

SONICATOR

Ultrasonic Liquid Processors



INTRODUCING THE NEW DIGITAL SONICATOR



Exclusive Features

- Digital Design
- Touch Screen Display
- Self Diagnostics
- Sequence Programming

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SONICATOR 4000

The Sonicator 4000 is the world's **most advanced** ultrasonic liquid processor and the only true digital Sonicator available. Digital circuitry ensures that the **precise**, desired level of ultrasonic energy is delivered to the sample each time.

The most important feature of a Sonicator is **reproducibility**. The digital signal processor enables the system to track frequency changes in the converter and horn assembly to maintain electrical efficiency at all times. The outcome is more **efficient** operation, sample-to-sample **consistency** and a **reliable** end result.

Output amplitude is controlled from 1-100%, giving a greater degree of resolution and the ability to pinpoint the amplitude needed to effectively process your sample. Internal diagnostic capabilities can indicate when horns require replacement. This feature eliminates an important variable that can affect the ability to reproduce desired results.

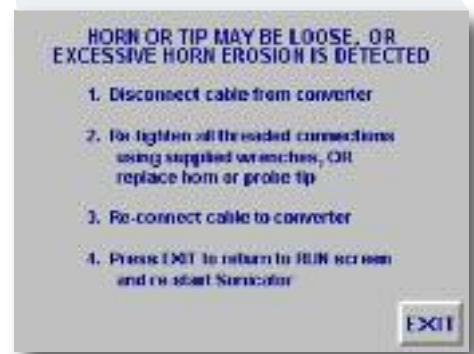
For consistent and reproducible results, the Sonicator 4000 has set a new standard for ultrasonic processing.



This screen is an example of a program in progress. Amplitude, pulse on/off time, temperature and energy delivered values are all clearly displayed.



This Program Setting screen enables the user to set the parameters for their program. Up to 10 individual programs can be saved.



The Sonicator's fault detection circuitry has detected a failure. A self diagnostic test will identify the problem and give instructions on how to clear the error.

Fully Digital Design

Digital signal processing enables precise control of amplitude and output power. The result is consistent and reproducible sample processing.

Expandable Operating System

Software updates and new features can be downloaded to the Sonicator through the USB port located on the back of the unit. Programs can be e-mailed to the end user and uploaded in minutes. This feature ensures the Sonicator 4000 will always be at the forefront of ultrasonic technology.

Touch Screen Control

A large, color LCD touch screen clearly displays all operating parameters and options.

Programmability

Parameters including processing times, pulse on/off and amplitude can be saved to memory and run by the touch of a button.

Amplitude Control

Output amplitude is controlled from 1-100% giving a greater degree of resolution and the ability to pinpoint the amplitude needed to effectively process your sample.

Run Multiple Programs in Sequence

Multiple programs can be run in sequence. For example, the unit can be programmed to sonicate at 50% amplitude for 5 minutes, shut off for 2 minutes and re-start at 25% amplitude for 10 minutes. Up to 5 programs can be run in succession.

Self Diagnostics

In the event that a problem is detected, the Sonicator will prompt the user that an error has occurred. Help screens offer step by step instructions to help solve the problem.

Total Energy Output Display

Energy delivered to the probe is displayed in both Watts and Joules.

Auto Tuning

The Sonicator digitally tracks frequency changes in the convertor / tip assembly caused by load and temperature changes and maintains electrical efficiency at all times. Manual tuning is unnecessary.

Overload Protection

The unit is equipped with fault detection circuitry to shut down sonication in the event that an error is detected.

Temperature Monitoring

An optional temperature probe is available for those customers who wish to monitor the temperature of their sample. If the temperature limit is reached, sonication shuts down to prevent overheating of the sample.

Pulse Mode

Adjustable pulse On and Off times can be programmed from 1 second to 24 hours.

RoHS Compliant

The new Sonicator is built lead free.

Specifications

Power Rating	600 Watts
Operating Frequency	20 kHz
Input	100 – 240V, 50 - 60Hz
Programmability	10 memories plus sequencing
Programmable Timer	1 second to 72 hours
Adjustable Pulse On/Off	1 second to 24 hours
Dimensions	11" wide x 20" long x 5.5" high
Shipping Weight	37 lbs.
Warranty	2 years

Ordering Information

Part # **S-4000** includes:

- Generator
- Convertor with cable
- ½" replaceable tip horn
- Power cable
- Wrench set
- Operation manual

Please specify desired voltage for export.

