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SONICS
Newtown, CT

Introducing the VCX Series . . .

POWERFUL

PRODUCTIVE

PREDICTABLE

§ Exclusive Optotune™ automatic tuning
§ Integrated temperature controller
§ Energy (Joules) monitor
§ Digital Wattmeter
§ Microprocessor controlled
§ Sealed Converter
§ 3-year unconditional warranty

Dear Colleague,

Thirty-four years ago, Sonics began its journey into the field of ultrasonic liquid processing. Over the years, your queries and recommendations have given us invaluable insight into the needs of the research community, and your collaboration has significantly contributed to the evolution and refinement of our products. Thanks to you, the Vibra-Cell is the most reliable and technically advanced ultrasonic processor on the market today..

The instruments displayed in this catalog are the product of this synergy. They offer the widest range of processing capabilities, and incorporate innovative features that translate into performance, reliability, and simplicity.

At Sonics, we look forward to strengthening our partnership with you in the new millennium, as we work together on new and exciting ultrasonic solutions.

Robert Soloff - President

Ultrasonics is our only business...

and since 1969 we have had the privilege of serving the research and industrial community with the most comprehensive line of Ultrasonic Processors in the industry.

Dedication to excellence, and attentiveness to the needs of our customers, has resulted in continuous growth. And even though we are now in a position of leadership, our philosophy has remained steadfast; to earn your trust by conducting business in a straightforward manner, and offering the highest quality products at reasonable prices.

Sonics' ISO 9001 Certification...

and compliance to CE directives is your assurance that every Ultrasonic Processor is manufactured to stringent international standards and subjected to rigorous quality controls. In addition, your investment is safeguarded with the best customer protection in the industry; a transferable three-year unconditional warranty.

Should anything go wrong within that period, we will repair it without charge for parts and labor.

ISO 9001 Registered

Sonics & Materials, Inc. 53 Church Hill Road, Newtown, CT 06470-1614 USA
203.270.4600 - 800.745.1105 - 203.270.4610 fax - info@sonics.biz

SONICS
Newtown, CT USA

General Information

The Vibra-Cell is the most technologically advanced high intensity Ultrasonic Processor available to the researcher. Highly functional and versatile, it can safely process a wide range of organic and inorganic materials; from microliters to liters. Typical applications include: sample preparation, cell lysing, organelle isolation, disaggregation, extraction, homogenization, particle size reduction, soil testing, acceleration of chemical reactions, testing for cavitation erosion, foam abatement, degassing and atomization.

In addition, when used with environmentally safe aqueous cleaning solutions, the Vibra-Cell becomes a powerful cleaning tool, capable of removing the most tenacious contaminants from normally inaccessible locations. Unlike ultrasonic baths, which dissipate the vibrational energy over a large area, the Vibra-Cell probe focuses the energy to create a concentrated, high intensity cleaning zone.

How Does it Work ?

The ultrasonic power supply (generator) converts 50/60 Hz voltage to high frequency electrical energy. This electrical energy is transmitted to the piezoelectric transducer within the converter, where it is changed to mechanical vibrations. The longitudinal vibrations from the converter are intensified by the probe (horn), creating pressure waves in the liquid. These in turn produce microscopic bubbles (cavities), which expand during the negative pressure excursion, and implode violently during the positive excursion. This phenomenon, referred to as cavitation, creates millions of shock waves and releases high levels of energy into the liquid.

Superior Technology

To eliminate the need for constant attention, and to give you complete freedom to focus on what's important, the Vibra-Cell combines our proprietary Optotune™ automatic tuning control with power-on-demand technology. Feedback from the probe is continuously evaluated, and frequency and power is automatically adjusted to ensure optimum transfer of energy from the power supply to the probe, as well as preselected amplitude maintenance. Additionally, the VCX Series has the unique capability of digitally monitoring both the power in watts and the energy in Joules. All units are remote actuation compatible, and incorporate sensitive overload protection circuitry. The converters are designed for heavy-duty operation, and for long-term reliability are sealed to inhibit failures due to humidity, dirt or corrosive fumes. Filtering ensures compliance with worldwide rules and regulations governing RF interference and leakage current. For maximum economy, all 1/2" (13 mm), 3/4" (19 mm) and 1" (25 mm) probes are available with replaceable tips; when cavitation erosion is advanced, it is only necessary to replace the tip, not the complete probe.

For Your Information... Power Ratings - Real or Exagerated

With ultrasonic processing, the higher the wattage and the larger the probe diameter, the greater the volume that can be processed. Because power rating determinations vary widely with manufacturers, it is recommended that probe selection be carefully reviewed in order to ensure that the implied processing capabilities of the unit under consideration are valid. For example, a 100 watt unit should be able to drive a 1/2" (13 mm) probe, and **effectively** process up to 100 milliliters.

Because at Sonics, we think that it is important for you to know as much as possible about our equipment, all units in this catalog have been rated in terms of both wattage **and** processing capabilities.

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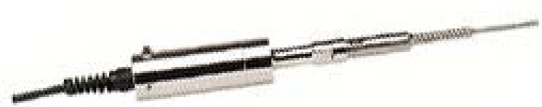
Ultrasonic Processors for OEM Applications

Sonics is structured to serve the OEM market, and over the years we have accumulated more experience working with OEM applications than all other ultrasonic companies combined. Our contributions have been numerous and applications diverse; from preparation of samples for particle size analysis, to the dissolution of reagents for diagnostic investigations.

For most applications we have at our disposal a wide selection of proven products designed specifically for the OEM market; they are readily available, and cost effective. In addition to these products, we can provide customized equipment for specific applications.

Our Development Engineers are forever working on new and innovative products, and they typically devote as much time in the field working collaboratively with manufacturers, as they do in the laboratory, designing and refining products to satisfy their exact requirements. Their involvement with a variety of critical projects has compelled us to develop equipment that is both rugged and reliable, establishing our company as the supplier of choice for demanding ultrasonic applications.

So whether you have an existing application, or just want to explore how the inclusion of ultrasonics can enhance your process, and add value to your product line, please feel free to contact a member of our technical staff. Your needs will be assessed confidentially, without obligation or preconceived solutions . . . just customized alternatives to address your particular requirements.



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SONICS
Newtown, CT USA
800-745-1105

ULTRASONIC PROCESSORS FOR LOW VOLUME APPLICATIONS

130 Watt Ultrasonic Processor With Thumb Actuated Pulser
150 microliters to 150 milliliters

VC 130 PB

- Automatic Tuning
- Digital wattmeter
- Thumb actuated pulser
- Variable power output control

Specifications

POWER SUPPLY	Net power output: 130 Watts. Frequency: 20 kHz Dimensions (HxWxD): 4 1/2" x 9 3/4" x12 1/2" (115 x 250 x 320 mm) Weight: 6.5 lbs. (3 kg.) Can be run continuously or in a pulsing mode using the pulsing button.
CONVERTER	Model CV 188 with pulsing button. Compatible with VC 130 PB. Model CV 18 without pulsing button. Compatible with VC 130 PB1. Piezoelectric lead zirconate titanate crystals (PZT). Diameter: 1 1/4" (32mm) Length: 5 3/4" (146 mm) Weight: 3/4 lb. (340 g) Cable length: 5´ (1.5 m)
STANDARD PROBE	Tip diameter: 1/8" (3 mm). Processing capability: 250 µl to 10 ml. Length: 5 7/16" (138 mm). Titanium alloy: TI-6AL-4V
ELECTRICAL REQUIREMENTS	Unless otherwise specified, units are wired for 117 volts, 50/60 Hz. For export, please specify desired voltage option.

Ordering Information

	Order No.
130 Watt Ultrasonic Processor with thumb actuated pulser.	**VC 130 PB**
130 Watt Ultrasonic Processor with footswitch jack.	**VC 130 PB-1***

Shipped complete and ready for operation with a 1/8" (3 mm) probe, tool kit, and instruction manual.

Optional Accessories

<u>For Optional Accessories and other volumes, please click here...</u>**

<u>A different Probe can be substituted for the one listed</u>

* Model VC 130 PB does not have a footswitch jack. Model VC 130 PB-1 has a footswitch jack but the converter does not incorporate a thumb actuated pulser.

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ULTRASONIC PROCESSORS FOR LOW VOLUME APPLICATIONS

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130 Watt Ultrasonic Processor - With Timer & Pulser
150 microliters to 150 milliliters

VC 130

- Automatic Tuning
- Digital wattmeter
- Ten minute timer
- Full function pulser
- Variable power output control

Specifications

POWER SUPPLY	Net power output: 130 Watts. Frequency: 20 kHz Dimensions (HxWxD): 4 1/2" x 9 3/4" x12 1/2" (115 x 250 x 320 mm) Weight: 7 lbs. (3 kg) Timer - solid state - Variable from 1 minute to 10 minutes Pulser - solid state - Off cycle 1 second - On cycle variable from 1 to 10 seconds Footswitch jack
CONVERTER	Model CV 18. Piezoelectric lead zirconate titanate crystals (PZT). Diameter: 1 `1/4" (32mm) Length: 5 3/4" (146 mm) Weight: 3/4 lb. (340 g) Cable length: 5´ (1.5 m)
STANDARD PROBE	Tip diameter: 1/4" (6 mm). Processing capability: 10 ml to 50 ml.* Length: 5 7/16" (138 mm). Titanium alloy: TI-6AL-4V
ELECTRICAL REQUIREMENTS	Unless otherwise specified, units are wired for 117 volts, 50/60 Hz. For export, please specify desired voltage option.

Ordering Information

	Order No.
130 Watt Ultrasonic Processor	**VC130**

Shipped complete and ready for operation with a 1/4" (6 mm) probe*, tool kit, and instruction manual.

Optional Accessories

* For other volumes, please refer to probe and microtip listings by clicking here or on the navigation bar. A different probe can be substituted for the one listed.

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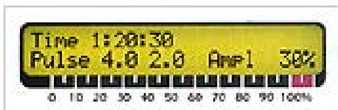
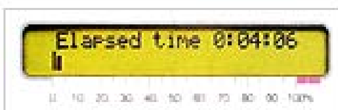
ULTRASONIC PROCESSORS FOR HIGH VOLUME APPLICATIONS

500 & 750 Watt Ultrasonic Processor - 250 Microliters to Liters

Real time display . . .





VC-505/ VC-750

- **Automatic Tuning and Frequency Control**
  Eliminates the need for constant adjustment of the power supply
- **Microprocessor Based – Programmable**
  Digital accuracy and repeatability assures adherence to the most exacting protocol.
- **Energy Monitor**
  Digitally displays the actual amount of energy (Joules) delivered to the probe.
- **Wattmeter**
  Digitally displays the actual amount of power (watts) delivered to the probe.
- **Automatic Amplitude Compensation**
  Ensures uniform probe amplitude regardless of the varying loading conditions encountered during the processing cycle.
- **Real Time Display**
  Provides a window on the process. No more assumptions. No more approximations. All parameters are continuously displayed on the screen, providing operating mode confirmation without process interruption.
- **Variable Power Output Control**
  Allows the ultrasonic vibrations at the probe tip to be set to any desired amplitude. Selected output level is clearly displayed on the screen.
- **Ten Hour Process Timer**
  Controls the processing time – from one second to ten hours.
- **Elapsed Time Indicator**
  Monitors both the elapsed time and the duration of processing.
- **Independent On/Off Pulser**
  Enables safe treatment of temperature sensitive samples at high intensity. Both on and off cycles are independently controllable from .1 second to 10 seconds.
- **User friendly**
  Menu driven fill-in-the-blank prompts lead you intuitively through all functions.
- **Less Space - More Power**
  Compact upright configuration minimizes bench space. Innovative technology packs 750 watts of power. It is the most powerful

unit in the industry for it's size.

* On a flow-through basis

Click here or on navigation bar for specifications

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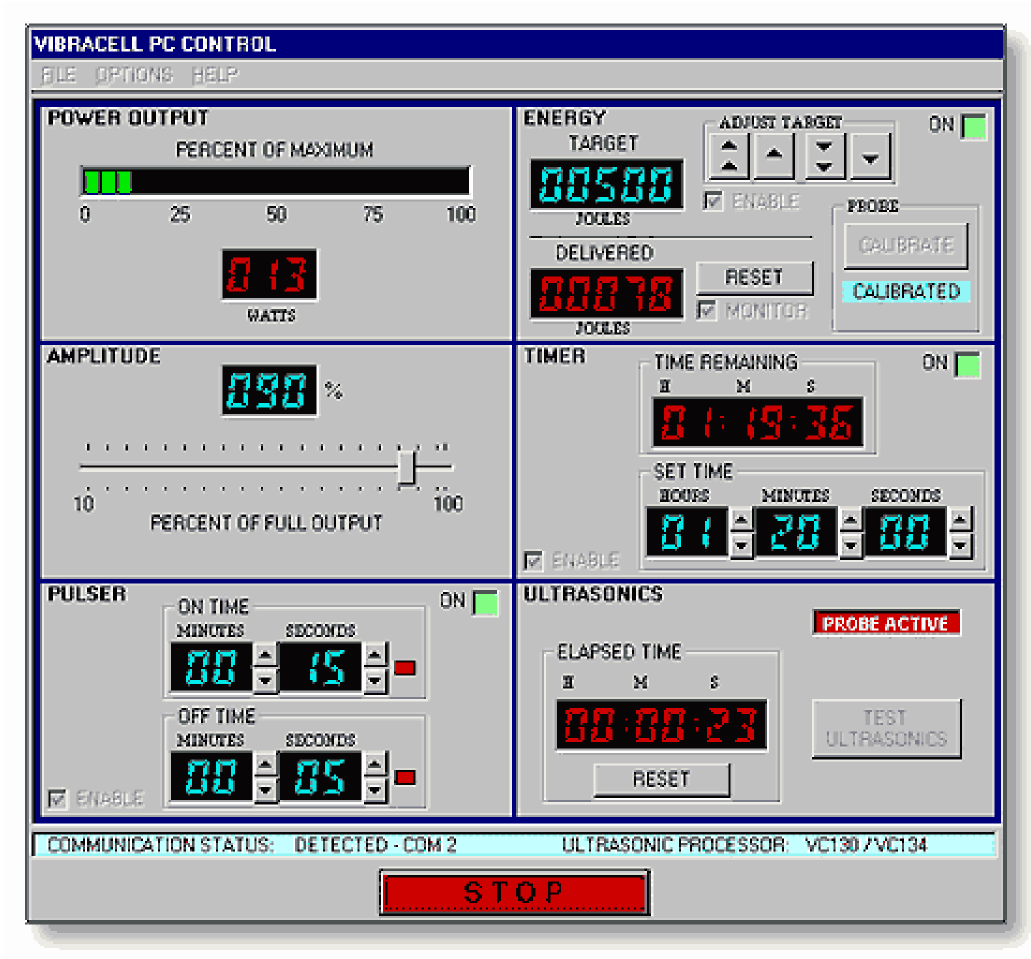
Personal Computer Interface



- Converts any PC with Windows into a fully functioning operator interface station.
- Significantly extend the Vibra-Cell capabilities by controlling and monitoring the amplitude, power output (watts), energy (joules), processing time and pulsing mode.
- Procedures and captured data can be saved and retrieved at any time for duplication or analysis.
- Easy to set-up, easy-to-operate. Point-and-click operation leads intuitively through all functions.
- Consists of CD-Rom, interface module, interconnecting cables and operating instructions.
- Compatible with VC 130 PB, VC 130, VC 750.
  Order No. 830-00314

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SONICS
Newtown, CT

ULTRASONIC PROCESSORS FOR HIGH VOLUME APPLICATIONS

500 and 750 Watt Ultrasonic Processors - VCX Series - 250 microliters to liters*

simply stated... the VCX sets the standard as the most productive and advanced Ultrasonic Processor in the industry

Real time display . . .

VCX 500 - VCX 750

- **Automatic Tuning and Frequency Control**
  Eliminates the need for constant adjustment of the power supply.
- **Integrated Temperature Controller**
  Precludes harmful overheating of the sample and guarantees process integrity by terminating the ultrasonics when the sample temperature reaches a predetermined limit. Allows process control and monitoring from 1°C to 100°C.
- **Consistent Reproducibility**
  Time saving memory facilitates complex protocol duplication, automates repetitive tasks, and eliminates technician to technician method variability. Conveniently stores up to ten procedures.
- **Microprocessor Based – Programmable**
  Digital accuracy and repeatability assures adherence to the most exacting protocol.
- **Energy Monitor**
  Digitally displays the actual amount of energy in Joules delivered to the probe.
- **Wattmeter**
  Digitally displays the actual amount of
- **Real Time Display**
  Provides a window on the process. No more assumptions. No more approximations. All parameters are continuously displayed on the screen, providing operating mode confirmation without process interruption.
- **Variable Power Output Control**
  Allows the ultrasonic vibrations at the probe tip to be set to any desired amplitude. Selected output level is clearly displayed on the screen.
- **Ten Hour Process Timer**
  Controls the processing time - from one second to 10 hour.
- **Elapsed Time Indicator**
  Monitors both the elapsed time and the duration of processing.
- **Independent On/Off Pulser**
  Enables safe treatment of temperature sensitive samples at high intensity, and provides mixing by repeatedly allowing the sample to settle back under the probe after each burst. Both on and off cycles are independently controllable from .1 second

power in watts delivered to the probe.

- **Automatic Amplitude Compensation**
  Ensures uniform probe amplitude regardless of the varying loading conditions encountered during the processing cycle.

to 10 seconds.

- **User Friendly**
  Menu driven fill-in-the-blank prompts lead you intuitively through all functions.
- **Less Space - More Power**
  Compact upright configuration minimizes bench space. Innovative technology packs 750 watts of power. It is the most powerful unit in the industry for it's size.

* On a flow-through basis

Ordering Information

	Order No.
500 Watt Ultrasonics Processor	**VCX 500**
750 Watt Ultrasonic Processor	**VCX 750**

Shipped complete and ready for operation with a 1/2" (13 mm) probe, tool kit, and instruction manual.

Optional Accessories

For optional accessories, and other volumes, please refer to probe and microtip listings in the accessories section or by clicking here

Click Here for Specifications

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SONICS
Newtown, CT

Ultrasonic Processor for Industrial Applications

1500 Watt Ultrasonic Processor

VCF 1500

- Automatic Tuning
- Up to 40 Liters on a batch basis
- Up to 100 liters/hour on a flow through basis

The VCF 1500 can be used by itself or with the optional high volume continuous flow cell. When used in conjunction with the flow cell, throughput rate is typically 100 liter/hour – variables being viscosity and desired degree of processing. The flow cell is recommended for the treatment of low viscosity samples that do not require extended exposure to ultrasonics. Designed primarily for dispersing and homogenizing. For optimum performance, when working on a flow through basis, it is recommended that the sample be premixed with a mechanical mixer or a stirrer. Easily disassembled for inspection and cleaning.

