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NASA TECH BRIEF

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Thermal Stress-Relief Treatments for 2219 Aluminum Alloy Are Evaluated

Residual stresses incurred in roll-forming of 5- by 27-inch by 33-foot diameter 2219 aluminum alloy Y-ring segments result in distortion of the Y-ring during subsequent machining. The Y-ring is made by roll forming, welding, and machining three equal segments. No empirical data are available to apply to this problem because of the massive aluminum parts. It is necessary to develop some form of stress-relief treatment that will not significantly degrade mechanical or stress corrosion properties of the metal.

An investigation is conducted to evaluate three theoretically promising thermal stress relief treatments in terms of their effect on residual stress, mechanical properties, and stress corrosion resistance.

The treatments evaluated are post aging (350°F, 9 hours) fullscale and subscale parts formed in the aged T81 condition, stress relieving (435°F, 3 hours) fullscale and subscale parts formed in the aged T81 condition, and aging (350°F, 18 hours) subscale parts formed in the unaged T31 condition.

Resistance to stress corrosion cracking of a full scale Y-ring segment formed in the aged T81 condition is improved by post aging at 350°F for 9 hours but a decrease in short transverse ductility results.

No stress corrosion cracking is observed on specimens from a full scale Y-ring segment formed in the aged T81 condition when stress relieved at 435°F for 3 hours. This treatment, however, results in a decrease in average short transverse yield strength of approximately 7,000 psi.

Residual stresses of subscale Y-ring segments formed in the aged T81 condition are reduced by post aging at 350°F for 9 hours or by stress relieving at 435°F for 3 hours. A slight advantage is indicated for the stress relief treatment. No appreciable degradation of long transverse mechanical properties is observed for either treatment. Restraining parts during thermal treatments does not significantly affect either residual stresses or long transverse mechanical properties.

The lowest residual stresses are obtained for subscale Y-ring segments formed in the unaged T31 condition and aged after forming. Long transverse mechanical properties are excellent. Residual surface stresses after aging are slightly higher for parts restrained during aging.

No stress corrosion cracking was observed on specimens from a full-scale Y-ring segment formed in the aged T81 condition when stress relieved at 435°F for 3 hours. The lowest residual stresses were obtained by forming subscale parts in the unaged T31 condition and aging after forming.

Note:

Inquiries concerning this invention may be directed to:

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Reference: B66-10448

Patent status:

Inquiries about obtaining rights for the commercial use of this invention may be made to NASA, Code GP, Washington, D.C. 20546.

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