

**University of Technology, Sydney**

**Faculty of Science**

**A STUDY OF THIN-FOIL ROLLING  
AND THE DEVELOPMENT OF AN Al-  
Fe-Mn-Si LIGHT GAUGE FOIL ALLOY**

**Part 1**

**Course: N054 Doctorate in Science – (by Thesis)**

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**2007**



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*14<sup>th</sup> December 2006.*

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## **ACKNOWLEDGMENTS**

I would like to thank the following people who have assisted in the production of this thesis:

IAS, in particular Tony Santino for assistance on modelling of thin film foils.

ALCOA AUSTRALIA ROLLED PRODUCTS for their support on this project.

Dr Greg Heness, who's assistance was essential in completing this thesis, and his support in upgrading from a masters to a doctorate in Applied Science.

Milt Milner, Rob Sanders Jr, Mike Ringle, Tom Rouns and other members of ATC for there assistance in analysing the microstructure.

Jennifer Russell, Paul Munro and members of the Department of Physics – UTS for their assistance with surface topography.

My wife Fiona, children Tamika and Jai - Your support and patience over the years has kept me going when I wanted to stop, and I dedicate this to you.

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## ABSTRACT

There has been a trend in recent years to produce thinner but stronger thin-foil aluminium alloys at higher production velocities. This thesis discusses and examines product quality, rolling parameters, thermal treatment, web handling and alloy development in the context of the production of thin-foil aluminium products. The information is to be included in the ALCOA metallurgical database

Web failures are categorised and investigated over the life of the project. A short definition is provided followed by remedies to reduce or avoid re-occurrences. The effect of boundary lubrication between the metal and roll surfaces on web failure is summarized by the Mansell curve. The Mansell curve expresses rolling lubrication as a function of film strength and film thickness, and will be useful in determining rolling lubricant composition and temperature.

Optimal settings based on current rolling practices are determined for unwind tension/stress, lubricant viscosity, load and rewind tension/stress to achieve a consistent desired mill speed. The parameters are determined using existing rolling theory and are essential in maintaining production volume with decreasing gauge.

The improved stability of the process provides the foundation for trials on a new unique high strength alloy, AA8150 and accompanying process, developed and registered by the author. Alloy 8150 utilises a unique combination of high cold reduction, solid solution strengthening, constituent and dispersion strengthening to produce a fine grained structure with high strength and formability characteristics.

The wrought aluminium alloy 8150 contains iron, manganese and silicon at greater than 20% from the eutectic composition. High cold reduction with no intermediate thermal treatment results in highly misorientated random alignments in the deformation zone that surround large constituent particles,  $\text{Al}_{12}(\text{FeMn})_3\text{Si}$  and  $(\text{FeMn})\text{Al}_6$ , making them effective recrystallisation nuclei sites. The  $\text{Al}_{12}(\text{FeMn})_3\text{Si}$  and  $\text{Al}_{12}(\text{MnFe})_3\text{Si}$  dispersoids/precipitates that occur during thermo-mechanical processing reduce the energy of the high angle boundaries, 'pinning' the boundary causing a new boundary to be formed as it curves around the particle, enhancing the nucleation of recrystallisation sites.