

## Powerful but gentle

PowerWheel application at Julian Electric

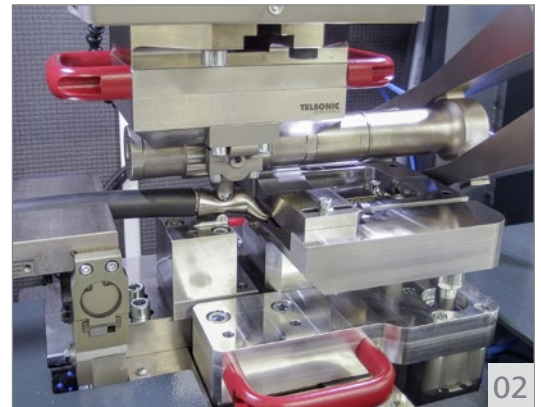
PLASTIC WELDING

METAL WELDING

CUTTING

CLEANING

SCREENING



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Securely contacting thick cables in the tubular cable lug with an ultrasonic welding process is already challenge enough. But when a top-class connection needs to be created between different materials with aluminium and nickel-plated copper, the requirements are even higher. With the Telsonic PowerWheel process, a supplier welds cables for heavy utility vehicles extremely powerfully and safely in the series production process. A special sonotrode is one of the reasons why everything runs smoothly.



«The fact that we are able to weld with the PowerWheel ultrasonic welding process with such high forces and performances without damage was a great surprise to the customer,» recalls Claus Regenber, managing director of Telsonic GmbH in Germany. At the American supplier Julian Electric, the compact machine welds 160mm<sup>2</sup> thick aluminium cables with a tubular cable lug made from nickel-plated copper in a series-production process. For this purpose, for 3.2 seconds the sonotrode presses on the contact point with a force of 3800 Newtons. The powerful generator has a maximum output of ten kilowatts and during the welding process applies around 18,000J to the welding point. It is no surprise that afterwards the connection is even and firm enough to meet the requirements of heavy lorries and construction and agricultural machinery. Rather surprising is that the cable and tubular cable lug remain undamaged. This is not only due to unique PowerWheel ultrasonic welding process from Telsonic, but also to the special shape of the sonotrode. At the contact point with the workpiece, it is shaped in a specially patented way.

- 01 Easily accessible PowerWheel® high-performance ultrasonic welding press
- 02 PowerWheel® MT8000 with Teslo®Vario quick-change tool system
- 03 Tubular cable lug 160mm<sup>2</sup> made from nickel-plated copper

### PowerWheel has an advantage in terms of process engineering

Tubular cable lugs (TCL) are especially well-suited for contacting aluminium round strand cables with a cross-section of 10–160mm<sup>2</sup> for use in automotive drying rooms. Ultrasonic welding has proven its superiority for electrical contacting between tubular cable lugs and aluminium strand conductors. The quality and process safety requirements are not to be underestimated, however. In this respect, for around ten years, Telsonic's PowerWheel process has proven itself to be reliable and process-safe. Because it can do so many things better than other processes.

The top benefit of its design is that the sonotrode moves directly from above on to the contacting point and the anvil. This avoids the standard bend vibration problem that occurs with a hammer sonotrode, because the sonotrode bends due to the nature of its design. The higher the force the sonotrode has to move against the workpieces with, the greater this disadvantage is. Over the long term this bending vibration then also destroys the converter. None of this happens with PowerWheel welding.

**Strand bundles to be contacted are getting ever thicker**

For applications with lorries or construction and agricultural machines, cables need to be thicker than in passenger vehicles. But there, too, cables are becoming ever thicker, because more vehicle functions need to be supplied with power. The growing e-mobility provides for further applications up to the high-voltage range. For secure contacting, both high pressure and great power need to be applied. For the strand bundle to be securely contacted, at least 90% of the individual wires must be bonded to one another. Furthermore, the strand bundle must stick to the interior wall of the tubular cable lug, as evenly and balanced as possible to the anvil and sonotrode. The adhesion must at least correspond to the nominal cross-section area.

Despite the high power and forces, however, for a secure welding none of the individual strands must be damaged or cut through. Claus Regenbergs sums up the complicated, conflicting goals: «In addition to great force and high power, there is also the demand for a welding process that is as gentle as possible.» With PowerWheel, Telsonic AG has in recent years developed the ultrasonic welding process it invented into an extremely effective process suitable for series production that virtually resolves these conflicting goals. With this welding technology, a standard machine delivers up to 10kW welding power at a maximum pressure of 8kN without the usual frequency hopping problems. This allows surfaces and cable diameters to be welded in sizes that were previously unheard of.

**PowerWheel enables significant material savings**

During the actual welding process, the Telsonic sonotrode makes a previously unknown unrolling welding movement. This ensures the highest amplitude is always at the centre of the weld, and not at its end. In this way the cable ends for isolation remain undamaged. With PowerWheel, even very thin wires can be welded powerfully and securely. But massive copper terminals and solid aluminium terminals can also be welded together. This creates galvanically perfect connections that can be better isolated. As a result, previously standard splices can be welded up to 30 percent narrower. Consequently, terminals can be smaller and the isolation of welding is easier. At the same time, considerable material costs can be saved. A south-German premium OEM manufacturer welds splices 50 per cent thinner using PowerWheel technology and saves around 300,000euros in material costs each year.

Despite all technical refinements, the welding of strong aluminium strand bundles for large utility vehicles in a massive copper tubular cable lug requires great care. Finally, its wall thickness is 1.6 mm. Due to nickel plating, the material is very brittle and therefore prone to crack formation during the actual cold forming process and when the sonotrode is applied. However, the nickel layer is necessary due to the large difference in the electrochemical voltage series of aluminium and copper. This reduces the risk of corrosion.

**A patented curvature delivers optimal results**

The highlight of the PowerWheel ultrasonic welding process, however, was created by the Telsonic experts for Julian Electric with the shape of the sonotrode. It has a concave shape at the lower end, which roughly corresponds to the curvature of the receiving end of the tubular cable lug. This patented solution has two unbeatable advantages: Firstly, the tubular cable lug is centred automatically when the sonotrode moves down, without the surface being damaged. The tubular cable lug lies on the anvil, without being fixed to it. When the sonotrode moves down, it moves the workpiece automatically to the best adjacent position, centres it and holds it during the welding process. Secondly, due to the curvature the sonotrode is always in optimal contact and at the best angle to the tubular cable lug during the unrolling movement. Ultimately this leads to an optimum amplitude ratio to the welding object. As a result, at Julian Electric model-specific pre-assembled cable sets with securely contacted tubular cable lugs for reliable connection in the rough environment of lorries, construction and agricultural machinery are created in series production.

Telsonic is just as satisfied as the customers and users of the PowerWheel ultrasonic welding technology. The process, which has proven itself over many years, is also suitable for many other 3D contact parts. These contact types are increasingly used in electromobility and the component-specific requirements can be processed excellently with this patented process. Due to increasing production quantities and variety of variants as well as the developing electromobility, Telsonic is currently offers quick-change tool systems in order to significantly reduce set-up times.

by Claus Regenbergs, Managing Director at Telsonic GmbH, Erlangen, and Jürgen Fürst, SUXES GmbH, Stuttgart