NOTE: The flow cell includes a very high amplitude probe and should not be used with a booster.

Specifications

POWER SUPPLY	Net power output: 1500 Watts. Frequency: 20 kHz Dimensions (H x W x D): 6 1/2" x 17" x 22 1/2" (165 x 432 x 571 mm) Weight: 49 lbs. (22.2 kg.)
AIR COOLED CONVERTER	Model CV 154. PZT piezoelectric lead zirconate titanate crystals (PZT) Diameter: 2 13/16" (71 mm) Length: 6 1"2" (165 mm) Weight: 2 lbs. (900 g) Cable length: 10´ (3 m)

BOOSTER	BHNVC 15 - Increases amplitude by 50%
STANDARD PROBE	Tip diameter: 1" (25 mm). Solid or with threaded end and replaceable tip. Please specify. (see caution on page 8) Processing capabilities: 2 liters - up to 60 liters when used with a special extender** and a mechanical mixer Length: 5" (127 mm) Weight: 1 lb (450 g) Titanium alloy: TI-6AL-4V
ELECTRICAL REQUIREMENTS	220 volts, 50/60 Hz.
CONTINUOUS FLOW CELL Optional	Weight: 9 lbs. (4.1 kg) Housing: 316 stainless steel. Quick opening clamps Probe: Titanium alloy TI-6AL-4V Operating pressure: Up to 50 psi (345 kPa/3.45 Bar)

Ordering Information

	Order No.
1500 Watt Ultrasonic Processor	**VCF-1500**
High volume continuous flow cell with probe	**630-0573**
Replacement probe for high volume continuous flow cell	**630-0571**
Sound abating enclosure for VCF 1500	**630-0427**
Sound abating enclosure for high volume continuous flow cell (H x W x D) 36”x 16 x 16 (914 x 406 x 406 mm)	**630-0474**

* Can be supplied with a solid probe. Please specify. Probes with replaceable tip should never be used with low surface tension liquids. See caution below.
** Replaces probe. Diameter 1 1/2" (33 mm). Length 20" (50 mm).

CAUTION: All probes, including those with replaceable tips, are tuned to resonate at 20 kHz +/- 100 Hz. If the replaceable tip is removed or isolated from the rest of the probe, that element will no longer resonate at 20 kHz and the power supply will fail. Organic solvents (e.g. methylene chloride) and low surface tension liquids will penetrate the interface between the probe and the replaceable tip, thus carrying the particulates into the threaded section and isolating the tip from the probe. When working with organic solvents or low surface tension liquids, ALWAYS use a solid probe or as an alternate a full wave 10" (254 mm) probe or an extender. NEVER use a probe with a replaceable tip.

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SONICS
Newtown, CT

Ultrasonic Equipment For Sonochemistry

*The chemical effects of ultrasound are diverse and include dramatic improvements in both stoichiometric and catalytic reactions. In some cases, ultrasonic irradiation can increase reactivities by nearly a million-fold. It does so through the process of acoustic cavitation; the formation, growth and implosive collapse of bubbles in a liquid.

During cavitational collapse, intense heating of the bubbles occurs. The localized hot spots have temperatures in the range of 5000°C, pressures approaching 500 atmospheres, lifetimes of a few microseconds, and heating and cooling rates greater than 10^9 K/s.

Applications for chemical reactions exist in both homogeneous liquids and in liquid-solid system. Of special synthetic use is the ability of ultrasound to create clean, highly reactive surfaces on metals. Ultrasound has also been found to be beneficial for the initiation or enhancement of catalytic reactions, in both homogeneous and heterogeneous cases.

Recommended Ultrasonic Processor

VC 750, VCX 500, or VCX 750.

Sonochemical Reaction Vessels

The sonochemical reaction vessel consists of a borosilicate reaction chamber and a precision stainless steel collar, or adapter. The collar and adapter screw onto a solid or threaded end 1/2" (13 mm) probe at the nodal point (point of no activity). With the suslick reaction vessel, the glass chamber slides into the collar and is held in place by an internal O-ring. With the other vessels, the glass chamber slides onto the 1" (25 mm) outside diameter portion of the 5" (127 mm) tubular adapter, and is secured in place by the action of a threaded nylon bushing compressing an O-ring. Moving the adapter in or out of the vessel allows the probe to be immersed at different depths, ensuring optimum transfer of energy into the sample.

The Suslick sonochemical reaction vessel consists of a borosilicate glass cell and a precision machined stainless steel collar. Three side ports accept septum for syringe charging or retrieval. The vessel screws onto a 1/2" (13 mm) solid or threaded end probe. Glass chamber height: 3 1/4" (82 mm). Supplied with plastic caps. Order No. 830-00007.

3-10 ml Sonochemical reaction vessel.** Two 14/20 side necks. Supplied with bushing and O-ring. Glass chamber height: 4 7/8" (123 mm). Order No. 830-00011.

10-50 ml Sonochemical reaction vessel.** Bottom well capacity: 10 ml. Main body capacity: 50 ml. Two 14/20 side necks. Supplied with bushing and O-ring. Glass chamber height: 4 3/4" (120 mm). Order No. 830-00012.

40-250 ml. Sonochemical reaction vessel.** Three 14/20 side necks. Flat bottom accommodates magnetic stirrer. Supplied with bushing and O-ring. Glass chamber height: 6 3/8" (162 mm). Order No. 830-00013.

Special Probes

1/2" (13 mm) special solid probe 10" (254 mm) long. Recommended when working with low surface tension liquids and the tubular adapter. Order No. 630-0217.

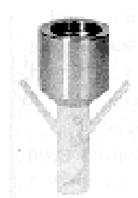
1/2" (13 mm) special probe 10" (254 mm) long with threaded end, and replaceable tip. Recommended when working with the tubular adapter. Order No. 630-0218.

Tubular Adapter

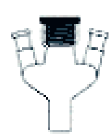
5" (127 mm) long. Stainless steel. Internally threaded. Order No. 830-00014.

*From an article by Dr. Kenneth Suslick, Professor of Chemistry and Beckman Institute Professor, University of Illinois at Urbana/Champaign 61801.

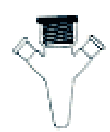
**Must be used with solid tubular
adapter. Order No. 830-00014 and special probes listed above. Refer to catalog.



Suslick Vessell
830-00007



3-10 ml Vessell
830-00011



10-50 ml Vessell
830-00012

40-250 ml Vessell
830-00013

Adapter
830-00014

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SONICS
Newtown, CT

ULTRASONIC ATOMIZERS

Low & Medium Atomization Rate - 20 & 40 kHz

VC 130 AT / VC 134 AT

- From microliters to gallons – continuous or intermittent
- Pressureless atomization - low velocity mist
- Dispenses material with minimum overspray
- Low cost atomizng probe replacement

General Description

Unlike conventional atomizing nozzles, that rely on pressure and high-velocity motion to shear a fluid into small drops, the ultrasonic atomizer uses only low ultrasonic vibrational energy for atomization. The liquid can be dispensed to the atomizing probe (nozzle) by either gravity feed or a small low-pressure metering pump, and atomized continuously or intermittently. The amount of material atomized can be as little as 2 µl/sec. Because the velocity of the droplets generated is very low, the probe should be mounted with the tip facing downward, and air disturbances kept to a minimum. A wide variety of coatings, chemicals, lubricants, and particulate suspensions can readily be atomized. However, factors such as viscosity, miscibility, and solid content deserve consideration. For optimum atomization, the viscosity should be below 60 cps and the solid concentration kept below 30%. Because the atomization process depends on setting a liquid film into motion, typically the more viscous the liquid, the more difficult the application. The atomization of liquids containing long-chained polymer molecules is problematic, even in diluted form, due to the highly cohesive nature of the material. In many cases, mixtures with particulates can be atomized, because the solids are simply carried along in the drops. The low transport velocity of the liquid through the probe permits even abrasive slurries to be processed with negligible erosion of the passageway. The aperture is relatively large, and practically uncloggable. The higher the frequency, the smaller the drop size. The median drop size at 20 kHz is 90 microns, and 45 microns at 40 kHz.

How Does It Work?

The ultrasonic power supply converts 50/60 Hz to high frequency electrical energy. This electrical energy is transmitted to the piezoelectric transducer within the converter, where it is changed to mechanical vibrations. The ultrasonic vibrations are intensified by the probe and focused at the tip where the atomization takes place. The liquid travels through the probe, and spreads out as a thin film on the atomizing surface. The oscillations at the tip disintegrate the liquid into micro-droplets, and then eject them to form a gentle, low viscosity mist.

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SONICS
Newtown, CT

Questions & Answers

What is ultrasonics?

Everything that makes a sound vibrates, and everything that vibrates makes a sound. However, not all sounds are audible. Ultrasound literally means beyond sound; sound above the human audible spectrum. Using 18,000 Hertz (cycles per second) as the approximate limit of human hearing, ultrasonics refers to sound above that frequency.

What are the differences between an ultrasonic processor and an ultrasonic bath?

The intensity within a bath is fixed, low, location dependent, and inconsistent, due to the fluctuation in the level and temperature of the liquid.

With an Ultrasonic Processor, processing is fast and highly reproducible. The energy at the probe tip is high (at least 50 times that produced in a bath), focused and adjustable.

20 kHz versus 40 kHz

40 kHz if often used for ultrasonic atomization because the droplet size at that frequency is half that generated at 20 kHz. On the other hand, the frequency of choice for most ultrasonic liquid processing applications is 20 kHz, because the amplitude at the probe tip and the resulting cavitation is twice that generated at 40 kHz.

Are there any limitations with ultrasonic processing.

Yes. Viscosity, temperature and liquid characteristics.

As the viscosity of the material increases, its ability to transmit vibrations decreases. Typically, the maximum viscosity at which a material can be processed effectively is 5000 cps. With standard systems, the practical upper limit on temperature is approximately 100°C. Solid probes can safely be used with both aqueous solutions and low surface tension liquids (e.g. solvents), however, probes with replaceable tips should never be used with low surface tension liquids.

Which instrument should I use?

The 500 and 750 watt units are the most versatile because they can process both large and small volumes - on a batch basis, as little as 250 µl with a microtip, and as much as 1 liter with a 1" (25 mm) probe. On a flow through basis, up to 10 liters per hour.

However, since every instrument will perform equally well up to a certain volume, for samples up to 150 ml we recommend the 130 watt unit.

Which probe is best suited for my application?

The larger the probe diameter, the larger the volume that can be processed, but at lesser intensity. See probe listings for recommendations; and for dependable performance, always use a solid probe when working with low surface tension liquids.

Can probes be manufactured to any length?

No. Probes are made to resonate at a specific frequency (half a wave length or multiple thereof). 20 kHz probes are typically 5" (127 mm) long and can be made longer in 5" increments. 40 kHz probes are typically 2.5" (63,5 mm) long and can be made longer in 2.5" increments.

Do all manufacturers rate their instruments the same way?

Unfortunately not. Unlike some other manufacturers, we use the RMS rating - the amount of power, measured in watts, that a unit is capable of delivering continuously. Most of our competitors use the Peak Power rating - the maximum amount of power, measured in watts, that a unit is capable of delivering only for a short time.

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ACCESSORIES

Optional Accessories For
VC 130 and VC 130 PB

Optional Accessories For
VC 750, VCX 500 and VCX 750

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Thank you for visiting the Sonics' Web Site. Please fill out the form below to receive more information on our product lines.

Name

Title

Company Name

Address 1

Address 2

City State Country

Zip

Phone Fax Email

Are you a current customer of Sonics?

☐ Yes ☐ No ☐ Former Customer

Are you presently using ultrasonic equipment for your liquid processing needs?

☐ Yes ☐ No If "Yes" what type & brand?

What is your time frame for purchasing ultrasonic liquid processing equipment?

☐ *immediate* ☐ Weeks ☐ Months ☐ Gathering Information

What category are you interested in learning about? Check all that apply.

☐ Life Science Research ☐ Industrial Application ☐ Sample Preparation

☐ Particle Size Reduction ☐ Chemical Applications ☐ Atomization

What Product would you like more information on? Check all that apply.

Ultrasonic processors for low volume applications

☐ VC 130 ☐ VC 130PB

Ultrasonic processors for high volume applications

☐ VC 750 ☐ VCX 500 ☐ VCX 750

Ultrasonic processors for industrial applications

☐ VCF 1500

Ultrasonic equipment for sonochemistry

☐ VC 750 ☐ VCX 500 ☐ VCX 750

Ultrasonic atomizers

☐ Dual Inlet Atomizing Probe ☐ Wide Dispersion Atomizing Disk - 20 kHz ☐ Wide Dispersion Atomizing Disk - 40 kHz

How can Sonics assist you in your search for ultrasonic equipment

☐ Have a Salesperson Call
☐ Product Inquiry
☐ Pricing
☐ Application Question
☐ Service Request
☐ Schedule a Demonstration

Other

Send Literature

☐ Brochure ☐ Data Sheets

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Trade Show *(Name of Conference or Exhibition)*	
Internet Search *(Name of Search Engine)*	
Referral *(Referred by:)*	
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☐ Please contact me as soon as possible regarding this matter.

Submit Comments | Clear Form

Revised: November 11, 2002 .

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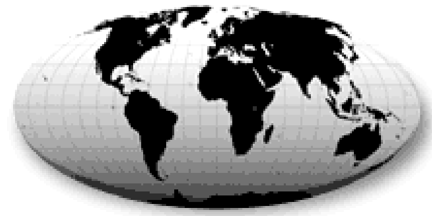

This page contains product information, manuals and brochures on Sonics' Liquid Processing Equipment. If you do not find what you are looking for please go to our information request page or call us.

User Guides - Current Production Models

English

VC130-VC130PB-VC134-VC134PB, VC-70, VC70T PDF

VCX500-VCX 750 PDF

VC505-VC750 PDF

VCF1500 PDF

VCF1500HV PDF

French

VC130-VC130PB-VC134-VC134PB PDF

VC505-VC750 PDF

VCX500-VCX750 PDF

User Guides - Out of Production Models

VC40 40-watt (1988) PDF

VC50 50-watt (1989) PDF

VC50 AT (1990) PDF

VC50T 50-watt with timer (1997) PDF

VC60 high tech 60-watt (1990) PDF

VC100 100-watt (1992) PDF

VC250-VC250B-VC500 250 & 500 watt (1983) PDF

VC300-VC375-VC600-VC600Dual 300, 375, 600, & 600D (1993) PDF

VC501-VC602 PDF

VCX400-VCX600 400 & 600 watt with micro (1995) PDF

Resources

What are Ultrasonics and UltrasonicProcessing ?

Press Releases

New Ultrasonic Probes

Ultrasonic Processing Guide

Faster Ultrasonic Processing

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rsoloff@sonics.biz

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eneeb@sonics.biz

Lois Baiad – *Manager, Sales Administration*. Lois is responsible for all sales administration functions; regarding products, pricing, quotations, orders, expediting, shipping, and invoicing.
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service@sonics.biz

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Sonics' uncompromising philosophy and commitment to quality has led us to a position as a world wide leader in the design, manufacture and distribution of:

Plastics Assembly

- Ultrasonic, Vibration, Spin, Hot Plate, & Heat Staking equipment for the welding, joining and fastening of thermoplastic components, textiles and other synthetic materials

Vibra-cell™ Liquid Processing

- Ultrasonic liquid processors for dispersing, blending, cleaning, atomizing and reducing particles as well as expediting chemical reactions

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Links

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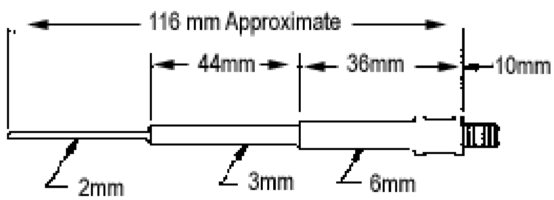
OPTIONAL ACCESSORIES FOR VC 130 AND VC 130PB

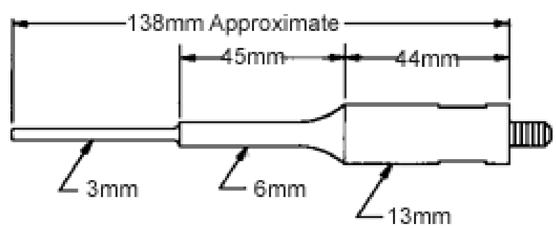
Stepped Microtips and Probes

Microtips and probes intensify and radiate the ultrasonic energy into the sample. Smaller diameter tips produce greater intensity of cavitation, but the energy released is restricted to a narrower, more concentrated field. Conversely, larger diameter tips produce lower intensity, but the energy is released over a greater area. The larger the tip diameter, the larger the volume that can be processed, but at reduced intensity.

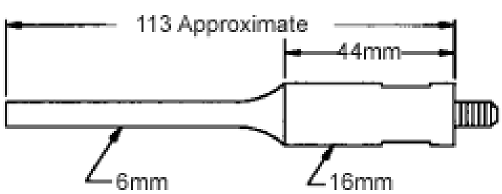
2mm (5/64") Probe
Order No. 630-0423



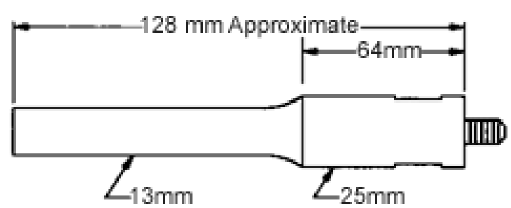
3mm (1/8") Probe
Order No. 630-0422



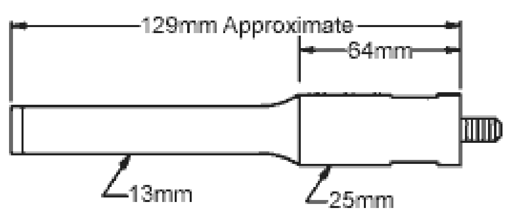
6mm (1/4") Probe
Order No. 630-0435



13mm (1/2") Probe
Order No. 630-0561



13mm (1/2") Probe with replaceable tip*
Order No. 630-0560



STEPPED MICROTIPS AND PROBES

Tip Diameter	5/64" (2 mm)	1/8" (6 mm)	1/4" (6 mm)	1/2" (13 mm)
Intensity	Ultra High	Very High	High	Medium

Volume (batch)	150 µl- 5 ml	250 µl- 10 ml	10- 50 ml	50- 150 ml
Amplitude* (in micrometer) (in inch)	207 .0081	182 .0071	123 .0048	75 .0030

Replaceable Tip

13 mm (1/2") tip**
Order No. 630-0406

Continuous Flow Cell

The continuous flow cell screws into the converter in place of the probe. Recommended only for the treatment of low viscosity samples which do not require extended exposure to ultrasonics. Designed primarily for dispersing and homogenizing at rates up to 15 liters/hour.
Vessel composition: Glass
The probe and processing chamber are fabricated from titanium alloy TI-6AL-4V and are autoclavable.
For low pressure applications only.
Order No. 630-0566

NOTE: All probes and replaceable tips are fabricated from high grade titanium alloy TI-6AL-4V and are autoclavable.
Ultrasonic probes are tuned to resonance, causing their lengths to vary because of variations in the modulus of elasticity.
.

