D. Effects of Clamping Pressure on Micro Weld Formation in Ultrasonically Welded Lap Joints

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Maximizing and predicting of joint strength in ultrasonic welding of metals and rapid prototyping applications, is of importance for the over seven trillion bonds across many industries and scales worldwide.

Shear strength testing of aluminium (1100) sheet couples joined ultrasonically was performed to review the formation of micro welds at the interfacial surfaces. The manually controllable parameters of ultrasonic power, clamping load, and weld time were varied to achieve optimal strength for a lap joint.

A correlation was found between clamping load applied during the overall welding period and the measured shear strength observed in subsequent pull tests. Further investigation using SEM image analysis of interfacial surfaces showed micro weld formation at high clamping loads was significantly less and differed in area than those formed at low and moderate clamping loads. Previous research states zero sliding or friction at the contact surface of the welding tool and A1 sample to explain the resultant weld shear strength correlations. Micro weld characterization
and formation was not previously reviewed. The experiments performed currently show that frictional effects due to both sliding and slipping, as well as localized strain rates occur as a function of the applied clamping load, and as such guides the formation of micro welds at interfacial joint surfaces.

The contribution of clamping pressure to the production of micro welds at the interfacial surfaces and the quantity and quality of micro welds defined the joint strength. Collections of constitutive equations have been suggested over the past 50 years of ultrasonic joining; however, the complete model is not yet confirmed. Analysis from previously suggested models as applicable to the current experiment yield further steps in establishing a complete
model.