A Wide Variety of Options and Accessories

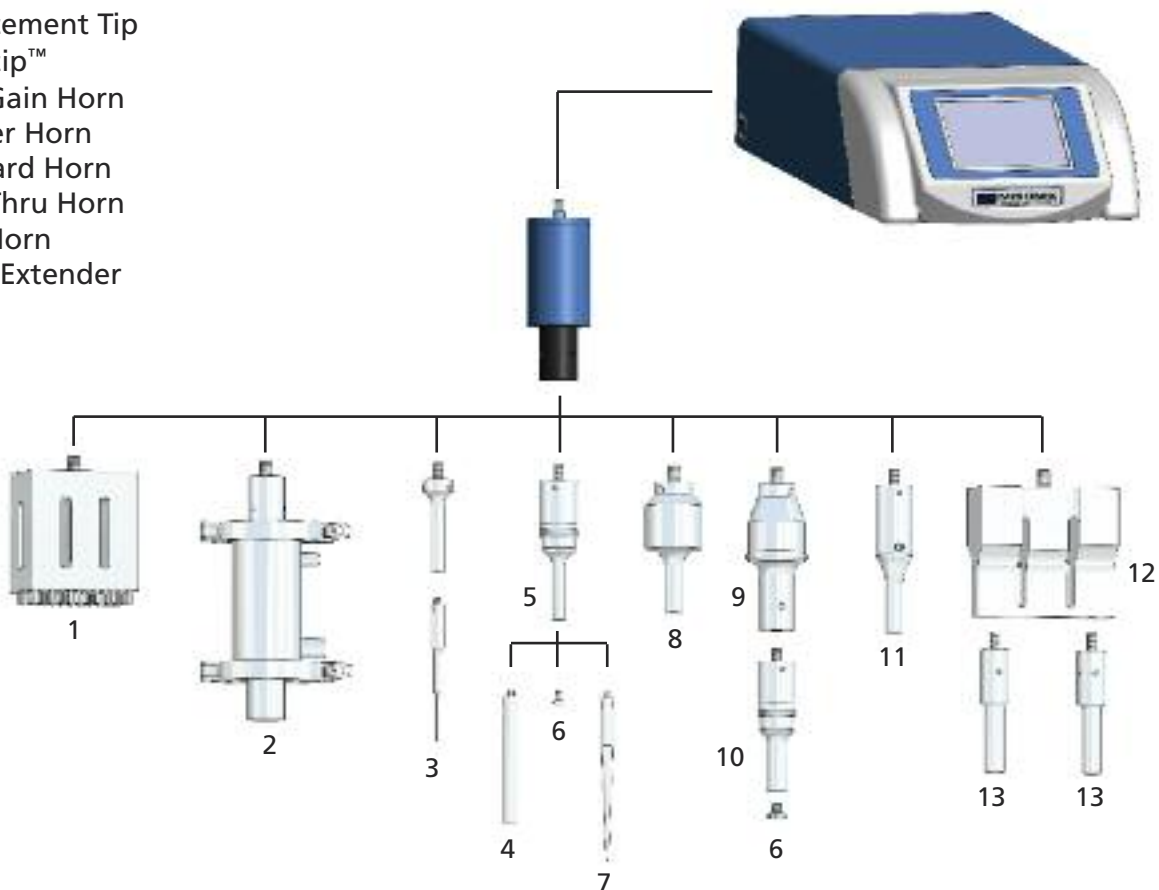
Direct Sonication Method

Horns transmit the ultrasonic energy into a solution. Direct sonication (inserting a horn directly into a vessel) is the most popular way to process a sample. This method offers high intensity and effectively processes most samples.

The diameter of the horn's tip dictates the liquid volume that can be effectively processed. Smaller tip diameters (Microtip™ probes) deliver high intensity sonication and the energy is focused within a small, concentrated area. Larger tip diameters can process larger volumes, but offer lower intensity. Boosters and High Gain horns can be used to increase the output of large diameter horns. Horns are offered with either replaceable or solid tips and are made from titanium.



