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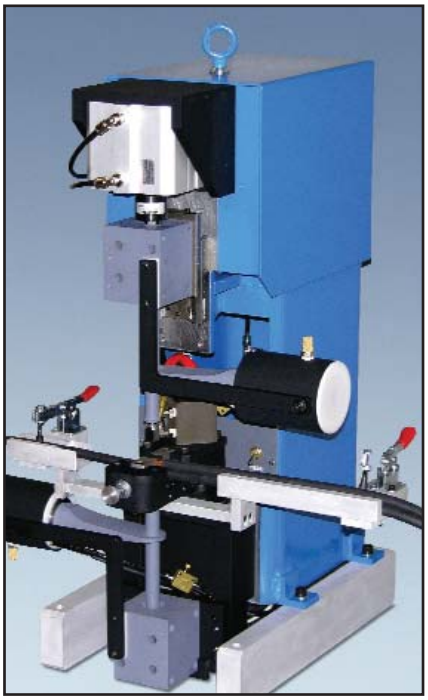
Absolutely the Best Way to Weld Tin-Coated and Oxidized Wires and Terminals

By Janet Devine, President, Sonobond Ultrasonics

Electronic applications that must face high-temperature, high-humidity, and other environmentally challenging conditions can benefit from welding the tin-coated wires and terminals essential to those applications. Fortunately, ultrasonic welding technology from Sonobond provides an effective and reliable means of welding these wires and terminals. Tin-coated copper wiring is preferred for marine motors and electronics, appliances, solar panel wiring, and some automotive applications, and Sonobond's ultrasonic systems can achieve consistently reliable welds that remain highly conductive without sacrificing the protective properties of the tin coating.

Ultrasonic metal welding relies on electromagnetic energy above the audio range and below the RF range.

The company's unique Wedge-Reed System, first patented in 1960, can provide the most durable and precise welds of any ultrasonic metal welder manufacturer. This exclusive capability sets Sonobond apart from its competitors. The Wedge-Reed System was specifically designed for high-impedance metal welding. It combines low vibratory amplitude with high vibratory force, directed in a shear mode parallel to the interface of the materials to be welded. The shear mode is essential for ultrasonic metal welding.



This is a dual-head SpliceRite™ system for wire splicing and metal bonding using ultrasonic waves.

The Wedge-Reed System uses a vertical, vibrating reed, driven by a wedge-shaped coupler and transducer assembly perpendicular to the reed. With the line of static clamping force directly above the parts to be welded, high clamp force can be achieved without bending stress or stalling. The tin coating is dispersed and the copper wire is welded without compromising the conductivity of the copper.

In contrast, other wire welders typically use a lateral drive system, combining high vibratory amplitude and low vibratory force; they are designed for low-impedance plastic welding but rotated 90° to provide the shear motion necessary for metal welding. The welding tip is part of, or attached to, a longitudinally vibrating transducer horn assembly driven paral-

lel to the metals being welded. Because of its cantilevered approach, clamping force is applied some distance from the weld, resulting in a bending moment on the coupler that limits static force. While this lateral positioning works for many applications, it does not produce acceptable welds for tinned or oxidized wires and terminals.

How it Works

Ultrasonic metal welding relies on electromagnetic (EM) energy above the audio range and below the RF range. A power supply converts input line power into high-frequency electrical power and transmits the energy to a transducer. The transducer converts the electrical energy into vibratory energy. This vibratory energy is delivered to the welding area in the form of sound waves above the audio frequency range-in the ultrasonic frequency range. Metal welding occurs when oscillating or vibrating shear forces are applied at the interface between two metals held together with moderate clamping force. The resulting internal stresses cause deformation at the interface.

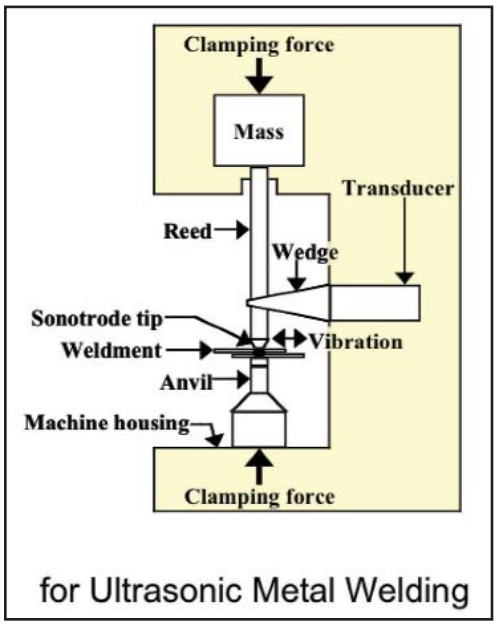
Highly localized interfacial slip at the interface tends to break up oxides and surface films, permitting metal-to-metal contact at many points. Continued oscillation breaks down the points, the contact area grows, and diffusion occurs across the interface, producing a structure similar to that of a diffusion weld. Ultrasonic welding produces a localized temperature rise from the combined effects of the deformation and the interfacial slip, which fuses the materials at the interface without melting them and creating a highly conductive metallurgical bond.

