Sonicator

ULTRASONIC PROCESSOR

Part No. Q700

OPERATION MANUAL

Qsonica, LLC.
53 Church Hill Rd.
Newtown, CT 06470 USA
Phone: 203.426.0101
Fax: 203.426.7026
info@sonicator.com
www.sonicator.com

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1. Warranty

Your Ultrasonic Processor is warranted and backed by the manufacturer for a period of two years from the date of shipment against defects in material and workmanship under normal use as described in this instruction manual. During the warranty period, the manufacturer will, at its option, as the exclusive remedy, either repair or replace without charge for material and labor, the part(s) which prove to be defective, provided the unit is returned to us properly packed with all transportation charges prepaid.

Ultrasonic probes are guaranteed against defects for a period of one year from date of shipment. A defective probe will be replaced once without charge, if failure occurs within the warranty period. Wear resulting from cavitation erosion is a normal consequence of ultrasonic processing, and is not covered by this warranty.

The manufacturer neither assumes nor authorizes any person to assume for it any other obligations or liability in connection with the sale of its products. The manufacturer hereby disclaims any warranty of either merchantability or fitness for a particular purpose. No person or company is authorized to change, modify, or amend the terms of this warranty in any manner or fashion whatsoever. Under no circumstances shall the manufacturer be liable to the purchaser or any other person for any incidental or consequential damages or loss of goodwill, production, or profit resulting from any malfunction or failure of its product.

This warranty does not apply to equipment that has been subject to unauthorized repair, misuse, abuse, negligence or accident. Equipment which, shows evidence of having been used in violation of operating instructions, or which has had the serial number altered or removed, will be ineligible for service under this warranty.

All probes are manufactured to exacting specifications and are tuned to vibrate at a specific frequency. Using an out-of-tune probe will cause damage to the equipment and may result in warranty nullification. The manufacturer assumes no responsibility for probes fabricated by another party or for consequential damages resulting from their usage.

The aforementioned provisions do not extend the original warranty period of any product that has either been repaired or replaced by the manufacturer.

2. Warnings

Please read the manual in its entirety. Necessary instruction and guidance are provided to help ensure the successful operation of this device.

Your new Ultrasonic Liquid Processor has been designed, built and tested to assure maximum operator safety. However, no design can completely protect against improper use that may lead to bodily injury and/or property damage. For total safety and equipment protection, read the instruction manual carefully before attempting to operate this equipment. Observe the following **WARNINGS**:

- High voltage is present in the generator (power supply), converter and high frequency cable. There are no user-serviceable parts inside any of these devices. Do NOT attempt to remove the generator cover or converter case.
- Do NOT touch any open cable connections on the unit while the power is turned ON.
- Do NOT operate generator with converter disconnected from high voltage cable. High voltage is present in the cable and may pose a shock hazard.
- Do NOT attempt to disconnect the converter high voltage cable while the unit is running.
- The generator must be properly grounded with a 3-prong plug. Test electrical outlet for proper grounding before plugging in unit.
- Install the ultrasonic processor in an area free from excessive dust, dirt, explosive or corrosive fumes and protected from extremes in temperature and humidity. Do not place the Generator within a Fume Hood.
- Hearing protection is highly recommended. It is recommended that a sound abating enclosure or ear protection be used when operating the Ultrasonic Processor
- NEVER immerse the converter in liquids of any kind, or let condensed moisture or liquid drip into the converter.
- NEVER grasp an activated horn or probe. It can cause severe burns and tissue damage.
- NEVER allow a probe to vibrate in air.
- NEVER hold or clamp the converter by the front driver or by the horn itself. This can cause permanent damage to the system. Support the converter by only clamping around the converter housing (upper portion).
- If needed air cool the convertor with dry compressed air.
- Do NOT allow the tip of a vibrating horn or probe to touch the counter top or any other hard surface. It could damage the probe, overload the generator, or damage the surface.
- Avoid touching the bottom or sides of a glass or plastic container with an activated probe. It could crack or shatter the glass or melt the plastic.
- Turn OFF the power switch, unplug the generator and disconnect the power cord from the back of the generator before attempting to replace the fuses.
- Inspect high frequency cable for cracks in the protective outer jacket.
- Do not operate unit with a damaged cable. Doing so may cause serious injury.
- In case of AC power loss, wait 3 minutes minimum before reapplying power.
- Do not turn off AC mains power while running a horn. Stop sonication via touch screen prior to stopping power.

Symbols

Caution, Risk of electric shock, Hazardous voltage

Caution, Risk of danger. Refer to User Manual.

3. Specifications

Generator		
Input Voltage	100 VAC – 120 VAC @ 50/60 Hz	220 VAC – 240 VAC @ 50/60 Hz
Rated Current	12 Amps max.	6 Amps max.
Fuse Rating	15 Amps*	8 Amps*
Weight	16 lbs. (7.3 Kg)	
Dimensions	8"W x 15.25"L x 8.5"H 203 mm x 387 mm x 216 mm	
Output Voltage	1000 V rms (max.)	
Output Frequency	20 KHz	

Converter	
Weight	2 lbs. (900 g)
Dimensions	7.25" L x 2.5" Dia. (183 mm x 63.5 mm)
Materials	Aluminum Alloy

Standard ½ ” Horn	
Weight	0.75 lbs. (340 g)
Dimensions	5.375" L x .5" Dia. (136 mm x 13 mm)
Materials	Titanium Alloy

Environmental	
Pollution Degree	2
Installation Category	II
Operating Limits	Temperature: 41 - 104ºF (5 - 40ºC) Relative Humidity 10 - 95% (Non Condensing) Altitude: 6,651 ft. (2000 m)
Shipping/Storage	Temperature: 35 -120 °F (2 - 49 °C) Relative Humidity 10 - 95% (Non Condensing) Ambient Pressure Extremes: 40,000 ft. (12,192 m)
Restriction of Hazardous Substances (ROHS)	RoHS Compliant Directive 2002/95/EC
Relative humidity	Maximum relative humidity 80% for temperatures up to 31ºC decreasing linearly to 50% relative humidity to 40ºC
Other	For indoor use only

*Only use IEC approved Fast acting fuses, Cooper Bussman series S500.

The Power Cord supplied with the ultrasonic processor must be used. If the 220V plug is not configured to match the wall receptacle, a properly grounded universal AC socket adapter must be added.

Important: Universal adapters do not convert voltage or frequency. The manufacturer is not responsible for damage caused by the use of an improper power cord or adapter. Transformers are not recommended.

WEEE Statement

This product contains electrical or electronic materials. The presence of these materials may, if not disposed of properly, have potential adverse effects on the environment and human health. Presence of this label on the product means it should not be disposed of as unsorted waste and must be collected separately. As a consumer, you are responsible for ensuring that this product is disposed of properly. To find out how to properly dispose of this product contact Customer Service.

4. Principles of Operation

The ultrasonic electronic generator transforms AC line power to a 20 KHz signal that drives a piezoelectric converter/transducer. This electrical signal is converted by the transducer 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/probe where the tip longitudinally expands and contracts. The distance the tip travels is dependent on the amplitude selected by the user through the touch screen pad. As you increase the amplitude setting the sonication intensity will increase within your sample.

