

ULTRASONIC WELDING TECHNOLOGY

FUNDAMENTALS OF NONWOVENS

Ultrasonic welding technology. For nonwovens.

Herrmann Ultraschall is a world-leading company in the field of ultrasonic welding. For our customers, we assume both the role of consultants and application solution providers with regards to the ultrasonic joining of nonwovens. This brochure contains practical advice and introductory information for the welding of nonwovens by means of ultrasonics.

In addition to leading-technology products, we provide excellent application consulting to solve joining tasks, taking economic aspects into account. Please note that this brochure is intended to be an introduction to joining technology for nonwovens using ultrasonics and in no way replaces application-specific consulting given by our experts.



Typical product examples for ultrasonic joining of nonwovens from the fields of hygiene, medical, and consumer. The detailed application examples are described in the Herrmann Ultraschall brochure for the respective industry.

Due to high process speeds and reproducible weld results, the technology is mostly used for high-volume production in the textiles, medical, hygiene, filter, and general technical industries.

Optimized and repeatable weld results in terms of strength, tightness, and visual appearance can only be achieved if the combination of materials, the anvil profile, and the ultrasonic system are appropriately designed to match the process.

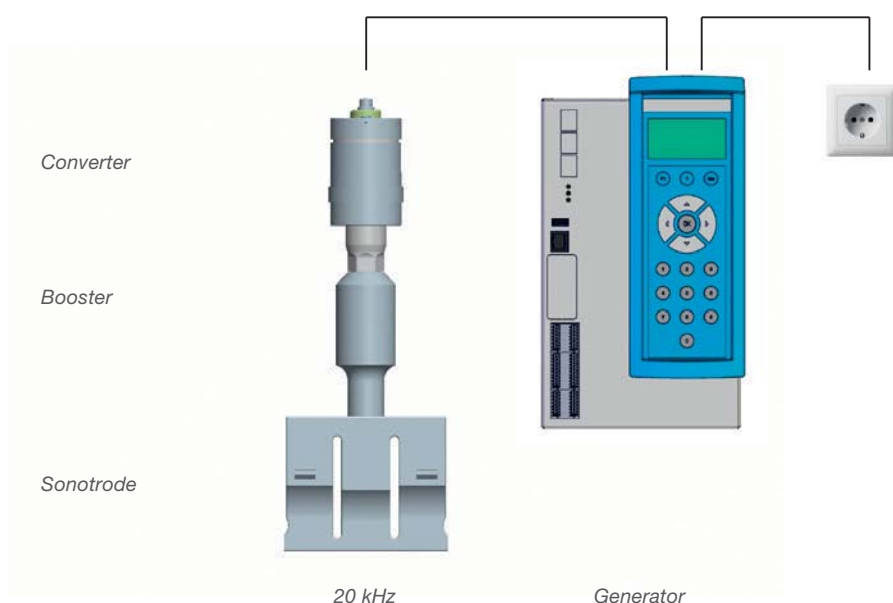
In order to attain consistently good welding results, it is important that the selection of structures and materials is made with ultrasonics in mind, from the beginning. Difficulties in the production process are already avoided during the preliminary stages by doing this.

Subsequent changes may become rather complex and time-consuming and oftentimes only yield a compromise.

Generation of ultrasonic vibrations

The ultrasonic generator converts the supply voltage into high frequency voltage of between 20 and 35 kHz which is converted into mechanical vibrations in the converter using the piezoelectric effect. The weld tool, referred to as sonotrode, transfers the vibrations into the joining area. At an ultrasonic frequency of 20 kHz, for example, this means 20,000 movements per second.

The resulting friction heat melts the material directly at the joining points of the individual material layers. Due to low energy consumption, the material undergoes very little thermal stress. The weld tools hardly heat up at all. The welded materials can be processed immediately, meaning that ultrasonic systems (or ultrasonic modules) can also be easily integrated into high-speed production lines.



Material properties of nonwovens.

Influential characteristics.

