_s), which is process-parameters dependent, is used to heat the workpieces at the weld interface. Together with I and P , E_s controls the upset length, the duration of the welding process, temperature profiles near the weld interface and the weld quality. Optimization of the inertia friction welding for better quality, reduced energy consumption and materials saving requires information about the process efficiency $\eta = E_s/E_o$ and its dependence on the process parameters. Critical sample energy per unit surface area ($\approx 79 \text{ MJ/m}^2$) was identified above which good quality metallurgical bonds were produced between LSHR and Mar-M247 alloys.

Keywords: Inertia friction welding; Ni alloys; superalloys; process efficiency; weld quality.

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