Autotune Series
High Intensity Ultrasonic Processor

750 Watt Model

USER'S GUIDE

Printed in U.S.A January 2001

TABLE OF CONTENTS

The Ultrasonic Processor supplied with this instruction manual is constructed of the finest material and the workmanship meets the highest manufacturing standards. It has been thoroughly tested and inspected before leaving the factory and when used in accordance with the procedures outlined in this manual, will provide you with many years of safe and dependable service.

tube thoroughly, coat with silicone, then air dry. "Sigmacote manufactured by Sigma Chemical Co., 3050 Spruce Street, St. Louis, Missouri 63103, U.S.A., phone (314) 771-5765, is ideally suited for that purpose.

Probes may be autoclaved, or sterilized by immersing in boiling water or in a detergent bactericide and a disinfectant.

High viscosity and concentration are problematic. 5,000 cps and 15% concentration by weight are maximum limits. If the sample is so thick that it will not pour or circulate easily, it is too thick for ultrasonic processing.
Use the Sealed Atmosphere Chamber for processing pathogenic and biohazardous materials.

Use the Continuous Flow Cell for processing large volumes. When working with temperature sensitive samples, circulate the sample through a coiled tube immersed in a salted ice bath to minimize temperature elevation.

Use the Cup Horn for processing pathogenic, radioactive, and biohazardous materials in complete isolation without probe intrusion. Because plastic tubes have a tendency to absorb vibrations, it is preferable to use stainless steel tubes or glass tubes when working with a cup horn. To expedite processing add glass beads to the sample. If desired, crushed ice can be added to the water inside the cup horn, in order to optimize cooling.

The problem of oxidation is a serious one particularly where the study of sulpdhydril enzymes is concerned. This may be partially controlled using free radical traps such as cysteine, reduced gluthathione or comparable substances or by isonating in the presence of an inert atmosphere. Whereas it is true that gas is required for effective cellular disruption, it is not necessary that the vapor phase be oxygen or air since any gas except carbon dioxide will work just as well for cellular disruption. The Sealed Atmosphere Treatment Chamber permits extraction to be made using such gases, e.g. helium or nitrogen. Forcing inert gas through the liquid will also reduce aerobic oxidation.

Since the greatest concentration of energy is immediately beneath the probe, it is imperative that the sample be kept as close to the tip as possible. Liquids are easily processed because the free moving cells circulate repeatedly below the probe. Solid materials, however, have a tendency to be repelled by the ultrasonic, and should be processed in a vessel large enough to accommodate the probe, yet small enough to restrict sample movement. For small samples, conical shaped test tubes are recommended. Although plastic tubes work well, glass and stainless steel tubes usually work better than plastic ones.

Allowing the probe to come into contact with the vessel will decrease the power output, and cause tiny glass particles to migrate into the liquid. Although these glass particles will not adversely affect the chemical composition of the sample, they will form a thin grey layer on centrifuging. If the probe has to come in contact with a solid sample, use a standard 20 mm (3/4˝) diameter stainless steel centrifuge tube cut to 70 mm (3˝) length. Do not use a glass tube. Microtips must never be allowed to come in contact with anything but the liquid, because the stress resulting at the point of contact with a hard surface will cause the microtip to fracture. Although larger probes will not fracture if they come in contact with a glass vessel, they may cause minute grey (glass) particulates to migrate into the sample and even cause the vessel to fracture.

Before each application, place the tip in water or alcohol and energize the power supply for a few seconds to remove any residual substances.

If concerned with sample loss in test tube due to sticking, siliconize the test tube as follows: Wash and dry the test

IMPORTANT SAFEGUARDS

READ BEFORE INSTALLING OR USING THE EQUIPMENT

Your Ultrasonic Processor has been designed with safety in mind. However, no design can completely protect against improper usage, which may result in bodily injury and/or property damage. For your protection and equipment safeguard, observe the following warnings at all times, read the operating instructions carefully before operating the equipment, and retain this instruction manual for future reference. If the Ultrasonic Processor is used in a manner contrary to that specified in this instruction manual, the protection features designed into the unit may be impaired.

