Serving an Entire Spectrum of Industry and R&D Needs

Ultrasound spray nozzle systems have replaced pressure nozzles in a wide range of industrial and R&D applications. Concerns over the environment and unacceptable quantities of waste have caused scientists, engineers and designers to adopt ultrasonic spraying systems as a technology that is more precise, more controllable, and more environmentally friendly.

Sono-Tek ultrasonic nozzles, with their characteristic soft spray, dramatically reduce overspray, which saves money and reduces atmospheric contamination. They also open up a broad range of new application possibilities. They are ideal, for example, when extremely low flow rates are required. Since they will not clog or wear out, they help reduce downtime in critical manufacturing processes.

For substrate coatings, moisturizing, thin film coatings, spray drying, web coating, fine line spraying, and many other industrial and R&D applications, Sono-Tek ultrasonic nozzles yield results far superior to other techniques.

Sono-Tek Ultrasonic Nozzles reduce:
- Material consumption by up to 80%.
- Wasteful overspray and atmospheric contamination.
- Waste disposal.
- Servicing and downtime.

WHEN PRECISION COUNTS...

For any application requiring precise, controllable spray of a liquid, Sono-Tek ultrasonic nozzles offer reliable, repeatable performance. Typical applications include:

**ELECTRONICS/SEMICONDUCTOR**
- Fluxing through-hole and SMT circuit boards (SonoFlux™ and SelectaFlux™ Series Spray Fluxers)
- Dispensing photolithographic chemicals onto semiconductor wafers and flat panel displays
- Precision fluxing on SMT circuit boards and components (SelectaFlux systems)
- Producing solder powder (MoltenMist™ nozzle)
- Superconductor substrates
- Carbon Nanotube (CNT) deposition

**ADVANCED ENERGY**
- Silicon solar cell coatings
- Thin film solar cell coatings
- Anti reflection coatings
- Organic solar cell polymers and CNTs
- Fuel cell coatings (PEMs, SOFCs)
- Fuel reforming processes
- Polymer coatings for electrolysis
- Ultrasonic spray pyrolysis
- Advanced battery coatings

**MEDICAL/BIO MEDICAL**
- Stent and other implantable medical device coatings (catheters, balloons, guide wires)
- Coatings for blood-collection tubes & syringes
- Microencapsulation of pharmaceuticals
- Pharmaceutical spray drying
- Coatings for diagnostic test kits
- Protein, enzyme, and reagent coatings
- Coatings onto sutures and surgical gauze
- Pacemaker component coatings
- Hydrophilic coatings onto surgical rods, screws, plates
- Supercritical CO₂ for creating drug-loaded nanophase material

**GENERAL/INDUSTRIAL**
- Fragrance, flavor, and oil coatings
- Ceramic spray drying
- Slurry/suspension atomization
- Solvent and adhesive bonding
- Chemical reaction chambers
- Combustion
- Solgel coatings
- Carbon nanotube deposition

**FOOD AND FOOD PACKAGING**
- Depanning oil coating
- Decorative glazes
- Antimicrobial coatings

**WEB COATINGS**
- Float glass, paper, and textiles (WideTrack™ system – width range capability from 2” [50.8 mm] to unlimited widths)
- Plastics

**VACUUM APPLICATIONS**
- Chemical vapor deposition (MOCVD)
- Polymer vapor deposition (OLED, Stents)
- Physical Vapor Deposition (PVD)

VERSATILE, RELIABLE, CONSISTENT

- Spray patterns are easily shaped for precise coating applications
- Highly controllable spray produces reliable, consistent results
- Non-clogging
- No moving parts to wear out
- Corrosion-resistant titanium and stainless steel construction
- Ultra-low flow rate capabilities
- Intermittent or continuous operation
ULTRASONIC ATOMIZATION WITH SONO-TEK SPRAY NOZZLES

The Process

Ultrasonic nozzles employ high-frequency sound waves (outside human audible range) to produce atomization. Disc-shaped ceramic piezoelectric transducers receive high frequency electrical energy from the Sono-Tek Broadband Ultrasonic Generator, (see page 13) and convert that energy into vibratory mechanical motion at the same frequency. The transducers are coupled to 2 titanium cylinders that amplify the motion.

The excitation created by the transducers produces standing waves along the length of the nozzle, the amplitude of which is maximized at the atomizing surface, located at the end of the small diameter portion of the nozzle.

In general, high-frequency nozzles are smaller, create smaller drops, and have a lower flow capacity than nozzles that operate at lower frequencies (see Flow Rate Capacities table on page 9).

Liquid is introduced onto the atomizing surface through a large, non-clogging feed channel (the orifice) running the length of the nozzle. Liquid emerging onto the atomizing surface absorbs the vibrational energy, causing it to atomize.

Construction

The nozzle body typically is fabricated from titanium because of its outstanding acoustical properties, high tensile strength, and excellent corrosion resistance. The protective housing is fabricated from 316 stainless steel (titanium option available).

Energy Control

The vibrational amplitude must be carefully controlled. Below the so-called critical amplitude, there is insufficient energy to produce atomization. If the amplitude is too high, the liquid is literally ripped apart, and large “chunks” of fluid are ejected. Only within a narrow band of input power is the amplitude ideal for producing the nozzle’s characteristic fine, low-velocity spray.