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

The probe tip diameter dictates the amount of sample 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.

The choices of a generator and horns/probes are matched to the volume, viscosity and other parameters of the particular application. Horns are available for both direct and indirect sonication. The Accessories section has more information on this subject.

Please consult with a product specialist for assistance with selecting a probe for your application.

Relationship of Amplitude and Wattage

Sonication power is measured in watts. Amplitude is a measurement of the excursion of the tip of the probe (probe is also known as a horn).

Some ultrasonic processors have a wattage display. During operation, the wattage displayed is the energy required to drive the radiating face of a probe, at that specific amplitude setting against a specific load, at that particular moment. For example, the unit experiences a higher load when processing viscous samples then when compared to aqueous samples.

The speed /cruise control on an automobile, can, to a certain extent, be compared to an Ultrasonic Processor. The speed/cruise control is designed to ensure that the vehicle maintains a constant rate of travel. As the terrain elevations change, so do the power requirements. The cruise control senses these requirements, and automatically adjusts the amount of power delivered by the engine in order to compensate for these ever changing conditions. The greater the terrain rate of incline and greater the resistance to the movement of the vehicle, the greater the amount of power that will be delivered by the engine to overcome that resistance and maintain a constant speed.

The ultrasonic processor was designed to deliver constant amplitude, to your liquid sample, regardless of these changes in load (much like the vehicle's cruise control described above). As a liquid is processed, the load on the probe will vary due to changes in the liquid sample (i.e. viscosity, concentration, temperature, etc.). As the resistance to the movement of the probe increases (increased load on the probe), additional power will be delivered by the power supply to ensure that the excursion at the probe tip remains constant. The displayed wattage readings will vary as the load changes, however the amplitude will remain the same.

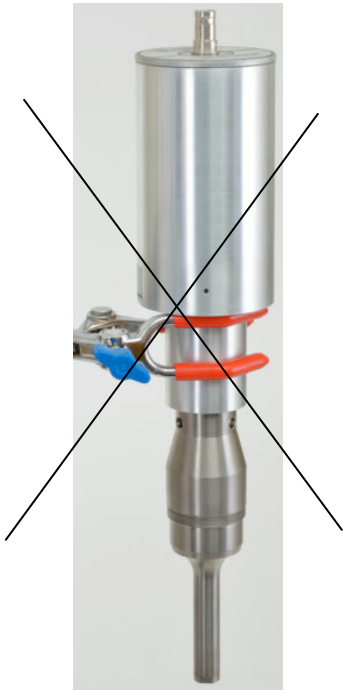
The resistance to the movement of the probe determines how much power will be delivered to maintain amplitude. For example, a ½" probe at 100% amplitude will require approximately 5 watts to operate in air. The amplitude of this probe is approximately 120um. Insert the probe in water and the wattage reading will increase to approximately 90 watts. The wattage required to operate the probe will increase as the load increases but the amplitude remains the same.

The AMPLITUDE control allows the ultrasonic vibrations at the probe tip to be set to any desired level. Although the degree of cavitation/ultrasonic energy required to process the sample can readily be determined by visual observation, the amount of power required cannot be predetermined. A sensing network continuously monitors the output requirements, and automatically adjusts the power to maintain the amplitude at the preselected level. The greater the resistance to the movement of the probe due to higher viscosity, deeper immersion of the probe into the sample, larger probe diameter or higher pressure, the greater the amount of power that will be delivered to the probe. Setting the AMPLITUDE control to its maximum will not cause the maximum power rating of the unit to be delivered to the sample. The maximum power (700 watts) that the Ultrasonic Processor is capable of delivering will only be delivered when the resistance to the movement of the probe is high enough to draw maximum wattage.

It is the intensity of cavitation that measures the effectiveness of the sonication, not the total power applied to the system. Intensity is directly related to the amplitude of the radiating face of the tip or horn. It is amplitude that must be provided, maintained, and monitored. The unit provides controlled amplitude under varying load conditions in order to give reproducible results.

Note: Improper clamping can damage the system and void the warranty.

Correct way to clamp



Not correct

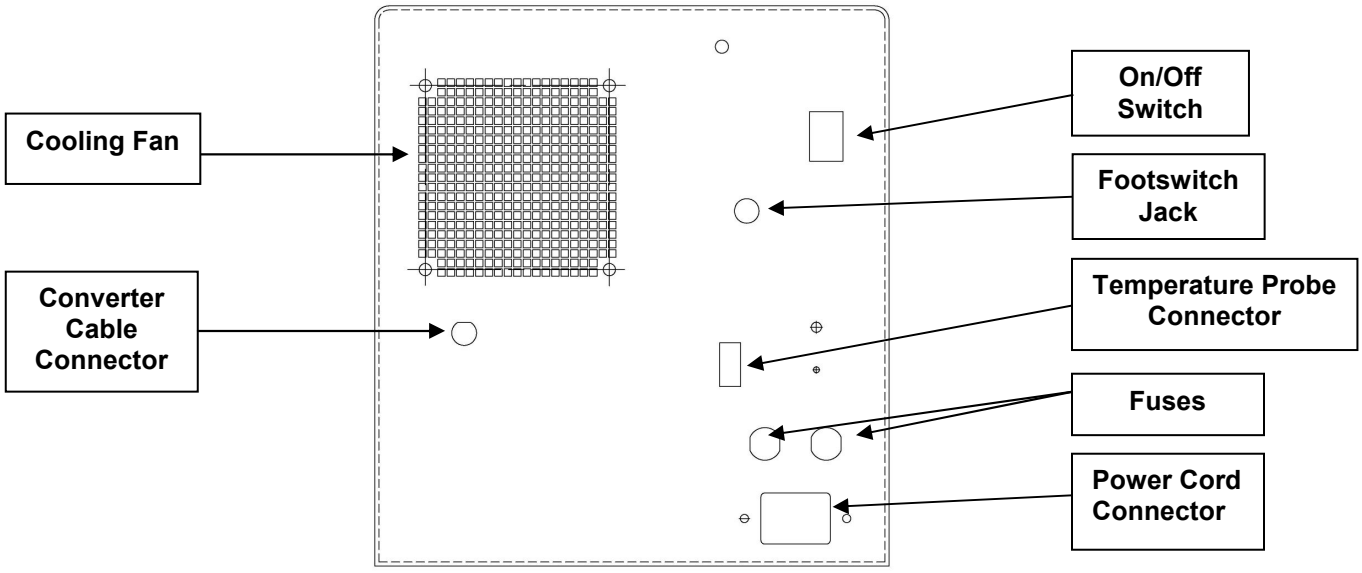
Note: Using a Qsonica sound enclosure or stand will ensure a proper fit.

5. Description of Components / Functions of Controls

The Model # Q700 includes a standard 1/2" diameter probe (#4220).

