DUKANE

Intelligent Assembly Solutions

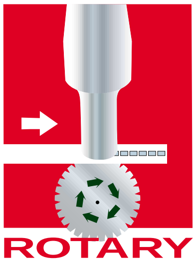
Ultrasonic Processing of Fabric and Film

Technical Bulletin

Ultrasonic Processing Techniques

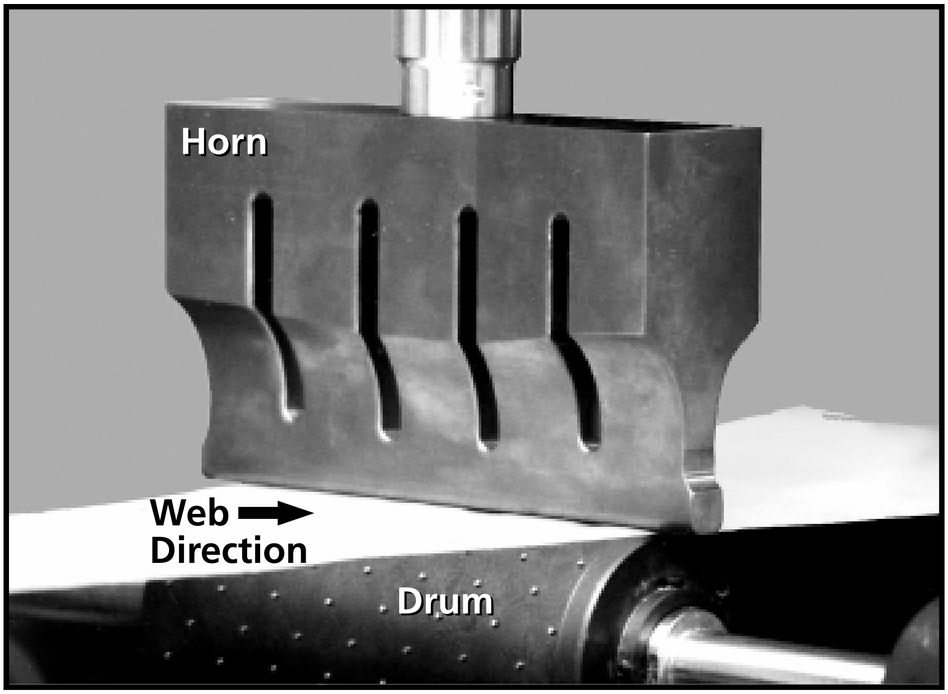
Fabrics and films used in the nonwoven, medical, filtration, textile and packaging industries can be processed using ultrasonic energy. Several of the common techniques applied are ultrasonic rotary/continuous bonding, ultrasonic slitting, plunge and traversing.

Rotary/Continuous Ultrasonic Bonding



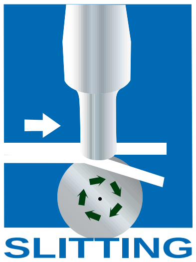
Ultrasonic bonding assembles two or more layers of materials by passing them between a vibrating horn and a rotary drum (often referred to as an ***anvil***). The figure below illustrates ultrasonic bonding. The rotary drum is usually made from hardened steel and has a pattern of raised areas machined into it.

The high frequency mechanical motion of the vibrating horn and the compressive force between the horn and the rotary drum create frictional heat at the point where the horn contacts the material(s). The frictional heat bonds the material together only at the horn/material contact points. This gives the bonded material a high degree of softness, breathability and absorption. These are the exact same properties which are critical for hospital gowns, sterile garments, diapers and other applications used in the medical industry and clean room environments.



Ultrasonic bonding requires far less energy than thermal bonding which uses heated rotary drums to bond materials together. As a result, ultrasonic bonding is economical and requires no consumables, adhesives or mechanical fasteners.

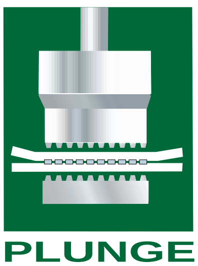
Ultrasonic Slitting



When a thermoplastic material is slit ultrasonically, its edges are also sealed. Sealing the edges of a woven fabric is beneficial because the yarns are prevented from unraveling and the smooth, beveled edges prevent buildup of the roll material. When two or more layers are ultrasonically slit together, the layers will become joined. The strength of the bond is determined by the material and anvil geometry.

Many factors influence the speed at which fabric can be ultrasonically slit. Some of the parameters are the geometry of the cutting wheel (anvil), the material composition, material weight and thickness.