Flow Rates

Since the atomization mechanism relies only on liquid being introduced onto the atomizing surface, and not pressure, the rate at which a liquid is atomized depends solely on the rate at which it is delivered to the surface. Therefore, every ultrasonic nozzle has an inherently wide flow rate range. The “turn down” ratio (ratio of maximum to minimum possible flow rate) approximately 5:1 for large orifices and 10:1 for small orifices.
SPRAY SHAPE CREATED BY NOZZLE

ATOMIZING SURFACE GEOMETRY

Depending on nozzle style, the atomizing surface shape is conical, focused, or flat. (See page 6 for further nozzle style information and specific dimensions by model number.)

The illustration of the conical style nozzle in the diagram below indicates a cone shaped spray pattern resulting from the conically shaped atomizing surface. Typically, spray diameters from 1-3” (25.4 - 76.2 mm) can be achieved.

The center illustration (focused nozzle style) is characteristic of Sono-Tek focused nozzles. For this type of nozzle, the orifice size ranges from 0.015 - 0.052” (0.395 - 1.32 mm). Focused nozzles are usually recommended for use in applications where flow rates are very low and narrow spray patterns are needed.

The illustration of the flat nozzle style on the right depicts a cylindrical spray shape used in applications where the flow rate can be relatively high, but where the width of the spray pattern must be limited.

The atomizing surface of Sono-Tek ultrasonic nozzles can be shaped to produce various types of spray patterns (see the inset at the left). However, the soft spray produced often requires further shaping in order to meet the needs of an application, particularly where high precision of uniform deposition is required.

**WideTrack™ System**

In applications requiring wide width spray patterns, low velocity air/gas is introduced to shape the atomized spray. A jet block (shown above and below), which holds the nozzle, uses two jets of air/gas that pulse alternately to shear the spray as it emerges from the nozzle. The position of the jets can be adjusted, creating a pattern up to 24” wide with a single nozzle. By combining several spray assemblies, a uniform spray pattern of any width can be achieved in either spray-up or spray-down configurations.

Other spray shaping methods produce very narrow patterns, down to 0.020” (0.5 mm) in diameter. These methods have proven to be valuable tools for low flow applications and are ideal for spraying into tight geometries. Both the MicroMist™ and AccuMist™ series of nozzles are intended for producing narrow, precise spray patterns.

**MicroMist™ Nozzle**

The MicroMist system combines Sono-Tek’s unique focusing ultrasonic atomizing nozzle with low-pressure air/gas to produce a soft, highly focused beam of small spray drops.

An isolated hypotube delivers liquid to the nozzle’s atomizing surface while air/gas, delivered through the nozzle orifice at a fixed low pressure, shapes the atomized drops into a very precise, targeted spray.
AccuMist™ Nozzle

The AccuMist™ system combines Sono-Tek’s unique MicroSpray ultrasonic atomizing nozzle with low-pressure air/gas to produce a soft, highly focused beam of small spray drops.

Compressed air/gas, typically at 1 psi, is introduced into the diffusion chamber of an air shroud, which surrounds the nozzle, producing a uniformly distributed flow of air/gas around the nozzle stem.

The ultrasonically produced spray at the tip of the stem is immediately entrained in the low pressure air/gas stream. An adjustable focusing mechanism on the air shroud allows complete control of spray width.

The spray envelope is hourglass-shaped. The width of the shape is controlled by moving the focus-adjust mechanism in and out (see illustration below).

Vortex Nozzle

This type of air-shaping system produces an intermediate width spray pattern, wider than the AccuMist nozzle but narrower than the WideTrack spray pattern. The vortex nozzle uses low velocity, rotational air/gas to produce a wide, stable spray pattern.

The Vortex nozzle produces a conical spray pattern that is 2 - 4” (50.8 - 101.6 mm) in diameter, depending on distance to the substrate. The vortexing velocity can be varied depending on the application.

Impact EDGE™ System

The Impact EDGE™ System (patent pending) combines Sono-Tek’s ultrasonic atomizing nozzle with a controlled jet of air from the flat jet air deflector. The ultrasonically produced spray at the atomizing surface is immediately entrained in the air stream, creating a fan-shaped spray pattern. The velocity of the air stream is controllable, allowing low or high-impact of the atomized spray onto the product or substrate. This versatile air shaping system is capable of spray patterns up to 15” (38 cm) with unlimited widths possible in wide area applications where multiple nozzles are used in tandem.
NOZZLE SPECIFICATIONS

The following product descriptions provide basic information about standard Sono-Tek nozzles. Other configurations are available to accommodate specific requirements.

All maximum flow rates quoted are approximate and have been measured using water at room temperature and standard atmospheric pressure. Refer to the Flow Rate Capacities table on page 9 for further details about recommended configurations for specific flow rates.

Over 500 different ultrasonic nozzle configurations are available from Sono-Tek. To determine what system will best meet your needs, please feel free to speak with one of our sales engineers at (845)795-00 (USA) or email: info@sono-tek.com.

MATERIALS

Lead zirconate-titanate transducers
Titanium alloy body (Ti-6Al-4V)
316 stainless steel housing
Kalrez® and Viton® O-rings
Stainless steel SMA electrical connector

LIQUID INLET

316 stainless steel Swagelok® (titanium optional)
Fitting [standard sizes for 1/4", 1/8", & 1/16" (6.35 mm, 3.18 mm, and 1.59 mm tubing)]

OPERATING TEMPERATURE RANGE

- 20°C to 150°C (-4°F to 302°F)
External Pressure Range: Vacuum to 100 psi

Viton® and Kalrez® are registered trademarks of EI Dupont deNemours Inc., Swagelok® is a registered trademark of Crawford Fitting Co.