- Make sure the Ultrasonic Processor is properly grounded via a 3-prong outlet.
- High voltage is present in the power supply. Do not remove the cover unless qualified to do so.
- To avoid electric shock, disconnect the electrical power cord before removing the cover prior to servicing.
- Never operate the power supply unless it is connected to the converter.
- Never secure anything to the probe, except at the nobal point (point of no activity).
- Never touch a vibrating probe.
- Never allow a microtip or extender to vibrate in air for more than 10 seconds.
- When using a microtip, always keep the amplitude below 40.
- Never operate a probe with threaded end without a tip, extender or microtip.
- Air cool the converter when sample temperature exceeds 100°C, and when working at high intensity for more than 30 minutes.
- It is recommended that a sound abating enclosure or ear protection be used when operating the Ultrasonic Processor.

LOW SURFACE TENSION LIQUIDS • ORGANIC SOLVENTS

All probes, including those with replaceable tips, are tuned to resonate at a specific frequency. If the replaceable tip is removed or isolated from the rest of the probe, that element will no longer resonate at the intended frequency, and the power supply will fail. Low surface tension liquids penetrate the interface between the probe and the replaceable tip, and carry the particulates into the threaded section, isolating the tip from the probe. When processing low surface tension liquids , ALWAYS use a solid probe.

Gram negative bacteria typically require 10 to 15 minutes of processing, while staphylococcus require 20 to 30 minutes.

When processing difficult cells, pretreatment with an enzyme such as lysozyme or byaluronidase might be beneficial. Glycosidase has been used successfully with yeast, lysostaphin with staphylococcus, collagenase with skin and cartilage, and trypsin hyaluronidase with liver and kidney.

If enzymes cannot be used, the following procedures should be considered: Freezing the sample at -70°C overnight, then thawing it in water Immediately prior to ultrasonic processing.

Whenever possible, the tissues should be diced very small to permit movement within the liquid. Tough tissues such as skin and muscle should be macerated first in a blender or the like for about 10 seconds, and confined to a small vessel during ultrasonic treatment. Freezing followed by powdering could also be resorted to if this procedure is not detrimental. If sub-cellular particles are desired intact, keep the amplitude low, and increase the processing time.

Always immerse the probe deep enough below the surface of the sample to inhibit aerosoling or foaming. Foaming substantially reduces cavitation. Processing at a lower power setting without foam is more effective than processing at a higher power setting with foam. Decreasing the power, increasing processing time and lowering the temperature of the sample will usually prevent aerosoling and foaming. Do not use any antifoaming agents or surfactants.

During cavitation, free radicals are formed which, if they are allowed to accumulate, can greatly affect the biological integrity of the sample by reacting with proteins, polysaccharides, or nucleic acids. Although during short periods of processing their formation is not normally considered a problem; for longer durations, the addition of free radical scavengers such as N_2O, cysteine, reduced glutahione, dithiothreitol or other SH compounds, might be beneficial. Saturating the sample with a protective atmosphere of helium or hydrogen gas, or dropping a small pellet of dry ice in the sample, will usually inhibit free radical formation.

Since the greatest concentration of energy is immediately beneath the probe, it is imperative that the sample be kept

DISRUPTING CELLS

Single-cell organisms (microorganisms) consist of a semipermeable, tough, rigid outer cell wall surrounding the protoplasmic (cytoplasmic) membrane and cytoplasm. The cytoplasm is made up of the nucleic acids, proteins, carbohydrates, lipids, enzymes, inorganic ions, vitamins, pigments, inclusion bodies, and about 80% water. In order to isolate and extract any of these substances from inside the cell, it is necessary to break the cell wall and protoplasmic membrane. In some cases the cell may excrete the desired substance without assistance, but in most cases, the cells must be ultrasonically processed in order for these substances to be released.

Micro-organisms differ greatly in their sensitivity to ultrasonic disintegration. For example, the most readily disintegrated are the rod-like forms (bacilli), while the spherical organisms (cocci) are much more resistant. The group Mycobacteria, to which the tuberculosis organism belongs is particularly difficult to disrupt. Generally, animal cells are more easily disintegrated than plant cells, and red blood cells are more readily disintegrated than muscle cells because they lack a protective cell wall.

