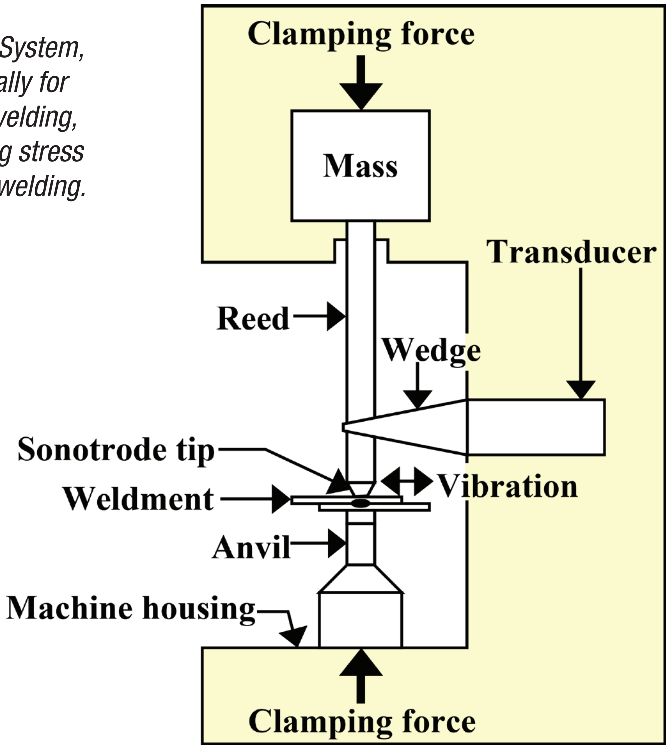
SONOBOND® ULTRASONICS

A Comparison of Wedge-Reed and Lateral Drive Ultrasonic Welding Systems

The Wedge-Reed System, designed specifically for ultrasonic metal welding, eliminates bending stress or stalling during welding.



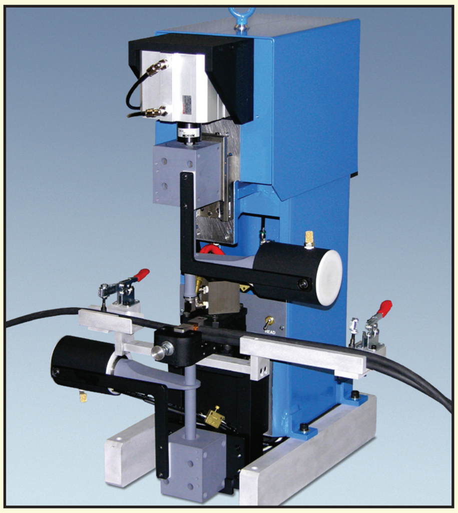
Achieving Shear Motion

For effective ultrasonic metal welding, the direction of the vibration must be in a shear mode parallel to the interface of the materials to be welded. The two methods of achieving this are the Wedge-Reed System and the lateral drive system.

The Wedge-Reed System, developed specifically for ultrasonic metal welding and patented in 1960, uses a vertical vibrating reed, driven by a wedge-shaped coupler and transducer assembly that is perpendicular to the reed. This creates the sheer motion for the weld. 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.

In contrast, the lateral drive system was originally designed for welding plastic, with the vibration direction perpendicular to the plane of the weld. For metal

(Continued on next page)



The Dual Head SpliceRite™ welds stranded bare copper wire up to 100mm² and tinned wire to 60mm² with just a single pulse.

The Wedge-Reed System for ultrasonic metal welding is based on engineering conventions that provide a UNIQUE ability to weld tin-coated and oxidized wires and terminals.

The Ultrasonic Process

The ultrasonic welding process begins with a power supply that converts input line power into high frequency electrical power and transmits that energy to a transducer. The transducer transforms the electrical energy into vibratory energy. This vibratory energy is delivered to the welding area in the form of sound waves that are above the audio frequency range – known as ultrasonics.

When the vibrating, shear forces of the ultrasonic waves are directed via the welding tip to the interface between two metals held together under clamping force, internal stresses cause deformation where the metals are in contact.