*Based on maximum orifice diameters for each model. MicroSpray series nozzles are limited to 0.3 gph/ml/s max. flow rate.

**Other Configurations available**
Our ultrasonic nozzles are used in a variety of environments, from very high temperatures to vacuum and pressurized situations, therefore the following options and accessories are available to control the demands of various industry requirements.

Flanges / Vacuum / Pressure Environment
Sono-Tek nozzles can be configured with flanges for use in vacuum or pressurized environments.

Microbore tubes
Microbore feed assemblies are installed in Sono-Tek nozzle systems in situations where the operating flow rate is very low (e.g., under 1 ml/min). It also serves to isolate the liquid stream from the vibrations within the nozzle prior to the liquid emerging onto the atomizing surface. This is important for liquids with high vapor pressures, which tend to begin to atomize within the feed orifice, thereby creating distortions in the resulting spray pattern.

Cooling / Heating Ports
For applications where the nozzle is exposed to temperatures exceeding 150° C (302° F) or lower than -20° C (-4° F), we recommend gas/air temperature control ports. Ultrasonic nozzles are temperature constrained only by the piezoelectric transducers. These transducers must be maintained at a temperature between -20° C to 150° C (-4° F to 302° F). Temperature control ports are available for all styles and frequencies of Sono-Tek nozzles.

Thermocouples
Monitoring of the internal temperature of the nozzle where the transducers are located can be done with a thermocouple installed into an additional port.

DUAL LIQUID FEED
All Sono-Tek Ultrasonic Nozzle Systems can have an optional dual liquid feed assembly installed. This option allows for even greater flexibility in your process, as two liquids can be mixed right at the nozzle’s atomizing surface, or sprayed alternately, one liquid following the other.

Frequencies available from 25 - 120 kHz, depending on your drop size requirements.
In an ultrasonically produced spray, drop size is governed by the frequency at which the nozzle vibrates, and by the surface tension and density of the liquid being atomized. Frequency is the predominant factor. The higher the frequency, the smaller the median drop size.

The percentage of drops below a given diameter is plotted for Sono-Tek nozzles using a log-log scale on the left, as it results in a series of straight lines in the representation. The log normal chart shown below on the right represents a 60 kHz median drop size calculation.

Several parameters characterize the mean and median drop size of a particular distribution. The number median diameter defines the 50% point in drop size; that is, one-half of the number of drops in the spray have diameters larger than this value while the other half have diameters smaller than this value.

The number mean and weight mean diameters are average diameters. The number mean diameter is obtained by adding together the diameter of each drop in a spray sample and dividing that sum by the number of drops in the sample. The weight mean diameter for a given density is obtained by adding together the volume of each drop in a spray sample (volume is proportional to diameter cubed), taking the cube root of this sum, and finally dividing by the number of drops. The Sauter mean diameter is a parameter used primarily in combustion applications. It measures the effective ratio of drop volume to surface area.

Sono-Tek ultrasonic nozzles produce a soft, low-velocity spray that eliminates the overspray typically associated with pressure nozzles. Spray velocities are in the range 0.7 - 1.2 feet per second, compared to 35 - 70 feet per second for pressure nozzles.

The unpressurized nature of ultrasonic atomization allows Sono-Tek to offer nozzles over a wide spectrum of flow rate ranges. For example, our MicroSpray™ series of nozzles can handle flow rates from μl/min to greater than 0.3 gph (0.3 ml/s), depending on orifice size. Our highest capacity nozzle is rated at 6 gph (6 ml/s).

Important: The data shown is for water. Other materials may give different results. The median drop diameters for most organic solvents will be from 60-75% of the values for water.
FLOW RATE CAPACITIES

The flow rate range is governed by four factors: orifice size, atomizing surface area, frequency, and liquid characteristics. Orifice size plays a principal role in determining both maximum and minimum flow rates. Maximum flow rate is related to the velocity of the liquid stream as it emerges onto the atomizing surface. The atomization process relies on the liquid spreading out onto this surface. At low stream velocity, surface forces are sufficiently strong to “attract” the liquid, and cause it to cling to the surface. As the velocity of the stream increases, a velocity is reached where the stream becomes totally detached from the surface, preventing atomization. In theory, there is no lower limit to flow rate since the process is independent of pressure. However, in practical terms, a lower limit does exist. As the flow is reduced, a point is reached where the velocity becomes so low that the liquid emerges onto the atomizing surface haphazardly, causing the atomization pattern to become distorted. Typically, the minimum velocity of the liquid stream from an orifice of a given size is about 20% of the maximum velocity. The amount of atomizing surface area available is another factor influencing maximum flow rate. There is a limit as to how much liquid an atomizing surface can support and still sustain the film that is required to produce atomization. If the quantity “dumped” onto the surface becomes too great, it overwhelms the capability of the surface to sustain the liquid film.

In every instance, one of these factors will set the maximum flow rate. The table below lists, for each available frequency classification, the maximum flow rates of water for typical combinations of atomizing surface diameters and orifice sizes. Maximum flow rates for other liquids may vary significantly from these values.

### FLOW RATE CAPACITIES FOR WATER (gph or ml/s)

<table>
<thead>
<tr>
<th>Atomizing Surface Shape</th>
<th>Freq (kHz)</th>
<th>Tip Dia. (in)</th>
<th>0.015</th>
<th>0.030</th>
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</table>
Several factors affect the ability of a liquid to be atomized. These include viscosity, solids content, miscibility of components, and the specific dynamic behavior of the liquid. There are no hard-and-fast rules governing a liquid’s atomizability using ultrasonics. Some liquids that seem easy to atomize at first can prove difficult, while others that seem impossible actually perform well.

