

B. Process Innovations in Ultrasonic Metal Welding

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The extension of ultrasonic metal welding to automotive and aerospace structures and components requires advances in current welding systems, as well as new systems able to address the materials and quality and production conditions of these industries. This presentation will detail recent advances to increase ultrasonic metal welding power capability, develop alternative welding configurations to meet vehicle joint configuration requirements, and implement more robust process control. Specifically, the development of new high power 5.5 kW welding transducers, high “Q” tooling, and digital power supply control strategies; the application of a 10 kW ultrasonic torsion welding system to automotive alloys; and the development of 11 kW push-pull, 7 kW over-under, and one-sided ultrasonic metal welding systems will be presented.

A 5.5 kW peak power ultrasonic transducer has been developed to meet the high power requirements of thick section metal welds and is being applied to lateral drive and push-pull ultrasonic metal welding systems. Power supply modifications, as well as high Q tooling, have been used to achieve more robust process control. Dual transducer systems (push-pull and over-under) have been developed to expand the power output, and hence types and thicknesses of materials that can be welded. One-sided ultrasonic metal welding systems have been developed to achieve tooling simplification, improved accessibility, and reduced cost, with weld performance comparable to that of traditional ultrasonic welding systems. Finally, through weld tooling modifications and parameter optimization, ultrasonic torsion welding has been developed for application to automotive aluminum sheet alloys.

A new generation of ultrasonic welding systems, having higher powers, advanced controls and innovative means of delivering ultrasonic energy to the weld, is greatly expanding the potential applications of ultrasonic metal welding.