5a. Q700 Front Panel

5b. Q700 Rear Panel



FUNCTIONS OF KEYS, CONTROLS, INDICATORS, AND CONNECTORS

FRONT PANEL	
Touch screen display	Displays prompts and control parameters including: • Amplitude selected • Output power delivered to the probe in watts • Selected duration of processing • Actual processing time • Elapsed time • Set and read temperature • Pulse on/off duration • Accumulated amount of energy in Joules delivered to the probe
0 – 9 key	Input digits for programming screens
EXIT key	Moves to previous screen
ENT key	Completes parameter entry on programming screens
CLR key	Deletes selected parameter entry
RUN key	To proceed to program run screen
SAVE key	Stores a program to the selected memory number. Up to 10 programs (0-9) can be stored.
START/STOP key	Starts or stops the ultrasonics.
PAUSE key	Suspends operation, without clearing program/run totals. Press pause again to resume program/run and continue accumulating run data.
▲ ▼ key	Used to set the amplitude of vibration at the probe tip. Also used to increase or decrease the amplitude in small increments while the unit is runnng.

For explanations of each screen and button on the ultrasonic processor and complete programming instructions please see Section 7 of this manual.

REAR PANEL	
On / Off Switch	Turns the power supply on and off.
Footswitch Connector	Connects to the footswitch cable.
Temperature Probe Connector	Connects to the Temperature monitoring probe or thermocouple
Converter Cable Connector (Output)	Connects to the converter.
Power Supply Connector	Connects to the electrical line cord and encases the fuse(s).

6. Preparation for Use

INSPECTION

Prior to installing the ultrasonic processor, perform a visual inspection to detect any evidence of damage, which might have occurred during shipment. Before disposing of any packaging material, check it carefully for small items.

The ultrasonic processor was carefully packed and thoroughly inspected before leaving our factory. The carrier, upon acceptance of the shipment, assumed responsibility for its safe delivery. Claims for loss or damage sustained in transit must be submitted to the carrier.

If damage has occurred, contact your carrier within 48 hours of the delivery date. DO NOT OPERATE DAMAGED EQUIPMENT. Retain all packing materials for future shipment.

ELECTRICAL REQUIREMENTS

The ultrasonic processor requires a fused, single phase 3-terminal grounding type electrical outlet. For power requirements, check the label on the back of the unit.

WARNING

For your personal safety, do not, under any circumstances, defeat the grounding feature of the power cord by removing the grounding prong.

INSTALLING THE ULTRASONIC PROCESSOR

The ultrasonic processor should be installed in an area that is free from excessive dust, dirt, explosive and corrosive fumes, and extremes of temperature and humidity. If processing flammable liquids, use an approved fume hood and do not place the power supply in the fume hood.

When positioning the unit, be sure to leave adequate space behind the unit so that all connections can be easily disconnected.

7. Operating Instructions (Getting Started)

CAUTION

- Do not operate the power supply unless it is connected to the converter.
- Never allow liquid to spill into the converter.
- Do not allow a Microtip to vibrate in air.
- Do not allow the vibrating Microtip to contact anything but the sample.
- Never place a washer between the converter, probe or horn.
- Never apply grease to the mating surfaces or threads of the converter, probe or Microtip.
- Should it become necessary to remove a probe, use the wrenches supplied. Never attempt to remove the probe by twisting the converter housing or holding it in a vice, as this may damage the electrical connections within the housing.

Note: *Overheating will damage the converter. See addendum for converter cooling instructions.*

Note: *Standard probes/horns can operate at a maximum temperature of* ***140^0F****. Customized probes/horns can be made for higher temperatures.*

CAUTION

LOW SURFACE TENSION LIQUIDS – ORGANIC SOLVENTS

The probes (solid or with a replaceable tip) are tuned elements that resonate at a specific frequency. If the replaceable tip is removed or isolated from the rest of the probe, the element will no longer resonate at that frequency, and the power supply will fail. Unlike aqueous (water based) solutions which rarely cause problems, solvents and low surface tension liquids are problematic. These liquids penetrate the probe/replaceable tip interface, and force the particulates into the threaded section isolating the tip from the probe. ***When processing low surface tension liquids, ALWAYS use a solid probe.***

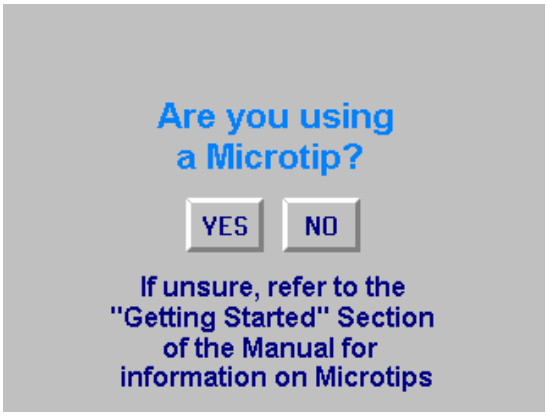
1. Connect the power cord into the receptacle on the rear of the ultrasonic processor.
2. Make sure the unit is switched off. Plug the electrical line cord into the electrical outlet.
3. If the optional foot switch is used, insert the plug into the jack located on the rear panel.
4. Important set up tips are discussed in the Addendum
5. **For best results it is critical to use the appropriate size and type of accessory to process your sample**. If you are not sure that you have the proper horn for your sample volume please refer to the product brochure or call for assistance.
6. **Horns/Probes must be properly tightened.** Depending on the accessories purchased, often the horn and the flat tip are attached to the converter at the factory. **Check the tightness of the horn and flat tip by using the wrench set**. Please refer to images in the Maintenance section of this manual. A loose horn or tip may cause damage to the generator circuitry or parts of the converter and horn. A loose horn may also show a fluctuation in wattage readings. **Always use the wrenches supplied with the unit.**
7. If you will be using a Microtip or extender, remove the flat tip on the end of the replaceable tip probe, then attached the Microtip or extender in its place.
8. ***Microtips must be used in pulse mode to prevent overheating*** - which could potentially crack the tip. Contact us with questions.
9. Horns and probe tips wear after normal usage. Using a severely worn probe tip can damage internal generator components.

10. If using a laboratory stand, mount the convertor /probe assembly using a clamp. Be sure to secure the clamp to the upper section of the convertor housing only. Never secure the clamp to any other portion of the convertor/probe assembly. If you are using an acoustic enclosure mount the convertor properly in the convertor collar.
11. Connect the converter cable to the power supply and then to the top of the convertor. Push the connectors in and turn the chrome rings clockwise ¼ turn to secure the connectors.
12. If the application requires long processing times we recommended chilling the sample and pulsing sonication. If processing for over 20 minutes the converter may get warm and require cooling with dry, compressed air. ***See converter cooling instructions in the Addendum.***

Operation:

Your new ultrasonic processor has been designed with a color LCD user interface with touch screen capabilities. All program and run functions are controlled through the touch screen panel.

This is the first screen that appears after Ultrasonic processor is switched On.



1. Answer the Microtip Question - Yes or No.

   a. When using a Tapered Microtip, the **YES** button **must** be selected.

