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## Influence of heat treatment and its sequence on elevated-temperature properties of Al-Mn-Mg 3004 alloy

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### Abstract:

Various heat treatments with different sequences between the peak precipitation treatment (375°C/48h, referred to as “P”) and the high temperature treatment (450-600 °C, referred to as “H”) were performed in Al-Mn-Mg 3004 alloys to simulate their thermal treatments during thermomechanical fabrication processes in the present work. Their influences on the dispersoid precipitation and elevated-temperature properties (yield strength and creep resistance at 300 °C) were investigated. The results indicate that the size of dispersoids increased while the volume fraction of dispersoids decreased with increasing “H” temperature when “P” was performed either prior to or after “H” (denoted as “PH” and “HP”, respectively), which results in the reduction of the elevated-temperature properties. However, the yield strength and creep resistance after “PH” treatments were always higher than those after “HP” treatments at the same “H” temperature. When the “H” temperature during “PH” treatments is controlled below 500°C, the materials can still maintain the appropriate yield strength and creep resistance, providing the possibility for Al-Mn-Mg 3004 alloy to adapt to the conventional fabrication processes but still maintain high elevated-temperature properties.

**Keywords:** Al-Mn-Mg 3004 alloys; Heat treatments; Dispersoid precipitation; Elevated-temperature properties

### 1. Introduction

Due to their excellent formability, corrosion resistance and high strength, Al-Mn-Mg 3xxx alloys have been widely used in the fabrication of containers and packaging materials [1]. Though Al-Mn-Mg 3xxx alloys have traditionally been classified as non-heat-treatable aluminum alloys, the precipitation of a number of dispersoids during heat treatment has been discovered in 3003 alloys, resulting in an improvement of the mechanical properties at room temperature (RT) [2-5]. Li’s group [4] found that the yield strength (YS) of 3003 alloys at RT increased from 52 MPa after homogenization (600°C/24h) to 80 MPa after the precipitation treatment at a relatively low temperature (375°C/24h), in which a large amount of dispersoids precipitated and contributed to the improvement in strength. Recently, Liu *et al.* [3, 6, 7] systematically investigated the influence of the dispersoid precipitation on the elevated-temperature strength and creep resistance in 3004 alloys and found that the YS and creep resistance at 300 °C increased

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