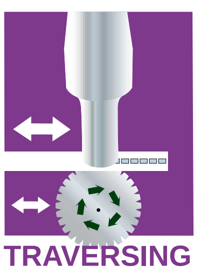
Plunge Mode



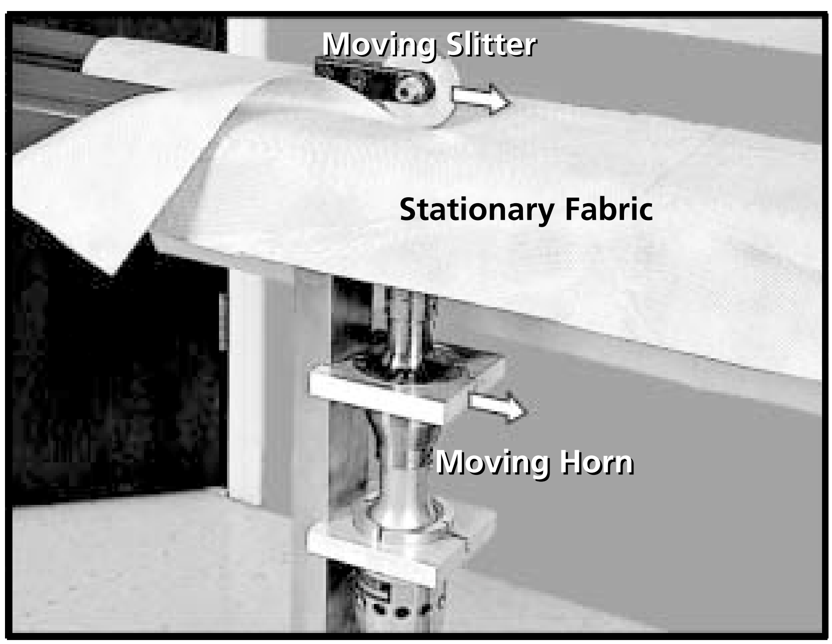
In the ***plunge method***, the material remains in a fixed location and is periodically contacted by the horn. The horn operates perpendicular to the material that is on the anvil. The horn can also be used to cut and seal. Typical plunge applications include but are not limited to:

- Filters
- Bra Straps
- Embossing
- Strapping
- Belt Loops
- Hook and Loop
- Vertical Blinds
- Buckles

Traversing Mode



With the ***traversing method***, the material remains stationary and the horn and anvil move across it. Typical applications for this method are cutting materials to length as shown in the photo, and splicing rolls together.



Thermoplastics Used

The fabrics and films best suited to ultrasonic processing contain thermoplastic materials with similar melting temperatures and compatible molecular structure. These materials have many of the following characteristics:

- A broad melting range
- Uniform thickness
- A high coefficient of friction
- 65% min. thermoplastic content
- Sufficient rigidity and thickness to accept energy at the material interface (0.0005 inch/0.0127mm minimum)

Polyester is considered to be a good material for ultrasonic applications. However ultrasonics can produce strong, neat stitches in both Nylon 6 and Nylon 6/6. Most polyolefins (Polypropylene and Polyethylene) also have good ultrasonic welding characteristics and are one of the lightest weight materials. Characteristics of the most common thermoplastics and their typical fabric and film uses are listed below in order of preference.

Thermoplastic	Characteristics	Uses
Polyester	Abrasion resistant, strong, resistant to most organic solvents and chemicals.	Clothing, conveyor belts, disposable garments, fiberfill, filters, laminates, mattress pads, packaging, quilts, recording tape and sheets.
Nylon	Abrasion resistant, elastic strong, resistant to most organic solvents and chemicals. Hygroscopic – may require drying before assembly.	Camping gear, carpet, cooking bags, filters, hook and loop material, lingerie, meat bags, rainwear and seat belts.
Polypropylene	Good chemical resistance. Has a unique wicking property that allows them to draw moisture from the skin to the outer surface.	Bagging, carpet backing, outdoor furniture, snack food packaging, tents and upholstry.
Polyethylene	Flexible, tough and inexpensive.	Disposable clothing, laminates and packaging film.
Polyvinyl Chloride	Water resistant. resistant to many chemicals and good insulating properties. Adding plasticizer can inhibit its weldability.	Films, outdoor furniture, shrink packaging and tarpulins.
Acrylic	Unaffected by most detergent solutions, inorganic acids and alkalines. Attacked by aromatic hydrocarbons, esters and ketones.	Awnings, blankets, filters, knitting yarns and sportswear.
Urethane	Thermoplastic urethane coated materials exhibit excellent strength when bonded ultrasonically. Thermosetting urethane degrades when subjected to ultrasonic energy.	Filters, rainwear and sponges.

Fabric Types and Films

Fabrics are classified into five categories as listed here; Films however have only one category.

Fabrics – Woven

Construction

Formed by the regular interleaving of filaments or yarns, in two directions perpendicular to one another.

Factors Influencing Weldability

Thread density, tightness of weave and uniformity of material thickness. Weld strength may vary due to the perpendicular orientation of filaments or yarns.

Fabrics – Nonwovens

Construction

Formed by bonding and/or interlocking fibers, yarns or filaments by mechanical, thermal or solvent means.

Factors Influencing Weldability

Uniformity of material thickness and thermoplastic content. The random orientation of fibers gives nonwovens excellent strength.

Fabrics – Knits

Construction

Formed by interconnecting continuous loops of filaments or yarns

Factors Influencing Weldability

Thermoplastic content, style of knit and elasticity of material. Elasticity of knits may affect the trueness of the weld in continuous processing resulting in a scalloped effect.

Fabrics – Coated Materials

Construction

Fabrics and films covered with a layer of thermoplastic such as polyethylene or urethane. The base material need not be thermoplastic (e.g. coated cardboard).

Factors Influencing Weldability

Coating material and its thickness.

Fabrics – Laminates

Construction

Fabrics and films consisting of two or more dissimilar layers in a sandwich form.

Factors Influencing Weldability

The mating surface should have a lower melting temperature than the other layers.

Films

Construction

Formed from the thermoplastic material which has been cast, extruded or blown into a film, generally under 0.01 inch (0.25mm) thick.

Factors Influencing Weldability

Film thickness, density and thermoplastic material characteristics.

Weldability

Many factors influence the weldability of the various fabric and film types. Please send in your material to our laboratory for free feasibility testing.

Form No. 11119–E–04

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