*Do not use with low surface tension liquids. Use solid probe **Order No. 630-0561** instead.
See Caution Below
**Supplied individually or in sets of five.

Click here or on the tool bar to the left for more accessories.

CAUTION: all probes, including those with replaceable tips, are tuned to resonate at 20 kHz ± 100 Hz. If the replaceable tip is removed or isolated from the rest of the probe, that element will no longer resonate at 20 kHz and the power supply will fail. Organic solvents (e.g. methylene chloride) and low surface tension liquids will penetrate the interface between the probe and the replaceable tip, thus carrying the particulates into the threaded section and isolating the tip from the probe. When working with organic solvents or low surface tension liquids, ALWAYS use a solid probe or as an alternate a full wave 10" (254 mm) probe or an extender. NEVER use a probe with a replaceable tip.

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VC-505 & VC-750 Watt Ultrasonic Processor Specifications

POWER SUPPLY	Net power output: VC-500 - 500 watts VC-750 750 Watts. Frequency: 20 kHz Dimensions: (H x W x D): 9 1/4" x 7 1/2" x 13 1/2" (235 x 190 x 340 mm) Weight: 15 lbs. (6.8 kg).
SEALED CONVERTER	Model CV 33. PZT piezoelectric lead zirconate titanate crystals. Diameter: 2 1/2" (63.5 mm) Length: 7 1/4" (183 mm) Weight: 2 lbs. (900 g) Cable length: 5´ (1.5 m)
STANDARD PROBE	Tip diameter: 1/2" (13 mm) solid or with threaded end and replaceable tip (please specify).* Processing capability: 10 ml to 250 ml.** Length: 5 3/8" (136 mm) Weight: 3/4 lb (340 g) Titanium alloy: TI-6AL-4V
ELECTRICAL REQUIREMENTS	Unless otherwise specified, units are wired for 117 volts, 50/60 Hz. For export, please specify desired voltage option.
ORDERING INFORMATION	**Order No.** 500 Watt Ultrasonic Processor . . . . VC 505 750 Watt Ultrasonic Processor . . . . VC 750 Shipped complete and ready for operation with a 1/2" (13 mm) probe with replaceable tip*, tool kit and instruction manual
OPTIONAL ACCESSORIES	* For other volumes, please refer to probe and microtip listings by clicking here or on the navigation bar. A different probe can be substituted for the one listed ***See caution below. A different probe can be substituted for the one listed.**

Special EPA Environmental Testing Package

For Extracting pesticides/PCB, and nonvolatile and semivolatile organic compounds from soil, sludge and waste samples in accordance with EPA Method 3550.

SINGLE TEST SYSTEM

1 each. Model VC 505 – 500 watt ultrasonic processor with converter and 1/2" (13mm) probe with threaded end and replaceable tip.

1 each 1/8" (3 mm) tapered microtip Order No. 630-0418.

1 each. 3/4" (19 mm) solid probe Order No. 630-0208.

* CAUTION: all probes, including those with replaceable tips, are tuned to resonate at 20 kHz +/- 100 Hz. If the replaceable tip is removed or isolated from the rest of the probe, that element will no longer resonate at 20 kHz and the power supply will fail. Organic solvents (e.g. methylene chloride) and low surface tension liquids will penetrate the interface between the probe and the replaceable tip, thus carrying the particulates into the threaded section and isolating the tip from the probe. When working with organic solvents or low surface tension liquids, ALWAYS use a solid probe or as an alternate a full wave 10" (254 mm) probe or an extender. NEVER use a probe with a replaceable tip.

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VCX 500 - VCX 750 Ultrasonic Processor Specifications

POWER SUPPLY	Net power output: VCX 500 - 500 Watts. VCX 750 - 750 Watts. Frequency: 20 kHz Dimensions (H x W x D): 9 1/2" x 7 ½" x 13 ½" (235 x 190 x 340 mm) Weight: 15lbs. (6.8 kg.)
SEALED CONVERTER	Model CV 33. PZT piezoelectric lead zirconate titanate crystals. Diameter: 2 1/2" (63.5 mm) Length: 7 1/4" (183 mm) Weight: 2 lb. (900 g) Cable length: 5´ (1.5 m)
STANDARD PROBE	Tip diameter: ½" (13 mm). solid or with threaded end and replaceable tip. Please specify.* Processing capability: 10 ml to 250 ml.** Length: 5 3/8" (136 mm). Weight: 3/4 lb. (340 g) Titanium alloy: TI-6AL-4V
TEMPERATURE *(Optional)*	Stainless steel – Order No. **830-00060**
ELECTRICAL REQUIREMENTS	Unless otherwise specified, units are wired for 117 volts, 50/60 Hz. For export, please specify desired voltage option.

Ordering Information

	Order No.
500 Watt Ultrasonics Processor	**VCX 500**
750 Watt Ultrasonic Processor	**VCX 750**

Shipped complete and ready for operation with a 1/2" (13 mm) probe, tool kit, and instruction manual.

* A different probe can be substituted for the one listed.

CAUTION: all probes, including those with replaceable tips, are tuned to resonate at 20 kHz % 100 Hz. If the replaceable tip is removed or isolated from the rest of the probe, that element will no longer resonate at 20 kHz and the power supply will fail. Organic solvents (e.g. methylene chloride) and low surface tension liquids will penetrate the interface between the probe and the replaceable tip, thus carrying the particulates into the threaded section and isolating the tip from the probe. When working with organic solvents or low surface tension liquids, ALWAYS use a solid probe or as an alternate a full wave 10" (254 mm) probe or an extender. NEVER use a probe with a replaceable tip.

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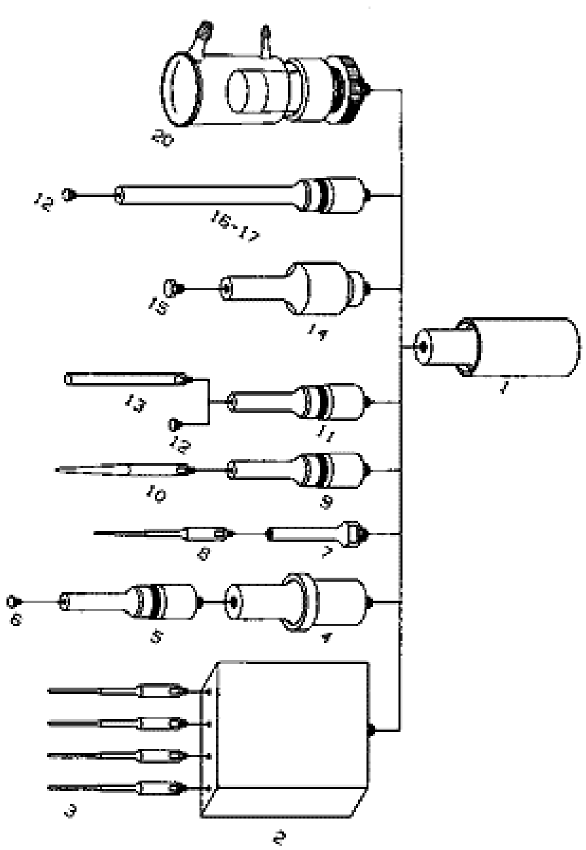
OPTIONAL ACCESSORIES FOR VC 750, VCX 500 & VCX 750

The accessories and attachments described in this section are compatible with most 20 kHz Ultrasonic Processors. Please specify make, model, and threaded stud size (1/2" -20 or 3/8" -24) when ordering.



Probes (Horns)

Probes intensify and radiate the ultrasonic energy into the sample. Probes with smaller tip diameters produce greater intensity of cavitation, but the energy released is restricted to a narrower, more concentrated field immediately below the tip. Conversely, probes with larger tip diameters produce reduced intensity, but the energy is released over a greater area. The larger the tip diameter, the larger the volume that can be processed, but at reduced intensity. High gain probes produce higher intensity than standard probes, and are usually recommended for processing larger volumes or difficult applications. Probes are fabricated from high grade titanium alloy TI-6AL-4V because of its good acoustical properties, low toxicity, high resistance to corrosion, and excellent resistance to cavitaton erosion. They are autoclavable, and are available with threaded ends to accept replaceable tips, microtips and extenders.

Caution:
Do not use a tapered microtip with a coupler. Do not use a stepped microtip without a coupler. Do not use a probe with threaded end and replaceable tip when working with organic solvents or low surface tension liquids. Use a solid probe instead. See caution below.

No.	DESCRIPTION	Order Number
1	Converter Model CV33	CV00033
2	Four element coupler	630-0558
3	⅛" (3 mm) stepped microtip	630-0422
4	Booster	BHNVCGD
5	½" (13 mm) solid probe	630-0219
	½" (13 mm) probe with threaded end and replaceable tip	630-0220
	¾" (19 mm) probe solid	630-0208
	¾" (19 mm) probe with threaded and replaceable tip	630-0207
	1" (25 mm) solid probe	630-0209
	1" (25 mm) probe with threaded and replaceable tip	630-0210
6	½" (13 mm) replaceable tip	630-0406
	¾" (19 mm) replaceable tip	630-0407
	1" (25 mm) replaceable tip	630-0408
7	Coupler	630-0421
8	⅛" (3 mm) stepped microtip	630-0422
9	½" (13 mm) probe with threaded end and replaceable tip	630-0220
10	⅛" (3 mm) tapered microtip	630-0418
	3/16 (5 mm) tapered microtip	630-0419
	¼ (6 mm) tapered microtip	630-0420
11	Probe - solid or with threaded end and replaceable tip - same as 5	
12	Replaceable tip - same as 6	
13	½" (13 mm) half wave extender 5" (127 mm) long	630-0410
	¾" (19 mm) half wave extender 5" (127 mm) long	630-0409
	1" (25 mm) half wave extender 5" (127 mm) long	630-0444
	¾" (19 mm) full wave extender 10" (254 mm) long	630-0518
	1" (25 mm) full wave extender 10" (254 mm) long	630-0519
14	¾" (19 mm) solid high gain probe	630-0306
	¾" (19 mm) high gain probe with threaded and replaceable tip	630-0305
	1" (25 mm) solid high gain probe	[illegible]
	1" (25 mm) high gain probe with threaded and replaceable tip	[illegible]
15	Replaceable tip ¾" (19 mm) or 1" (25 mm) - same as 6	
16	½" (13 mm) solid full wave probe 10" (254 mm) long	630-0217
17	½" (13 mm) full wave probe 10" (254 mm) long with threaded and replaceable tip	[illegible]
20	1½" (38 mm) cup horn	[illegible]
	2½" (64 mm) cup horn	630-0431
	3" (76 mm) cup horn	630-0496

CAUTION: all probes, including those with replaceable tips, are tuned to resonate at 20 kHz ± 100 Hz. If the replaceable tip is removed or isolated from the rest of the probe, that element will no longer resonate at 20 kHz and the power supply will fail. Organic solvents (e.g. methylene chloride) and low surface tension liquids will penetrate the interface between the probe and the replaceable tip, thus carrying the particulates into the threaded section and isolating the tip from the probe. When working with organic solvents or low surface tension liquids, ALWAYS use a solid probe or as an alternate a full wave 10" (254 mm) probe or an extender. NEVER use a probe with a replaceable tip.

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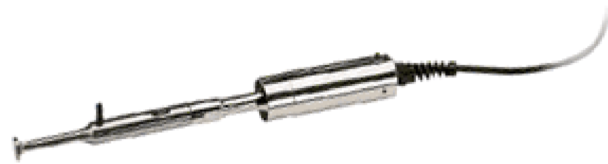
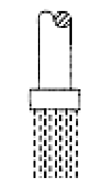
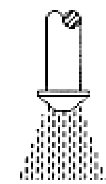


POWER SUPPLY
Net power output: 130 Watts.
Frequency: 20 kHz (Model VC 130 PB). 40 kHz (Model 134 PB).
Dimensions: (H x W x D): 4 1/2" x 9 3/4" x 12 1/2" (115 x 250 x 320 mm)
Weight: 6.5 lbs. (3 kg)

CONVERTER
Piezoelectric lead zirconate titanate crystals (PZT).
20 kHz - Model CV 188 with pulsing button. Compatible with 130 PB.
Model CV 18 without pulsing button. Compatible with 130 PB1.
40 kHz - Model CV 244 with pulsing button. Compatible with 134 PB.
Model CV 24* without pulsing button. Compatible with 134 PB1.
Diameter: 1 1/4" (32 mm)
Length: CV 188 - 5 3/4" (146 mm). CV 244 - 4 3/4" (121 mm)
Weight: 3/4 lb. (340 g)
Cable length: 5´ (1.5 m)



FLAT TIP



CONICAL TIP

ATOMIZING PROBE
Orifice 3/32" (2.3 mm). Port 10-32 THD. Titanium alloy TI-6AL-4V

MEDIAN DROP SIZE
20 kHz: 90 microns. 40 kHz: 45 microns

ELECTRICAL REQUIREMENTS
Unless otherwise specified, units are wired for 117 volts, 50/60 Hz. For export please specify desired voltage option.

Ordering Information

Order No.
130 Watt Ultrasonic Atomizer 20 kHz . . . . **VC 130 AT****
130 Watt Ultrasonic Atomizer 40 kHz . . . . **VC 134 AT****

* A shorter version of CV244 - 3 1/2" (89 mm) long. 1 1/4" (32mm) diameter is available on special order. Model CV243. Compatible with 134 PB1.

**Shipped complete and ready for operation with an atomizing probe or wide dispersion atomizing disc, tool kit, and instruction manual.

Please specify order numbers when ordering power supply, converter, probe and wide dispersion atomizing disc.

Example: VC 130 AT with VC 130 PB power supply, CV 188 converter and 20 kHz atomizing probe Order No. 630-0437.

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Atomizing Probes

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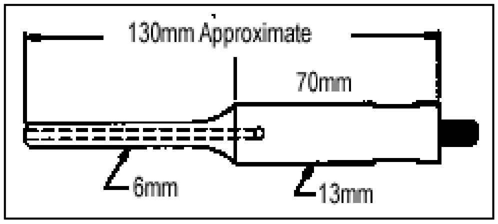
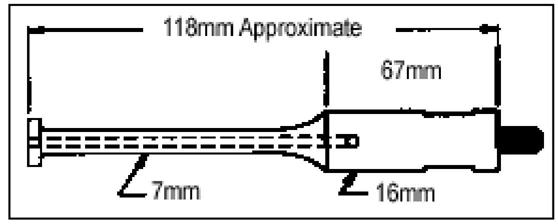
20 kHz Atomizing Probes

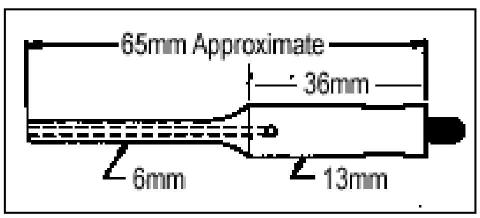


Standard tip half wave
Low atomization rate - max 60 ml./min.
Order No. 630-0437

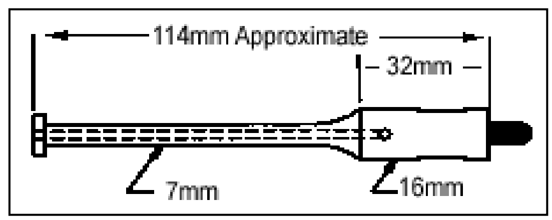


Flat tip half wave
Medium atomization rate - max. 100 ml./min.
Order No. 630-0545

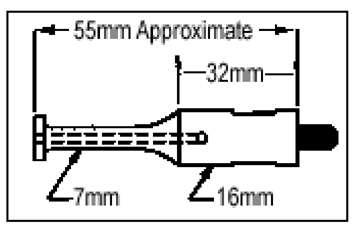
40 kHz Atomizing Probes



Standard tip half wave
Low atomization rate - max. 30 ml./min.
Order No. 639-0499



Flat tip full wave
Medium atomization rate - max. 50 ml./min.
Order No. 630-0547



Flat tip half wave
Medium atomization rate - max. 50 ml./min.
Order No. 630-0552

ULTRASONIC ATOMIZERS

High Atomization Rate - 20 kHz and 40 kHz

Dual Inlet Atomizing Probe - 20 kHz

The dual inlet atomizing probe works with the VC 130 PB Ultrasonic Processor, and screws into the CV 188 converter. The inlet ports permit dissimilar materials to be processed simultaneously. The liquids flow through the probe and out of the tip mixed and atomized. One port can be sealed when processing only one liquid or when atomizing

premixed materials. Atomization can be continuous or intermittent. With water, the maximum delivery capability is 8 liters/hour. The probe is fabricated of titanium alloy TI-6AL-4V. Median drop size: diameter: 90 microns.
Port 10-32 THD.
Order No. 630-0434

Wide Dispersion Atomizing Disc - 20 kHz

The wide dispersion atomizing disc works with the VC 130 PB Ultrasonic Processor, and screws into the CV 188 converter. The liquid dispensed onto the disc surface is disintegrated, and ejected to form a wide low velocity spray pattern. Atomization can be continuous or intermittent. With water the maximum delivery capability is 20 liters/hour. The disc is fabricated of titanium alloy TI-6AL-4V. Median drop size: diameter: 90 microns. Disc diameter: 4" (102 mm)
Order No. 630-0544

Wide Dispersion Atomizing Disc - 40 kHz

The wide dispersion atomizing disc works with the VC 134 PB Ultrasonic Processor (same as the VC130 PB Ultrasonic Processor but 40 kHz) and screws into the CV 244 or CV 243 converter. The liquid dispensed onto the disc surface is disintegrated, and ejected to form a wide low velocity spray pattern. Atomization can be continuous or intermittent. With water the maximum delivery capability is 10 liters/hour. The disc is fabricated of titanium alloy TI-6AL-4V. Median drop size: diameter: 45 microns. Disc diameter: 3" (76mm)
Order No. 630-0542

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ISO 9001 Registered

Sonics & Materials, Inc. 53 Church Hill Road, Newtown, CT 06470-1614 USA
203.270.4600 - 800.745.1105 - 203.270.4610 fax - info@sonics.biz

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USER'S GUIDE

AUTOTUNE SERIES HIGH INTENSITY ULTRASONIC PROCESSOR

70 Watt Model • 100 Watt Model
130 Watt Model • 150 Watt Model

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The Ultrasonic Processor supplied with this instruction manual is constructed of the finest material and the workmanship meets the highest 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.

