

**A. Ultrasonic Metal Welding of Aluminum Sheet**

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Ultrasonic metal welding of copper refrigerator tubes, aluminum wire and foils is well known; however, ultrasonic welding thicker gauge aluminum is much less known. Economic and efficient joining of aluminum sheet is an enabler for the increased utilization of aluminum in the automotive industry, use of aluminum will reduce vehicle weight and improve fuel economy. Ultrasonic metal welding provides some advantages over traditional joining methods of aluminum such as resistance spot welding since there is no heat-affected zone and riveting as there is no cost of a physical part, e.g. rivet.

In this study, various types of ultrasonic welders were modified or manufactured to enable welding of various gauges of aluminum sheet from 0.9 to 3 mm thick. Progress of the weld formation has been quantified by measurements on cross-sections of welds and the results will be presented. The mechanism of weld formation will be discussed for several types of ultrasonic welders. The welding time for a fully developed weld joining 1 to 1 mm sheet is about 0.3 to 0.4 s for a 7 mm diameter weld. Typical lap-shear failures loads for 0.9 mm 6XXX aluminum sheet are 3.0 to 4.0 kN and up to 8.0 kN for 3 mm 5xxx aluminum sheet. Fatigue life is similar to other types of aluminum joining methods, e.g. RSW, GMAW, etc. The performance of aluminum ultrasonic spot-welds compares favorably to joints made from other types of welding or mechanical fasteners. USW for joining aluminum automotive body parts shows promise to be an efficient, low-cost technology.