There are, however, guidelines that offer a good indication of the probability for success. Liquids can be categorized as follows:

- Pure, single component liquids (water, alcohol, bromine, etc.).
- True solutions (salt water, polymer solutions, etc.).
- Mixtures with undissolved solids (coal slurries, polymer beads/water, silica/alcohol, suspensions, etc.).

For pure liquids, the only factor limiting atomizability is viscosity. In general, the upper limit of viscosity is on the order of 100 cps. True solutions, for the most part, behave the same as pure liquids, except when the solution contains very long-chained polymer molecules. In that case, the polymer molecules can interfere with the atomization process because of their length. Such molecules will inhibit the formation of discrete drops when they span the region of the bulk liquid where two or more drops are about to be formed.

For mixtures with undissolved solids, there are three major factors that influence atomizability. These are: particle size, concentration of solids, and the dynamic relationship between the solid(s) and carrier(s).

If the particle size is more than one-tenth the median drop diameter, the mixture may not atomize properly. For drops that contain one or more solid particles, their size must be significantly greater than the size of the solid. If not, there is a good chance that a majority of the drops will form without entrapping the solid component, causing separation.

The concentration of solids is important. A practical upper limit on solids concentration is about 40%. Conditions must be just right in order to achieve atomization at higher concentrations. Finally, even if the particle size is appropriate, atomizability is affected by other dynamic factors such as the viscosity of the carrier and the ability of the solid component to remain suspended.
Since a liquid delivery system is required for every spray application, it is important to specify a system that is optimized for performance with Sono-Tek nozzles. We can provide a wide range of properly interfaced liquid delivery systems, including the following basic designs:

**Gear Pump**

Ideal in circumstances where electronic control of flow rate is important, in continuous or intermittent flow situations. Features include:

- Available in flow rate ranges of 10 - 70 or 40 - 200 ml/min (0.16 - 1.2 or 0.7 - 3.4 gph).
- Continuous circulation of liquid. Liquid is directed either back to the source (when the nozzle is idle) or to the nozzle, via a three-way valve. This mode of operation is ideal for achieving accurate delivery in intermittent flow applications.
- Total electronic control of flow rate and on/off functions, internally or through external PLCs or PCs.
- Pulseless operation.

**Syringe Pump**

Intended primarily for use in applications where the flow rate must be carefully controlled, particularly in low flow rate situations, or where the material being sprayed is incompatible with other types of liquid delivery systems.

Very wide flow rate range, from 0.001 m/min to approximately 30 ml/min. Flow rates depend on the capacity of the syringe used and the speed at which the syringe plunger is moved forward.

The pump is capable of both single-shot dispense operation and continuous flow operation up to the capacity of the syringe.

- Highly precise stepper motor drive mechanism.
- Microprocessor controlled delivery rate, refill rate, and total dispense volume can be independently set.
- Alphanumeric LCD display and keypad.
- Contains a look-up table of standard syringes arranged by manufacturer, material, and size.
- Both RS232C and TTL interface capabilities.
- Stall condition auto shut off of pump.
- Two-syringe capacity - 10 μ to 60 ml.

**Pressure Reservoir**

A cost-effective liquid delivery solution designed to be used when flow rates or dispense volumes must be carefully controlled, and where a highly reliable yet simple approach to liquid delivery is required.

The liquid to be sprayed is placed in a closed reservoir and pressurized by an external source of gas (air or any other nonflammable gas). The gas pressure provides the driving mechanism that forces the liquid out of the reservoir and into the line supplying the nozzle. Features include:

- Resistance to solids-bearing, corrosive, or abrasive materials.
- Compatibility with both continuous and one-shot operation.
- 1-liter, 1-gallon, and 3-gallon capacities.
- Low-pressure regulator and gauge for reservoir pressure control.

A liquid delivery system can also be tailored to meet specific requirements. Options are available for chemical resistant materials as well as unique mounting and valving configurations.
MicroFlow™
Precision Positive Displacement Pump
A high precision stand-alone multi-piston positive displacement pump system. The system is capable of continuous liquid flow, making it advantageous compared to syringe pumps that may require frequent refilling or change over. Features include:

- Wide range of flow rates – μl/min to 30ml/min.
- High accuracy dispense ±0.5%.
- Continuous flow capability.
- PC Windows®-based software control.

AccuFlow™
High Accuracy, Low Flow Gear Pump
A stand-alone automated gear pump system incorporating separate liquid reservoirs for controlled sample dispense, solvent purge and waste. Features include:

- Ultra-low flow capability flow rates down to 5μl/min.
- Standard flow range 5 - 450 μl/min (Custom systems to 1μl/hr).
- Extreme accuracy - pulsation <1% repeatability ±1%.
- Continuous flow capability.
- 4 line digital LCD display.

SonicSyringe™
Ultrasonic Dispersion Syringe Pump (patent pending)

The SonicSyringe™ was developed in response to a demand for a liquid delivery solution that would be able to effectively mix particles held in suspension that have a natural tendency to quickly settle out and agglomerate. The SonicSyringe disperses agglomerated particles quicker and more uniformly than magnetic stirring or sonic baths. Continuous high frequency ultrasonic vibrations hold particles evenly suspended, delivering consistent particle suspension characteristics during the entire coating process. An Ultrasonic Control Module provides high-frequency electrical input and controls intensity and duration of vibrations (user programmable).