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WARRANTY

Your Ultrasonic Processor is warranted and backed by the manufacturer for a period of **three 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 manufacture 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.

This warranty is in lieu of any other warranties, either express, implied, or statutory. 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.

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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 equipment damage. Please 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.

- When mounting the probe, always clamp the upper portion of the converter housing. Never clamp the probe.
- 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. Refer all servicing to qualified service personnel.
- 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 nodal 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.
- 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.

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WARNING or CAUTION

Where you see this alert symbol and WARNING or CAUTION heading, strictly follow the warning instructions to avoid personal injury or equipment failure.

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CAUTION

LOW SURFACE TENSION LIQUIDS – ORGANIC SOLVENTS

The probes (solid or with a replaceable tip) are tuned elements that resonate at a specific frequency. When working with the ½" (13mm) probe with replaceable tip, if the replaceable tip is removed or isolated from the rest of the probe, the probe will no longer resonate at the desired 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

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SECTION 1 – INSTALLATION

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.

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ELECTRICAL REQUIREMENTS

The Ultrasonic Processor requires a fused, single phrase 3-terminal grounding type electrical outlet capable of supplying 50/ 60 Hz at 100 volts, 115 volts, 220 volts, or 240 volts, depending on the voltage option selected. For power requirements, check the label on the back of the unit.
Should it become necessary to convert the unit for different voltage operation, proceed as follows.

1. Ensure that the power cord is not connected to the electrical outlet.
2. Open the fuse holder cover using a small screwdriver.
3. Pull out the red fuse holder from its housing.
4. To convert from 100/115V to 220/240V replace the two ¼” (6mm) x 1 ¼” (32mm) 3 Amp slow blow fuses, with two $^{3}/_{16}$” (5mm) x $^{13}/_{16}$” (20mm) 1.6 Amp fuses.
5. To convert from 220/240V to 100/115V reverse the procedure above.
6. Rotate the fuse holder 180° from its original position, and reinsert it into its housing. For 100/115V operation the voltage displayed will be 115. For 220/240V operation the voltage displayed will be 220.
7. Change the electrical power cord as required.

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

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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.

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SECTION II – OPERATION

PRINCIPLES OF ULTRASONIC DISRUPSION

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. This phenomenon, referred to as cavitation, creates millions of shock waves in the liquid, as well as elevated pressures and temperatures at the implosion sites. Although the cavitational collapse last but a few microseconds, and the amount of energy released by each individual bubble is minute, the cumulative effect causes extremely high levels of energy to be released into the liquid. The larger the probe tip, the larger the volume that can be processed but at a lesser intensity. For information regarding the processing capability of each probe, consult the tables below.

NOTE

The Ultrasonic Processor is available with four probes – a 2mm ($^5/_{64}$") microtip, a 3mm ($^1/_8$") microtip, a 6mm ($^1/_4$") microtip, and a 13mm ($^1/_2$") probe.

- The 2mm microtip is optional, and can process between 150 microliters and 5 milliliters.
- The 3mm microtip is standard with some models, and can process between 250 microliters and 10 milliliters.
- The 6mm microtip is standard with some models, and can process between 10 and 25 milliliters.
- The 13mm probe is optional, available with or without replaceable tip, and can process between 50 and 150 milliliters.

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FUNCTIONS OF CONTROLS, INDICATORS, AND CONNECTORS

FRONT PANEL	
AMPITUDE control	When depressed, switches the main power on or off. When rotated, controls the amplitude of vibrations at the probe tip.
PULSING button*	Located on the converter. When depressed activates the ultrasonic.
PULSE/CONTINUOUS switch*	Select the application of ultrasonics as pulse or continuous.
TIMER**	Sets the duration of ultrasonic application from 1 minute to 10 minutes. When depressed, activates the ultrasonics for the duration of time selected.
PULSER**	Activates the ultrasonics on a pulsed mode. Pulse duration can be varied from 1 second OFF / 1 second ON, to 1 second OFF / 10 seconds ON. Off cycle is always 1 second ON cycle is variable from 1 second to 10 seconds. In the OFF position the ultrasonics is continuous. Intermittent operation inhibits heat build-up in the liquid and provides more efficient processing by allowing the material to settle back under the probe tip after each burst.
WATTMETER	Indicates in watts the amount of ultrasonic power delivered to the probe.

* For units with thumb activated pulser.
** For units without thumb activated pulser.

REAR PANEL	
9 pin D-sub connector	Connects to external actuation device, and enables remote power activation and monitoring.
Footswitch jack*	Connects to the footswitch cable.
4 pin connector	Connects to converters with pulsing button.
BNC connector	Connects to converters without pulsing button.
Power module	Connects to the electrical line cord and houses fuse(s) for AC line protection.

* Optional

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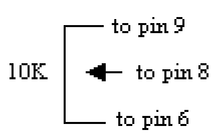
FUNCTIONS OF CONTROLS, INDICATORS, AND CONNECTORS
(cont.)

9-PIN D-SUB CONNECTOR

Pin No.	Description
1	Not connected
2	Not connected
3	Not connected
4	Enables connection to a frequency counter.
5	Enables connection to an external power monitor (10 mv = 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. *See below*



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NOTE

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

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PREPARATION FOR USE

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

1. Ensure that the AMPLITUDE 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; using the wrenches provided, screw securely the probe into the converter.

> **CAUTION**
> 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. Mount the converter / probe assembly in a laboratory stand, secure the clamp to the upper section of the converter housing only. Do not secure the clamp to any other portion of the converter / probe assembly.
6. Connect the converter cable to the power supply.

> **NOTE**
> Should it become necessary to remove a probe, use the wrenches supplied. If the probe has been attached to the converter for a long period of 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 wrench, twist the converter off the probe. A tap of a hammer may be applied to the end of the wrench. Never attempt to remove the probe by twisting the converter housing, as this may damage the electrical connections within the housing.

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USING THE ULTRASONIC PROCESSOR

The speed control on an automobile, can, to a certain extent, be compared to an Ultrasonic Processor. The speed control is designed to maintain the vehicles 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 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.

The Ultrasonic Processor is designed to deliver constant amplitude. As the resistance to the movement of the probe increases, additional power will be delivered by the power supply to ensure that the excursion at the probe tip remains constant. Using a more powerful power supply will not deliver more power into the liquid. Rather, it is the resistance to the movement of the probe that determines how much power will be delivered into the sample.

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 draw maximum wattage.

This phenomenon can be demonstrated as follows: depress the probe down against a piece of wood. The greater the down 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.

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CAUTION

- Do not operate the power supply unless it is connected to the converter.
- Never allow a microtip to vibrate in air for more than 10 seconds.
- Do not allow the vibrating probe to come in contact with anything but the sample.

1. Immerse the probe into the sample.
2. For continuous operation with units equipped with a pulsing button, set the PULSE / CONTINUOUS switch to CONTINUOUS. For pulsed operation, set the PULSE / CONTINUOUS switch to PULSE. Then set the AMPLITUDE control to 40.
3. For continuous operation with units not equipped with a pulsing button, set the AMPLITUDE control to 40.
4. For pulsed operation set the PULSER as required.
5. For timed operation set the TIMER as required and depress the TIMER knob.
6. If necessary, rotate the AMPLITUDE control to increase or decrease the intensity as required.

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IMPORTANT

Proper care of the probe is essential for dependable operation. The intense cavitation will, after a prolonged period of time, cause the tip to erode, and the power output to decrease without showing up on the wattmeter. 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 most important that only the contaminated surface be removed. This procedure can be repeated as long as the wattmeter reads less than 20 watts with the probe out of the sample, when the AMPLITUDE control is set at 100. If the wattmeter reads over 20 watts the probe or replaceable tip should be changed.

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OPERATING SUGGESTIONS AND TECHNIQUES

DISRUPTING CELLS

Single-cell organisms (micro-organisms) consist of a semipermeable, tough, rigid outer cell wall surrounding the protoplasmic membrane and cytoplasm. The cytoplasm is made up of nucleic acid, protein, 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 lysed in order for these substances to be released. Breaking cell membranes and releasing the contents present significant challenges. The process must be fast and thorough to maximize the protein yield. Because the energy applied must be great enough to break the cell membranes or walls, yet gentle enough to avoid physically or chemically damaging cell content, the Vibra-Cell with its variable intensity capability is ideally suited for this application.

The level of intensity that should be used is application dependent. For example high intensity might be recommended for the break up of cells, but should never be used when the release of intracellular components might be objectionable e.g. Organelle isolation.

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

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 that 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 inhibit 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.

Increasing hydrostatic pressure (typically 15-60 psi) and viscosity can enhance cell disruption. For micro-organisms, the addition of glass beads in the 0.05 to 0.5mm 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

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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.

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, the amplitude should be kept low, and the processing time increased.

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 much 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 duration's, the addition of free radical scavengers such as, carbon dioxide, 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 also inhibit free radical formation.

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 processing 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. e.g. Forcing helium or nitrogen through the sample will also reduce aerobic oxidation.

Since the greatest concentration of energy is 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

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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 contact the vessel will decrease the power output, and cause minute grey glass particles to migrate into the sample. 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 20mm (3/4") diameter stainless steel centrifuge tube cut to 70mm (3") length. Do not use a glass tube. Microtips must never 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 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 tube thoroughly, coat with silicone, then air dry. "Sigmacote" manufactured by Sigma Chemical Co., 3050 Spruce Street, St. Louis, Missouri 63103, USA, 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. Because with ultrasonics the sound waves are propagated through the sample, if the sample is so thick that it will not pour or circulate easily, it is too thick for ultrasonic processing.

Use the Continuous Flow Cell for processing large volumes. This accessory is recommended for the treatment of low viscosity samples, which do not require extended exposure to ultrasonics. When working with temperature sensitive sample, circulate the sample through a coiled tube immersed in a salted ice bath to minimize the temperature elevation that takes place within the cell.

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 contain the sample in a 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 also be added to the water inside the cup horn, in order to optimize cooling. Processing samples in a Cup Horn will usually take 3 to 4 times longer than processing with direct probe intrusion.

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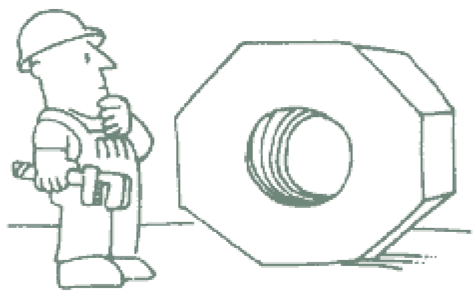
SECTION III – SERVICE INFORMATION



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, or that it will stop working all together. The most probable causes for malfunction are listed below and should be investigated.

- The unit was plugged into an electrical outlet that provides a different voltage from that required. See *Electrical Requirements.*
- The probe is not secured properly.
- If the probe has a replaceable tip, the tip is not secured properly, or the probe has been used with low surface tension liquids.
- A fuse(s) has failed. If a fuse(s) has failed, proceed as follows:
    1. Ensure that the power switch is set to OFF.
    2. Open the fuse holder cover using a small screwdriver, and pull out the red fuse holder from its housing.
    3. Replace the fuse(s).
    4. Set the AMPLITUDE control to 50 and the power switch to ON. With the probe in air (out of sample), the wattmeter should read below 20 watts. If the reading exceeds 20 watts, set the power switch to OFF, and disconnect the probe from the converter.
    5. Set the power switch back to ON. If the wattmeter reads below 20 watts, the probe has failed or is out of tune due to excessive erosion, and should be replaced. If the wattmeter reads above 20 watts, either the converter or power supply has failed and the complete Ultrasonic Processor should be returned for repair.

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OVERLOAD CONDITION

If the Ultrasonic Processor stops working, and OVERLOAD is displayed on the screen, check for possible causes as outlined in the above paragraph, then set the power switch to OFF then back to ON to reset the instrument. If the overload condition still exists, contact the Service Department.

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 the factory before returning any instrument. Include date of purchase, model number and serial number. For instruments not covered by the warranty, a purchase order should be forwarded to avoid unnecessary delay. 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.

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

IMPORTANT

I CERTIFY THAT THE ULTRASONIC PROCESSOR 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 CERTICATION CAN BE MADE.

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USER'S GUIDE

AUTOTUNE SERIES HIGH INTENSITY ULTRASONIC PROCESSOR WITH TEMPERATURE CONTROLLER

250 Watt Model • 500 Watt Model
600 Watt Model • 750 Watt Model

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The Ultrasonic Processor supplied with this instruction manual is constructed of the finest material and the workmanship meets the highest 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.

Rev. 01 6/28/02

WARRANTY

Your Ultrasonic Processor is warranted and backed by the manufacturer for a period of **three 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 manufacture 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.

This warranty is in lieu of any other warranties, either express, implied, or statutory. 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.

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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.

- When mounting the probe, always clamp the converter housing. Never clamp the probe.
- 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. Refer all servicing to qualified service personnel.
- 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 nodal 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.

WARNING or CAUTION

Where you see this alert symbol and WARNING or CAUTION heading, strictly follow the warning instructions to avoid personal injury or equipment failure.

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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

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SECTION 1 – INSTALLATION

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.

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ELECTRICAL REQUIREMENTS

The Ultrasonic Processor requires a fused, single phrase 3-terminal grounding type electrical outlet capable of supplying 50/60 Hz at 100 volts, 115 volts, 220 volts, or 240 volts, depending on the voltage option selected. 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.

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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.

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SECTION II – OPERATION

PRINCIPLES OF ULTRASONIC DISRUPSION

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. This phenomenon, referred to as cavitation, creates millions of shock waves in the liquid, as well as elevated pressures and temperatures at the implosion sites. Although the cavitational collapse last but a few microseconds, and the amount of energy released by each individual bubble is minute, the cumulative effect causes extremely high levels of energy to be released into the liquid. The larger the probe tip, the larger the volume that can be processed but at a lesser intensity. For information regarding the processing capability of each probe, consult the tables below.

	TAPERED MICROTIPS			STEPPED MICROTIP
TIP DIAMETER	1/8" (3mm)	3/16" (5mm)	1/4" (6.5mm)	1/8" (3mm)
INTENSITY	ultra high	very high	high	very high
VOLUME (batch)	1-10ml	3-20ml	5-50ml	250ul-10ml

	STANDARD PROBES		
TIP DIAMETER	1/2" (13mm)	3/4" (19mm)	1" (25mm)
INTENSITY	high	medium	low
VOLUME (batch)	10-250ml	25-500ml	500-1000ml

	HIGH GAIN PROBES	
TIP DIAMETER	3/4" (19mm)	1" (25mm)
INTENSITY	high	medium
VOLUME (batch)	25-500ml	500-1000ml

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FUNCTIONS OF KEYS, CONTROLS, INDICATIONS, AND CONNECTORS

FRONT PANEL	
LCD screen	Displays prompts and the following control parameters: • Amplitude selected • Output power delivered to the probe in watts, and as percentage of the total power • Selected duration of processing • Actual processing time • Elapsed time • Set and read temperature • Pulse duration • Accumulated amount of energy in Joules delivered to the probe.
0 – 9 key	Input 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.
TEMP key	Used with the numeric keys to set the high temperature limit – from 1°C to 99°C. Red indicator lights when the temperature limit has been reached.
PULSER key	Used with the numeric keys to set the pulse mode. The ON cycle and OFF cycle can be set independently from .1 second to 9.9 seconds. Red indicator lights when pulser is in the OFF portion of the cycle.
START/STOP Key	Starts or stops the ultrasonics. In the STOP mode the red indicator goes off.
PAUSE key	Suspends operation. Red indicator lights when the processing cycle is interrupted.
RECALL Key	Used with numeric keys to recall any of 10 stored programs. Lit red indicator signals that a program identification number must be entered.
SAVE key	Used with the numeric keys to assign a number to a program and store that program in memory. Up to 10 programs (0-9) can be stored. Lit red indicator signals that a program identification number must be entered.
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%*

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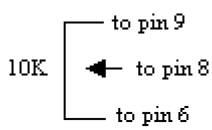
FUNCTIONS OF KEYS, CONTROLS, INDICATIONS, AND CONNECTORS (cont.)

REAR PANEL	
9 pin D-sub connector	Connects to external actuation device, and enable 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 the fuse(s).

9-PIN D-SUB CONNECTOR

Pin No.	**Description**
1	Not connected
2	Not connected
3	Not connected
4	Enables connection to a frequency counter.
5	Enables connection to an external power monitor (5 mv = 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. *See below*



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NOTE

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

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PREPARATION FOR USE

CAUTION

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

1. Ensure that the AMPLITUDE dial is set fully counter-clockwise.
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, check for cleanliness the mating surface of the converter and probe or stepped microtip (consisting of coupler and stepped tip), and using the wrenches provided, screw them securely to the converter.
5. To attach a tapered microtip or extender to a probe, remove the replaceable tip from the ½" (13mm) probe, and using the wrenches provided, screw them securely to the probe.

CAUTION

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.

6. Mount the converter / probe assembly in a laboratory stand. Secure the clamp to the 2 ½" (63mm) diameter converter housing only. Do not secure the clamp to the probe.
7. Connect the converter cable to the power supply.

NOTE

Should it become necessary to remove a probe, use the wrenches supplied. If the probe has been attached to the converter for a long period of 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 wrench, twist the converter off the probe. A tap of a hammer may be applied to the end of the wrench. Never attempt to remove the probe by twisting the converter housing, as this may damage the electrical connections within the housing.

