

Technical report

on the torsional ultrasonic welding procedure SONIQTWIST®
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The procedure developed by Telsonic has shown to provide high quality results in the joining of plastics. How exactly does SONIQTWIST® work?

Torsional ultrasonic welding: a gentle yet powerful process

The torsional ultrasonic welding procedure called SONIQTWIST® was developed by Telsonic AG in 2006 and quickly established itself as the joining procedure for a great variety of plastics and metals. Torsional energy is gently exerted to the area of the joint, thus suitable even for highly sensitive parts. On the other hand, even very strong forces may be applied in very short time which is critical, for example, for joining aluminium or copper lines. Even painted plastic parts can be joined firmly and safely without leaving visible indentations. So, what are the mechanisms behind this revolutionary procedure that no automobile manufacturer, no automotive parts supplier, and no medical device manufacturer can do without anymore?

The secure and firm joining of two plastic or metal parts is a long known process which can be reliably carried out with conventional procedures such as longitudinal ultrasonic welding or adhesive procedure. The torsional ultrasonic procedure SONIQTWIST®, which was developed in 2006 by Swiss Telsonic AG, has proven to provide good results where other procedures fail.

Suitable procedure for many tasks

The torsional welding procedure is suited for joining of plastics and metals such as copper and aluminium. However, it works just as well for the bending, riveting, separation, fine forming, dimensional and shape calibration of functional surfaces. The very low impact on the welding parts spares sensitive electronic components. The vibration stress induced on the lower workpiece of the joining parts is only a tenth of the stress induced by conventional ultrasonic welding technique.

Moreover, no membrane effect occurs, so filter membranes and other thin parts such as foils can also be welded with this procedure. With foils, hardly any notch effect and material thinning is noticeable. This makes the procedure highly interesting particularly for the field of medical engineering. Furthermore, the procedure is insensitive to interference media in the weld seam. Water, grease, silicone, oil and other media cannot negatively

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influence the result. For example, the procedure achieved reliable results for seal welding of oil dampers for furniture parts without any leakage of liquid.

Inserting high energy in a very short time

Strictly speaking, SONIQTWIST® is a high frequency friction welding procedure which can be categorized somewhere in between vibration welding and ultrasonic welding. The sonotrode oscillates torsionally around its longitudinal axis in both directions. In very short time - between 0.1 and 0.4 seconds - a lot of energy is applied to the boundary surface of both parts, with a very high frequency of 20 kHz and an amplitude of up to 80 µm. This boundary friction enables both parts to be joined firmly and safely.

The design of the torsional devices is similar to conventional ultrasonic welding equipment, with generator, converter and sonotrode. However, in contrast to conventional systems, the sonotrode no longer oscillates longitudinally but torsionally, which contributes to the components' reduced load. Nevertheless, ultrasonic can be transmitted via the sonotrode with a power of up to 10 kW. Even with difficult materials, this allows for strengths which could hitherto hardly be attained by conventional ultrasonic welding procedures. Pull-off strengths of 500 newton or more can be achieved, depending on the component and requirements. For example, also safe welding connections in the far field range can be realized over several centimetres.

However, the underlying functional principle is identical. In the case of the torsional welding procedure the electric vibrations produced by a generator are converted into mechanical oscillation by means of a piezo-electric transducer as a result of the piezo-effect. Linear vibrations are converted into torsional vibrations by means of a specific configuration of the acoustic components in the oscillating head of the SONIQTWIST®.

High energy input in short time

A generator works at a frequency of 20 kHz and up to four converters can be applied with one sonotrode. Thus, a maximum capacity of 10 kW is available which is often required primarily for metal welding joints. The high frequency enables a very high energy input in the shortest possible time - usually within 0.3 - 0.4 seconds. Upon switching off the ultrasonic power the sonotrode immediately returns to its initial position without any offset of parts.

This procedure requires no external heat supply. The Sonotrode contacts the upper one of the parts to be welded. This movement and the welding pressure produce an interface and molecular friction between the partner joints that plasticizes the plastic in the weld zone or create a molecular joint in the metal via the melting temperature. The process can be reliably controlled, monitored and

performed with repetition accuracy. The familiar process control can be used completely. All parameters, such as frequency, duration of welding or energy application, can be adjusted and monitored at any time. Moreover, the controller software offers many options for process control with a great variety of parameters such as, for example, energy input, welding depth or process time. The process speed is many times faster than for friction welding, depending on amplitude and force applied by the ultrasonic welding tool.

Examples from automotive and medical device technology

When attaching plastic holders for distance sensors to the inside of painted bumpers, conventional joining procedures provide satisfactory results only with great additional expense. Especially the lack of strength is complained about repeatedly. Besides strength, it is especially important that no marks are visible on the already finished-painted parts. Here, the criteria are especially strict and are uncompromisingly checked with a special light test. As SONIQTWIST® is working without energy directors and so without penetration by the sonotrode into the bumper, this process excludes the risk of marks.