Nonwovens

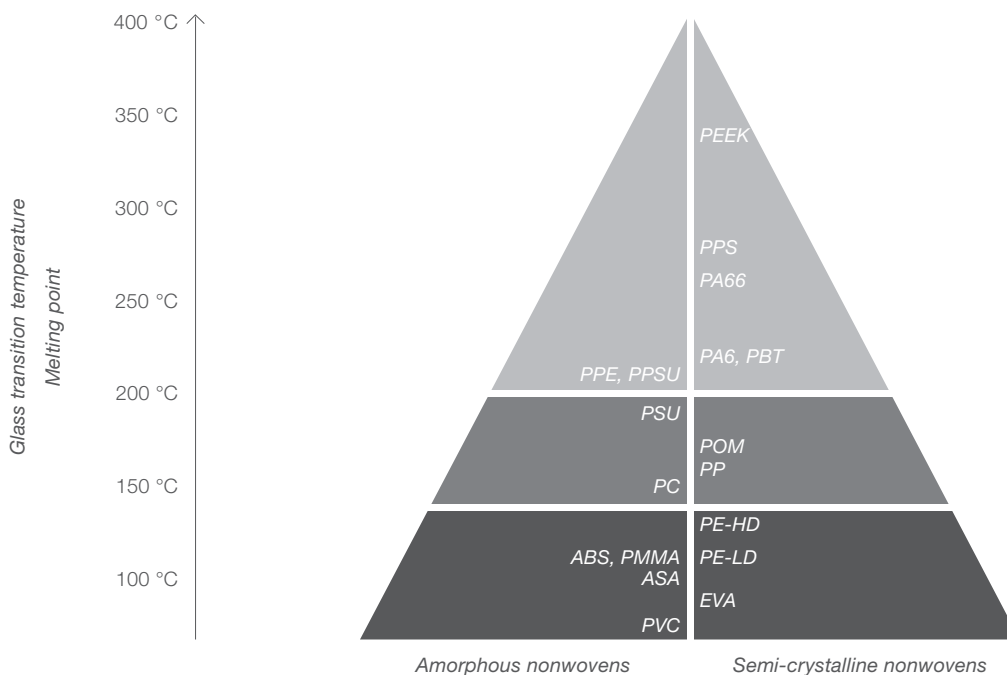
Nonwovens produced from fibers or continuous filaments can be processed by means of efficient ultrasonic welding, e.g. laminating, perforating, joining, embossing, cutting, or bonding. The resulting composite materials can be used for a large range of products or applications. Ultrasonic welding of nonwovens may also be combined with other materials and production processes, these include e.g.:

- Woven fabrics
- Membranes
- Meltblowns
- Spunbonds
- Tissue
- Carded
- BI-CO
- Airlaids
- Films
- Needled
- Wetlaid
- and many more...

The main influencing factors of the material ensuring successful application of ultrasonics are:

- Homogeneity
- Grammage
- Material mixture (within a layer and among the material webs)

When using a mixture of materials comprised of different plastic fibers, their melting points should be as close together as possible to obtain optimum weld results:



3D microscope images for fiber and melt flow analyses

These material factors have a significant effect on selection of the suitable ultrasonic system and the pattern design of the anvil drum with contour. Process speeds of up to 800 m/min and more can be realized with optimum synchronization and adjustment of these factors.

Anvil and anvil drum design.

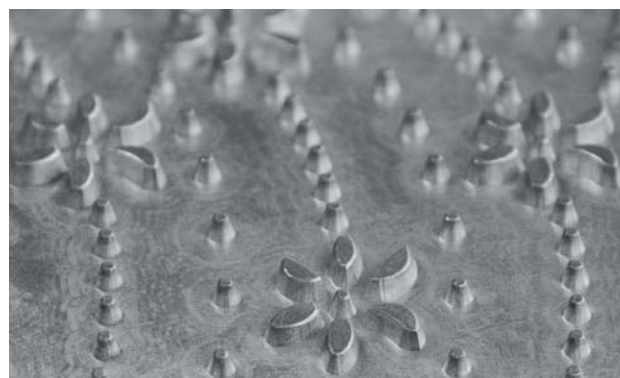
The formative element of your joining process.

Competence in contour developments

To ensure ideal process sequences, the ultrasonic system, the material combinations, and the rotary anvil must be perfectly adjusted to one another. Correct design of the anvil drum structure represents the primary precondition for consistent weld results.