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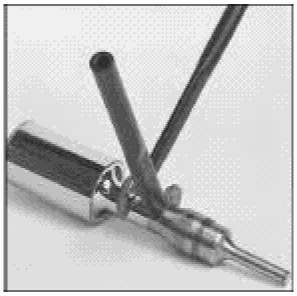
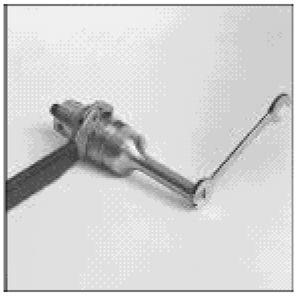


REMOVAL

TIGHTENING

TIP REMOVAL



TIP TIGHTENING

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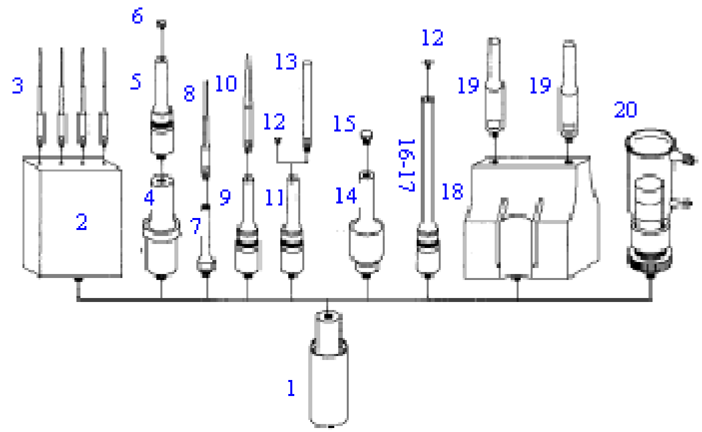

No	DESCRIPTION	Order Number
1	Converter Model CV33	CV00033
2	Four element coupler	630-0558
3	Stepped top(s) $^{1}/_{8}$" (3mm)	630-0535
4	Booster	BHNVCGD
5	Probe ½" (13mm) solid	630-0219
	Probe ½" (13mm) with threaded end and replaceable tip	630-0220
	Probe ¾" (19mm) solid	630-0208
	Probe ¾" (19mm) with threaded end and replaceable tip	630-0207
	Probe 1" (25mm) solid	630-0209
	Probe 1" (25mm) with threaded end and replaceable tip	630-0210
6	Replaceable tip ½" (13mm)	630-0406
	Replaceable tip ¾" (19mm)	630-0407
	Replaceable tip 1" (25mm)	630-0408
7	Coupler	630-0421
8	Stepped tip 1/8" (3mm)	630-0422
9	Probe ½" (13mm) with threaded end and replaceable tip	630-0220
10	Tapered microtip $^{1}/_{8}$" (3mm)	630-0418
	Tapered microtip $^{3}/_{16}$" (5mm)	630-0419
	Tapered microtip ¼" (6mm)	630-0420
11	Probe – solid or with threaded end and replaceable tip – same as 5	
12	Replaceable tip – same as 6	
13	Extender ½" (13mm)	630-0410
	Extender ¾" (19mm)	630-0409
	Extender 1" (25mm)	630-0444
	Full wave extender ¾" (19mm) – 10" (254mm) long	630-0518
	Full wave extender 1" (25mm) – 10" (254mm) long	630-0519
14	High gain probe ¾" (19mm) – solid	630-0306
	High gain probe ¾" (19mm) with threaded and replaceable tip	630-0305
	High gain probe 1" (25mm) – solid	630-0310
	High gain probe 1" (25mm) with threaded and replaceable tip	630-0311
15	Replaceable tip ¾" (19mm) or 1" (25mm) – same as 6	
16	Full wave probe ½" (13mm) solid – 10" (254mm) long	630-0217
17	Full wave probe ½" (13mm) – 10" (254mm) long with threaded and replaceable tip	630-0218
18	Aluminum coupler	630-0562
19	¾" (19mm) solid probe	630-0208
20	Cup horn 1 ½" (38mm)	630-0503
	Cup horn 2 ½" (64mm)	630-0431
	Cup horn 3" (76mm)	630-0496

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

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USING THE ULTRASONIC PROCESSOR

The speed control on an automobile, can, to a certain extent, be compared to an Ultrasonic Processor. The speed control is designed to maintain the vehicles 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 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.

The Ultrasonic Processor is designed to deliver constant amplitude. As the resistance to the movement of the probe increases, additional power will be delivered by the power supply to ensure that the excursion at the probe tip remains constant. Using a more powerful power supply will not deliver more power into the liquid. Rather, it is the resistance to the movement of the probe that determines how much power will be delivered into the sample.

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 draw maximum wattage.

This phenomenon can be demonstrated as follows: depress the probe down against a piece of wood. The greater the down 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.

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CAUTION

- 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 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

Refer to Section IV, for general operating suggestions and ultrasonic processing techniques.

1. Set ON/OFF power switch to ON. The switch will illuminate and the screen will display the power rating of the Ultrasonic Processor, cautionary notices, and the following control parameters.

TIME __:__:__	TEMP __ __°C
PULSE__:__:__	AMPL __ __%

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AMPLITUDE: 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 screen will display:

TIME __:__:__	TEMP __ __°C
PULSE__:__:__	AMPL 40 %

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The Ultrasonic Processor is now ready for continuous operation. To energize ultrasonics, press the START key or the footswitch. To de-energize ultrasonics, press the STOP key or release the footswitch. If the Time, Temperature, Pulse, Save, or Recall functions must be used, refer to the appropriate paragraph(s) below.

NOTE

Any combination of functions can be selected in any order. To clear an erroneous entry press the CLEAR key.

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 uninterrupted 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.

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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 exits, or if minimum reading cannot be obtained (less than 20%) with the probe out of the sample, check the instrument without the prove 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.
Refer to Section III if an overload condition exists.

Immerse the probe approximately 2 inches (5cm) into the sample. If a microtip is used, immerse the microtip approximately ½" (1cm) into the sample. If the probe is immersed to an insufficient depth, air will be injected into the sample, causing the sample to foam. Since the amplitude required is application dependent and subject to the volume and composition of the sample, it is recommended that the amplitude be increased or decreased as required as the sample is being processed.

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 the ON and OFF cycle are set for 1 second. To set the processing time, press the TIMER key.

The screen will display:

Time Setting
Hrs:__ Min:_ _ Sec:_ _

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

e.g

Time Setting
Hrs: 5 Min: 30 Sec: 25

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

TIME 5:30:25 TEMP __ __°C
PULSE__:__:__ AMPL 40 %

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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 duration 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 – will warn the operator against touching the ultrasonic probe. To set the pulser, press PULSER key.

The screen will display:

Pulse on __.__sec Pulse off __.__sec

Using the numeric keys, set the ON portion of the cycle, and press the ENTER/REVIEW key.

The 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 screen will display:

e.g.

Pulse on 2.5 sec Pulse off 1.0 sec

Press the ENTER/REVIEW key.

The screen will display:

TIME 5:30:25	TEMP __ __°C
PULSE 2.5 : 1.0	AMPL 40 %

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TEMPERATURE: The temperature function prevents overheating of the sample by continuously monitoring the sample temperature, and terminating the ultrasonics when the temperature reaches a predetermined setpoint. The ultrasonics is automatically reinstated when the temperature drops below the setpoint. If the temperature of the sample must be monitored and /or controlled, insert the optional Temperature Probe forcefully into the small jack on the rear panel, immerse the Temperature Probe in the sample and Press the TEMP key.

The screen will display:

e.g.

Probe Temperature 27° C Temperature Setpoint __° C

Using the numeric keys set the high temperature limit (setpoint).

The screen will display:

e.g.

Probe Temperature 27° C Temperature Setpoint 35° C

Press the ENTER/REVIEW key.

The screen will display:

TIME 5:30:25	TEMP 35° C
PULSE 2.5 : 1.0	AMPL 40 %

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.

a) Selected amplitude:
   e.g. Amplitude Control 40%
b) Set and read temperature:
   e.g. Temp Set 35°C Probe 27°C
c) Set processing time and elapsed processing time:
   e.g. Set 5:30:25 Time 0:57:03
d) Selected pulsing cycle, and actual pulsing cycle:
   e.g. Pulse 2.5 1.0/1.5 .5
e) Amount of power in watts, and accumulated amount of energy in JOULES delivered to the probe:
   e.g. 20 watts 0000000 Joules
f) Elapsed time since processing was initiated:
   e.g. Elapsed time 1:27:33

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NOTE

The amount of energy displayed will be only for one cycle. Initiating a new cycle will reset the display to zero.

SAVE: The save function retains in memory up to 10 control parameters under a storage identification (ID) number. To store the parameters under an ID number, (0-9) press the SAVE key. The indicator light on the SAVE key will illuminate and the screen will display.

e.g.

TIME 5:30:25	TEMP 35° C
#__ PULSE On 2.5	AMPL 40 %

Using the numeric keys, enter the ID number.

e.g.

TIME 5:30:25	TEMP 35° C
# 7 PULSE On 2.5	AMPL 40 %

Press the ENTER/REVIEW key to store the control parameters under the assigned ID number. The indicator light on the SAVE key will go out, and the screen will display the parameters stored under that ID number:

TIME 5:30:25	TEMP 35° C
PULSE 2.5 : 1.0	AMPL 40 %

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RECALL: The recall function can retrieve from memory; any of the 10 stored control parameters for verification or usage. To retrieve any parameters press the RECALL key. The indicator light on the RECALL key will illuminate, and the screen will display:

e.g.

```
ID    TIME __:__:__      TEMP _ _° C
# __  PULSE On __:__      Off __:__
```

Using the ID number and the numeric keys, select the desired parameters, which must be retrieved. The screen will display:

e.g.

```
ID    TIME 5:30:25     TEMP 35° C
# 7   PULSE On 2.5     Off 1.0
```

To retrieve from memory the parameters stored under that ID number, press the ENTER/REVIEW key. The screen will display:

```
TIME 5:30:25           TEMP 35° C
PULSE 2.5 : 1.0        AMPL  40 %
```

NOTE

To review all the information that has been stored, press keys 0 to 9 one at a time.

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IMPORTANT

Proper care of the probe is essential for dependable operation. The intense cavitation will, after a prolonged period of time, cause the tip to erode, and the power output to decrease without showing up on the wattmeter. 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 most important that only the contaminated surface be removed. This procedure can be repeated as long as the wattmeter reads less than 20 watts with the probe out of the sample, when the AMPLITUDE control is set at 100. If the wattmeter reads over 20 watts the probe or replaceable tip should be replaced with a new one.

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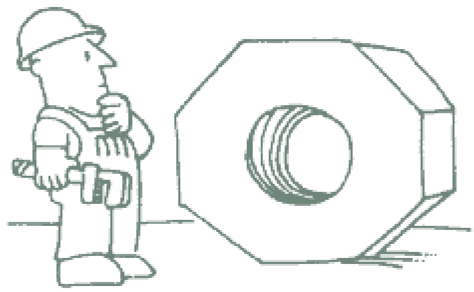
SECTION III – SERVICE INFORMATION



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 due to an overload condition or that it will stop working all together. The most probable causes for malfunction are listed below and should be investigated.

- The unit was plugged into an electrical outlet that provides a different voltage from that required. See *Electrical Requirements.*
- The probe and/or microtip is not secured properly.
- If the probe has a replaceable tip, the tip is not secured properly, or the probe has been used with low surface tension liquids.
- A fuse(s) has failed. If a fuse(s) has failed, proceed as follows:
  1. Ensure that the power switch is set to OFF.
  2. Open the fuse holder cover using a small screwdriver, and pull out the red fuse holder from its housing.
  3. Replace the fuse(s).
  4. Set the AMPLITUDE control to 50 and the power switch to ON. With the probe in air (out of sample), the wattmeter should read below 20 watts. If the reading exceeds 20 watts, set the power switch to OFF, and disconnect the probe from the converter.
  5. Set the power switch back to ON. If the wattmeter reads below 20 watts, the probe has failed or is out of tune due to excessive erosion, and should be replayed, if the wattmeter reads above 20 watts, either the converter or power supply has failed and the complete Ultrasonic Processor should be returned for repair.
  6. If the Ultrasonic Processor stops working due to an overload condition as indicated on the display, investigate and remedy the problem, then set the power switch to OFF then back to ON to reset the instrument.

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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 the factory before returning any instrument. Include date of purchase, model number and serial number. For instruments not covered by the warranty, a purchase order should be forwarded to avoid unnecessary delay. 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.

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

IMPORTANT

I CERTIFY THAT THE ULTRASONIC PROCESSOR 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 CERTICATION CAN BE MADE.

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TEMPERATURE PROBE CALIBRATION

Ultrasonic Processors shipped with the optional Temperature Probe have been calibrated as a set. If the Temperature Probe is acquired separately, calibration should be performed in accordance with the procedure outlined below.

NOTE

For optimum accuracy, the Temperature Probe and ultrasonic Processor should be calibrated as a set.

To calibrate the Ultrasonic Processor, proceed as follows:

1. Fill a 500 ml vessel with approximately 50% ice and 50% water. Allow 5 minutes for the water temperature to stabilize.
2. Fill another 500ml vessel with boiling water, and maintain boiling condition with an immersion heater or other heating device.
3. Forcefully insert the Temperature Probe into the small jack on the rear panel.
4. While holding the TEMP key depress, set the ON/OFF power switch to ON.

The switch will illuminate and the screen will display the following message:

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TEMPERATURE PROBE CALIBRATION
PLACE TEMPERATURE PROBE
INTO ICE WATER BATH

5. Immerse the temperature Probe in the center of the ice water bath for a period of 40 seconds. Do not allow the probe to contact the vessel. When the self-calibration for low temperature is complete, the screen will display the following message:

PLACE TEMPERATURE PROBE
INTO BOILING WATER

6. Immerse the Temperature Probe in the center of the boiling water for a period of 40 second. Do not allow the probe to contact the vessel.

When the calibration for high temperature is complete, the screen will display the following message:

TEMPERATURE PROBE
CALIBRATION COMPLETED

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SECTION IV - OPERATING SUGGESTIONS AND TECHNIQUES

DISRUPTING CELLS

Single-cell organisms (micro-organisms) consist of a semipermeable, tough, rigid outer cell wall surrounding the protoplasmic membrane and cytoplasm. The cytoplasm is made up of nucleic acid, protein, 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 lysed in order for these substances to be released. Breaking cell membranes and releasing the contents present significant challenges. The process must be fast and thorough to maximize the protein yield. Because the energy applied must be great enough to break the cell membranes or walls, yet gentle enough to avoid physically or chemically damaging cell content, the Vibra-Cell with its variable intensity capability is ideally suited for this application.

The level of intensity that should be used is application dependent. For example high intensity might be recommended for the break up of cells, but should never be used when the release of intracellular components might be objectionable e.g. Organelle isolation.

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

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 that 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 inhibit 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.

Increasing hydrostatic pressure (typically 15-60 psi) and viscosity can enhance cell disruption. For micro-organisms, the addition of glass beads in the 0.05 to 0.5mm 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-

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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.

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, the amplitude should be kept low, and the processing time increased.

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 much 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, carbon dioxide, 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 also inhibit free radical formation.

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 processing 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. e.g. Forcing helium or nitrogen through the sample will also reduce aerobic oxidation.

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Since the greatest concentration of energy is 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 contact the vessel will decrease the power output, and cause minute grey glass particles to migrate into the sample. 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 20mm (3/4”) diameter stainless steel centrifuge tube cut to 70mm (3”) length. Do not use a glass tube. Microtips must never 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 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 tube thoroughly, coat with silicone, then air dry. “Sigmacote” manufactured by Sigma Chemical Co., 3050 Spruce Street, St. Louis, Missouri 63103, USA, 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. Because with ultrasonics the sound waves are propagated through the sample, if the sample is so thick that it will not pour or circulate easily, it is too thick for ultrasonic processing.

Use the Continuous Flow Cell for processing large volumes. This accessory is recommended for the treatment of low viscosity samples, which do not require extended exposure to ultrasonics. When working with temperature sensitive sample, circulate the sample through a coiled tube immersed in a salted ice bath to minimize the temperature elevation that takes place within the cell.

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 contain the sample in a 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 also be added to the water inside the cup horn, in order

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to optimize cooling. Processing samples in a Cup Horn will usually take 3 to 4 times longer than processing with direct probe intrusion.

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Click for English Guides Summary

USER'S GUIDE

AUTOTUNE SERIES
HIGH INTENSITY
ULTRASONIC PROCESSOR

250 Watt Model • 500 Watt Model
600 Watt Model • 750 Watt Model

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The Ultrasonic Processor supplied with this instruction manual is constructed of the finest material and the workmanship meets the highest 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.

Rev. 01 6/28/02

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WARRANTY

Your Ultrasonic Processor is warranted and backed by the manufacturer for a period of **three 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 manufacture 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.

This warranty is in lieu of any other warranties, either express, implied, or statutory. 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.

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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.

- When mounting the probe, always clamp the converter housing. Never clamp the probe.
- 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. Refer all servicing to qualified service personnel.
- 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 nodal 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.

WARNING or CAUTION

Where you see this alert symbol and WARNING or CAUTION heading, strictly follow the warning instructions to avoid personal injury or equipment failure.

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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

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SECTION 1 – INSTALLATION

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.

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ELECTRICAL REQUIREMENTS

The Ultrasonic Processor requires a fused, single phrase 3-terminal grounding type electrical outlet capable of supplying 50/60 Hz at 100 volts, 115 volts, 220 volts, or 240 volts, depending on the voltage option selected. 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.

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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.

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SECTION II – OPERATION

PRINCIPLES OF ULTRASONIC DISRUPSION

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. This phenomenon, referred to as cavitation, creates millions of shock waves in the liquid, as well as elevated pressures and temperatures at the implosion sites. Although the cavitational collapse last but a few microseconds, and the amount of energy released by each individual bubble is minute, the cumulative effect causes extremely high levels of energy to be released into the liquid. The larger the probe tip, the larger the volume that can be processed but at a lesser intensity. For information regarding the processing capability of each probe, consult the tables below.

	TAPERED MICROTIPS			STEPPED MICROTIP
TIP DIAMETER	1/8" (3mm)	3/16" (5mm)	1/4" (6.5mm)	1/8" (3mm)
INTENSITY	ultra high	very high	high	very high
VOLUME (batch)	1-10ml	3-20ml	5-50ml	250ul-10ml

	STANDARD PROBES		
TIP DIAMETER	1/2" (13mm)	3/4" (19mm)	1" (25mm)
INTENSITY	high	medium	low
VOLUME (batch)	10-250ml	25-500ml	500-1000ml

	HIGH GAIN PROBES	
TIP DIAMETER	3/4" (19mm)	1" (25mm)
INTENSITY	high	medium
VOLUME (batch)	25-500ml	500-1000ml

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FUNCTIONS OF KEYS, CONTROLS, INDICATIONS, AND CONNECTORS

FRONT PANEL	
LCD screen	Displays prompts and the following control parameters: • Amplitude selected • Output power delivered to the probe in watts, and as percentage of the total power • Selected duration of processing • Actual processing time • Elapsed time • Set and read temperature • Pulse duration • Accumulated amount of energy in Joules delivered to the probe.
0 – 9 key	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 mode. The ON cycle and OFF cycle can be set independently from .1 second to 9.9 seconds. Red indicator lights when pulser is in the OFF portion of the cycle.
START/STOP Key	Starts or stops the ultrasonics. In the STOP mode 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%*

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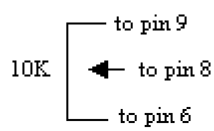
FUNCTIONS OF KEYS, CONTROLS, INDICATIONS, AND CONNECTORS (cont.)

REAR PANEL	
9 pin D-sub connector	Connects to external actuation device, and enable 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 the fuse(s).

