Projection Welded Hermetic Ring Seals –
At the Intersection of Physics and Electronic Packaging Technology

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Abstract

During the previous 75 years, resistance projection welding was the process of choice for hermetic sealing of semiconductors, RF modules, electro-optics and related devices. It has fallen out of favor with increased competition from other processes such as laser, parallel seam, brazing, soldering, etc. Yet, with all the technologies that currently compete in the sealing arena, we will demonstrate that projection welding is still an undisputed leader. The process began with the mass production of smaller parts such as TO-18 and TO-5 packages. These smaller parts could be welded with moderately powered equipment such as single phase AC welders or capacitor discharge equipment. For welding larger packages such as TO-3 components, much more robust and expensive equipment was required. This larger and more costly equipment was not considered a good investment for any but the largest manufacturers. In the 1960s industry began to search for alternative methods and processes to seal larger packages. In those days, it was assumed that larger welds required increased weld current. It has only been in the 21st century that it became clear that for sealing larger packages, more weld current was not nearly as important as lower welder impedance. This discovery has resulted in the development of a new class of weld sealing equipment. All resistance welding owes its technology to its inventor, Elihu Thompson who received a patent for the process in 1887. Since then, the most important application for the resistance welding process has been the welding of automobiles, and the overwhelming amount of research and production of equipment has been directed to this end. Depending on who you believe, the resistance of a typical automotive weld is about 200-400 micro-ohms, and for a number of reasons, this resistance has been considered the target impedance for all welding equipment. What we learned through our work is that the impedance of larger ring welds, can be roughly an order of magnitude lower than 200-400-micro-ohms. This discovery has provided the insight to develop a new class of welding equipment whose performance is more closely matched to the requirements of lower impedance welds. By matching the requirements of a welding machine with the requirements of the weld, we have significantly reduced the cost and increased the performance of the equipment. This article, will illustrate some results of our manufacturing experiences on a number of hermetic products.