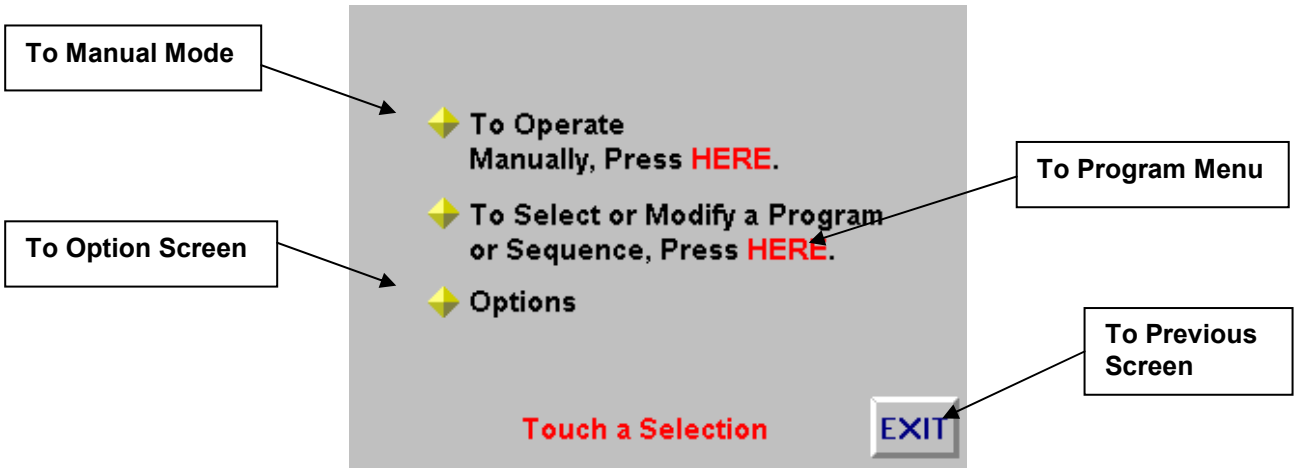
   b. When using a ½" diameter probe or any larger accessory select **NO**.

   c. When using a Stepped Microtip (part #4422 with coupler), select **NO**.

If you are not familiar with the microtips call for assistance.

Warning: Improper selection may result in tip damage or poor sonication. Damage caused by not following this step is not covered under the warranty.

After answering the Microtip question, the following screen appears:



This screen allows the user to select Manual mode, Program menu or Options screen.

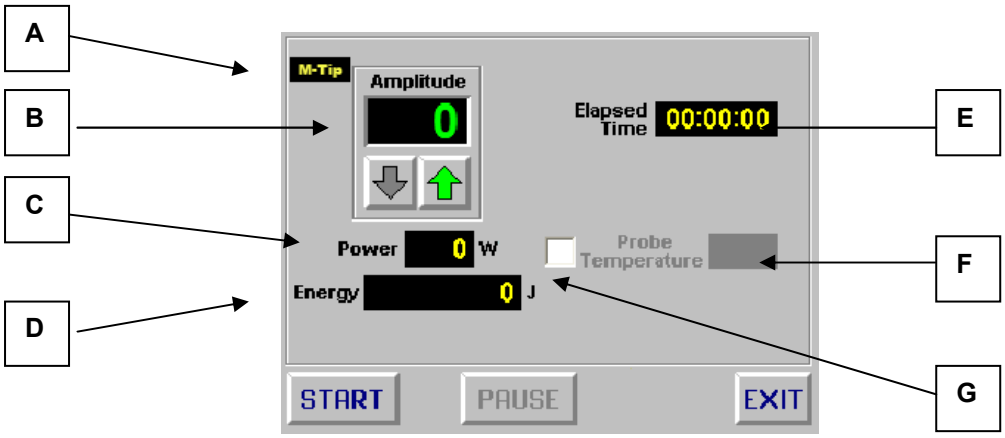
2. Select the Mode of Operation or access Options screen.

    a. Manual Mode: Selecting Manual Run allows the user to set the unit output level manually (setting 1 – 100%). Starting and stopping the ultrasound output is also manually performed.

    b. Program Mode: Allows the user to create a program with specific On / Off times and output setting. The ability to save up to 10 programs and sequence several individual programs together can also be performed in this mode.

    c. Options: Allows the user to change display contrast, and select either ºC or ºF if temperature monitoring is enabled. Footswitch and temperature probes are optional items and are not shipped unless specifically ordered with the unit.

The following screen displays the **Manual Mode**.



A. Microtip Mode – Indicates that the unit is set for use with microtips only. This mode should not be used with standard probes or horns (1/2" or larger). See page 15 for information on selecting YES or NO at the "Are you using a Microtip screen".
B. Amplitude (intensity) setting - Output amplitude may be set between 1-100%.
C. Power displayed in Watts.
D. Energy displayed in Joules.
E. Elapsed Time – Total time of active sonication.
F. Temperature probe measurement (note: if "OPN" appears, it indicates temperature monitoring has been activated but the probe is not connected).
G. Temperature probe On/Off indicator. Touch the box to activate temperature monitoring. A check mark will appear indicating that temperature monitoring is activated.

Select the appropriate Amplitude (intensity setting) for your sample by touching the Up or Down arrow. Touch Start to begin sonication. Touch Pause to pause sonication.

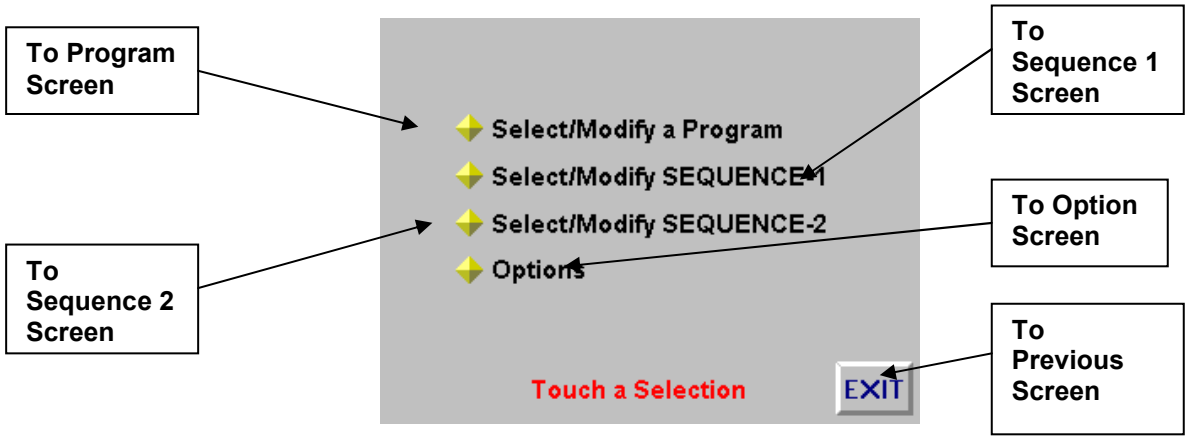
Manual and Program modes both show the Start, Pause and Exit buttons. After touching the Start button and activating sonication, the Start button becomes a Stop button. After touching the Pause button, the Pause button becomes the Resume button.