Ultrasonic processing will typically cause the temperature of the sample to increase especially with small volumes.Since high temperatures inhibits cavitation, the sample temperature should be kept as low as possible–preferably just above its freezing point. This can be accomplished by immersing the sample vessel in an ice-salt-water bath. Temperature elevation can also be minimized by using the pulser.

Cell disruption can be enhanced by increasing hydrostatic pressure (typically 15-60 psi) and viscosity. For microorganisms, the addition of glass beads in the 0.05 to 0.5 mm size range promotes cell disruption. Beads are almost a prerequisite when working with spores and yeast. A good ratio is one volume of beads to two volumes of liquid. Glass beads are available from Cataphote, Inc. P.O. Box 2369, Jackson, Mississippi 39225-2369 USA, phone (800) 221-2574 or (601) 939-4612, FAX (601) 932-5339, Jayco Inc. 675 Rahway Ave., Union, NJ 07083 USA, phone (908) 688-3600, FAX (908) 688-6060, or Sigmund Lindner GmbH. P.O. Box 29. D-95483 Warmensteinach, Germany. Phone (49) 0 92 77 9 94 10, FAX (49) 0 92 77 9 94 99.

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. Responsibility for its safe delivery was assumed by the carrier upon acceptance of the shipment. Claims for loss or damage sustained in transit must, therefore, be made upon 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

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.

Should it become necessary to replace a fuse(s), proceed as follows:

1. Disconnect the power cord.
2. Open the fuse holder cover using a small blade screwdriver.
3. Pull out the red fuse holder from its housing.
4. With 110/115 volt units, replace the two ¼˝ x 1¼˝ 15 Amp slow blow fuses Type MDL. With 220/240 volt units, replace the two 5 x 20mm 7.5 Amp slow blow fuses Type GDC.
5. Reconnect the power cord.

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.

RETURN OF EQUIPMENT

It is suggested that equipment in need of repair be sent back to the factory.In order to receive prompt service, always contact the factory before returning any equipment, and obtain a Return Authorization Number. Include date of purchase, model number and serial number. For equipment not covered by warranty, a purchase order should be forwarded to avoid unnecessary delay. Care should be excersized to provide adequate packing to insure against possible damage in shipment. Equipment should be sent to the attention of the “Service Department” with all transportation charges prepaid and return of shipment indicated.

Ultrasonic Processors should always be returned with their converter and probe.

IMPORTANT

I CERTIFY THAT ULTRASONIC PROCESSOR(S) AND/OR ACCESSORIES RETURNED FOR REPAIR ARE FREE OF ANY BIOHAZARDOUS OR RADIOACTIVE MATERIAL AND ARE SAFE FOR HANDLING.

DO NOT RETURN ANY EQUIPMENT UNLESS SUCH CERTIFICATION CAN BE MADE.

OVERLOAD CONDITION

The fuse and overload protection circuit protect the Ultrasonic Processor against improper usage, or malfunction. Should a fuse(s) fail, or the electronic overload circuit become activated, proceed as follows:

1. Ensure that the probe, replaceable tip, or microtip is securely fastened.

2. Check the fuse(s) and replace as required. (See page 2)

3. Set the AMPLITUDE control to 40 and the ON/OFF power switch to ON. With the probe or microtip in air (out of the sample), the wattmeter should read below 20 watts. If the reading exceeds 20 watts, set the ON/OFF power switch to OFF and disconnect the probe from the converter.

4. Set the ON/OFF power switch back to ON. If the wattmeter reads below 20 watts, it is indicative that the probe or microtip has failed or is out of tune due to excessive erosion, and that it should be replaced. If the reading still exceeds 20 watts, either the converter or power supply has failed and the complete unit should be returned for repair.

PRINCIPLES OF ULTRASONIC DISRUPTION

The ultrasonic power supply converts 50/60 Hz line voltage to high frequency electrical energy. This high frequency electrical energy is transmitted to the piezoelectric transducer within the converter, where it is changed to mechanical vibrations. The vibrations from the converter are intensified by the probe, creating pressure waves in the liquid. This action forms millions of microscopic bubbles (cavities) which expand during the negative pressure excursion, and implode violently during the positive excursion. It is this phenomenon, referred to as cavitation, which causes considerable amount of energy to be released at the point of implosion, and generates the powerful shearing action at the probe tip.
The larger the probe tip, the larger the volume that can be processed but at a lesser intensity. For information regarding processing of each probe, consult the tables below.