- Compatible with slurries with particle sizes up to 25 μ.
- Capable of operation with small liquid sample sizes (only 5-10 ml/ required).
- Can be fully integrated into Sono-Tek’s FlexiCoat and ExactaCoat programmable XYZ coating systems.
- Thoroughly mixes particles in seconds and holds them evenly suspended for several hours or more.

SonoFlow CSP™
An adaptation of the CSP Flow designed specifically for applications using suspensions with particles that tend to agglomerate and fall out of suspension rapidly. The system employs (2) SonicSyringe ultrasonic agitators to create continuous ultrasonic vibrations.

All system functions are controlled with Windows®-based software for ease of setup and use.
**THE SONO-TEK BROADBAND ULTRASONIC GENERATOR**

The Broadband Ultrasonic Generator delivers the high frequency electrical energy required to operate all Sono-Tek ultrasonic atomizing nozzles.

This versatile, rugged, state-of-the-art power generator, designed and manufactured by Sono-Tek, incorporates features that simplify process control and enhance the operation of our nozzle systems.

- Operates over a frequency range of 25 - 120 kHz (frequency is user selectable for any nozzle within this range).
- Uses advanced phase-locked-loop control technology to automatically lock onto a nozzle’s specific operating frequency.
- Provides both audible and visual alarms in the event of system malfunction.
- Contains an output for connection to a remote alarm.
- Can be triggered on/off by an external control signal.
- Contains an LCD power meter and power level control for setup and monitoring of nozzle operation.
- Contains an input for remote power control.
- Is available in two versions: a 100-240 VAC free-standing unit, and a 24 VDC modular system intended for use in multiple nozzle configurations.

**MODELS AVAILABLE**

- **Free-standing:** 100 - 240 VAC
- **Modular:** 24 VDC

**INPUT POWER REQUIREMENTS**

- **Free-standing:** 90 - 260 VAC, 50/60 Hz, 75 VA max
- **Modular:** 23 - 25 VDC ±5% regulation, 60 VA max

**OUTPUT POWER**

- 15 W max. continuous
- 20 W max. intermittent

**FREQUENCY RANGE**

- 25 - 120 kHz

**EXTERNAL TRIGGER INPUT**

- 5 - 240 V(AC or DC) or switch closure

*For applications using liquids which are very difficult to atomize, a high power output generator is available. Contact us for further details.

A high precision generator is also available for high precision applications using very low flow rates and low power requirements.
SONO-Tek ultrasonic nozzles are proven successful for dispensing photolithographic chemicals onto semiconductor wafers and flat panel displays. It is ideal for photoresist processes where high precision is required.

Benefits of ultrasonic spray for photoresist include:

- Uniform coverage inside deep well topographies such as MEMs.
- Reduction in photoresist consumption.
- Tight deposition density control.
- High transfer efficiency.
**FUEL REFORMERS**

Sono-Tek ultrasonic nozzles have proven to be effective in both manufacturing of fuel reforming system components and ultrasonic atomization of fuel in reforming processes.

Applications include:
- Ultrasonic atomization of hydrocarbon-based fuels such as methanol and diesel into a steam reformer for fast, thorough mixing of fuel and hot air/steam at low flow rates.
- Spraying catalyst slurries such as alumina suspensions onto membranes in a reforming chamber or conductive solid oxide fuel cells.
- Spraying polymer solution onto porous substrates to form electrolyte membranes for fuel cells or membranes for H₂ separation from syn-gas.
- Various catalyst coatings onto open-cell filter components including aluminum screens, ceramic honeycombs or stainless steel foam, maintaining porosity without blocking micropores.

Ultrasonic nozzles offer many benefits in fuel reforming processes:
- Deagglomeration of particles in suspension.
- Uniform thin films.
- Controllable drop sizes.
- Ability to coat complex filter geometries uniformly, improving active catalyst surface area.
- Minimal overspray of expensive catalyst materials.
- Greater control for washcoat processes, with uniform deposition and control of coating thickness.

**Other Applications in the electronics industry include:**
- Microsphere deposition on flat panel displays.
- Superconductor substrates.

Sono-Tek remains at the forefront of emerging electronics applications, offering precision thin film coating systems for new technologies such as advanced batteries, ultracapacitors, nanowires, carbon nanotubes and OLED flat panel displays.
Sonoflux™ Series

STATIONARY SPRAY FLUXING SYSTEMS

Using our patented ultrasonic spray technology, Sonoflux systems are state-of-the-art tools for applying solder flux to circuit-board assemblies prior to wave soldering.

Sonoflux™ 2000F is a highly flexible system designed to adapt easily to every installation. It features a user-friendly programmable controller to monitor and control all system functions and a selection of sophisticated options, including totally automatic operation.

Sonoflux series spray fluxing systems:

- Require only a monthly clean up, even with rosin flux.
- Reduce flux usage and VOC emissions up to 80%.
- Eliminate thinner usage and titration.
- Typically pay for themselves within one year of operation.
- Are capable of spraying up to 24” wide.
- Are available as fully programmable systems, with up to 1500 recipe storage.
- Are compatible with ALL fluxes, including lead-free.
- Deposition density control.