The anvil pattern is a critical factor for the required product design, particularly with regard to the contact pressure area, the geometry, and the embossing depth.

Herrmann Ultraschall provides continuous support for their customers, from the first product idea through to technically sophisticated system solutions. The design of customized anvil drum structures for ideal weld quality is backed up by near-production testing.



HELIXBOND – Super soft and flexible joining points

A recently developed and patented anvil geometry provides a wealth of new options for bonding web material using ultrasonics. The anvil is lined with helical springs ensuring optimum weld spots of elliptic shape. This concept allows for joining without breaking the fibers. A concentric joining area around the actual weld spot, in which the material gradually transitions from molten state to the existing fiber structure, is the basis for strong bonds.

Benefits and advantages

- No breakage of fibers, which ensures high-strength bonds
- Displacement of particles (e.g. SAP) from the joining area
- Significant increase of the process frame
- Very soft and flexible joining points



Ultrasonic applications.

One process, many solutions.

For welding, laminating, embossing, perforating, and cutting of nonwovens, the efficient ultrasonic process ensures significant increase in productivity. Ultrasonics is not only fast but also saves energy and does not require additives. This makes any kinds of consumables, such as adhesive, unnecessary. Standstill time due to cleaning of machines is prevented.

Welding / longitudinal seal

When welding nonwovens in combination with longitudinal seals, high-strength connections are established at the joint areas. Rotary ultrasonic systems are particularly suitable for joining applications in marginal areas.

Benefits / special features:

- Additional web material transport
- Fast processing
- Tight and strong connection



Welding / cross seal

When welding cross seals, instantaneous peak power must be precisely controlled and introduced into the joint areas in a minimum of time. For such applications, correct selection of the anvil geometry and the ultrasonic system is of particular importance.

Benefits / special features:

- Consistent and uniformly strong connection
- High product throughput per minute
- Soft hand feel

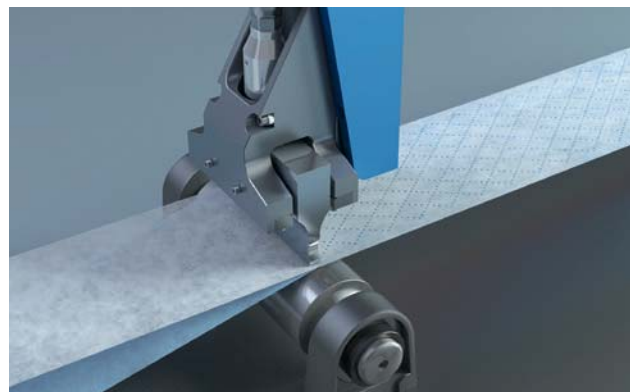


Laminating

Targeted joining of several layers of nonwovens by means of ultrasonics and an anvil drum with structure. Bonding of the material web is merely performed in "spots", which prevents any adverse effects e.g. on filter properties or stretching behavior of elastic composites.

Benefits / special features:

- Energy-saving
- No adhesives required
- Fast processing



Embossing

With an engraved anvil drum a pattern structure is permanently embossed onto a textile surface through application of pressure. During this process additional design effects may be achieved, depending on color combinations of the material layers to be embossed.

Benefits / special features:

- Textile hand feel is maintained
- Low energy consumption
- Color designs possible without additional print



Perforating

Defined perforation of films and silicone layers by means of ultrasonics and an anvil drum. This ensures an increase in process speed compared to thermal processes, without any negative influence on the material.

Benefits / special features:

- High process speeds
- Process control
- Fiber-free perforation



Cutting

Cutting and simultaneous sealing of nonwovens in one single process ensures fiber-free joining of marginal areas. This technology is also used for splicing of material webs so that the joining point quality is suitable for end products.