	TAPERED MICROTIPS			STEPPED MICROTIPS
TIP DIAMETER	1/8˝ (3 mm)	3/16˝ (5 mm)	1/4˝ (6.5 mm)	1/8˝ (3 mm)
INTENSITY	Ultra High	Very High	High	Very High
VOLUME (batch)	1-10 ml	3-20 ml	5-50 ml	250 µl-10 ml

	STANDARD PROBES		
TIP DIAMETER	1/2˝ (13 mm)	3/4˝ (19 mm)	1˝ (25 mm)
INTENSITY	High	Medium	Low
VOLUME (batch)	10-250 ml	25-500 ml	500-1000 ml

HIGH GAIN PROBE		
TIP DIAMETER	3/4˝ (19 mm)	1˝ (25 mm)
INTENSITY	High	Medium
VOLUME (batch)	25-500 ml	500-1000 ml

FRONT PANEL	
LCD screen	Displays prompts and the following control parameters: – Amplitude selected – Output power delivered to the probe in watts, and as a percentage of the total power. – Selected duration of processing – Elapsed time – Actual processing time – Pulse duty cycle–on/off duration
0 - 9 keys	Inputs digits
CLEAR key	Clears preceding entry.
ENTER / REVIEW key	Enters data into the program, and selects various parameters, for display on the LCD screen.
TIMER key	Used with the numeric keys to set the duration of ultrasonic application – from 1 second to 9 hours, 59 minutes, 59 seconds.
PULSER key	Used with the numeric keys to set the pulse parameters. The ON cycle and OFF cycle can be set independently from .1 second to 9.9 seconds. Red indicator lights when pulser is in OFF portion of the cycle.

REVIEW: The REVIEW function provides a "window" on the process by displaying various operating parameters without process interruption. Pressing the ENTER / REVIEW key repeatedly during processing, will consecutively display the following information.

IMPORTANT

Proper care of the probe is important for dependable operation. The intense cavitation will, after a prolonged time, cause the tip to erode,and the power output to decrease without showing up on the power monitor. The smoother and shinier the tip, the more power will be transmitted into the sample. Any erosion of the probe tip will increase the rate of future erosion. For that reason it is recommended that after every 5 or 6 hours of use the tip be examined, and if necessary, polished with emery cloth or an abrasive wheel. Since the probe is tuned to vibrate at a specific frequency, it is important that only the contaminated surface be removed. This procedure can be repeated until the wattmeter reads in excess of 20 watts with the probe out of the sample, then the probe or replaceable tip should be replaced.

a. Select amplitude:
   e.g. Amplitude Control 40%
b. Set processing time and elapsed processing time:
   e.g. Set 5:30:25 Time 0:57:03
c. Selected pulsing cycle, and actual pulsing cycle:
   e.g. Pulse 2.5 10/15 .5
d. Amount of power delivered to the probe:
   e.g. 20 watts
e. Elapsed time since processing was initiated:
   e.g. Elapsed time 1:27:33

PULSER: By inhibiting heat build-up in the sample, the pulse function enables safe treatment of temperature sensitive samples at high intensity. In addition, pulsing enhances processing by allowing the material to settle back under the probe after each burst. The ON and OFF pulse durations can be set independently from .1 second to 9.9 seconds. During the OFF portion of the cycle, the red indicator on the **PULSER** key will illuminate. If the OFF portion of the cycle exceeds two seconds, a cautionary message -CAUTION- PROBE ON STANDBY- on the LCD screen will warn the operator against touching the ultrasonic probe. To set the pulser, press the **PULSER** key. The LCD screen will display:

Pulse on_._sec
Pulse on_._sec

Using the numeric keys, set the ON portion of the cycle, and press the **ENTER REVIEW** key. The LCD screen will display:

e.g.

Pulse on 2.5 sec
Pulse off_._sec

Using the numeric keys, set the OFF portion of the cycle. The LCD screen will display:

e.g.