Sonoflux ultrasonic spray fluxers are available as stand-alone systems or as units for retrofit inside wave-soldering machines. The Sonoflux 2000F is proven to be the industry’s most reliable, cost effective system for the application of flux in printed circuit board assembly.
RECOMMENDING SPRAY FLUXING SYSTEMS
Sono-Tek reciprocating systems offer the same ultrasonic spray fluxing benefits of uniformity and non-clogging performance that the SonoFlux 2000F is known for worldwide, on a robust reciprocating platform. These systems are ideal for manufacturers who need to change board widths frequently or simply prefer a reciprocating system. Two different systems are available, both incorporating Sono-Tek’s high Impact flux transfer system for maximum top-side fills. Flexibility and precision make these systems particularly well suited to a wide range of fluxing applications.

SonoFlux EZ (pictured above) is an economical ultrasonic spray fluxing system featuring easy integration into existing wave solder processes, 2–18 inches (50-457 mm) PCB width range, recipe storage and process control through backlit LCD display.

SonoFlux Servo™ is a fully automated ultrasonic spray fluxing system with selective area fluxing capability. Features include:

- 2–18 inches (50-457 mm) spray width range
- 2-24 inches (50-610 mm) optional.
- Process control through compact PC notebook with Windows®-based software.
- 500,000 recipe storage.
- Single or dual mode fluxing.
- Easy integration and operation with all wave solder machines.
- High precision flux delivery pump.
- Conveyor speed sensing option.

Selective Fluxing Systems
SELECTAFLUX™ SERIES ULTRASONIC SPRAY FLUXING SERIES
The SelectaFlux system is designed for selective fluxing applications. The SelectaFlux ultrasonic nozzle’s controlled-velocity will not harm or disturb components while giving maximum top-side fill. The system is available as an OEM, retrofit or inline system. SelectaFlux nozzles can spray in any orientation.

The spray envelope is bow-shaped. The width of the bow is controlled by moving the focus-adjust mechanism in and out. The distance between nozzle and substrate can be varied from near-contact to approximately two inches.

SelectaFlux spray fluxing systems feature:

- Compatibility with ALL fluxes.
- Wide range of delivery rates from 1 - 250 microliters/second.
- Also ideal for tinning and odd-shaped components.
- Spray pattern adjustable from 0.070 -1.50 inches.
FlexiCoat™ & ExactaCoat™ Programmable XYZ Systems

Sono-Tek's line of XYZ motion ultrasonic coating systems offer unique options that enable us to customize these machines based on customers' process requirements. They are ideal for Solar and Fuel Cell manufacturing as well as research and development coatings in different environments, from fully inert to high-temperature needs or rotational Z-axis for rod-shaped substrates. All systems are controlled via PathMaster Windows-based software and include a user-friendly teach pendant trackball for programming.

FUEL CELLS

FlexiCoat FC-R is designed for coating Solid Oxide Fuel Cell (SOFC) rods with ceramic slurries or metal oxide suspensions such as Nickel Oxide.

ExactaCoat FC is a tabletop system often used in R&D or low volume production for coating Proton Exchange Membranes (PEMs) or other electrolyte materials with metal catalyst inks. These ultra-thin materials require several layers of coating to achieve necessary weight gain of inks without deformation of the delicate membranes. Sono-Tek has developed coating processes that provide excellent results with durable, pinhole-free coatings.

FlexiCoat FC is a production scale coating system with expanded capabilities for catalyst coatings onto GDLs or fuel cell membranes.

HyperSonic is a robust high speed reciprocator designed to enable customers to scale up their process to high volume, once they've completed R&D phases.

Available options for XYZ motion systems include:
- Heat and/or vacuum plate
- Camera
- Laser Pointer
- Substrate holder
- Dual nozzle configuration
- SMEMA conveyor systems
- Programmable nozzle tilt
- Solvent detection system
SOLAR CELLS

Applications include:

- Solder bus fluxing of silicon solar cells
- Phosphoric doping of silicon solar cells
- CIGs coatings for thin film solar cells
- TCO and active layer coatings for thin film solar cells
- OSC (Organic Solar Cells) coatings

**ExactaCoat SC** is a flexible R&D tabletop coating system suited for coating active layers in thin film solar cell manufacturing.

**FlexiCoat SC** is capable of high temperature spray pyrolysis coatings for thin film solar cells (up to 500 degrees C).

**SelectaFlux** systems are commonly used in solder bus fluxing of silicon solar cells using Tabber Stringer machines. Precise, targeted application of flux is more effective than other coating methods such as roller or jetting technologies. Sono-Tek’s SelectaFlux nozzles retrofits seamlessly.

**ExactaCoat Inert** is designed specifically for applications requiring < 1 ppm oxygen environments, such as Organic Solar Cell (OSC) active layer coatings. The unique capabilities of this system enable fine tuning of coating morphology characteristics, which can greatly affect cell performance.

**HyperSonic** is a high speed reciprocating system designed to provide a high volume manufacturing solution for phosphoric doping or anti-reflective coating of conveyorized silicon or reel-to-reel thin film solar cell applications. This robust reciprocator easily retrofits onto existing lines and is available in three coating widths and multiple nozzle configurations.
Implanted Device Coatings

Lubricious, antimicrobial and hydrophilic thin film coatings for:

- Cardiac, Peripheral, Biliac Stents
- Catheters and Balloons
- Guide Wires
- Bandages, Wound Dressings, Sutures
- Surgical Masks, Gloves
- Hospital Textiles
- Blood Collection Tubes
- Surgical Implants
- Orthopedic Rods, Pins, Screws
- Electronics, Diagnostic Devices

Stent Coating Systems

Designed to coat cardiac or peripheral stents with anti-restinosis polymers. The complex geometry of stents and many other implantable devices requires uniform thin film coverage of all strut surfaces without webbing of the polymer material.