The torsional ultrasonic welding procedure does not require additional auxiliary surfaces. Since SONIQTWIST® achieves high strength due to the procedure itself, users do not need extruded functional surfaces ("ears" or "wings") on the holding devices. The expense is also considerably lower compared to the adhesive procedure, in which the surfaces must be absolutely free of grease and prepared with primer.

Membranes for drip chambers without the membrane effect

When producing drip chambers for infusions for medical use a very thin fine filter from a hydrophilic membrane is welded into the chamber. Here, the welding process creates high-strength joints which are highly resilient to thermal exposure during sterilisation. The SONIQTWIST® enables secure joining of different mixed plastics. This new procedure also proved to be suitable for small PP-parts of only eight millimetres in diameter, exhibiting high process safety and very short cycle times.

Inline-capable and process safe

The SONIQTWIST® torsional devices are flexible and inline-capable and can be integrated in nearly every position. Thanks to the particular setup of the different units the change-overs are easy and fast. Process control via software also resolved the problem of non-destructive tests. Today, 100% controls are possible, compared to the random sampling before. The procedure can be automated by means of standard handling equipment without big capital expenditures.

1,015 words, 8,030 characters

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((Info box Joining operations))

Possible joining methods with SONIQTWIST®

- Welding
- Flanging
- Riveting
- Cut'n' seal (Pieces of foil and tissue are cut out and directly welded into a injection-mould plastic part)
- Size and shape calibration of functional surfaces
- Fine forming

((Info box applications))

Realised applications with SONIQTWIST®

Joining plastics

PA

- Housing round, with internal electronic tight weld, e.g. sensors
- Housing, square, with internal electronic tight weld, e.g. sensors
- Writing utensils, cosmetics tight weld
- Fixing components on Duroplast honeycomb plate
- Tight weld high-strength pressure vessel made from PA6.6GF30, 80 mm in diameter

PP/EPDM

- Weld inflated part with uneven surface on foil –medical component
- High-strength welding of distance sensors to bumpers without any visible marks on the painted side, welding possible also on finished-painted parts
- Weld holder to car inner lining

ABS

- Tight weld shock absorbers through the oil medium -
- Ring welding of car loudspeakers made of PC/ABS tight weld. Replacing complicated riveting procedure

Others / Metal joining

- Welding of two alu components for the power supply in a car engine compartment
- Intricate work on valve seats (MIM)
- Foil valves made of PE

((Info box benefits))

Benefits of SONIQTWIST®

- Very low vibration stress in the lower part. Only 1/10 of stress induced compared with conventional ultrasonic weld procedures (ideal for sensitive parts, electronics)
- Very short welding time (often < 1 second)
- Good accessibility as only one vertical movement is required
- Very high weld strength can be achieved
- Comprehensive control options of process
- Far zone welds in centimetre range
- No membrane effects in foils, tissues and thin parts (no energy concentration in centre of foil and no hole effect)
- Great welding depth possible
- Rectangular shapes can also be welded securely. Parts do not have to be round in shape.
- A power of up to 10,000 Watts possible
- Foreign bodies in the welding seam do not impair process

((Company info for Telsonic AG))

Pioneer and technology leader from Switzerland

The Swiss company TELSONIC AG is a pioneer in the field of ultrasonic technology. The company, founded in 1966, owns subsidiaries in Germany, England, South-East Europe, China and the USA as well as a joint venture in India and representations in many countries. Today, TELSONIC is one of the leading companies worldwide in ultrasonic technology and owner of numerous patents. Fields of application of ultrasonic technology comprise welding, cut'n'seal, cleaning, and screening as well as chemical processes and packaging. Again, Telsonic is technology leader with his torsional welding Power Wheel®. The technology has facilitated new solutions in many applications of the automotive industry and initialized a great number of saving opportunities.

List of pictures of TELSONIC AG. Download [www. pressearbeit.org](http://www.pressearbeit.org)



Picture No. 41-01 TC_Soniqtwist_4Teile.jpg
The torsional ultrasonic welding procedure of Telsonic AG delivers best results for joining plastic parts for additional functions, such as for example distance sensors, cable clips or fixing pins, to painted exterior parts in automobile manufacturing.



Picture No. 41-02 TC_SQ-Nozzle.jpg
Torsional ultrasonic weld procedure joins plastic parts with fine contours and openings such as for example nozzles, valves or spouts in a very gentle manner.



Picture No. 41-03 TC_FB-SQ_BlowMoldPart.jpg
The torsional ultrasonic weld procedure SONIQTWIST® by Telsonic AG enables duplication and cutting of foils in very short cycle time.



Picture No. 41-04 TC_FB-SQ_MembranPlastic.jpg
Sensitive membranes are effortlessly embedded into a plastic part with the help of the torsional ultrasonic weld procedure SONIQTWIST® by Telsonic AG.



Picture No. 41-05 TC_FB-SQ-PressetSP750.jpg
The torsional devices of Telsonic for the ultrasonic weld procedure SONIQTWIST® supply energy from 1 - 10 kW.