1. 96 Probe Horn
2. Floccell
3. Stepped Microtip™
4. Extender
5. Standard Horn
6. Replacement Tip
7. Microtip™
8. High Gain Horn
9. Booster Horn
10. Standard Horn
11. Flow Thru Horn
12. Dual Horn
13. Probe Extender



ories to Meet Virtually Any Application

Indirect Sonication Method

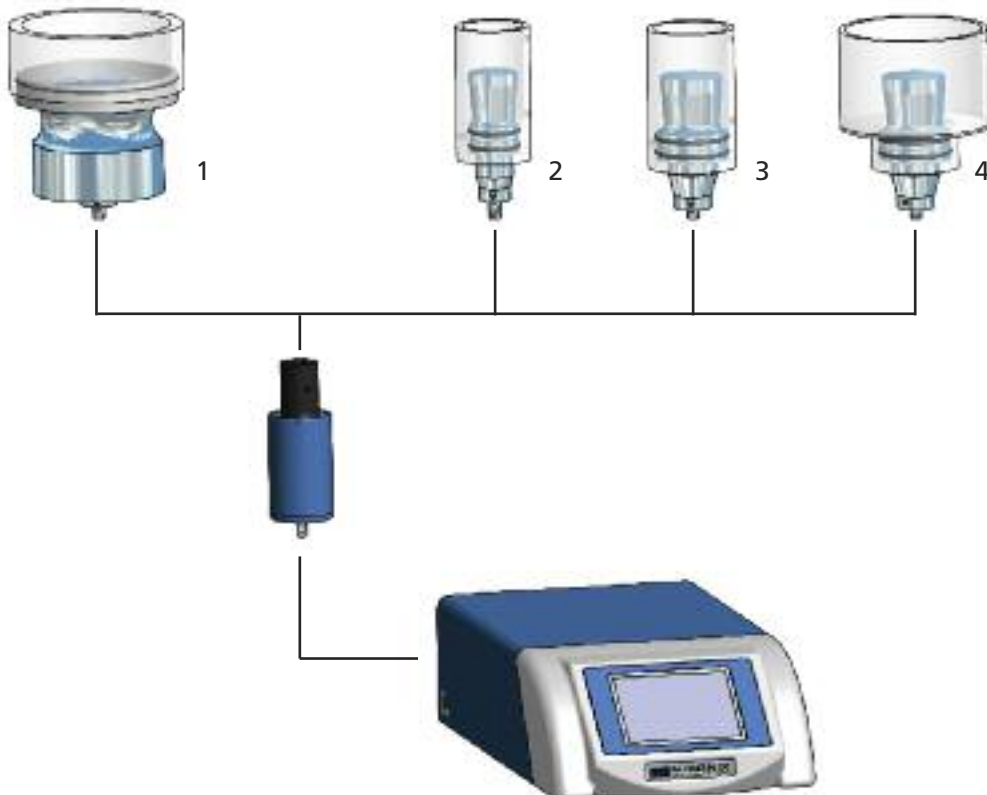
Indirect sonication eliminates the need for a probe to come in contact with your sample. This technique is often described as a high intensity ultrasonic bath, capable of processing multiple sample vessels at one time.

Indirect sonication is most effective for very small samples because foaming and sample loss are eliminated. Pathogenic or sterile samples are ideal for this method because aerosols and cross contamination are prevented.

The Cup Horn and Microplate Horn deliver indirect sonication. Simply place your microtubes or microtiter plate within the water filled reservoir and the sonic energy is transferred into each individual well or tube. These units are ideal for high throughput applications.



1. Microplate Horn
2. Cup Horn A
3. Cup Horn B
4. Cup Horn C



Direct Horn Options

Horns (also known as probes) are made from titanium and machined to specific sizes and shapes. When driven at their resonant frequency, they expand and contract longitudinally. This mechanical vibration is amplified and transmitted down the length of the probe. In liquid, the probe causes cavitation which constitutes the main mechanism for sample processing.

Choosing the appropriate horn is extremely important. The sample volume to be processed is directly related to the tip diameter. Smaller tip diameters (Microtip™ probes) deliver high intensity sonication, but the energy is focused within a small, concentrated area. Larger tip diameters can process larger volumes, but offer lower intensity. Probes are offered with replaceable, solid or sapphire tips.