MediCoat DES 1000™

A lab-friendly benchtop system incorporates a programmable stent movement and rotation device, located in an easily accessible spray area that allows for manual loading and unloading of stents in a controlled inert environment.

- Integrated control of the nozzle, liquid delivery, and stent movement/rotational device.
- Wide range of delivery rates from 0.3–100 ml/hour.
- All system components are compatible with the typical solvents and polymers used in stent coating.

Sono-Tek has a long history of providing ultrasonic nozzle systems for applying precision medical device coatings in a number of areas.

Materials sprayed include:

- Polymers
- Silver Nitrate
- Silicone
- Heparin
- Blood Plasma
- EDTA
- CNTs
- Chloroform
- Acetone
- Toluene
- DMAC
- THF
MEDICAL TEXTILES

WideTrack ultrasonic system for spraying silver, silane, triclosan and ammonium-based antimicrobial agents onto a wide variety of surfaces to prevent infection and/or inhibit the growth of mold, gram (+) and gram (-) bacteria and fungi.

- Flexible width control for various width substrates.
- Can be configured for one side or dual side application.
- Spray up or spray down capability.
- Precise coating allows for uniform release of antimicrobial compound onto applied surface.

Nanotechnology

SPRAY DRYING

Extended horn atomizing nozzles easily retrofit into most spray drying systems.

- Available in 25, 48, 60 and 120kHz frequencies.
- Capable of extremely small batch production (1 ml/hr flow rate).
- For use with organic or aqueous-based solutions.
- Dual liquid delivery option available (ideal for microencapsulation).
- Thermocouple probe for precise temperature monitoring.

MICROENCAPSULATION

Applications include targeted drug delivery, slow release pharmaceuticals, and nanoencapsulation.

BLOOD COLLECTION TUBE COATINGS

Applications include targeted coating of tube side walls, layering of chemistries, polymers, or clotting agents.

Custom multiple nozzle systems have been configured for high volume production needs.

Common materials sprayed include Heparin, Silicone and EDTA. Extended horn nozzle design allows atomizing surface to reach inner diameter lengths.

- Fully automated control of electronics.
- Soft, low velocity spray will not collect on the base of the tube.
- 20+ years of BCT process experience.

*MediCoat II™*
Automated stent coating system with high production capabilities.

- Two user-friendly stent loading cassettes hold up to eight stents each.
- Attach stents using Sono-Tek's exclusively designed mandrels or customer may use their own attachment method.
- Integrated control of nozzle, liquid delivery, & stent motion.
- Easy load/unload chamber and sealed process chamber.

**MediCoat DES 1000**
Wide Track glass coating systems feature highly controllable, uniform spray coatings for float or panel glass processes. Ideal for anti-stain, self-cleaning (nanophase) and other protective coatings for low-e glass. Its proven reliability and low maintenance design make it excellent for 24/7 glass manufacturing processes.

- Virtually no overspray and no mess.
- Drip-free spray.
- Proven reliability for 24/7 manufacturing operations.

Wide Track’s control center and state-of-the-art pumping system are designed for flexibility, easy access, and operation.

- Pump control system delivers repeatable flow to each nozzle.
- Integrated air conditioning system keeps electronics cabinet cooled.
- Real time monitoring of all system functions.
- Control tower with 19” touch screen HMI.
- Width Range Up to 156” (4 m) — standard configuration for 8 spray assemblies (custom widths available).
- 3 - 100 ml/min flow rate range.

Glass coating applications:
- Protective coatings on low-e (solar glass)
- Touch screen (carbon nanotubes)
- Anti-reflection solar glass coatings
- Self-cleaning glass (nanophase)
- Anti-glare coatings
- Anti-static coatings
- Architectural glass
- Flat panel displays
WideTrack HS uses less material, creates less chemical waste, less overspray, and less atmospheric contamination than pressure nozzle systems. In fact, the ultrasonic spray is so efficient, it’s difficult to discern that it is even spraying.

Shown in the photos below the deposition achieved with Sono-Tek’s WideTrack HS system is equal to the pressure nozzle system shown above and the uniformity of the coating is superior with smaller, even particle sizes, requiring less time for drying/curing. In addition, Sono-Tek’s ultrasonic nozzles are non-clogging, creating further savings in reduced downtime and maintenance costs.

**Ultrasound advantages for the textile industry:**
- Reduced waste (up to 80%)
- ISO 14001: Reduce, Reuse, Recycle
- 50-60% reduction in water
- Substantial chemical reduction
- Reduction in energy for drying/curing (up to 40%)
- Selective finishing of face/back of fabric
- No dilution of solution with wet-on-wet finishing

**TEXTILES**

**Textile applications:**
- Stain resist
- Water repellent
- Anti-microbial
- Moisture management
- Flame retardant

**PRESSURE NOZZLE SYSTEM**

**SONO-TEK’S WIDETRACK SYSTEM**

**clearly beneficial**
Ultrasonic nozzles are suitable for a number of food and food packaging applications such as:
- Depanning oil coatings
- Antimicrobial coatings for extended shelf life
- Decorative glazes, eggwash coatings
- Thin film plastic wrap coatings for extended shelf life
- Moisture barrier coatings onto biodegradable trays
- Nutraceuticals, flavors and herbal extracts

SonoCoat PAN
DEPANNING OIL COATING SYSTEM

Designed to apply uniform thin film coatings of depanning oil in commercial baking applications, the SonoCoat PAN system can be configured with Vortex, Impact or WideTrack nozzles.