If sonication is stopped, Energy and Elapsed Time values remain on display. If the Start button is touched again, the values are reset. If sonication is Paused and Resumed, the Energy and Elapsed time data will resume counting from the point at which it was paused.

The Temperature Probe option can be selected if you wish to monitor the temperature of the sample being processed.

Program Menu

The unit can be programmed to sonicate at specific, user-selected time intervals including pulse mode.

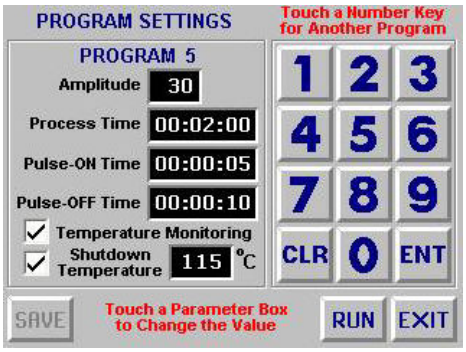


Select/Modify a Program – Create, select or modify up to 10 different programs.

Select/Modify Sequence 1 & 2 – Select a sequence of programs for the unit to run in succession. A maximum of 6 programs can be sequenced at one time.

Option Screen - The Option menu enables the selection of Temperature units, Footswitch operational mode and Display contrast.

Programming Screen



How To Create a Program

The ultrasonic processor has the ability to save up to 10 programs.

1. Select a program number from the keypad, the program number will appear above the Amplitude box.

***For each of the following steps**: After touching a field, the background will change to yellow indicating an active field. After entering data, the entry is completed by touching Enter (ENT), touching the field a second time or by touching a new field.*

2. Program a value into the Amplitude field.
3. Program total Process Time (total active sonication time).
4. Program Pulse On time – If no data is entered (00hr:00min:00sec), the unit will run continuously without pulsing.
5. Program Pulse Off time – If no data is entered, the unit will run continuously without pulsing.

Process Time, Pulse On and Pulse Off times are measured in Hours: Minutes: Seconds format.

6. Activate Temperature Monitoring (if necessary).
7. Program a Shutdown Temperature (if necessary). Enter a temperature value. During sonication, if the temperature reaches the Shutdown value, the unit will pause sonication. The unit will remain paused until the temperature drops below the pre-set value. Once the temperature drops below the value, sonication can be manually resumed.
8. Touch Save to store the program to the memory number selected in step 1.
9. Touch Run to proceed to the following screen.

Total programmed time of active sonication. Rest or Off time is not included in this value.

Total time of active sonication that has occurred during the current program. Rest or Off time is not included in this value.

Program Progress

10. Touch Start to begin the program.

How To Run A Saved Program

From the program screen (see image at top of previous page), touch the program number on the right side of the screen and the selected program settings will appear.

Follow steps 9 and 10 from the previous page.

This Run screen is an example of a sample program in progress.

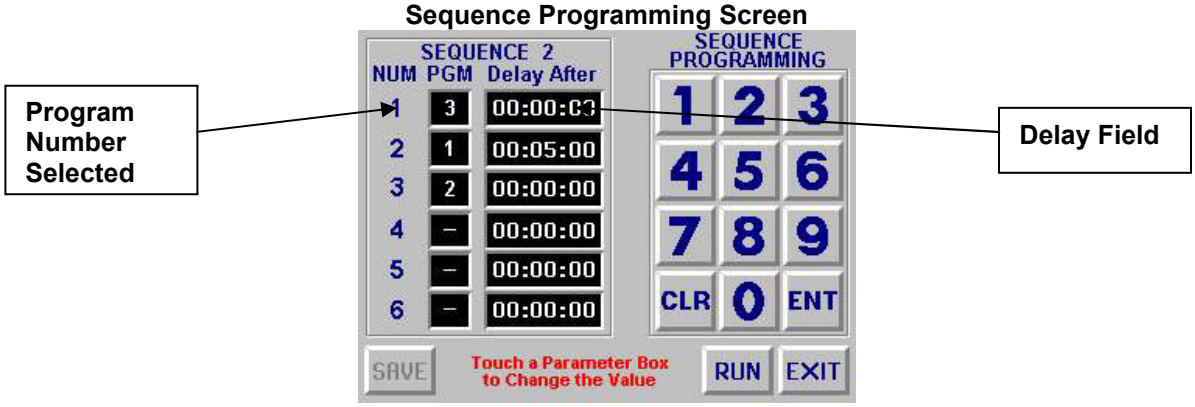
The Temperature Monitoring and Shutdown Temperature option have been selected during this example program.

Program Progress is displayed by a bar graph. This displays the progress of the current program including both the On and Off time combined.

Sequencing

After selecting Sequence 1 or 2 from the Program Menu, the following screen will appear:

Sequence Programming Screen



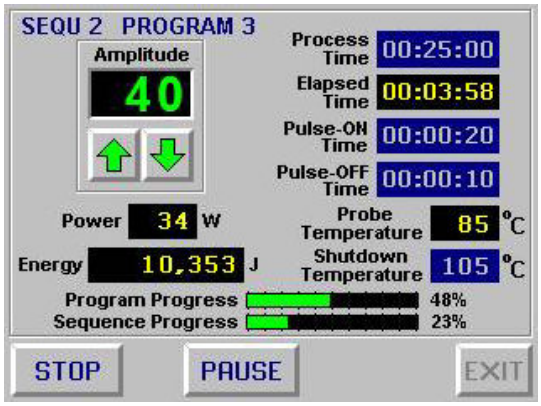
After creating multiple programs, a sequence of those programs may be selected. Select the Program Number and the amount of time desired between Programs. Save the settings and touch Run to begin the sequence of programs.

How to Create a Sequence

1. Touch the Program (PGM) field, select the appropriate program number and touch ENT.
2. Enter each desired program number in order, in the PGM fields.
3. If a delay or rest time between programs is desired, touch the Delay After field. Enter the appropriate time frame.
4. Unused PGM fields should have a dash (-). Select unsused programs, touch CLR and ENT if necessary.
5. The last Delay After field as well as any unused fields should be cleared to 00:00:00 as displayed in NUM 3, PGM 2 as shown above. Select unsused fields, touch CLR and ENT if necessary.
6. Touch Save to store the sequence.

How to Run a Sequence

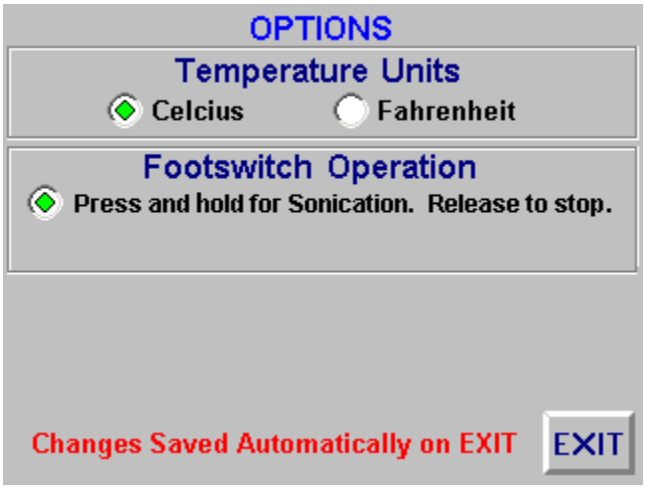
From the Sequence Program Screen, touch Run, the following screen will appear:



Sequence Progress Bar – The measure of the total of all programs in the sequence including On, Off and Delay After times.
The following Option Screen can be accessed from either Menu Screen.

