

Predicting the Response of Aluminum Casting Alloys to Precipitation Hardening Heat Treatment

A heat treatment model has been developed in order to predict the response of cast aluminum alloy components to a complete precipitation hardening heat treatment, including solutionizing, quenching, and aging, and the necessary database for A356 alloy was generated. The model predictions were compared to measurements made on commercial cast components and they were found to be in good agreement.

BENEFITS

A robust computer model is developed for predicting the results of precipitation hardening heat treatments on aluminum alloy castings.

The necessary database is generated for A356 alloy, including thermal conductivity, quenching heat transfer coefficients, mechanical properties, and dilation and creep characteristics.

A method is developed for applying quenching heat transfer coefficients locally.

IMPACT

The developed model is a useful tool for optimizing heat treatment schedules.

The methodology developed for A356 alloy can be extrapolated to other precipitation hardenable alloys.

FOR MORE INFORMATION, PLEASE CONTACT:

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(a)

(b)

Fig 1. (a) Commercial casting used for validating the model, and (b) ABAQUS model of the commercial casting.

(a)

(b)

(c)

Fig 2. Measured and model-predicted (a) Hardness, (b) Yield strength, and (c) Ultimate tensile strength

(a)

(b)

(c)

Fig 3. Measured and model-predicted (a) Residual stresses for both T6 and T7 aging conditions, (b) total length increments for T6 aged, and (c) for T7 aged casting