Features include:
- Proven in 24/7 continuous operation.
- Reduced oil usage – up to 50%.
- Reduced maintenance & waste.
- Enhanced environmental impact & safety.
- HMI touch screen control with integrated AC cooling
- Food grade construction.
- 5 - 55 ml/min flow rate range.

Process parameters controlled via the HMI include:
Oil deposition level, multiple deposition level "recipes", line speed, oil density, concentration of effective chemistry, nozzle power relative to flow rate, and preheat temperature. Gentle spray plumes create very thin oil coatings with minimal overspray. The depanning coating process is optimized by adding a small amount of heat to the oils before atomization.
WideTrack for Biodegradable Packaging Films

Nano/micro barrier coatings onto PLA (Poly Lactic Acid) film webs for enhanced functional characteristics.

Designed to apply ultra-thin layers of clay nanoparticles onto continuous reel-to-reel compostable films for food packaging. The system includes full PLC control with HMI interface and integrated pumping system.

Total Customer Support

With over 30 years of industry leadership in ultrasonic spray technology, Sono-Tek has the experience and expertise to help you integrate our technology into your application. From large-scale, automated turnkey systems to individual spray system components, Sono-Tek delivers the support you need to take full advantage of the benefits of ultrasonic spraying. Sono-Tek has extensive experience in providing turnkey systems for a variety of specialized applications. Our engineers will fully assess your requirements, make on-site visits, and prepare detailed specifications.

The system will then be designed and fabricated by Sono-Tek to your precise requirements, and after being thoroughly tested prior to shipment, our engineers and service technicians will install it and train your staff on operation and maintenance.

We at Sono-Tek Corporation want you to be 100% satisfied with the quality and reliability of our products. We are available to answer your equipment or process questions, and you can count on us to provide unique and creative solutions for optimum results. For an in-depth technical description of our ultrasonic nozzles and their capabilities or further product information, visit our website: www.sono-tek.com.

Custom Solutions

Sono-Tek’s engineering and production capabilities include the design and manufacture of custom engineered spray solutions.

We have provided custom designed spray equipment for a variety of clients and for a variety of applications.

Our custom offerings complement our complete line of standard ultrasonic spray equipment, and they can incorporate features such as X-Y motion, conveying systems, substrate rotation, enclosures, a wide range of liquid delivery systems, and PLC integration.
For customers who want to test an application, Sono-Tek offers a laboratory testing service. On-site analysis of your application is available with our technicians and engineering team. Our 30 years of experience coating a wide range of substrates and the expertise of our engineering staff gives us the ability to help customers solve process issues with our inhouse laboratory coating services.

Practical testing of theory using actual parameters and precision tools, operated by our spray technology experts, results in significant savings for our customers.

Our in-house laboratory is equipped with precision equipment to gauge the effectiveness of your process. Some of the tools available in our laboratory facility include film thickness measuring tools, high power microscopes, conveyors, drop size measurement equipment, customized stent and other delicate substrate handling systems, spray drying and XYZ motion systems.

- On-site analysis of your application using the skills of our technicians and engineering team
- Proof-of-concept research and development
- Reduce your time to market with our process expertise
Some examples of improvements and process developments that have been developed using ultrasonic spray technology and prototyping services offered by Sono-Tek:

- Increased throughput and minimized excess misting while providing uniform coverage over a wide area in a float glass spray application resulting in a 75% reduction in material usage.
- Designed a nozzle to meet precise drop size requirements in spraying of microparticulates in medical applications, such as drug delivery.
- Developed a highly effective process for spraying of nanoparticle solutions with significantly less agglomeration than conventional methods.
- Developed a process for applying flame-retardant solutions to fabrics.
- Optimized thin film coatings from 5μ down to .1μ and increased uniformity from ±10% down to ±2%.
- Optimized coating morphologies from a grainy structure to continuous smooth films.
- Reduced consumption of expensive drug/polymer solution being sprayed by 80% - saving the customer $14,000 per month with a 2 month ROI.

Some of the projects that can be performed in our spray laboratory include:

- Prototyping and customizing nozzles to specific applications.
- Customizing frequency and drop size based on liquid vapor pressure and surface tension.
- Spray characterization studies with different nozzles under different operating conditions.
- Testing spray performance using actual parameters.
- Adjusting spray parameters to increase efficiency and improve results.
- Improving process and reducing reject rate.
- Troubleshooting process problems resulting from unsatisfactory spray quality.

CASE STUDY: In one application utilizing traditional pressure nozzles, a manufacturer was shutting down every 15 minutes to clean clogged nozzles, which resulted in non-uniform thin films on their substrate. Our engineering staff designed a custom ultrasonic nozzle system, which prevented clogging and allowed the customer to operate for 3 days without cleaning. The resulting savings added up to $45,000 annually as well as providing environmental savings and dramatically reducing material used in the process.
Global Solutions in Ultrasonic Spray Technology

Sono-Tek’s corporate headquarters are located in Milton, NY USA, with additional offices in Hong Kong. Our extensive global support and distribution network provides factory trained personnel with local language support in dozens of countries worldwide.

For further info please contact:

Tel. +45 70 20 40 73 | info@boelnordic.com | www.boelnordic.com

Comprehensive Solutions in Process Automation and Technology