

## Article

# Optimization of Flat-Rolling Parameters for Thermally Stable Alloy of Al-Cu-Mn System with Micro Additions of Si and Zr

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**Abstract:** The phase composition, microstructure, and mechanical properties of flat-rolled experimental Al-Cu-Mn system alloy with Si and Zr additions have been studied. The experimental results have been compared with data for the AA2219 commercial alloy pertaining to the same alloying system. Hot deformation of an experimental alloy causes the precipitation of ~100 nm sized dispersoids and refinement of the eutectic phase particles. The yield strength and relative elongation of the hot-deformed experimental alloy are 255 MPa and 8.6%, respectively. Subsequent cold deformation reduces the relative elongation by 3.5% and increases the yield strength by 50 MPa, while the ultimate tensile strength does not change. After long-term 350 °C exposure, the mechanical properties of the experimental alloy remain the same as those of the as-deformed one, whereas the yield strength of the 2219 alloy decreases by 2 times and the ultimate tensile strength by 1.4 times. Comparison of these experimental results with data for the 2219 alloy and other Al-Cu-Mn system alloys cited in this work and reported elsewhere suggests that a good thermal stability of Al-2Cu-2Mn-0.4Si-0.2Zr alloy rolled stock can be achieved through treatment using the regimes designed herein.

**Keywords:** aluminum alloy; Al-Cu-Mn system; deformation; thermostability; microstructure; mechanical properties



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## 1. Introduction

Aluminum and its alloys are widely used in a number of branches due to their unique combination of mechanical and physical properties, high processability, and, most importantly, low cost and abundance. Deformable 2xxx series aluminum alloys (Al-Cu and Al-Cu-Mn) have found broad application in the aircraft and spacecraft industries due to the possibility of their long-term operation over a wide temperature range without compromise in performance [1]. The 2219 (Al-6Cu-Mn) alloy of the abovementioned series is still commonly used as a construction material for operation at elevated (up to 315 °C) and cryogenic temperatures [2]. However, high performance of AA2219 alloy products can only be achieved after combined heat and deformation treatment including ingot homogenization, quenching, and aging of deformed semi-finished products [3]. This process route requires strict adherence to the processing parameters, which is difficult to realize in the conditions of large industrial enterprises and their narrow process windows, as it increases the overall time consumption and cost of production and dictates the necessity to use special process equipment. Furthermore, there are indications that the strength of this alloy decreases dramatically at elevated temperatures (above 200 °C) [4,5].

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