9-PIN D-SUB CONNECTOR

Pin No.	**Description**
1	Not connected
2	Not connected
3	Not connected
4	Enables connection to a frequency counter.
5	Enables connection to an external power monitor (5 mv = 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. *See below*



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NOTE

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

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PREPARATION FOR USE

CAUTION

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

1. Ensure that the AMPLITUDE dial is set fully counter-clockwise.
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, check for cleanliness the mating surface of the converter and probe or stepped microtip (consisting of coupler and stepped tip), and using the wrenches provided, screw them securely to the converter.
5. To attach a tapered microtip or extender to a probe, remove the replaceable tip from the ½" (13mm) probe, and using the wrenches provided, screw them securely to the probe.

CAUTION

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.

6. Mount the converter / probe assembly in a laboratory stand. Secure the clamp to the 2 ½" (63mm) diameter converter housing only. Do not secure the clamp to the probe.
7. Connect the converter cable to the power supply.

NOTE

Should it become necessary to remove a probe, use the wrenches supplied. If the probe has been attached to the converter for a long period of 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 wrench, twist the converter off the probe. A tap of a hammer may be applied to the end of the wrench. Never attempt to remove the probe by twisting the converter housing, as this may damage the electrical connections within the housing.

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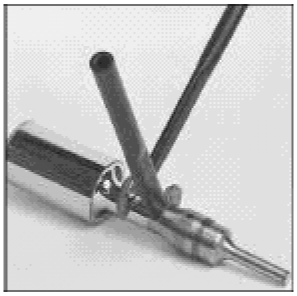
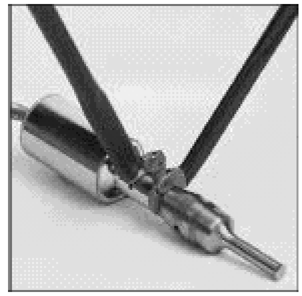
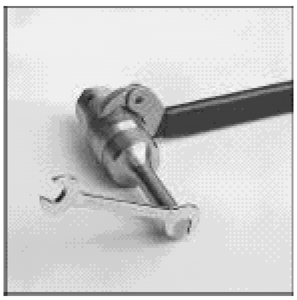


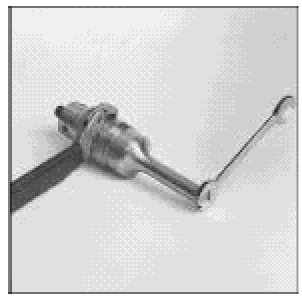
REMOVAL



TIGHTENING



TIP REMOVAL



TIP TIGHTENING

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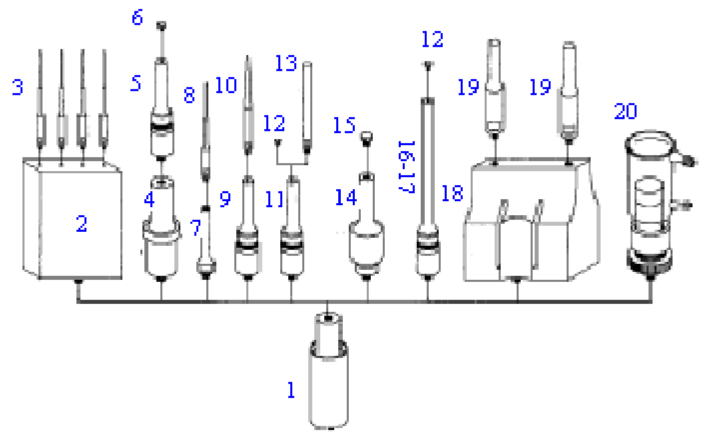

No	DESCRIPTION	Order Number
1	Converter Model CV33	CV00033
2	Four element coupler	630-0558
3	Stepped top(s) $^1/_8$" (3mm)	630-0535
4	Booster	BHNVCGD
5	Probe ½" (13mm) solid	630-0219
	Probe ½" (13mm) with threaded end and replaceable tip	630-0220
	Probe ¾" (19mm) solid	630-0208
	Probe ¾" (19mm) with threaded end and replaceable tip	630-0207
	Probe 1" (25mm) solid	630-0209
	Probe 1" (25mm) with threaded end and replaceable tip	630-0210
6	Replaceable tip ½" (13mm)	630-0406
	Replaceable tip ¾" (19mm)	630-0407
	Replaceable tip 1" (25mm)	630-0408
7	Coupler	630-0421
8	Stepped tip 1/8" (3mm)	630-0422
9	Probe ½" (13mm) with threaded end and replaceable tip	630-0220
10	Tapered microtip $^1/_8$" (3mm)	630-0418
	Tapered microtip $^3/_{16}$" (5mm)	630-0419
	Tapered microtip ¼" (6mm)	630-0420
11	Probe – solid or with threaded end and replaceable tip – same as 5	
12	Replaceable tip – same as 6	
13	Extender ½" (13mm)	630-0410
	Extender ¾" (19mm)	630-0409
	Extender 1" (25mm)	630-0444
	Full wave extender ¾" (19mm) – 10" (254mm) long	630-0518
	Full wave extender 1" (25mm) – 10" (254mm) long	630-0519
14	High gain probe ¾" (19mm) – solid	630-0306
	High gain probe ¾" (19mm) with threaded and replaceable tip	630-0305
	High gain probe 1" (25mm) – solid	630-0310
	High gain probe 1" (25mm) with threaded and replaceable tip	630-0311
15	Replaceable tip ¾" (19mm) or 1" (25mm) – same as 6	
16	Full wave probe ½" (13mm) solid – 10" (254mm) long	630-0217
17	Full wave probe ½" (13mm) – 10" (254mm) long with threaded and replaceable tip	630-0218
18	Aluminum coupler	630-0562
19	¾" (19mm) solid probe	630-0208
20	Cup horn 1 ½" (38mm)	630-0503
	Cup horn 2 ½" (64mm)	630-0431
	Cup horn 3" (76mm)	630-0496

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

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USING THE ULTRASONIC PROCESSOR

The speed control on an automobile, can, to a certain extent, be compared to an Ultrasonic Processor. The speed control is designed to maintain the vehicles 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 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.

The Ultrasonic Processor is designed to deliver constant amplitude. As the resistance to the movement of the probe increases, additional power will be delivered by the power supply to ensure that the excursion at the probe tip remains constant. Using a more powerful power supply will not deliver more power into the liquid. Rather, it is the resistance to the movement of the probe that determines how much power will be delivered into the sample.

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 draw maximum wattage.

This phenomenon can be demonstrated as follows: depress the probe down against a piece of wood. The greater the down 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.

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CAUTION

- 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 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

Refer to Section IV, for general operating suggestions and ultrasonic processing techniques.

1. Set ON/OFF power switch to ON. The switch will illuminate and the screen will display the power rating of the Ultrasonic Processor, cautionary notices, and the following control parameters.

TIME __:__:__	TEMP __ __°C
PULSE__:__:__	AMPL __ __%

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AMPLITUDE: 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 screen – Ampl 40%.

The screen will display:

TIME __:__:__	TEMP __ __°C
PULSE__:__:__	AMPL 40 %

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The Ultrasonic Processor is now ready for continuous operation. To energize ultrasonics, press the START key or the footswitch. To de-energize ultrasonics, press the STOP key or release the footswitch. If the Time, Temperature, Pulse, Save, or Recall functions must be used, refer to the appropriate paragraph(s) below.

NOTE

Any combination of functions can be selected in any order. To clear an erroneous entry press the CLEAR key.

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 uninterrupted 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.

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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 exits, 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.
Refer to Section III if an overload condition exists.

Immerse the probe approximately 2 inches (5cm) into the sample. If a microtip is used, immerse the microtip approximately ½" (1cm) into the sample. If the probe is immersed to an insufficient depth, air will be injected into the sample, causing the sample to foam. Since the amplitude required is application dependent and subject to the volume and composition of the sample, it is recommended that the amplitude be increased or decreased as required as the sample is being processed.

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 the ON and OFF cycle are set for 1 second. To set the processing time, press the TIMER key.

The screen will display:

Time Setting
Hrs:__ Min:_ _ Sec:_ _

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

e.g

Time Setting
Hrs: 5 Min: 30 Sec: 25

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

TIME 5:30:25 TEMP __ __°C
PULSE__:__:__ AMPL 40 %

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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 duration 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 – will warn the operator against touching the ultrasonic probe. To set the pulser, press PULSER key.

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The screen will display:

Pulse on __.__sec Pulse off __.__sec

Using the numeric keys, set the ON portion of the cycle, and press the ENTER/REVIEW key.

The 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 screen will display:

e.g.

Pulse on 2.5 sec Pulse off 1.0 sec

Press the ENTER/REVIEW key.

The screen will display:

TIME 5:30:25	TEMP __ __°C
PULSE 2.5 : 1.0	AMPL 40 %

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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.

a) Selected 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 1.0/1.5 .5
d) Amount of power in watts, and accumulated amount of energy in JOULES delivered to the probe:
   e.g. 20 watts 0000000 Joules
e) Elapsed time since processing was initiated:
   e.g. Elapsed time 1:27:33

NOTE

The amount of energy displayed will be only for one cycle. Initiating a new cycle will reset the display to zero.

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IMPORTANT

Proper care of the probe is essential for dependable operation. The intense cavitation will, after a prolonged period of time, cause the tip to erode, and the power output to decrease without showing up on the wattmeter. 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 most important that only the contaminated surface be removed. This procedure can be repeated as long as the wattmeter reads less than 20 watts with the probe out of the sample, when the AMPLITUDE control is set at 100. If the wattmeter reads over 20 watts the probe or replaceable tip should be replaced with a new one.

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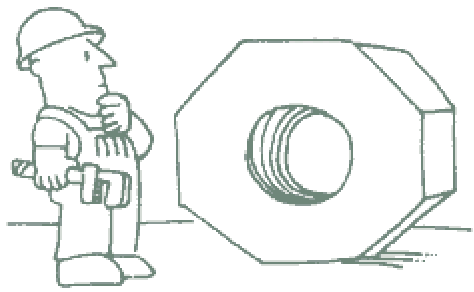
SECTION III – SERVICE INFORMATION



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 due to an overload condition or that it will stop working all together. The most probable causes for malfunction are listed below and should be investigated.

- The unit was plugged into an electrical outlet that provides a different voltage from that required. See *Electrical Requirements.*
- The probe and/or microtip is not secured properly.
- If the probe has a replaceable tip, the tip is not secured properly, or the probe has been used with low surface tension liquids.
- A fuse(s) has failed. If a fuse(s) has failed, proceed as follows:
  1. Ensure that the power switch is set to OFF.
  2. Open the fuse holder cover using a small screwdriver, and pull out the red fuse holder from its housing.
  3. Replace the fuse(s).
  4. Set the AMPLITUDE control to 50 and the power switch to ON. With the probe in air (out of sample), the wattmeter should read below 20 watts. If the reading exceeds 20 watts, set the power switch to OFF, and disconnect the probe from the converter.
  5. Set the power switch back to ON. If the wattmeter reads below 20 watts, the probe has failed or is out of tune due to excessive erosion, and should be replaced, if the wattmeter reads above 20 watts, either the converter or power supply has failed and the complete Ultrasonic Processor should be returned for repair.
  6. If the Ultrasonic Processor stops working due to an overload condition as indicated on the display, investigate and remedy the problem, then set the power switch to OFF then back to ON to reset the instrument.

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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 the factory before returning any instrument. Include date of purchase, model number and serial number. For instruments not covered by the warranty, a purchase order should be forwarded to avoid unnecessary delay. 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.

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

IMPORTANT

I CERTIFY THAT THE ULTRASONIC PROCESSOR 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 CERTICATION CAN BE MADE.

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SECTION IV - OPERATING SUGGESTIONS AND TECHNIQUES

DISRUPTING CELLS

Single-cell organisms (micro-organisms) consist of a semipermeable, tough, rigid outer cell wall surrounding the protoplasmic membrane and cytoplasm. The cytoplasm is made up of nucleic acid, protein, 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 lysed in order for these substances to be released. Breaking cell membranes and releasing the contents present significant challenges. The process must be fast and thorough to maximize the protein yield. Because the energy applied must be great enough to break the cell membranes or walls, yet gentle enough to avoid physically or chemically damaging cell content, the Vibra-Cell with its variable intensity capability is ideally suited for this application.

The level of intensity that should be used is application dependent. For example high intensity might be recommended for the break up of cells, but should never be used when the release of intracellular components might be objectionable e.g. Organelle isolation.

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

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 that 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 inhibit 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.

Increasing hydrostatic pressure (typically 15-60 psi) and viscosity can enhance cell disruption. For micro-organisms, the addition of glass beads in the 0.05 to 0.5mm 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

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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.

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, the amplitude should be kept low, and the processing time increased.

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 much 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 duration's, the addition of free radical scavengers such as, carbon dioxide, 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 also inhibit free radical formation.

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 processing 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. e.g. Forcing helium or nitrogen through the sample will also reduce aerobic oxidation.

Since the greatest concentration of energy is 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

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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 contact the vessel will decrease the power output, and cause minute grey glass particles to migrate into the sample. 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 20mm (3/4") diameter stainless steel centrifuge tube cut to 70mm (3") length. Do not use a glass tube. Microtips must never 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 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 tube thoroughly, coat with silicone, then air dry. "Sigmacote" manufactured by Sigma Chemical Co., 3050 Spruce Street, St. Louis, Missouri 63103, USA, 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. Because with ultrasonics the sound waves are propagated through the sample, if the sample is so thick that it will not pour or circulate easily, it is too thick for ultrasonic processing.

Use the Continuous Flow Cell for processing large volumes. This accessory is recommended for the treatment of low viscosity samples, which do not require extended exposure to ultrasonics. When working with temperature sensitive sample, circulate the sample through a coiled tube immersed in a salted ice bath to minimize the temperature elevation that takes place within the cell.

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 contain the sample in a 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 also be added to the water inside the cup horn, in order to optimize cooling. Processing samples in a Cup Horn will usually take 3 to 4 times longer than processing with direct probe intrusion.

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Click for English Guides Summary

USER'S GUIDE

AUTOTUNE SERIES
HIGH INTENSITY
ULTRASONIC PROCESSOR

1500 Watt Model

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The Ultrasonic Processor supplied with this instruction manual is constructed of the finest material and the workmanship meets the highest 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.

Rev. 04 6/28/02

WARRANTY

Your Ultrasonic Processor is warranted and backed by the manufacturer for a period of **three 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 manufacture 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.

This warranty is in lieu of any other warranties, either express, implied, or statutory. 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.

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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.

- When mounting the probe, always clamp the converter housing. Never clamp the probe.
- 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. Refer all servicing to qualified service personnel.
- 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 nodal point (point of no activity).
- Never touch a vibrating probe.
- Never allow an extender to vibrate in air for more than 10 seconds.
- When working with a ¾" (19mm) probe or extender, never allow the AMPLITUDE to be set above 70. Ignoring this caution will cause the probe or extender to fracture.
- Never operate a probe with threaded end without a tip, or extender.
- 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.

WARNING or CAUTION
Where you see this alert symbol and WARNING or CAUTION heading, strictly follow the warning instructions to avoid personal injury or equipment failure.

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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

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SECTION 1 – INSTALLATION

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.

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ELECTRICAL REQUIREMENTS

The Ultrasonic Processor requires a fused, single phrase 3-terminal grounding type electrical outlet capable of supplying 50/60 Hz at 220 volts, or 240 volts.

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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.

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SECTION II – OPERATION

PRINCIPLES OF ULTRASONIC DISRUPSION

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. This phenomenon, referred to as cavitation, creates millions of shock waves in the liquid, as well as elevated pressures and temperatures at the implosion sites. Although the cavitational collapse last but a few microseconds, and the amount of energy released by each individual bubble is minute, the cumulative effect causes extremely high levels of energy to be released into the liquid. The larger the probe tip, the larger the volume that can be processed but at a lesser intensity. For information regarding the processing capability of each probe, consult the tables below.

STANDARD PROBES			HIGH GAIN PROBES		
TIP DIAMETER	3/4" (19mm)	1" (25mm)	TIP DIAMETER	3/4" (19mm)	1" (25mm)
INTENSITY	medium	low	INTENSITY	high	medium
VOLUME (batch)	25-500ml	500-1000ml	VOLUME (batch)	25-500ml	500-1000ml

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FUNCTIONS OF CONTROLS, INDICATIONS AND CONNECTORS

POWER switch	When depressed, applies electrical power to the unit Illuminates in the ON position.
TEST switch	Used to determine if the system is working properly. With the AMPITUDE control set at 70, and the probe in air (not in the liquid), proper operation will be demonstrated by a reading of 20% or less on the power monitor when the TEST switch is depressed. If the high volume flow cell is used, make sure that the liquid has been drained out of it. If reading exceeds 20%, check the probe for excessive erosion, and the converter for elevated temperature.
RESET switch	If an overload condition should occur the RESET switch will illuminate. Depress the RESET switch to reset the power supply.
TIMER	Sets the duration of ultrasonic applications.
AMPLITUDE control	Controls the amplitude of vibrations at the probe tip.
Power monitor	Indicates the percentage of ultrasonic power delivered top the probe. (e.g. 50% = 750 watts)
Converter cable	Connects the power supply to the converter.
Fuse	Protects against electrical overload.
Power cord	Connects the power supply to the electrical outlet.

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PREPARATION FOR USE

CAUTION

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

1. Ensure that the AMPLITUDE dial is set fully counter-clockwise.
2. If the converter / probe assembly is not already assembled, check for cleanliness the mating surface of the converter and probe, clean if necessary, and use the wrenches provided, to secure these assemblies together.
3. To attach an extender to a probe, remove the replaceable tip from the probe, and use the wrenches provided, to secure these assemblies together.

CAUTION

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.

4. Mount the converter / probe assembly in a stand. Secure the clamp to the converter housing only. Do not secure the clamp to the probe.
5. Connect the converter cable to the power supply.

NOTE

Should it become necessary to remove a probe, use the wrenches supplied. If the probe has been attached to the converter for a long period of 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 wrench, twist the converter off the probe. A tap of a hammer may be applied to the end of the wrench. Never attempt to remove the probe by twisting the converter housing, as this may damage the electrical connections within the housing.

6. Ensure that the POWER switch is set to OFF.
7. Plug the electrical line cord into the electrical outlet.

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CAUTION

Your Ultrasonic Processor features automatic tuning and does not require any manual adjustments. DO NOT ATTEMPT TO TUNE MANUALLY. Ignoring this caution will cause the power supply to fail.

8. Set the AMPLITUDE to 50.

NOTE

Since the amplitude required is application dependent and subject to the volume and composition of the sample, it is recommended that the amplitude be first set at mid-range, then empirically determined and optimized while the sample is being processed.