Probe tips will pit or erode over time and require replacement. Using an excessively worn tip can affect your results and possibly overload the generator. Solid probes must be used for samples containing organic solvents or low surface tension liquids. Sapphire tips erode more slowly than titanium and are recommended for processing solutions that include abrasive materials.



Standard Probes

Part #	Type of Tip	Processing Volume	Tip Diameter	Intensity	Amplitude (microns)
200	Replaceable Tip	10-250 ml	1/2" (12.7 mm)	High	120 µm
201	Solid Tip	10-250 ml	1/2" (12.7 mm)	High	120 µm
201S	Sapphire Tip	10-250 ml	1/2" (12.7 mm)	High	120 µm
207	Replaceable Tip	25-500 ml	3/4" (19.1 mm)	Medium	60 µm
208	Solid Tip	25-500 ml	3/4" (19.1 mm)	Medium	60 µm
208S	Sapphire Tip	25-500 ml	3/4" (19.1 mm)	Medium	60 µm
209	Solid Tip	50-1,000 ml	1" (25.4 mm)	Low	30 µm
209S	Sapphire Tip	50-1,000 ml	1" (25.4 mm)	Low	30 µm
210	Replaceable Tip	50-1,000 ml	1" (25.4 mm)	Low	30 µm



Replacement Tips for Standard Probes

Standard 1/2", 3/4" and 1" horns have replaceable tips. During normal use, tips erode and become less effective over time. These worn tips can be easily removed and replaced.

Part #	Tip Diameter	For Use With
406	1/2" (12.7 mm)	#200
407	3/4" (19.1 mm)	#207
408	1" (25.4 mm)	#210



Microtip™ Probes

Microtips™ are very high amplitude tips specifically designed for small volume processing below 50ml. Microtips™ must only be used with #200 horn.

Part #	Processing Volume	Tip Diameter	Intensity	Amplitude (microns)
418	0.2-5 ml	1/16" (1.6 mm)	Ultra High	320 µm
419	0.5-15 ml	1/8" (3.2 mm)	Ultra High	240 µm
419A	2-25 ml	3/16" (4.8 mm)	Very High	150 µm
419B	5-50 ml	1/4" (6.4 mm)	High	115 µm
420*	0.5-15 ml	1/8" (3.2 mm)	Very High	205 µm



*The special stepped Microtip™ (#420) consists of two parts and screws directly into the converter.

Extenders

Standard probes may not be long enough to fit down into certain long necked vessels. Extender probes attach to standard horns of the same tip diameter and extend the length of the horn assembly. Extenders are available in 5" and 10" lengths with either solid, replaceable or sapphire tips.

Part #	Type of Tip	Length	Tip Diameter
406HW	Solid Tip	5"	1/2" (12.7 mm)
406HWT	Replaceable Tip	5"	1/2" (12.7 mm)
406HWS	Sapphire Tip	5"	1/2" (12.7 mm)
407HW	Solid Tip	5"	3/4" (19.1 mm)
407HWT	Replaceable Tip	5"	3/4" (19.1 mm)
407HWS	Sapphire Tip	5"	3/4" (19.1 mm)
408HW	Solid Tip	5"	1" (25.4 mm)
408HWT	Replaceable Tip	5"	1" (25.4 mm)
406FW	Solid Tip	10"	1/2" (12.7 mm)
406FWT	Replaceable Tip	10"	1/2" (12.7 mm)
407FW	Solid Tip	10"	3/4" (19.1 mm)
407FWT	Replaceable Tip	10"	3/4" (19.1 mm)
408FW	Solid Tip	10"	1" (25.4 mm)
408FWT	Replaceable Tip	10"	1" (25.4 mm)

Extenders offer the same processing volume and amplitude of their corresponding standard horn.



Note: Extender length may vary slightly due to variations in titanium.

Boosters

Booster horns increase the intensity of standard 3/4" and 1" horns. Boosters attach between the converter and horn to increase amplitude by the gain ratio indicated below. A 3 to 1 gain booster is available for custom applications.

Part #	For Use With	Gain Ratio
328A	3/4" and 1" probes	2 to 1
328B	3/4" and 1" probes	2.5 to 1



High Gain Horns

High gain horns (also known as high intensity horns) offer double the amplitude of standard $\frac{3}{4}$ " and 1" horns. High gain horns attach directly to the converter.