The ultrasonic welding process does not require fillers or other consumables, high temperatures, or high-level operating skills. The equipment is easy to operate, energy efficient, and produces high-quality welds.

When the patented Wedge-Reed System-exclusive to Sonobond Ultrasonics' metal welding systems-is used, tin-coated terminals, and copper wires to 60mm2 can be successfully welded without compromising the conductivity of the copper. The system combines low vibratory amplitude sonics with high vibratory force directed in a shear mode parallel to the interface of the materials. The line of static clamping force is directly above the parts to be welded, permitting the high clamp force needed to disperse the tin coating and produce a durable, precise weld.

System Differences

By definition, the impedance is proportional to vibratory force and inversely



Sonobond's patented Wedge-Reed System, designed for high impedance metal welding, combines low vibratory amplitude with high vibratory force directed in a shear mode. It uses a vertical, vibrating reed, driven by a wedge-shaped coupler and transducer assembly that's perpendicular to the reed. With the line of static clamping force directly above the parts to be welded, high clamp force can be achieved without bending stress or stalling.

proportional to vibratory distance or amplitude. With Sonobond's Wedge-Reed System, the vibratory amplitude is about one-third that of a lateral drive system and the vibratory force is about three times that of a lateral drive system operating at the same power level, resulting in an impedance value about nine times that of a lateral drive system. Since the density of the material being welded determines the load impedance, the Wedge-Reed System provides a much better impedance match to a metal weld than a lateral drive system because most metals are six to nine times more dense than plastics.

Previous production methods for tin-coated assemblies have included mechanical crimps and resistance welding, but neither of these approaches has provided acceptable results. Mechanical fastening is inconsistent and resistance welding or soldering use more energy and often produces inadequate bonding. The company's ultrasonic method is less expensive, uses a fraction of the energy needed for resistance welding, ensures RoHS compliance which is problematical with soldering, and speeds up the production process.

Sonobond offers a variety of ultrasonic welders that handle a range of wire bundle sizes starting at 1 x 1mm. Its SpliceRite™ units provide one-pulse wire splicing to 100mm² in stranded bare copper wire and to 60mm² in tinned wire. Its SonoWeld® and Dual Head Spot Welders can be custom-tooled to suit special configurations such as wire-to-terminal applications. Sonobond's equipment also welds tinned wire to other bare and coated wires or terminals, making it possible to complete most assemblies in less than 1s and requiring minimal operator training.

All machines feature a microprocessor controller capable of programming welds by height, energy, or time, and storing and recalling as many as 250 jobs. In addition, all systems have heat-treated, taper-lock tips that can be redressed and produce as many as 100,000 welds before being discarded. These tips are easily replaced without requiring machine readjustment or calibration. Also, Sonobond equipment is designed with automatic frequency control (AFC) and overload protection, and can detect and prevent wrong-part or no-part welding when equipped with a distance-measuring option.

Free Welding Viability Test

Manufacturers are encouraged to take advantage of Sonobond's free, no-obligation, Ultrasonic Welding Viability Test to learn whether Sonobond equipment meets their needs and specifications. Sonobond uses materials provided by the manufacturers, enabling them to confirm that the units will deliver the quality welds they need. Sonobond service and technical support is provided before, during, and after installation, ensuring its equipment is properly incorporated into the customer's production process.

Sonobond is a pioneer in ultrasonic technology with more than 150 patents in ultrasonic science, including the first patent earned in 1960, when the company was known as Aeroprojects, for ultrasonic metal welding. In the ensuing 54 years, Sonobond has established and maintained a strong reputation for innovative and quality-engineered products. The company manufactures a complete line of ultrasonic welding and bonding equipment used by leading firms in the electrical, automotive, appliance, HVAC, solar, aerospace, filtration, medical, body armor, and apparel industries.

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