Benefits / special features:

- Fiber-free welding of cutting edges
- High production speeds
- Material splices in end product-quality

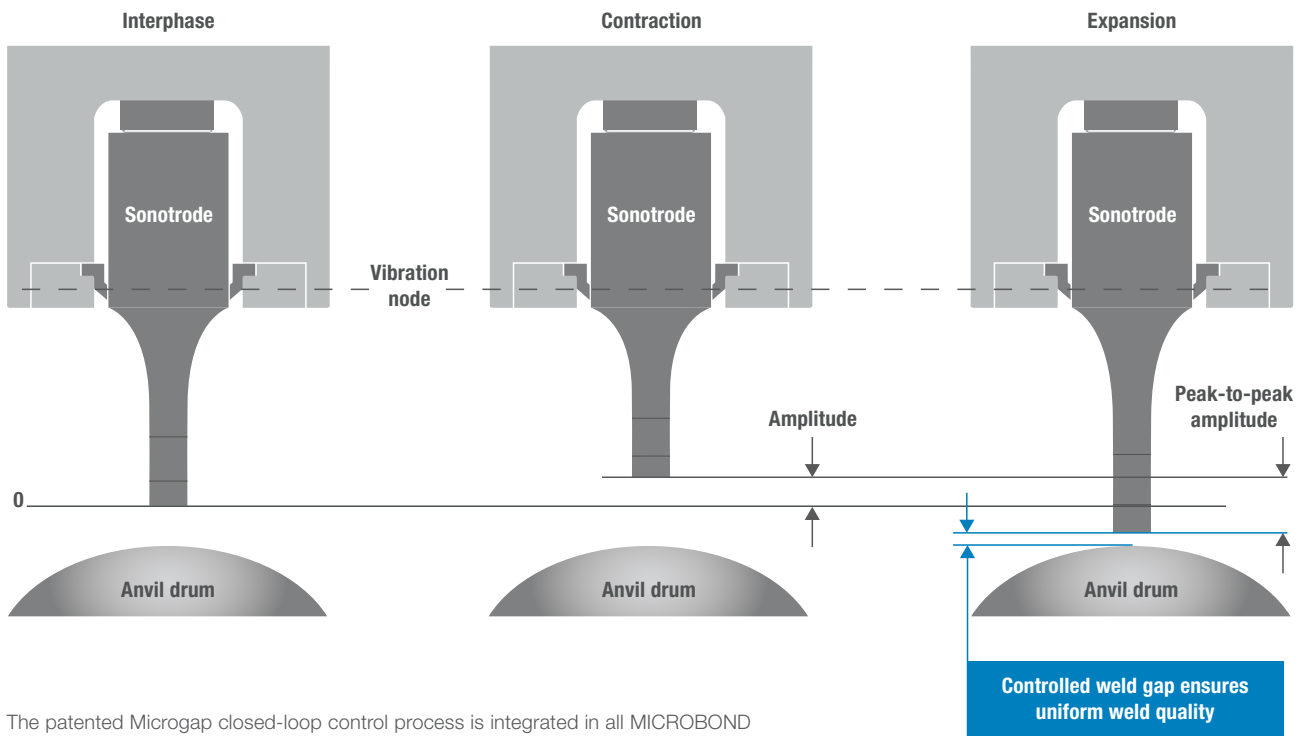


Continuous ultrasonic welding technology.

The safe way to achieve quality.

In ultrasonic welding mechanical vibrations are introduced into nonwovens under pressure. Molecular and boundary layer friction generates heat which increases the damping coefficient of the material. Then the material starts to melt in individual spots. This reaction is accelerated by itself since the damping factor of the plasticized material increases and a larger proportion of the vibration energy is converted into heat. The ultrasonic process is initiated by the stack. The stack is made up of the piezoelectric converter, the booster, and the weld tool (sonotrode).

During processing of continuous web material, reproducibility and weld quality are the most important aspects. Negative factors, such as thermal expansion, specific properties of the material to be processed, and different processing speeds have great influence on the quality of the weld result. By means of a consistent reference/actual comparison of the force value, the MicrogapControl unit adjusts the weld gap accurately to less than 1 μm . As a result, a constant and precise gap can be realized between the anvil drum with contour and the sonotrode.



The patented Microgap closed-loop control process is integrated in all MICROBOND systems. Whether you choose a robust solution with CSI-supported sonotrode or a sensitive application with rotating sonotrode is used – the Microgap technology always guarantees success.

Optimum selection for your applications.

System variations for stable joining processes.