Part #	Type of Tip	Processing Volume	Tip Diameter	Intensity	Amplitude (microns)
305	Replaceable Tip	25-500 ml	$\frac{3}{4}$ " (19.1 mm)	High	120 μ m
306	Solid Tip	25-500 ml	$\frac{3}{4}$ " (19.1 mm)	High	120 μ m
310	Solid Tip	50-1,000 ml	1" (25.4 mm)	Medium	60 μ m
311	Replaceable Tip	50-1,000 m	1" (25.4 mm)	Medium	60 μ m

Dual Horn

The Dual Horn allows a single Sonicator and converter to process two samples simultaneously. The rectangular shaped horn doubles the unit's output, and enables two, $\frac{3}{4}$ " probes to vibrate with the same intensity as a single $\frac{3}{4}$ " probe.

The Dual Horn is capable of withstanding the rigors and harsh chemicals of environmental testing labs. Sonication is used by environmental labs to process soil and sediment samples in lieu of soxhlet extraction methods. The Sonicator and Dual Horn meet the EPA requirements specified in Method SW846-3550.

The Dual Horn requires two #355 probes. It is recommended to purchase replacement probes in pairs. This guarantees the probes are properly matched and will perform with maximum efficiency.



Part #	Description
351	Dual Horn
355	$\frac{3}{4}$ " Solid Probe
438	Converter Stand and Positioner



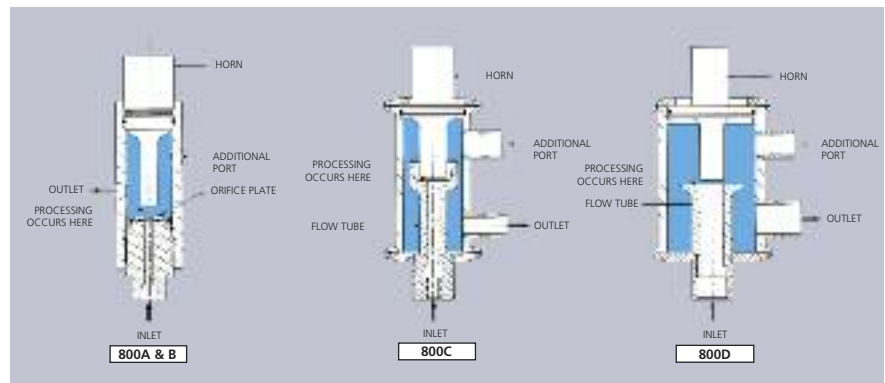
Flocells

Flocells offer inline or continuous processing of large sample volumes. Flocells are ideal for mixing and dispersing applications and can accommodate flow rates up to 40 liters per minute.

The liquid sample is pumped into the Flocell through the inlet at the bottom of the unit. As the sample passes through the cavitation field, it is processed. The processed liquid exits the unit through an outlet port. The sample can be recirculated multiple times if necessary. The degree of processing may be controlled by adjusting both the amplitude setting and the flow rate.



Each size is available in stainless steel and #800A is made of polycarbonate. The polycarbonate unit allows the user to view the liquid level inside the Flocell. A Flocell with sanitary connections for sterile processing is also available. Pump systems are not included.



Ordering Information

800A and **800B** are supplied with casing, $\frac{3}{32}$ " and $\frac{1}{8}$ " orifice plates. A $\frac{1}{2}$ " horn must be ordered separately.

Replacement Orifice Plates

Part

- 842** $\frac{3}{32}$ " Orifice plate
- 843** $\frac{1}{8}$ " Orifice plate
- 840** Blank orifice plate with pilot hole (extremely low flow rates)

800C is supplied as Flocell casing only. Horn and matching flow tube must be specified and ordered separately.

Part

- 820CT** $\frac{1}{2}$ " Tapped processing horn
- 820C** $\frac{1}{2}$ " Solid processing horn
- 821CT** $\frac{3}{4}$ " Tapped processing horn
- 821C** $\frac{3}{4}$ " Solid processing horn
- 822CT** 1" Tapped processing horn
- 822C** 1" Solid processing horn

845 Flow tube for use with 820CT, 820C, 821CT or 821C

846 Flow tube for use with 822CT or 822C

800D is supplied as Flocell casing with flow tube. The horn must be specified and ordered separately.

