Synopsis
Through-out the last decade there has been a large push in the automotive industry to increase the fuel efficiency and performance of their production line vehicles. With the limits of the combustion engine finally being pushed to their maximum automakers have had to turn in different directions to satisfy this demand. One direction has been weight reduction, through material changes. One such option is switching away from conventional steel frames and body panels to aluminium. With a density 3 times lower than steel switching to aluminum panels has a huge effect. This has resulted in a large push by the aluminium industry to research different methods of improving their products for automotive use.

Introduction
Fusion Technology™ from Novelis Inc is a multi-alloy aluminium casting method used to produce multilayer ingots. These ingots are then rolled into sheets producing a clad aluminium system having a perfect metallurgical bond between layers. This metallurgical bond allows the clad alloy to have a clean, oxide free interface. With this ability a customized product can be developed with an improved balance of corrosion resistance, durability, formability and brazeability. Some interesting phenomena however occur at this bonded interface, one being early recrystallization. This is an enormous problem in manufacturing where predictability of the material’s mechanical properties is of great importance to insure a high quality of finish. To insure this predictability it is of the utmost importance to properly understand the evolution of this interfacial region during recovery as this is what sets the foundation of recrystallization during annealing.

Results and Methodology
The static recovery of the interalloy region of cold rolled AA6XXX clad with AA3003 and a monolithic AA6XXX were studied. Typical recovery is modelled with an extrinsic property such as flow stress, however this study utilized the intrinsic dislocation density extracted from x-ray line profile analysis using a modified Williamson-Hall analysis [1]. The static recovery of dislocation density was fit to several models, but was found to best fit the model of Nes [2],

\[
\rho = \rho_0 \left[ 1 - k_1 \ln \left(1 + \frac{t}{\tau_1}\right) \right]^2
\]

where \( \rho \) is the instantaneous dislocation density, \( \rho_0 \) is the initial dislocation density, \( k_1 \) is a scalar constant, \( t \) is the annealing time, and \( \tau_1 \) is a time constant. In the model the recovery is controlled by the migration of jogged screw dislocations assuming that the jog spacing will remain approximately constant during annealing. This model was fit to isochronal recovery treatments such as shown below in Figure 1 and 2. The recovery was observed to be faster in the interalloy region than the AA6XXX alloy. These results will be discussed in the context of the standard continuous anneal self homogenization practice for this alloy.

Conclusion
The outcome of the recovery modeling showed the expected logarithmic decay, in which recovery is faster in the interalloy region compared to the higher solute containing core AA6XXX material. This change in recovery affects subsequent texture and grain growth in these alloys.

References