The Option menu enables the selection of **Temperature units** and **Footswitch operational mode**.

Option Screen



Temperature Units – A temperature probe (Part# 4102 or 4103) is required for use of this option.

The Temperature Probe option can be selected if you wish to monitor the temperature of the sample being processed.

The temperature probe must be plugged into the back of the ultrasonic processor and the probe tip must be in the liquid sample. If the initial sample temperature is above the set point, sonication will not turn on. During sonication, if the temperature reaches the Shutdown value, the unit will pause sonication. The unit will remain paused until the temperature drops below the pre-set temperature limit, at which time sonication can be manually resumed.

Footswitch Operation – A footswitch (# FS-3) is required for use of this option. After setting up a program, the footswitch can be used to remotely activate the unit.

Exit – The Exit button will save changes and return to the previous screen.

Techniques for Optimizing Results

Probe Depth

Immerse the probe tip 1.5 times the tip diameter into the solution, without touching the bottom. For example, the ½" horn should be immersed at least ¾" below the liquid surface. Immersion depth must be sufficient to prevent foaming and allow the sample to mix well. If the probe is too deep it will sonicate against the bottom of the vessel and not promote good mixing to affect the sample near the top of the vessel.

Foaming and Aerosoling

Aerosoling and foaming generally occur when the tip is not immersed deep enough into the solution or the amplitude setting is too high. Lowering the tip in the solution, decreasing power, and reducing solution temperature will prevent foaming. Lowering the power and increasing sonication time will usually reduce aerosoling; in severe cases, use an aerosol cap or sealed atmosphere treatment chamber. In organic materials, protein release from cell material acts like a wetting agent and tends to promote foaming. For severe foaming:

Once foaming occurs, shut off power or reduce it below cavitation level before proceeding. It may be necessary to use a centrifuge or high vacuum to reduce tenacious foam. If foam persists, the sample may have to be discarded. *If foaming continues to be a problem, an indirect sonication device (such as a Cup Horn) may be a better option.*

Viscosity Limitations

Viscous solutions and highly concentrated liquids can be difficult to sonicate. If the liquid is so thick that it will not pour or circulate easily it is too thick and cannot be processed effectively.

Keeping Samples Cool

Intense ultrasonic processing causes the liquid temperature to elevate especially with small volumes. High temperatures reduce cavitation so the liquid should be kept as cold as possible. This can be accomplished by immersing the sample vessel in an ice-salt-water-alcohol bath, or by using a water-jacketed processing vessel with cold water circulation. To minimize temperature elevation, use the pulse mode.

Free Radical Information

Trace free radicals produced by ultrasonics will usually have little or no enzyme activity. The free radicals may be H_2O_2, O_3 as well as many other molecules and ions produced from air or water. If this kind of reaction is suspected, it can easily be avoided by using CO_2 or N_2 atmosphere. A CO_2 atmosphere is quickly obtained by placing a pellet of dry ice in the solution before processing and let it "bubble out". A CO_2 atmosphere stops luminescence in the cavitation bubble for the same reason it prevents it in a vacuum tube. It is this luminescence which causes the water and air molecules to break up producing the radicals. This CO_2 procedure, as simple as it is, again is ordinarily unnecessary.

9. Maintenance

It is recommended to periodically inspect the unit, both visually and physically, to insure optimum and safe performance. This inspection should be scheduled as a routine maintenance procedure, done with the unit power OFF and with the unit unplugged from the AC power source.

Long exposure to acids or caustics results in corrosion of metal parts or components. Check the generator, converter, and cables periodically for any signs of rust or discoloration. If discoloration is found, move the ultrasonic processor away from the source of the contaminant.

Examine the condition of the high voltage cable that attaches the converter to the generator. Inspect the wire insulation for damage, such as wear, burning from hot plate contact or breakage from extended use or rough handling. In general use, the cable assembly should not be used to carry the converter or pull it toward the user. Make certain the cable always has slack and is never tensioned. If necessary, move the generator or converter assembly closer to one another to accomplish this. If this is not possible, contact your Customer Service Representative to obtain a longer cable.
WARNING: Do not use a cable with broken end connections, exposed wires or frayed insulation. High voltage is present in the cable and will pose a shock hazard. Do not touch the converter assembly until the power switch is off and the unit is unplugged.

Microtip/ Probe Maintenance
Ultrasonic processors create high intensity vibration which puts stress on the converter and horn assembly. The sides and end of the probe must **never** be allowed to come in contact with anything but the solution. When using a Microtip, the stress resulting at the point of contact with the vessel could cause the Microtip to fracture.

Proper care of the probe is essential for dependable operation. The intense cavitation will, after usage for period of time, cause the tip to erode, and the power output to decrease. The smoother and shinier the tip, the more power will be transmitted into the sample. The vibrations may also cause the probe tip to loosen over time or the threaded connection to accumulate debris. **Note:** *A loose probe will usually generate a loud piercing or squealing sound.*

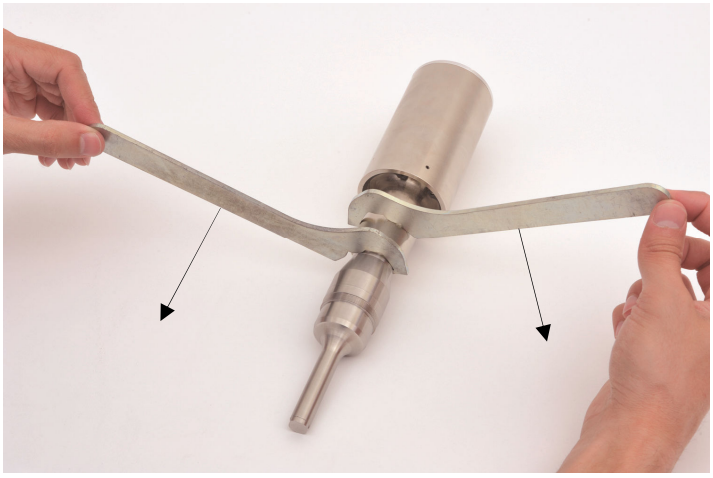
For that reason, **it is recommended that a preventative maintenance schedule be adopted to examine the unit at regular intervals.** The schedule should depend on frequency of use. Weekly maintenance schedules are recommended for units used frequently or monthly for those used infrequently. The tip must be examined for excessive wear and to ensure that the threaded connection is clean and attached properly to the convertor. Use a cotton swab and alcohol (i.e. ethanol, isopropyl, etc.) to clean the threaded mating surfaces.

When excessive wear (corrosion/pitting of the probe tip) is detected the probe should be replaced with a new one.