Part

- 822DT** 1" Tapped horn
- 822D** 1" Solid horn

Replacement Flow Tube

Part

- 847** Flow tube

Part #	800A	800B	800C	800D
Maximum Flow Rating	0.67 lpm	0.67 lpm	20 lpm	40 lpm
Static Pressure Rating	50 psi (350 kPa)	100 psi (700 kPa)	100 psi (700 kPa)	100 psi (700 kPa)
Inlet/Outlet Size	$\frac{1}{4}$ " NPT	$\frac{1}{4}$ " NPT	$\frac{1}{2}$ " NPT	1" NPT
Material of Tube Body	Polycarbonate	Stainless Steel	Stainless Steel	Stainless Steel

96 Probe Horn

Process an entire 96-well microtiter plate by direct probe sonication. Our one-piece design ensures uniform intensity across all 96 tips. The stand ensures that all 96 tips are properly aligned with each sample.

Part # **96P** (Horn and Stand)

Part # **96H** (Horn only)



Flow Thru Horn

The Flow Thru horn has inlet ports on either side and a 1/8" outlet at the tip. This enables one or more solutions to be pumped into the horn for mixing or atomizing applications. The horn may also be used as a continuous flow device to process large sample volumes.

Part # **434**



Sound Enclosure

Sonication produces high pitch noise that can cause discomfort to the user and anyone nearby. The Sound Enclosure reduces noise by approximately 20 dBA. The internal support collar is made to safely hold the converter and probe assembly. A 1/2" diameter steel rod is mounted inside the enclosure. The interior is water resistant for easy cleaning and the door is clear for observation of experiments. Exterior dimensions are 14.5" wide x 23" high x 12" deep.

Part # **432B**

Jack Stand

A Jack Stand is also available to move samples to a stationary probe mounted within the enclosure.

Part # **357**



Indirect Horn Options

Cup Horns

Cup horns offer indirect sonication and function as high intensity ultrasonic water baths. Multiple samples can be processed in sealed tubes or vials eliminating aerosols and cross contamination. This method is ideal for sterile or pathogenic sample processing.

Applications include ChIP Assay, cell disruption, liposome and protein preparation. Cup Horns offer less intensity than direct probe sonication but are capable of processing most standard sonicator applications.

The horn is held within an acrylic cup filled with water. Samples are placed within the cup, above the horn. Cavitation is produced in the water, processing the samples within the tubes or vials. Coolant ports are on each side of the cup for circulation of cold water to keep samples from overheating. A microtube holder is included with each Cup Horn.

#431A and #431B are very similar in size. The B model allows for more water to circulate around temperature sensitive samples. #431C enables the user to sonicate twenty 1.5ml tubes or several large vessels at one time.



431A



431B



431C

Part #	431A	431B	431C
Inner Diameter of Cup	2.5" (6.4cm)	3" (7.6cm)	5.5" (14.0cm)
Diameter of Horn	2" (5.1cm)	2.5" (5.1cm)	2.5" (6.4cm)
Replacement Microtube Holder	#441	#442	#443
Tube Capacity	8	8	20



The Sound Enclosure (#432B) is highly recommended for all Cup Horn users. In addition to reducing sonication noise to safe levels, it securely supports the Cup Horn in the proper position. The Sound Enclosure features ports on either side to allow coolant tubing to pass from the Cup Horn to a water source or pump system outside the box.

Microplate Horns

The Microplate Horn is a large, 6" diameter horn capable of processing a variety of sample sizes. An entire microtiter plate or several microtubes can be sonicated at one time.

A liquid media, such as water or glycol, is used to transmit the ultrasonic energy from the horn's surface to the sample. A rack of tubes or a standard 96-well microplate can be easily processed. Simply place your samples within the water filled reservoir and the sonic energy is transferred into each individual well or tube. This unit is ideal for high throughput applications.



The Horn is equipped with a clear acrylic collar to contain the liquid media within the reservoir. This allows the user to process deep well microplates or other tall vessels. Standard microtiter plates or PCR tubes require a smaller volume of liquid for sonication. For these applications, the clear acrylic collar may be removed and the lower, gray collar will allow for easier access to the samples.