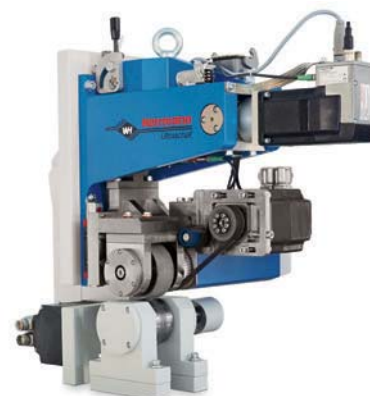
Stationary sonotrode with rotary anvil

- High energy input
- Extendable production widths through modular structure
- Continuous and intermittent welding options
- Consistent weld quality



Rotary sonotrode with rotary anvil

- High production speeds
- Prevention of creasing thanks to the transport function
- Soft hand feel of the weld areas
- High weld quality without material distortion



Stationary sonotrode with stationary anvil

- Compact design
- Ease of handling and integration
- Fast tool change



Precise welding parameters. For optimal reproducibility.

Process parameters

The great benefit of ultrasonic processes is the range of possible parameters and their exact adjustment. Due to this, it is possible to understand, control, monitor, and reproduce the ultrasonic joining process. Prevention of redundant rejects, reduction of standstill time, and high availability guarantee an efficient and economic manufacturing process.



Important ultrasonic welding parameters

The configurable graphic display of process parameters is used to document the continuous sequence, allowing fast and easy evaluation and optimization of processes. Typical process parameters suitable for display are:

- Frequency
- Amplitude
- Weld force
- Power
- Energy



Precise. Versatile. Economical.

The MICROBOND systems represent competence and experience in the field of continuous processing of web material. The patented Microgap technology guarantees consistent weld quality at breathtaking speeds and ensures implementation of complex applications while simultaneously providing ease of handling.

Thanks to intelligent power grading and a large number of variants and options, the ultrasonic systems can be specifically and individually configured for any weld application. With superior technology and ultimate efficiency, Herrmann Ultraschall sets standards for ultrasonic welding technology worldwide.

Continuous support from the beginning.

ULTRASONIC ENGINEERING.

The expert teams at Herrmann Ultraschall will support during every phase of a project. This includes production-related trials in the application laboratories, on-site assistance during start of production, as well as after-sales and training services. The cost-effectiveness of the processes is always the number one focus.



Ultrasonic laboratory nonwovens

Application tests

- Laboratory tests and initial sampling at speeds of up to 800 m/min
- Recommendation for suitable testing specifications
- Consulting on new application concepts
- Feasibility analysis for new product ideas based on original materials
- Scientific analyses in cooperation with leading universities

Application optimization

- Determination and optimization of production process limits
- Review of decisive weld and seam properties
- Verification of research results with the help of tensile tests, sealing tests, high-speed cameras, burst tests, microscopy, and microtome cuts
- Complete documentation of run-in tests and test series

Optimization of anvil design

- Optimized pattern design based on customer-specific requirements
- More than 100 test anvil drums with different patterns are available for test welds
- Support in determining the right anvil drum dimensions

Technical project management

- Consistent implementation of customer requirements and test results in design concepts
- 3D-supported collision analysis
- FEM-supported tool design
- Guidance on the integration of the welding process

Training and seminars

- Beginner and expert seminars
- Hands-on user training
- Trainings on-site or at our local facilities
- Customer-specific trainings

Start-up

- On-site integration and start-up of the ultrasonic systems by our service specialists
- Ensuring a smooth and fast production start-up
- Fine-tuning and optimization of the bonding process quality

After-Sales Service

- Optional 24-hour service hotline
- Preventative maintenance and servicing measures
- Reworking of tooling and spare parts management
- Targeted production process optimization



FIRST CLASS TECHNOLOGY. WORLDWIDE.



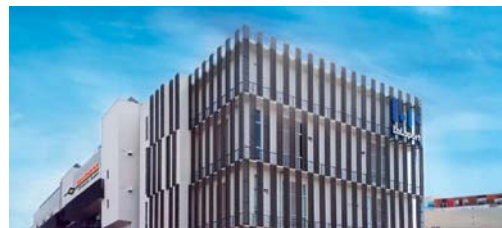
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