WARNING: Hand-tightening horns onto the convertor is not sufficient; properly tighten them with the appropriate Wrench Set. See below the steps for attaching and detaching microtip probes:

Follow the steps below for attaching and detaching accessories:

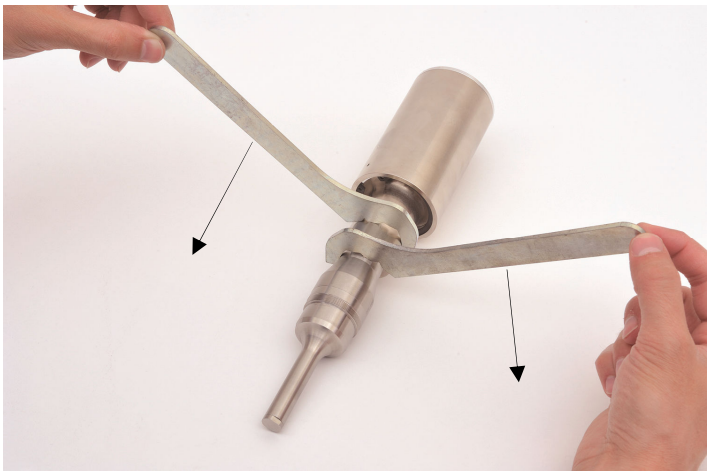
1. *Disconnect probe from convertor. Use the wrench set provided with the system.*



2. *Clean threaded stud. Use alcohol and a cotton swab to remove any debris on the threading of the connecting stud. Allow the alcohol to dry completely.*

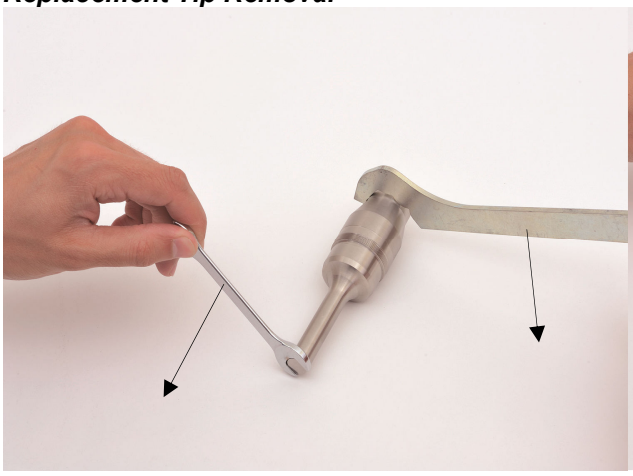
3. *Clean threading in converter. Hold the convertor horizontally and use alcohol and a cotton swab to remove any debris on the threading. Do not allow liquid to drip into Convertor. Allow the alcohol to dry completely.*

4. *Reattach probe to convertor. Screw the probe back onto the convertor and tighten with the wrench set provided.*

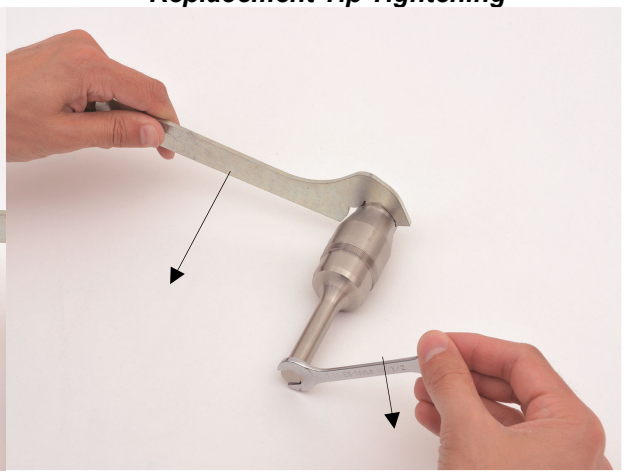


5. *The tips on replaceable tip probes can be removed for cleaning and/or replacement. When replacing horns or horn tips, Always clean the threaded mating surfaces of the convertor and horn. Use alcohol and a cotton swab to remove any debris on the threading of the tip or probe. Note: If the replaceable tip loosens during sonication, be sure to remove the tip for cleaning and inspect the threading on the tip and probe. Call the manufacturer for assistance if the threading is chipped or damaged in anyway.*

Replacement Tip Removal



Replacement Tip Tightening



Replacement Tip Removal

Replacement Tip Tightening

*Note: When tightening a Microtip the tip must not be in contact with the work surface. Always have the tip extending off of the table or work surface to minimize stress to the tip.

System Cleaning Instructions

The generator and converter may be cleaned using an acid-free cleaning solution (i.e. glass cleaner).

Probes should be cleaned using isopropyl alcohol. Probes are made from titanium and can be autoclaved (the converter is an electrical part and cannot be sterilized in this manner). Before each procedure place the probe tip in water or alcohol and turn the power on for a few seconds to remove residue. The tip also can be sterilized using alcohol with the power on.

9. Troubleshooting

Your Ultrasonic Processor was designed to provide you with years of safe and dependable service. Nevertheless, because of component failure or improper usage, the possibility does exist that it might not perform as it should, shut down or stop working all together. The most probable causes for malfunction are listed below and should be investigated.

- A connector or cable is damaged.
- The unit was plugged into an electrical outlet that provides a different voltage from that required. See *Electrical Requirements.*
- The horn, probe, booster or microtip is not tightened properly with the wrenches provided.
- The convertor and/or microtip has been dropped.
- A microtip being operated is damaged or worn past its useful life.
- A fuse(s) has failed.

OVERLOAD CONDITION
If the Ultrasonic Processor stops working, and an OVERLOAD indication is displayed on the screen, check for possible causes as outlined in the above paragraph. Then press the **OFF** key to switch the unit off, and the **ON** key to switch the unit back on to restart the equipment.

If the problem persists after inspecting all of these, please contact Customer Service for additional assistance or to replace a worn microtip or damaged part.

Note: Most faults can be solved by cleaning all mating and threaded surfaces using isopropyl alcohol and properly re-assembling tightly together using the appropriate wrenches.

Note: If the display freezes, switch Off main power, wait 5 seconds and switch back On.

Note: If you touch Start and sonication does not occur, switch Off main power, wait 5 seconds and switch back On.

If these steps do not solve your problem, please contact a Customer Service Representative.

10. Return of Equipment

It is suggested that an Ultrasonic Processor in need of repair be sent back to the factory.

In order to receive prompt service; always contact your Customer Service Representative before returning any instrument. Include date of purchase, model number and serial number.

Please obtain a *Return Authorization Number* prior to returning the instrument.

Care should be exercised to provide adequate packing to insure against possible damage in shipment. The Ultrasonic Processor should be sent to the "Service Department" with all transportation charges prepaid and return of shipment indicated.

Important

The user must certify that the ultrasonic processor and/or the accessories returned for repair are free of any biohazardous or radioactive material and are safe for handling. Please complete the "Safety Certification" form on the next page and send it in with your equipment.

Do not return any equipment unless such a certification can be made.