Protein Misfolding Cyclic Amplification Assay (PMCA)

The Microplate Horn is used in PMCA research. A tube holder and cover (#444) are available for proper sample positioning. Please specify if you intend to use the unit for PMCA when contacting Misonix.

Part #	Description
S-4000MPX	Sonicator / Microplate Horn Package
431MPX	Microplate Horn and Sound Enclosure only
431MPXH	Microplate Horn only
432MP	Sound Enclosure for Microplate Horn
444	PMCA adapter



431MPXH

Ordering Information

Part # **S-4000MPX** includes the generator, converter, cables, wrench set and # 431MPX.

Part # **431MPX** includes:

- Microplate Horn
- Sound Enclosure
- Pinch Clamps
- Silicone Tubing

Exterior dimensions of the Sound Enclosure are 10" wide x 10" deep x 17" high.



Converter Clamp

This reinforced plastic clamp will hold the converter on a ½" diameter support rod. The stand and rod are sold separately.

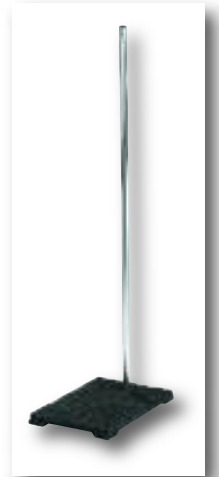
Part # **457**



Support Stand

The cast iron base is 6" x 9". The steel rod is ½" diameter and 24" long.

Part # **458**



Footswitch

Use the footswitch for hands free operation.

Part # **FS-3**



Temperature Monitoring

Two types of temperature probes are available for use with the #S-4000.

Part # **TP-4000A** 6" Temperature probe (rigid)



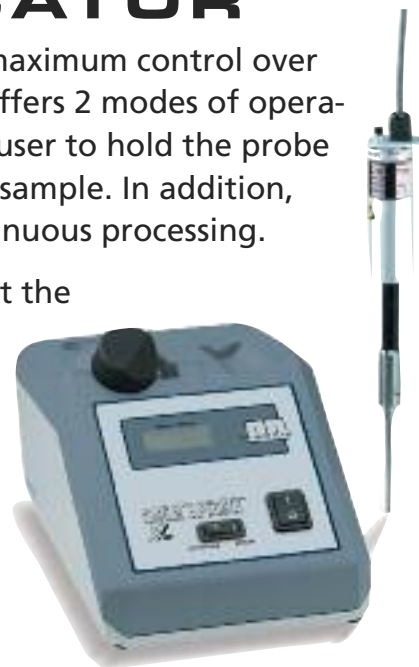
Part # **TP-4000B** Thermocouple (flexible)



SMALL VOLUME SONICATOR

The **XL-2000** Sonicator was designed specifically to give the user maximum control over the sonication process. This model is ideal for small samples and offers 2 modes of operation. The unit is equipped with a thumb switch, which allows the user to hold the probe and deliver precise pulses of energy, while closely monitoring the sample. In addition, the probe can be mounted in a stand or sound enclosure for continuous processing.

The improved load monitoring and frequency tracking ensure that the probe operates more efficiently to deliver consistent sonication intensity at any given amplitude setting. The user experiences shorter processing times and greater sample-to-sample consistency. A variety of microprobes are available to effectively process samples from 0.2ml – 100ml (see table below). The Cup Horn delivers indirect sonication and will gently process small samples inside sealed vials or tubes.



Features

- Compact design
- Thumb pulse switch
- Auto tuning

Ordering Information

Part # **XL-2000** includes:

- Generator
- Converter with cable
- Microprobe (#P-1)
- Power cable
- Wrench set
- Operation manual

Please specify desired voltage for export.

Part # **432A** (Sound Reducing Enclosure) is sold separately.