Pulse on 2.5 sec
Pulse off 10 sec

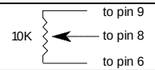
Press the **ENTER REVIEW** key. The LCD screen will display:

TIME	5:30:25
PULSE 2.5	10 AMPL 40%

START/STOP key	Starts a programmed cycle or stops a cycle currently running. In the STOP mode the program is terminated and the red indicator goes off.
ON/OFF power switch (located below the control panel)	Switches the main power on or off
AMPLITUDE control (located below the control panel)	Controls the amplitude of vibration at the probe tip. CAUTION ***When using a microtip, never allow the amplitude to exceed 40%***

	REAR PANEL
9 pin D-sub connector	Connects to external actuation device, and enables power and frequency monitoring.
Footswitch jack*	Connects to the footswitch cable.
Coax connector	Connects to the converter.
Power module	Connects to the electrical line cord and encases fuse(s).

9 PIN D-SUB CONNECTOR

Pin No.	Description
1	External overload protection
2	External overload reset
3	Not connected
4	Enables connection to a frequency counter.
5	Enables connection to an external power monitor (5mv = 1 watt).
6	Ground
7	Energizes the ultrasonics when connected to ground.
8 and 9	Enables the intensity to be remotely adjusted using an external 10K potentiometer. 

NOTE

To vary the intensity remotely using a variable DC power supply (0-5V) instead of a 10K potentiometer,connect the positive to pin 8 and the negative to pin 6.

NOTE

To clear an erroneous entry press the **CLEAR** *key.*

TIMER: In the pulsed mode the processing time will be different from the elapsed time because the processing time function monitors and controls only the ON portion of the duty cycle. For example, for 1 hour processing time. the elapsed time will be 2 hours if both the ON and the OFF cycle are set for 1 second. To set the processing time, press the **TIMER** key. The LCD screen will display:

TimeSetting
Hrs:_ Min:_ _ Sec:_ _

Using the numeric keys, set the processing time as required:

e.g. Hrs. 5 Min: 30 Sec: 25

Press the **ENTER / REVIEW** key. The LCD screen will display:

TIME 5: 30: 25
PULSE_._ _._ AMPL 40%

NOTE

If the **START** *key is pressed and the time limit has not been set, processing will remain uninterrupted until the* **STOP** *key is depressed.*

If the **START** *key is pressed and the time limit has been set, processing will remain uninterrupted until the set time limit expires, or the* **STOP** *key is pressed–whichever occurs first.*

If a footswitch is use, and the time limit has not been set, processing will remain uninterrupted as long as the footswitch is depressed.

If a footswitch is used, and the time limit has been set, processing will remain interrupted until the time limit expires or the footswitch is released–whichever occurs first.

The **START** *key and footswitch are mutually exclusive. If the process is initiated by the* **START** *key, the footswitch becomes inoperative. If the process is initiated by the footswitch, the* **STOP** *key, becomes inoperative.*

NOTE

The probe is tuned to vibrate at a specific frequency If the resonant frequency of the probe has changed, due to cavitation erosion or fracturing, a minimum reading will not be obtained. If an overload condition exists, or if minimum reading cannot be obtained (less than 20%) with the probe out of the sample, check the instrument without the probe to determine which component might be defective. If minimum reading is obtained using the converter without the probe, the probe is defective and should be changed.

A loose probe will usually generate a loud piercing sound.

If an overload condition exists, refer to page 18.

Immerse the probe approximately 2 inches (5 cm) into the sample. If a microtip is used, immerse the microtip approximately ½ inch (1 cm) into sample.
Since the amplitude required is application dependent and subject to the volume and composition of the sample, it is recommended that the amplitude be empirically determined and optimized while the sample is being processed.

PREPARATION FOR USE

CAUTION

Do not operate an Ultrasonic Processor that has been left in a very cold or hot environment for a prolonged period of time, until it has reached room temperature.

1. Ensure that the ON/OFF power switch is set to OFF.
2. Plug the electrical line cord into the electrical outlet.
3. If the optional footswitch is used, insert the plug into the jack located on the rear panel. Make sure that the plug is inserted forcefully all the way in.
4. If the converter/probe assembly is not already assembled, see page 9, and observe steps 5, 6, and 7.