SAFETY CERTIFICATION FORM

Items being returned:

_____
_____
_____
_____
_____
_____

Please check only one item below:

___ The equipment was never used or exposed to any radiological, biological or chemical agents and is safe to handle, use or dispose of.

___ The equipment was used but not in conjunction with or exposed to any radiological, geological or chemical agents and is safe to handle, use, or dispose of.

___The equipment was used in conjunction with or exposed to radiological, biological, or chemical agents and has been decontaminated, rendering it safer for handling, use, or disposal.

Authorization
By accepting authorization to return the equipment listed above, the undersigned assumes all responsibility and liability for radiological, biological and chemical decontamination. Delivery of the equipment can be refused if necessary documentation is not provided or where it is determined that the equipment has not been properly decontaminated. If it is determined that the equipment was not properly decontaminated, the Authorized Repair Facility reserves the right to bill the customer for any and all costs associated with the decontamination and/or appropriate disposal of the equipment. In the event the equipment has been exposed to radiological contamination, the signature of the Radioactive Safety Officer is required.

Print name: _____ RA # _____

Signature: _____ Date: _____

Addendum

Converter Cooling

Continuous sonication will cause both the probe and sample temperature to increase. The heat will transfer up to the converter. If the converter overheats the internal crystals can crack and the entire converter will require replacement. Converter damage due to overheating is not covered under warranty.

Cooling the sample buy submerging the beaker or tube in ice will help to cool the probe and converter. Chillers are also commonly used. If you have an application that requires greater than 10 minutes of continuous processing there is potential for the probe/converter assembly to increase in temperature.

The general rule is that if the converter is warm to the touch it should be cooled. Besides cooling the sample another effective way to cool the converter is by using compressed air. Each converter has 2 threaded ports for air cooling. 5psi of dry, clean air is required. One port is attached to the air source and the other port remains open as a vent.

Black fittings shown below are available at no charge upon request.


Standard Converter


Feel for holes under the label and use a razor to expose both holes.


Attach fittings.


Attach air hose to one fitting


Proper setup for air cooling the converter

Frequently Asked Questions (FAQ)

Probe size vs. Sample volume
Selecting the proper size probe is a critical factor when sonicating a sample. The sample volume to be processed must correlate with the tip diameter. Each probe has a recommended sample volume range. This range may overlap with other probes. For example the ½" probe can process approximately 20-250ml. Depending on the type of sample you may be able to process a little less than 20ml or more than 250ml. Depending on the vessel size and shape, the ½" probe may have difficulty fitting inside a 20ml volume and a ¼"microtip may be a better option. Many factors must be considered when selecting the appropriate probe for your application.

Small volumes require a small tip to fit inside the sample tube. Small tips (aka Microtips) are recommended for processing samples inside small, thin vessels and never samples larger than 50ml. Microtips are high intensity and made for short processing times. Using a microtip for long time periods will generate a considerable amount of heat. Microtips should be used in pulse mode to reduce heat buildup.

Larger volumes require a larger probe for effective processing. For example a 1" probe will process 1 liter much faster than a ¾" probe. Using the proper size probe will not only reduce the processing time but increase the lifespan of the probe. The addition of a stir bar can greatly aid processing of large samples. A probe should not be used to process a volume larger than indicated on the chart unless the application is reviewed and approved by a Qsonica representative.

While there is no absolute sample volume range for any probe/horn, below is a general guideline to follow. Using a sample volume outside each tip diameter's range is generally not recommended.

Tip Diameter	Processing Volume Range
1/16" (2mm)	0.2ml - 5ml
1/8" (3mm)	1ml - 15ml
1/4" (6mm)	5ml - 50ml
1/2" (12mm)	20ml - 250ml
3/4" (19mm)	50ml - 500ml
1" (25mm)	100ml - 1,000ml
1" with booster	750ml - 1,500ml

Vessel shape and size
A narrow vessel is preferable to a wide vessel. The ultrasonic energy is generated from the tip and is directed downward. As a sample is processed the liquid is pushed down and away in all directions. If the vessel is too wide it will not mix effectively and some sample will remain untreated at the periphery. Twice the volume in a narrow vessel takes a shorter time to process than the same volume in a wider vessel. The probe should never touch the sides or bottom of the vessel.

How to prevent foaming (small sample issue)
Foaming is a problem that often occurs with samples volumes below 1ml. The cause of foaming is generally 2 issues: too high of an amplitude setting or the tip is not immersed deep enough. Some samples foam very easily and a Cup Horn should be considered. Cup horns will not create foam.

Tip depth
The depth of the probe inside the sample vessel is another important issue. If the probe is too close to the surface of the liquid it can create foam. If the probe is too deep it may sonicate against the bottom of the vessel and not effectively processing the sample. The sample must flow freely below the tip in order to be mixed effectively. Without effective mixing you cannot ensure the entire sample volume will pass below the tip and become processed. The probe should be immersed at least 1.5 times the tip diameter. Before processing actual samples, it is recommended to test the probe in a vessel filled with water to observe the ultrasonic energy and the flow pattern of the liquid. During this test you can adjust the probe's depth until you see adequate mixing and movement of the water.

Booster Horn
A booster is a device that increases the amplitude (intensity) of a 1" or ¾" probe. For example, a 1 liter sample can be processed twice as fast with a 1" probe and booster when compared to the 1" probe used alone. Smaller diameter probes already offer high intensity and will crack if used with a booster. The booster may be beneficial when processing difficult samples with volumes above 500ml.

Power vs. intensity
Power is the measure of the electrical energy that is being delivered to the convertor. It is measured in watts and displayed on the sonicator's screen. At the convertor, the electrical energy is transformed into mechanical energy. It does this by exciting the piezoelectric crystals causing them to move in the longitudinal direction within the convertor. This change from electrical into mechanical energy causes a motion that travels through the horn/probe causing the tip to move up and down.

The distance of one movement up and down is called its amplitude. The amplitude is adjustable. Each probe has a maximum amplitude value. For example, with a ½" diameter probe at setting 100%, the probe will achieve an amplitude of approximately 120µm. At setting 50% the amplitude is approximately 60µm. Note this is approximate and not perfectly linear. Qsonica measures the amplitude of each probe at 100% and these values are published in the brochure.

Amplitude and intensity have a direct relationship. If you operate at a low amplitude setting, you will deliver low intensity sonication. If you operate at a high amplitude setting, you will have high intensity sonication. In order to be able to reproduce results, the amplitude setting, temperature, viscosity and volume of the sample are all parameters that need to remain consistent. The amplitude, not the power, is most critical when trying to reproduce sonication results.

Power has a variable relationship with amplitude/intensity. For example, sonicating water requires less wattage when compared to a viscous sample (such as honey). While sonicating both samples at the same amplitude setting the power/wattage will differ because the viscous sample will require more watts in order to drive the horn. The viscous sample puts a heavier load on the probe so they system must work harder to vibrate up and down at the same amplitude setting. The honey may draw double the watts when operated at the same amplitude as the water sample.

Small fluctuation in the wattage display during sonication is normal. Major swings in wattage (+/- 30 watts) may indicate a problem with the sample, setup or the sonicator itself.