9. Depress the POWER switch all the way to energize the unit. The switch will illuminate.
10. Depress the TEST switch and check the power monitor. With the probe in air (not immersed in the sample), the power reading should be less than 20%.

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 exits, or if minimum reading cannot be obtained (less than 20%) with the probe out of the sample, check the instrument without the prove 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.
Refer to Section III if an overload condition exists.

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USING THE ULTRASONIC PROCESSOR

The speed control on an automobile, can, to a certain extent, be compared to an Ultrasonic Processor. The speed control is designed to maintain the vehicles 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 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.

The Ultrasonic Processor is designed to deliver constant amplitude. As the resistance to the movement of the probe increases, additional power will be delivered by the power supply to ensure that the excursion at the probe tip remains constant. Using a more powerful power supply will not deliver more power into the liquid. Rather, it is the resistance to the movement of the probe that determines how much power will be delivered into the sample.

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 draw maximum wattage.

This phenomenon can be demonstrated as follows: depress the probe down against a piece of wood. The greater the down 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.

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CAUTION

- Never allow liquid to spill into the converter.
- 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 or extender attached.

1. Immerse the probe 2 to 3 inches (5-8 cm) into the liquid. 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 of the sample will usually prevent aerosoling and foaming. Do not use any antifoaming agents or surfactants.

2. Set the TIMER as required

3. Depress the START button.

4. Adjust the AMPLITUDE control as required.

5. If the converter runs hot, air-cool the converter with DRY compressed air.

CAUTION

When working with a ¾" (19mm) probe or extender, do not set the AMPLITUDE control above 70. With a 1" (25mm) probe, do not operate continuously with the AMPLITUDE control set above 90.

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IMPORTANT

Proper care of the probe is essential for dependable operation. The intense cavitation will, after a prolonged period of time, cause the tip to erode, and the power output to decrease without showing up on the wattmeter. 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 most important that only the contaminated surface be removed. This procedure can be repeated as long as the power monitor reading is less than 20% with the probe out of the sample, when the AMPLITUDE control is set at 100. If the reading exceeds 20%, the probe or replaceable tip should be replaced with a new one.

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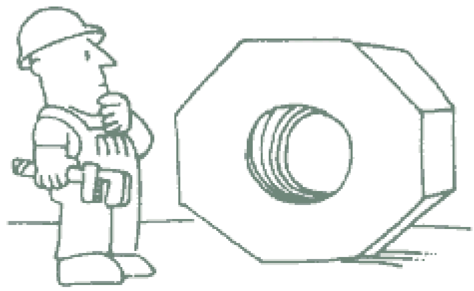
SECTION III – SERVICE INFORMATION



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 due to an overload condition or that it will stop working all together. The most probable causes for malfunction are listed below and should be investigated.

- The unit was plugged into an electrical outlet that provides a different voltage from that required. See *Electrical Requirements.*
- The probe and/or extender is not secured properly.
- If the probe has a replaceable tip, the tip is not secured properly, or the probe has been used with low surface tension liquids.
- A fuse(s) has failed. If a fuse(s) has failed, proceed as follows:
  1. Ensure that the POWER switch is set to OFF.
  2. Replace the fuse(s).
  3. Set the AMPLITUDE control to 50, the POWER switch back to ON, and depress the TEST switch. With the probe in air (out of sample), the power monitor should read below 20%. If the reading exceeds 20%, set the POWER switch to OFF, and disconnect the probe from the converter.
  4. Set the POWER switch back to ON and depress the TEST switch. If the power monitor reads below 20%, the probe has failed or is out of tune due to excessive erosion, and should be replaced, if the power monitor reads above 20%, either the converter or power supply has failed and the complete Ultrasonic Processor should be returned for repair.
  5. If the Ultrasonic Processor stops working due to an overload condition set the POWER switch to OFF, investigate and remedy the problem, then set the POWER switch back to ON to reset the instrument.

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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 the factory before returning any instrument. Include date of purchase, model number and serial number. For instruments not covered by the warranty, a purchase order should be forwarded to avoid unnecessary delay. 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.

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

IMPORTANT

I CERTIFY THAT THE ULTRASONIC PROCESSOR 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 CERTICATION CAN BE MADE.

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USER'S GUIDE

AUTOTUNE SERIES
HIGH INTENSITY
ULTRASONIC PROCESSOR

1500 Watt Model With High Volume Flow Cell

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The Ultrasonic Processor supplied with this instruction manual is constructed of the finest material and the workmanship meets the highest 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.

Rev 04 6/28/02

WARRANTY

Your Ultrasonic Processor is warranted and backed by the manufacturer for a period of **three 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 manufacture 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.

This warranty is in lieu of any other warranties, either express, implied, or statutory. 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.

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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. Refer all servicing to qualified service personnel.
- 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.
- When working with a ¾” (19mm) probe or extender, never allow the AMPLITUDE to be set above 70. Ignoring this caution will cause the probe or extender to fracture.
- Never operate a probe with threaded end without a tip, or extender.
- 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.

WARNING or CAUTION

Where you see this alert symbol and WARNING or CAUTION heading, strictly follow the warning instructions to avoid personal injury or equipment failure.

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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 with an older model High Volume Flow Cell equipped with a ¾" (19mm) or 1" (25mm) probe, ALWAYS use a solid probe

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SECTION 1 – INSTALLATION

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.

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ELECTRICAL REQUIREMENTS

The Ultrasonic Processor requires a fused, single phrase 3-terminal grounding type electrical outlet capable of supplying 50/60 Hz at 220 volts, or 240 volts.

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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.

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SECTION II – OPERATION

PRINCIPLES OF ULTRASONIC DISRUPSION

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. This phenomenon, referred to as cavitation, creates millions of shock waves in the liquid, as well as elevated pressures and temperatures at the implosion sites. Although the cavitational collapse last but a few microseconds, and the amount of energy released by each individual bubble is minute, the cumulative effect causes extremely high levels of energy to be released into the liquid.

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FUNCTIONS OF CONTROLS, INDICATIONS AND CONNECTORS

POWER switch	When depressed, applies electrical power to the unit Illuminates in the ON position.
TEST switch	Used to determine if the system is working properly. With the AMPITUDE control set at 70, and the probe in air (not in the liquid), proper operation will be demonstrated by a reading of 20% or less on the power monitor when the TEST switch is depressed. Make sure that the liquid has been drained out of it. If reading exceeds 20%, check the probe for excessive erosion, and the converter for elevated temperature.
RESET switch	If an overload condition should occur the RESET switch will illuminate. Depress the RESET switch to reset the power supply.
TIMER	Sets the duration of ultrasonic applications.
AMPLITUDE control	Controls the amplitude of vibrations at the probe tip.
Power monitor	Indicates the percentage of ultrasonic power delivered top the probe. (e.g. 50% = 750 watts)
Converter cable	Connects the power supply to the converter.
Fuse	Protects against electrical overload.
Power cord	Connects the power supply to the electrical outlet.

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PREPARATION FOR USE

NOTE
The High Volume Flow Cell is recommended only for the treatment of low viscosity samples, which do not require extended exposure to ultrasonics. Because the residence time within the cell is relatively short, it might be necessary to recirculate the sample.

CAUTION
Do not operate an Ultrasonic Processor that has been transferred from a very cold environment to a hot environment, or vice versa. Wait until it has reached room temperature

1. Ensure that the AMPLITUDE dial is set fully counter-clockwise.
2. Using the spanner wrenches provided, secure the converter to the High Volume Flow Cell.
3. Connect the converter cable to the power supply.

CAUTION
Never place a washer between the probe and the converter. Never apply grease to the mating surfaces or threads of the converter or probe.

4. Ensure that the POWER switch is set to OFF.
5. Plug the electrical line cord into the electrical outlet.
6. Drain the High Volume Flow Cell completely.
7. Set the AMPLITUDE to 50.

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CAUTION

Your Ultrasonic Processor features automatic tuning and does not require any manual adjustments. DO NOT ATTEMPT TO TUNE MANUALLY. Ignoring this caution will cause the power supply to fail.

8. Depress the POWER switch all the way to energize the unit. The switch will illuminate.

NOTE

Since the amplitude required is application dependent and subject to the volume and composition of the sample, it is recommended that the amplitude be first set at mid-range, then empirically determined and optimized while the sample is being processed.

9. Depress the TEST switch and check the power monitor. The power reading should be less than 20%.

NOTE

The probe within the High Volume Flow Cell 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 exits, or if minimum reading cannot be obtained (less than 20%) disconnect the converter and repeat the above procedure 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.
Refer to Section III if an overload condition exists.

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USING THE ULTRASONIC PROCESSOR

The speed control on an automobile, can, to a certain extent, be compared to an Ultrasonic Processor. The speed control is designed to maintain the vehicles 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 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.

The Ultrasonic Processor is designed to deliver constant amplitude. As the resistance to the movement of the probe increases, additional power will be delivered by the power supply to ensure that the excursion at the probe tip remains constant. Using a more powerful power supply will not deliver more power into the liquid. Rather, it is the resistance to the movement of the probe that determines how much power will be delivered into the sample.

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, or higher pressure, within the cell, 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 draw maximum wattage.

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CAUTION

Never allow liquid to spill into the converter.

1. With the liquid flowing through the High Volume Flow Cell, adjust the cell pressure and Amplitude control to achieve 60% reading on the power monitor. If the liquid is discharged into an open container or a low-pressure line, the pressure can be increased by reducing the flow rate with a valve on the discharge side. Unless absolutely necessary do not operate the power supply continuously with the Amplitude control set above 90%.

2. Set the TIMER as required

3. Depress the START button.

4. Using the AMPLITUDE control, increase or decrease the amplitude as required.

5. If the converter runs hot, air-cool with DRY compressed air.

6. Process the material at different flow rates, while maintaining constant pressure.

7. Evaluate the sample.

8. If the sample is over-processed or the temperature reaches an unacceptable level, reduce the amplitude.

NOTE

When working with high viscosity material, it is recommended that (if possible) the viscosity be reduced as much as possible prior to processing.

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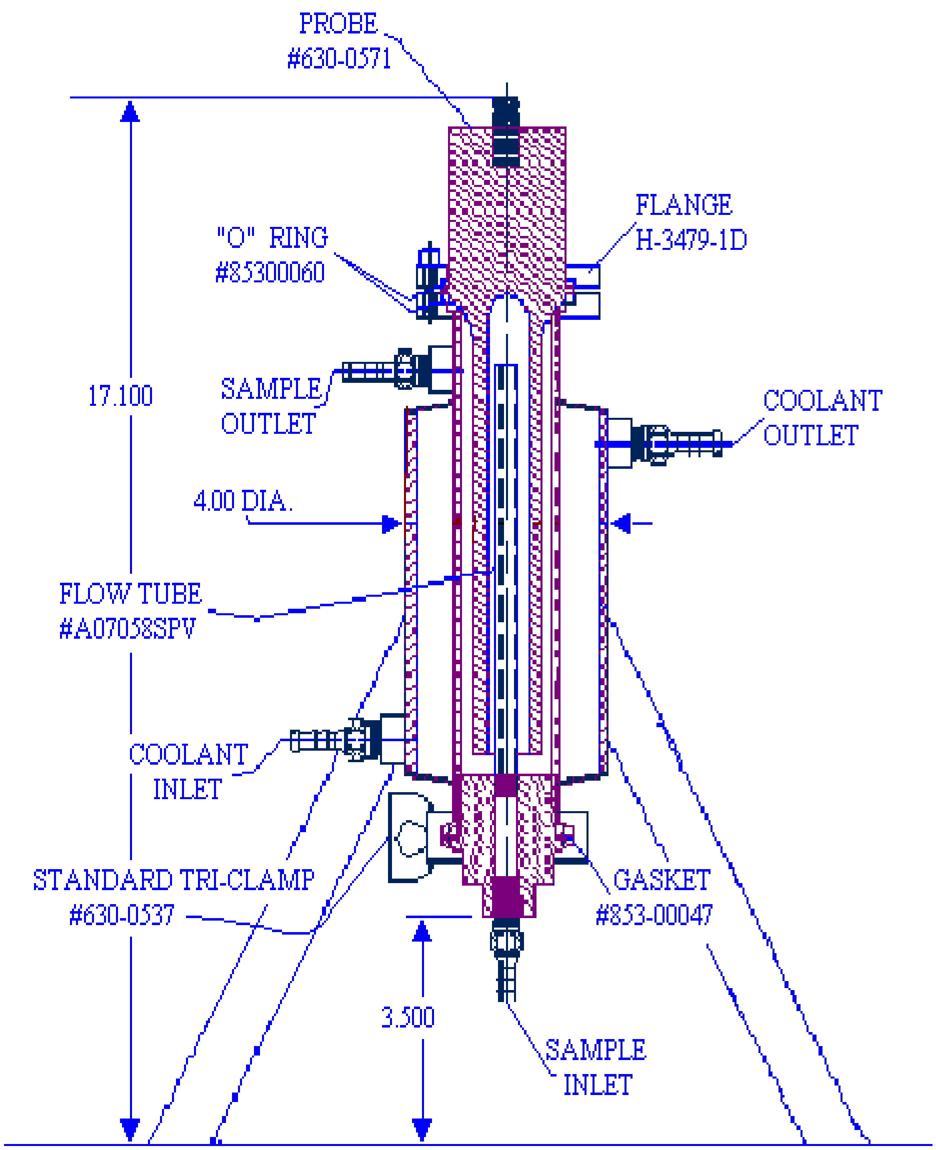

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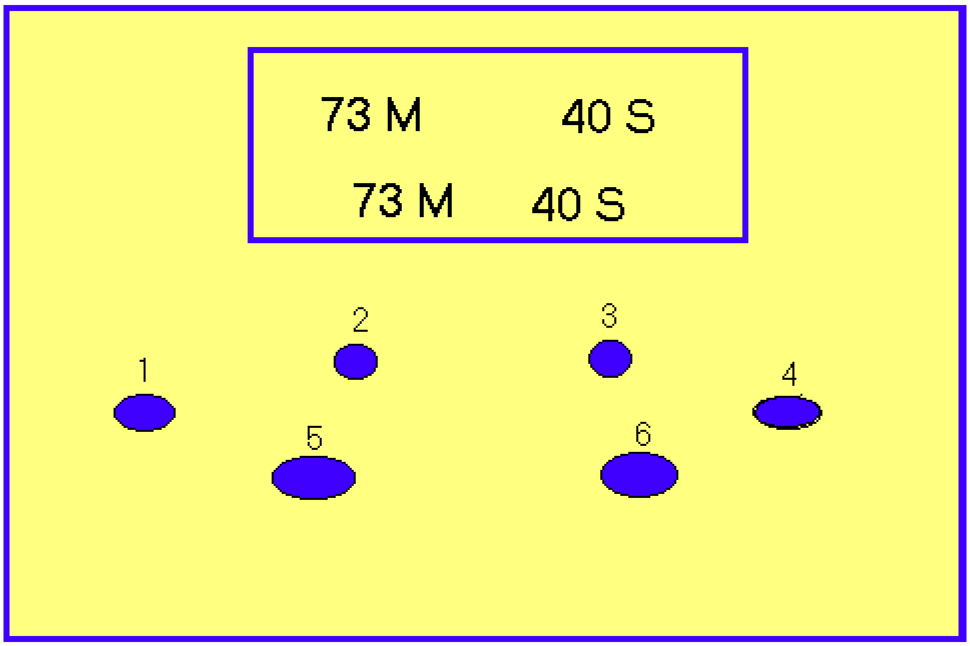
TIMER SETUP



Push buttons 1 – 4 are visible.

Push buttons 5 – 6 are not visible and are located under the front panel. These buttons can be pressed through the panel.

To set the timer:

1. Press 5 – 6 simultaneously to enter programming mode.
2. Press 4 to select the desired timing sequence.
3. Press 6 for "up/down mode". Press 4 to select "d" (down).
4. Press 6 for "out mode". Press 4 to select "b".
5. Press 5 once to exit programming mode.

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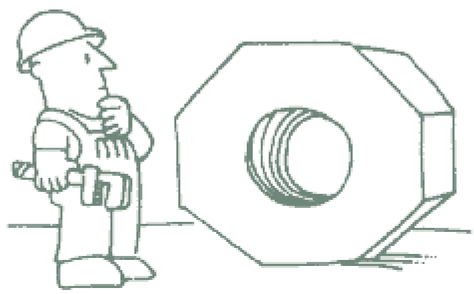
SECTION III – SERVICE INFORMATION



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 due to an overload condition or that it will stop working all together. The most probable causes for malfunction are listed below and should be investigated.

- The unit was plugged into an electrical outlet that provides a different voltage from that required. See *Electrical Requirements.*
- The probe is not secured properly to the converter.
- A fuse(s) has failed. If a fuse(s) has failed, proceed as follows:
  1. Ensure that the POWER switch is set to OFF.
  2. Replace the fuse(s).
  3. Drain the High Volume Flow Cell completely.
  4. Set the AMPLITUDE control to 50, the POWER switch back to ON, and depress the TEST switch. The power monitor should read below 20%. If the reading exceeds 20%, set the POWER switch to OFF, and disconnect the probe from the converter.
  5. Set the POWER switch back to ON and depress the TEST switch. If the power monitor reads below 20%, the probe has failed or is out of tune due to excessive erosion, and should be replaced, if the power monitor reads above 20%, either the converter or power supply has failed. The Ultrasonic Processor together with the High Volume Flow Cell should be returned for repair.

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6. If the Ultrasonic Processor stops working due to an overload condition set the POWER switch to OFF, investigate and remedy the problem, then set the POWER switch back to ON. Reset the instrument by depressing the TEST switch.

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Cliquetez Pour Sommaire Des Guides Francais

SONIFICATEUR HAUTE INTENITÉ SÉRIE AUTOTUNE

Modéle 130 watts

Références 75022

GUIDE D'UTILISATION

Rev. 01 6/28/02

MESURES DE SECURITE IMPORTANTES

LIRE ATENTIVEMENT AVANT D'INSTALLER OU DE FAIRE FONCTIONNER CET APPAREIL

Ce sonificateur a été conçu pour assurer un maximum de sécurité à l'utilisateur. Cependant, aucune conception ne peut assurer une protection totale en cas de mauvaise utilisation qui peut entraîner des blessures corporelles et/ou des dommages matériels. Pour la protection de l'utilisateur et de l'appareil, respecter les avertissiments suivants à tout monent, lire attentivement les instructions de fonctionnement avant de tenter de faire fonctionner l'appareil, et conserver ce manuel d'instructions pour le consulter plus tard.

- Une haute tension est présente au niveau de l'alimentation. Le capot ne peut être retiré que par une personne qualifiée.

- Pour éviter les chocs électriques, débrancher le cordon d'alimentation avant de retirer le capot pour effectuer une réparation.