IMPORTANT

Never assemble or disassemble a probe by holding the converter in a vise.
Never place a washer between the probe and the converter.
Never apply grease to the mating surfaces or threads of the converter, probe, replaceable tip or microtip.

5. Check for cleanliness the mating surfaces of the converter and probe or stepped microtip, as well as the threaded stud and hole. Check that the stud is tight.
6. Hand assemble the probe or stepped microtip assembly (consisting of coupler and stepped tip) to the converter, and using wrenches provided, tighten securely. See page 9.
7. To secure a replaceable tip, extender, or tapered microtip to the probe, use a spanner wrench and an open wrench. See page 9.
8. If the optional footswitch is used, insert the footswitch plug into the jack on the rear panel. Make sure that the plug is inserted forcefully all the way in.

N O T E

Should it become necessary to remove a probe, use the spanner wrenches supplied. If the probe has been on the converter for a long time it might be necessary to use a vise. Be sure the vise has soft jaws or other means to prevent scratching. Secure the wide diameter portion of the probe in the jaws of the vise. Never grip the converter in the vise. Using a spanner wrench, twist the converter off the probe. A tap of a hammer may be applied to the end of the spanner wrench. Never attempt to remove the probe off the converter by twisting the converter housing, as this may damage the electrical connections within the housing.

8. Connect the converter cable to the power supply.
9. Mount the converter/probe assembly in a laboratory stand. Secure the clamp to the 2½″ (63 mm) diameter converter housing only. Do not secure the clamp to any other portion of converter/probe assembly.

N O T E

Should an "OVERLOAD" message appear on the LCD screen, refer to page 14 and 18.

AMPL. the amplitude is the only parameter that must be set in order for the Ultrasonic Processor to be operational. The other control parameters–Time and Pulse, do not have to be set for continuous operation.

AMPL. displays the percentage of maximum of amplitude e.g. 40%, set by the AMPLITUDE control.

Rotate the AMPLITUDE control for a 40% reading on the LCD screen - Ampl 40%.

The LCD screen will display:

```
TIME_:__:__
PULSE_._ _._                    AMPL 40%
```

To energize the ultrasonics, press the **START** key or the footswitch. To de-energize the ultrasonics, press the **STOP** key or release the footswitch. If the Time or Pulse functions must be used, refer to pages 15 and 16.

CAUTION

- *Do not operate the power supply unless it is connected to the converter.*
- *Never allow liquid to spill into the converter. Do not use the cup horn without a splash shield.*
- *Do not allow a microtip or extender to vibrate in air for more than 10 seconds. When working with a microtip* ***never*** *allow the AMPLITUDE control to be set above the microtip limit 40%. Ignoring these instructions will cause the microtip and extender to fracture*
- *Do not allow the vibrating microtip to contact anything but the sample.*
- *When working with low surface tension liquids, do not use a probe with a replaceable tip.*
- *Never energize a threaded probe without the replaceable tip, extender, or microtip attached.*

NOTE

For general operating suggestions and ultrasonic processing techniques, refer to page 20.

1. Ensure that the probe or microtip is not immersed in the sample and that it does not come in contact with anything. If a cup horn is used, make sure that the water has been drained out of it. If a flow through cell is used, make sure that the sample has been drained out of it.
2. Set ON/OFF power switch to ON. The switch will illuminate and the LCD screen will display the power rating of the Ultrasonic Processor, cautionary notices, and the following control parameters.