Specifications

Power Rating	100 Watts
Operating Frequency	22.5 kHz
Input	115/230 VAC, 3/1.5A, 50/ 60Hz
Dimensions	7.5" wide x 13" long x 7" high



**Micro Cup Horn
Accessory**

Part # 431 M

Cup (inner diameter)
1 1/2" (38mm)

Probe Diameter
9/10" (6.4mm)

Microprobe Options

Part #	P-1	P-2*	P-3	P4**
Processing Volume†	0.5-15 ml	2-25 ml	0.2-5 ml	5-50 ml
Tip Diameter	1/8" (3.2 mm)	3/16" (4.8 mm)	3/32" (2.4 mm)	1/4" (6.4 mm)
Intensity	Very High	High	Very High	Medium
Amplitude (at 100% output)	180 µm	80 µm	210 µm	60 µm

†Processing volume can double with the use of a magnetic stir bar. *Requires #404C wrench. **Requires #403 wrench.

MISONIX SONICATORS

Ultrasonic Liquid Processing Equipment

For over 40 years, Misonix Sonicators have been at the forefront of ultrasonic liquid processing. The new Sonicator 4000 is the most technologically advanced and only true digital system available. Digital signal processing enables exclusive new features and greater control of frequency and amplitude. The result is greater accuracy, consistency and reproducibility.

How it works

A Sonicator system is comprised of 3 major components: Generator, Converter and Horn.

The **Generator (A)** provides high voltage pulses of energy at 20Khz and adjusts for varying sample load conditions, such as viscosity and temperature. The digital processor senses changes of impedance and increases or decreases power automatically.

The **Converter (B)** transforms electrical energy to mechanical energy. The electrical signal is converted to a mechanical vibration due to the characteristics of the internal piezoelectric crystals.

The vibration is amplified and transmitted down the length of the **Horn (C)**, where the tip longitudinally expands and contracts. The distance the tip travels is dependent on the amplitude selected by the user. As the amplitude is increased, the sonication intensity will increase.



In liquid, the rapid vibration of the tip causes cavitation (the formation and violent collapse of microscopic bubbles). The collapse of thousands of bubbles releases tremendous amounts of energy in the cavitation field. The erosion and shock effect of the collapsing cavitation bubble is the primary mechanism of liquid processing.

The probe tip diameter is related to the sample volume that can be effectively processed. Smaller tip diameters (Microtip™ probes) deliver high intensity sonication but the energy is focused within a small, concentrated area. Larger tip diameters can process larger volumes, but offer lower intensity.

Choosing the proper horn for a specific application is a critical detail that must not be overlooked. Using the wrong size horn can significantly extend sonication time or prevent samples from being effectively processed.

Misonix Sonicators are highly effective for many applications including:

- Cell disruption
- Nanoparticle dispersion
- Homogenization
- Shearing DNA
- Disaggregation
- Focused cleaning
- Mixing
- Degassing
- Sonochemistry



Power vs. Intensity

Customers often ask for an explanation of the wattage measurement and how to deliver a certain amount of energy to a sample. First, we must discuss the relationship between wattage and amplitude. Wattage is a measurement of how much energy/unit time is being delivered to the horn. Amplitude (measured in microns) is a measurement of the movement of the tip. The amplitude is controlled by the user on the touch-screen display.

A horn in air has virtually no resistance and requires a very small amount of power to vibrate. A horn in a viscous solution such as oil, requires a greater amount of power to maintain the same amplitude setting. The resistance to the movement of the horn will determine how much power (wattage) needs to be delivered in order to maintain the amplitude setting. For example, a Sonicator with a standard ½" horn is set at 50% amplitude and is immersed in water. The screen may display approximately 30 watts. The water is removed and replaced with oil. The higher viscosity of oil requires more wattage to maintain amplitude. The amplitude remains the same but the energy needed to maintain the amplitude could increase to approximately 100 watts.

The power/wattage relationship can be compared to cruise control in a car. If cruise control is set at 50 mph, the speed (amplitude) is maintained regardless of the terrain. As the car proceeds up a hill, more power is needed to maintain a constant speed. As a Sonicator experiences more resistance (a more viscous solution) the unit automatically increases the wattage delivered, to maintain the current amplitude setting.

The Sonicator Advantage

The powerful, 600-watt generator in combination with a wide variety of horn options, has the ability of handling virtually any sample volume, and can adjust to varying viscosities. Please feel free to contact an application specialist for personal assistance.

MISONIX SONICATORS

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An abstract graphic consisting of several overlapping, flowing, and wavy lines in shades of blue and white, creating a sense of motion and depth. The lines originate from the right side and flow towards the left, with some lines crossing each other. The background is a dark, deep blue.