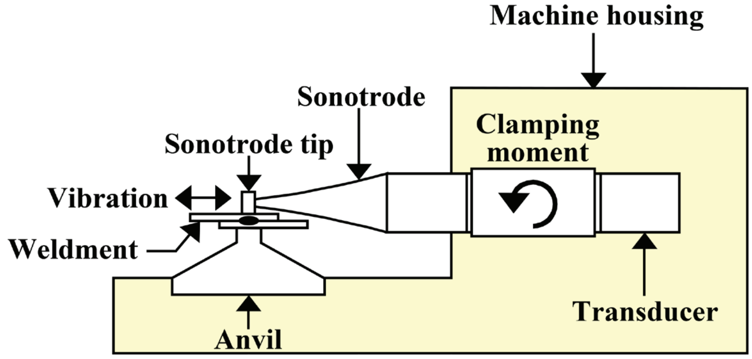
A localized increase in temperature, coupled with interfacial slip, breaks up oxides and surface films and permits metal-to-metal contact at many points. Continued vibration causes the points to deform, increasing the contact area and creating a structure similar to a diffusion weld but without melting. The result is a highly conductive, metallurgical bond without the change in structure caused by melting the metals.

1191 McDermott Drive • West Chester, PA 19380 • Phone: 800-323-1269 • 610-696-4710 • Fax: 610-692-0674
Internet: www.SonobondUltrasonics.com • E-mail: Sales@SonobondUltrasonics.com

A Comparison of Wedge-Reed and Lateral Drive Ultrasonic Welding Systems

(continued from other side)

welding, the vertical drive system welder is rotated 90 degrees to a lateral position to provide the necessary shear motion. The welding tip is part of, or attached to, a longitudinally vibrating transducer-horn assembly driven parallel to the weld interface. 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. This makes the lateral drive system incapable of producing acceptable welds for tinned or oxidized wires and terminals.



Vertical drive systems are rotated 90 degrees to a lateral position to achieve shear motion parallel to the welding interface. The resulting characteristics are not conducive to produce the conditions needed for welding tinned or oxidized wires and terminals.

Amplitude and Force

The Wedge-Reed System features low vibratory amplitude and high vibratory force, suitable for welding metals. The lateral drive system is characterized by high vibratory amplitude and low vibratory force, appropriate for welding plastics.

Just as power in electrical systems is a product of volts and amps, the power level produced by an ultrasonic system is proportional to the product of vibratory force (f) and vibratory amplitude (a), or $P \alpha f a$. In the Wedge-Reed System, the vibratory amplitude is about one-third and the vibratory force about three times that of a lateral drive system running at the same power level.

Similarly, just as impedance, or resistance, equals volts divided by amps in electrical systems, the acoustical impedance (Z) at the vibrating tip in ultrasonic systems is equal to vibratory force divided by amplitude, or $Z \alpha f/a$. Operating at the same power level, the Wedge-Reed System has an impedance value about nine times that of a lateral drive system.

Matching System and Load Impedance

In ultrasonics, as in electrical systems, the most efficient operation is achieved when the system impedance and the load impedance are closely matched.

The impedance at the weldment is proportional to its density. Since most metals are six to nine times as dense as plastics, it's clear that a Wedge-Reed System provides a better impedance match for a metal weld than a lateral drive system. This is especially true for oxidized and tinned metal surfaces, which present an even higher impedance than cleaned or bare metals.

While plastic has low impedance and requires high vibration amplitudes (up to about .005 inches) to weld, metal has high impedance and usually welds better at lower amplitude levels (about .001 inches or less).

Additionally, up to a certain point, the energy required to make a weld decreases as the static force increases, indicating that static force affects load impedance. Again, the Wedge-Reed System, with its ability to achieve high static clamping force, is better suited for metal welding than the lateral drive system.

Realizing Superior Performance

In summary, the Wedge-Reed System, originally designed and constructed for shear mode operation to weld metals, ensures durable and highly conductive welds of even tin-coated wires and terminals.

Its low vibratory amplitude and high vibratory force offer better impedance match and its high force clamping capability permits superior delivery of available power, and extends its range of applications beyond those of lateral drive systems with the same or higher power ratings.

60mm²

1191 McDermott Drive • West Chester, PA 19380 • Phone: 800-323-1269 • 610-696-4710 • Fax: 610-692-0674
Internet: www.SonobondUltrasonics.com • E-mail: Sales@SonobondUltrasonics.com