TIME_:__:__
PULSE_._ _._ AMPL_ _%

REMOVAL

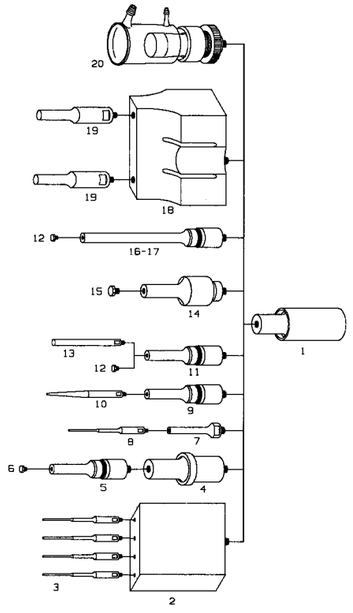
TIGHTENING

TIP REMOVAL

TIP TIGHTENING

No.	DESCRIPTION	Order Number
1	Converter Model CV33	CV00033
2	Four element coupler	630-0425
3	Stepped top(s) 1/8″ (3 mm)	630-0422
4	Booster	BHNVCGD
5	Probe 1/2″ (13 mm) solid	630-0219
	Probe 1/2″ (13 mm) with threaded end and replaceable tip	630-0220
	Probe 3/4″ (19 mm) solid	630-0208
	Probe 3/4″ (19 mm) with threaded and replaceable tip	630-0207
	Probe 1″ (25 mm) solid	630-0209
	Probe 1″ (25 mm) with threaded and replaceable tip	630-0210
6	Replaceable tip 1/2″ (13 mm)	630-0406
	Replaceable tip 3/4″ (19 mm)	630-0407
	Replaceable tip 1″ (25 mm)	630-0408
7	Coupler	630-0421
8	Stepped tip 1/8″ (3 mm)	630-0422
9	Probe 1/2″ (13 mm) with threaded end and replaceable tip	630-0220
10	Tapered microtip 1/8″ (3 mm)	630-0418
	Tapered microtip 3/16 (5 mm)	630-0419
	Tapered microtip 1/4 (6 mm)	630-0420
11	Probe - solid or with threaded end and replaceable tip - same as 5	
12	Replaceable tip - same as 6	
13	Extender 1/2″ (13 mm)	630-0410
	Extender 3/4″ (19 mm)	630-0409
	Extender 1″ (25 mm)	630-0444
	Full wave extender 3/4″ (19 mm)-10″ (254 mm) long	630-0518
	Full wave extender 1″ (25 mm)-10″ (254 mm) long	630-0519
14	High gain probe 3/4″ (19 mm) solid	630-0306
	High gain probe 3/4″ (19 mm) with threaded and replaceable tip	630-0305
	High gain probe 1″ (25 mm) solid	630-0310
	High gain probe 1″ (25 mm) with threaded and replaceable tip	630-0311
15	Replaceable tip 3/4″ (19 mm) or 1″ (25 mm) - same as 6	
16	Full wave probe 1/2″ (13 mm) solid-10″ (254 mm) long	630-0217
17	Full wave probe 1/2″ (13 mm)-10″ (254 mm) long with threaded and replaceable tip	630-0218
18	Aluminum coupler	630-0562
19	3/4″ (19 mm) solid probe	630-0208
20	Cup Horn 1 1/2″ (38 mm)	630-0503
	Cup Horn 2 1/2″ (64 mm)	630-0431
	Cup Horn 3″ (76 mm)	630-0496

CAUTION: Do not use tapered microtip with coupler. Do not use stepped tip without coupler. Do not use probes with threaded end and replaceable tip, when working with low surface tension liquids.



USING THE ULTRASONIC PROCESSOR

The Speed Control on an automobile, can, to a certain extent, be compared to the Ultrasonic Processor. This device is designed to maintain the vehicle rate of travel constant. As the terrain changes,so do the power requirements. The Speed 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 steeper the incline, the greater the amount of power that will be delivered by the engine, to overcome that resistance.

The Ultrasonic Processor is designed to deliver constant amplitude. As the resistance to the movement of the probe increases, so do the power requirements. The power supply senses these requirements, and automatically increases the amount of power delivered, in order to maintain the probe tip excursion at the preselected amplitude. Under identical loading conditions, the wattage delivered by two power supplies with different power ratings will be identical (provided both have sufficient power capability).

The AMPLITUDE control allows the ultrasonic vibrations at the probe tip to be set to any desired level. Although the degree of cavitation 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 fully clockwise will not cause the maximum power to be delivered to the sample. The maximum power 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 demand that much power.

This phenomenon can be demonstrated as follows: While observing the power monitor, depress the probe down against a piece of wood. The greater the pressure, and consequent greater resistance to the movement of the probe, the greater the amount of power that will be delivered by the power supply.