DEPARTMENT OF MECHANICAL ENGINEERING

THESIS DEFENSE

STUDENT: Rebecca Brown

TITLE: Multi-Pass Friction Stir Welding of AA2195 and AA7050: Effects on Microstructure, Mechanical Properties, and Process Response Variables

DATE & TIME: Tuesday, November 18th, 2008 at 2:00 p.m.

LOCATION: ME Conference Room

COMMITTEE: Dr. Anthony Reynolds - Advisor

Dr. Xiaodong Li – Second reader

GRADUATE STUDIES REPRESENTATIVE: Dr. Jeffrey Morehouse

ABSTRACT

The purpose of this study is to investigate the effects of multiple passes on the weld response variables, metallurgy, and weld properties for friction stir welds. The importance of this research stems from situations where there may be a need or desire to perform a friction stir weld pass through material which has already been friction stir welded, such as, weld repair. It is also pertinent to know whether the same parameters for a defect-free single pass can be applied to each of the multiple passes. Two sets of welds were initially made consisting of five passes each for AA2195-T8 and AA7050-T7451. For AA2195, a tool rotation speed of 320 rpm and a tool traverse speed of 3.4 mm s^{-1} were used for each pass. For AA7050, a tool rotation speed of 540 rpm and a tool traverse speed of 6.8 mm s^{-1} were used for each pass. Various tests and analyses were performed including response variable analysis, grain size measurements, hardness testing, transverse tensile testing, longitudinal tensile testing, residual stress testing, etc. Results showed that, in general, effects of the multiple passes were not observed in the weld nugget, whereas, the effects were cumulative in the heat affected zones. Essentially, the microstructure in the nugget is "reset" on each pass, while additional precipitate coarsening occurs in HAZ with each subsequent pass. Additionally, it was observed that weld shrinkage increased with each pass (AA7050) and that the residual stress was reduced by multiple passes.