- Vérifier que le sonificateur est correctement relié à la terre avec une fiche à 3 broches. Avant de brancher, vérifier que la prise électrique est correctement reliée à la terre.

- Ne jamais faire fonctionner le générateur s'il n'est pas connecté au convertisseur.

- Ne jamais faire fonctionner la sonde à embout remplaçable sans embout.

- Ne jamais toucher une sonde vibrante.

- Nous conseillons l'utilsation de protection acoustique pendant le fonctionnement du sonificateur.

Le sonificateur livré avec ce manuel d'instructions est fabrqué avec les meilleurs matériaux et sa fabrication répond aux normes les plus élevées. Il a été soigneusement vérifié et inspecté avant de quitter l'usine, et il fournira à l'utilisateur de nombreuses années de fonctionnement fiable er en toute sécurité s'il est utilisé en respectant les procédures décrites dans ce manuel.

LIQUIDES A FAIBLE TENSION DE SURFACE • SOLVANT ORGANIQUES

Toutes les sondes, y compris celles avec pointes remplaçables, sont ajestées pour résonner à une cetaine fréquence. Si le bout de Remplacement est retirée ou isolée du reste de la sonde, l'élément ne résonnera plus à cette fréquence, et l'alimentation sera défaillante. Les liquides à faible tension de surface pénètrent dans l'interface entre la sonde et le bout de Remplacement, et amènent des particules dans la partie filetée, isolant le bout de Remplacement de la sonde. TOUJOURS ultiliser une sond solide pour traiter les liquides à faible tension de surface avec une sonde de 13 mm.

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CHAPITRE I – INSTALLATION

INSPECTION

Avant d'installer le sonificateur, inspecter visuellement le colis et relever toute trace de dommage qui aurait pu survenir pendant le transport. Avant de jeter l'emballage, vérifier soigneusement qu'il ne contient pas de petites pièces.

Le processeur ultrasonique a été soigneusement emballé et inspecté avant de quitter notre usine. La responabilité de sa livraison en bon état est assumée par le transporteur du fait de l'acceptation du transport. Les reclamations pour perte ou dommage consécutifs au transport doivent de ce fait être adressées au transporteur.

En cas de dommage, contacter le transporteur dans les 48 heures à compter de la date de livraison. NE PAS FAIRE FONCTIONNER UN APPAREIL ENDOMMAGE. Conserver tous les matériaux d'emballage pour une future expédition.

EXIGENCES ELECTRIQUE

Le sonificateur nécessite une prise de courant monophasé à 3 broches reliée à la terre équipée d'un fusible capable de délivrer 50/60 Hz à 100 volts, 115 volts, 220 volts ou 240 volts, suivant l'option de tension choisie.

Pour les exigences électriques, se référer à l'arrière de l'appareil.

Avant de brancher le cordon d'alimentation dans la prise secteur, vérifier que le module de courant à l'arrière de l'appareil délivre la tension correcte. Si ce n'est pas le cas, débrancher le cordon d'alimentation, et ouvir le module de courant à l'aide d'un tournevis, retirer le support du fusible, changer les fusibles, tourner le module et réinsérer le. Pour 100 et 115 volts, la tension affichée sera 115. Pour 220 et 240 volts, la tension affichée sera 220.

AVERTISSEMENT

Pour la sécurité de l'utilisateur, le cordon d'alimentation est équipé d'une fiche à 3 broches. Ne pas, en aucun cas, défaire la mise à la terre du cordon d'alimentation en retirant la broche de terre. La fiche doit être branchée dans une prise murale à 3 broches.

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INSTALLATION DU SONIFICATEUR

Le sonificateur doit être dans un endroit à l’abri d’un excès de poussière, de saleté, de vapeurs explosives et corrosives, et des conditions extrêmes de température et d’humidité.

CHAPITRE II – FONCTIONNEMENT

PRINCIPE DE LA DESINTEGRATION ULTRASONIQUE

Le générateur ultrasonique convertit la tension du secteur 50/60 Hz en énergie électrique de haute fréquence à 20 kHz (20,000 cycles par seconde), suivant le modèle. Cette énergie électique de haute fréquence est transmise à un transducteur piézo-électrique dans le convertisseur, où elle est changée en vibration mécaniques. Les vibrations du convertisseur sont intensifiées par la sonde, créant des ondes de compression dans le liquide. Cette action génère des millions de bulles microscopiques (cavités) qui se propagent pendant la phase de pression négative, et qui implosent violemment pendant la phase de pression positive. C’est ce phénomène, appelé cavitation, qui dissipe une énergie considérable au niveau de la pointe de la sonde, permettant ainsi une agitation intense des molécules présentes dans le liquide.

REMARQUE

Le sonificateur est disponible avec cinq sondes – une microsonde de 2 mm ($^{5}/_{64}$”), une microsonde de 3 mm ($^{1}/_{8}$”), une microsonde de 6 mm ($^{1}/_{4}$”), une microsonde de 9.5 mm ($^{3}/_{8}$”) et une sonde de 13 mm ($^{1}/_{2}$”).

- La microsonde 2 mm est optionnelle, et peut traiter à 20 kHz entre 100 microlitres et 5 millilitres.
- La microsonde de 3 mm peut traiter entre 200 microlitres et 10 millilitres.
- La microsonde de 6 mm peut traiter entre 10 et 25 milliliters.
- La sonde de 13 mm est optionnelle, est diponible avec ou sans bout de Remplacement, et peut traiter entre 50 et 150 millilitres.

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FONCTION DES TOUCHES, INDICATEURS ET CONNECTEURS

	PANNEAU FRONTAL
Commande d' AMPLITUDE	Lorsqu'elle est appuyée, met le generareur sous ou hors tension. Lorsqu'elle est tournée, contrôle l'amplitude des vibrations à la pointe de la sonde.
Touche d'IMPULSION**	Située sur le convertisseur. Appuyer dessus pour activer les ultrasons.
Commutateur IMPULSION / CONTINU	Choisit entre le mode d'application des ultrasons en pulsations ou en continu.
MINUTERIE**	Règle la durée de l'application des ultrasons de 1 minute à 10 minutes. Appuyer dessus pour activer les ultrasons pour la durée choisie sur la minuterie.
GENERATEUR D'IMPULSION**	Active les ultrasons en mode pulsations. La durée des pulsations peut varier de 1 seconde OFF (arrêt) / 1 seconde ON (marche) à 1 seconde OFF / 10 secondes ON.
	Le cycle OFF est toujours de 1 seconde. Le cycle ON peut varier de 1 à 10 secondes. En position OFF, les ultrasons sont émis en continu. Un fonctionnement intermittent amenuise la formation de chaleur dans le liquide et permet au matériau de se stabiliser sous la pointe de la sonde après chaque groupe d'impulsions.
INDICATEUR DE PUISSANCE	Indique en watts la quantité de puissance ultrasonique délivrée à la sonde.

** Pour certain models.

	PANNEAU ARRIERE
Sub connecteur D9 broches	Se connecte au dispositif de commande, et permet l'activation et le contrôle à distance.
Jack pour pédale	Se connecte au câble de la pédale.
Connecteur 4 broches	Se connecte au convertisseur avec touche d'activation manuelle des impulsion.
Connecteur BNC	Se connecte au convertisseur sans touche d'activation manuelle des impulsions.
Module de courant	Se connecte au cordon d'alimentation et abrite le(s) fusible(s).

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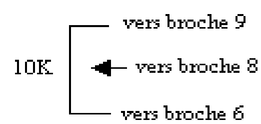
SUB CONNECTEUR D 9 BROCHES

Broche N°	Description
1	Non connectée
2	Non connectée
3	Non connectée
4	Permet une connexion à un computeur de frequences.
5	Permet une connexion à un moniteur de puissance externe (10 mV = 1 watt).
6	Terre
7	Excite les ultrasons quand connecté à la terre.
8 et 9	Permet de régler à distantce l'intensité à l'aide d'un potentiomètre 10K.



REMAQUE

Pour Regler à distance I'intensité à l'aide de 0-5V à la place du potentiomètre 10K, connecter le positif sur 8 et le négatif sur 6.

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PREPARATION AVANT UTILISATION

ATTENTION

Si le sonificateur a été laissé dans un environnement très froid ou très chaud pendant une période prolongée, ne pas le faire fonctionner avant qu'il ait atteint la température de la pièce.

1. S'assurer que la commande d'AMPLITUDE est OFF (arrêt).
2. Brancher le cordon électrique dans la prise de courant.
3. Si la sonde n'est pas déjà montée, passer à l'étape 4.
4. Monter la sonde à la main sur le convertisseur. Utiliser les clée à vis fournies et serrer correctement.

ATTENTION

Ne jamais monter ou démonter une sonde en maintenant le convertiseur dans un étau.

5. Installer le montage convertisseur / sonde sur une paillasse. Fixer la pince uniquement sur le logement du convertisseur de diamètre 32 mm.
6. Connecter le câble du convertisseur sur l'alimentation électrique.
7. Si la pédale optionnelle est utilisée, insére la fiche de la pédale dans la prise jack sur le panneau arrière. S'assurer que la fiche est entièrement insérée.

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UTILISATION DU SONIFICATEUR

Un régulateur de vitesse sur une automoble peut, dans une certaine mesure, être comparé à un sonificateur. Ce dispositif est conçu pour maintenir le véhicule à une vitesse constante. Lorsque le terrain change, les nécessités de puissance changent également. Le régulateur de vitesse détecte ces nécessités, et ajuste automatiquement la quantité de puissance délivrée par le moteur, pour compenser ces conditions sans cesse changeantes. Plus l'inclinaison est importante, plus la résistance du véhicule au mouvement augmente, et plus importante sera la puissance délivrée par le moteur pour compenser cette résistance.

Le sonificateur est conçu pour délivrer une amplitude constante. Lorsque la résistance au mouvement de la sonde augmente, les exigences de puissance augmentent également. L'alimentation en puissance détecte ces nécessités, et augmente automatiquiment la quantité de courant délivrée afin de maintenir constante le déplacement de la sonde. Dans des conditions de charge identiques, la quantité de watts délivrée par deux sonificateur avec des puissances differentes sera identique (à condition que les deux disposent d'une capacité de puissance suffisante).

La commande d'AMPLITUDE permet de régler les vibrations ultrasoniques à la pointe de la sonde sur le niveau désire. Bien que le degré de cavitation nécessaire pour traiter l'échantillon puisse aisément être déterminé à l'oeil nu, la quantité de courant nécessaire ne peut pas être prédéterminée. Un réseau sensible contrôle en continu les exigences de sortie, et ajuste automatiquement la puissance pour maintenir l'amplitude sur le niveau présélectionné. Plus la résistance au mouvement de la sonde due à une forte viscosité, plus la sonde est immergée profondément dans l'échantillon, plus la diamétre de la sonde est élevé, ou plus la pression est élevée, plus la quantité de courant délivré à la sond sera importante. Le réglage de la commande d'AMPLITUDE entiérement dans le sens horaire n'entraînera pas la sistribution de la puissace maximale à l'échantillon. La puissance maximale que le processeur ultrasonique est capable de délivrer sera uniquement délivrée lorsque la résistance au mouvement de la sonde est suffisamment élevée pour soutirer la quantité de watt maximale.

Ce phénoméne peut être démontré de la façon suivante. Appuyer la sonde contre un morceau de bois. Plus la pression exercée vers le bas est importante, et par conséquent plus la résistance au mouvement de la sonde est élevée, plus la quantité de courant délivrée par l'alimentation électrique est importante.

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ATTENTION

- Ne pas faire fonctionner le générateur sans l'avoir branché sur le convertisseur.
- Une haute tension est présent dans le générateur – Ne pas le faire fonctionner capot enlevé.
- Ne jamais laisser vibrer une microsonde à l'air (au dehors de l'echantillon) pendant plus de 10 secondes.
- Ne pas laisser une sonde vibrante entrer en contact avec autre chose que l'échantillon.

1. Immerger la sonde dans I'échantillon.
2. Pour un fonctionnement continu avec certain modéle metter PULSE/CONTINUOUS (pulsation/continu) sur CONTINUOUS, puis régler la commande d'AMPLITUDE sur 40.
3. Pour un fonctionnement en pulsation : 1) metter PULSE/CONTINUOUS (pulsation/continu) sur PULSE. 2) Régler la commande d'AMPLITUDE sur 40. 3) Appuyer sur la touche d'activation manuelle des pulsations sur le convertisseur.
4. Pour un fonctionnement en continu avec certain modéles, régler la commande d'amplitude sur 40.
5. Pour un fonctonnement en pulsation, utiliser la pédale optionnelle ou le PULSEUR.
6. Pour un fonctionnement minuté : 1) Régler la minuterie sur le temps désiré. 2) Régler la commande d'AMPLITUDE sur 40. 3) Appuyer sur le bouton TIMER (minuterie).
7. Si nécessaire, tourner la commande d'AMPLITUDE pour augmenter ou diminuer l'intensité à la demande.

IMPORTANT

Il est essentiel d'apporter un soin particulier à la sonde pour assurer un fonctionnement fiable. Une cavitation intense causera après une période prolongée une érosion de la pointe, et provoquera une baisse de puissance sans que cela soit visible sur l'indicateur de puissance. Plus la pointe est propre, plus grande sera la puissance transmise à l'échantillon. Une érosion de la pointe de la sonde accélère le processus d'érosion. Nous conseillons pour cette raison d'examiner la pointe après 5 ou 6 heures d'utilisation, et si nécessaire de la polir avec de la toile émeri ou avec une meule. La sonde vibre à une fréquence spécifique, il est très important d'éliminer uniquement la surface contaminée. Cette procédure peut être répétée aussi longtemps que l'indicateur de puisssance indique moins de 20 watts lorsque la sonde est hors de l'échantillon, et que la commande d'AMPLITUDE est réglée sur 100. Dans le cas contraire, il est nécessaire de changer la sonde ou le bout de Remplacement.

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CONSEILS ET TECHNIQUES D'UTILISATION

DESINTEGRATION DES CELLULES

Les organismes unicellulaires (micro-oranismes) sont constitués d'une paroi cellulaire externe semi-perméable, solide et rigide entourant la membrane protoplasmique (cytoplasmique) et le cytoplasme. Le cytoplasme est constitué d'acides nucléiques, de protéines, de glucides, de lipides, d'enzymes, d'ions inorganiques, de vitamines, de pigments, d'inclusions et d'environ 80% d'eau. Pour isoler et extraire n'importe quelle de ces substances de l'intérieur de la cellule, il est nécessaire de briser la paroi cellulaire et la membrane protoplasmique. Dans certains cas, les cellules peuvent sécréter la substance désirée, mais dans la plupart des cas la paroi cellulaire doit être désintégrée par ultraons pour libérer ces substances.

Les micro-organismes sont très différents dans leur sensibilité à la désintégration ultrasonique. Par exemple, les plus facilement désintégrés sont ceux en forme de bâtonnet (bacilles), alors que les organismes sphériques (coques) sont beaucoup plus résistants. Le groupe des mycobactérs, auquel appartient le micro-organisme responsable de la tuberculose est particulièrement difficile à désintégrer. Généralement, les cellules animales sont plus facilement désintégrées que les cellules végétales, et les globules rouges sont plus facilement désintégrés que les cellules musculaires car ces cellules ne possédent pas de paroi cellulaire.

Avec le traitement par ultrasons, l'agitation moléculaire dans l'échantillon provoque généralement une élévation de température – surtout avec de petits volumes. Les températures élevées réduisant la cavitation, la température de l'échantillon doit être conservée aussi basse que possible – de préférence juste au-dessus de son point de congélation. Ceci peut être réalisé en immergeant le récipient contenant l'échantillon san un bain de glace et d'eau salée. L'élévation de température peut également être réduite en utilisant le pulseur ou en soumettant l'échantillion à plusieurs séries de courtes sonications.

La désintégration des cellules peut être améliorée en augmentant la pression hydrostatique habituellement 1 à 4 bar et la viscosité. Pour les micro-organismes, l'addition de billes de verre d'une taille comprise entre 0.05 et 0.5 mm favorise la désintégration des cellules en concentrant l'énergie relâchée par la cavitation, et par écrasement physique. Les billes sont pratiquement indispensables pour la désintégration de spores ou de levures. Le bon dosage est de un volume de billes pour deux volumes de liquide.

Pour le traitement de cellules difficiles, un prétraitement par une enzyme comme le lysozyme ou la hyaluronidase peut être bénéfique. La glycosidase est efficace sur la levure, la lysostaphine sur les Staphylocoques, la collagénase sur la peau et le cartilage, et la trypsine hyaluronidase avec des tissues de foie et de reins.

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Si l'utilisation d'enzyme n'est pas possible, les procédures suivantes peuvent être essayées : congélation de l'échantillon à -70ºC pendant la nuit, puis décongélation dans un mélange eau glace immédiatement avant la sonication.

Chaque fois que cela est possible, les tissus doivent être coupés en tout petits morceaux pour permettre leur mouvement dans le liquide. Les tissus résistants comme la peau et les muscles doivent d'abord être liquéfiés dans un mixer ou un équivalent pendant environ 10 secondes, et transvasés dans un petit récipient pendant le traitement ultrasonique. La congélation suivie d'une réduction en poudre peut également être tilisée se cette procédure ne perturbe pas l'expérience. Si des particules subcellulaires inactes sont désirées, la commande d'amplitude doit être réglée assez bas et le temps de traitement augumenté.

Insérer la sonde suffisamment profondément en-dessous de la surface de l'échantillon pour éviter la formation d'aérosol ou de mousse. La mousse diminue considérablement la cavitation et peut entraîner une dénaturation des protéines. Un traitement à une puissance plus faible sans mousse est beaucoup plus efficace qu'un traitement à une puissance plus élevée avec sans mousse. La diminution de la puissance, láugmentation de la température du liquide empêchent généralement l'apparition d'aérosol et de mousse. Ne pas utiliser d'agent anti-moussant ou de surfactant.

Des radicaux libres se forment pendant la cavitation. Si on laisse ces radicaux libres s'accumuler, ceux-ci peuvent affecter de façon importante l'intégrité biologique de l'échantillion en réagissant avec les protéines, les polysaccharides ou les acides nucléiques. La formation de radicaux libres au cours de traitements de courte durée n'est normalement pas considérée comme un probléme. Pour des traitements prolongés, il peut être bénéfique d'ajouter des fixateurs de radicaux libres comme le N_20, la cystéine, la glutathione réduite, le dithiothréitol ou d'autres composés SH. La saturation de l'echantillon par une atomsphere protectrice d'helium ou d'hydrogéne gazeux, ou l'ajout d'un petit bout de glace carbonique dans l'échantillon diminue souvent la formation de radicaux libres.

La plus grande concentration d'énergie étant à proximité immediate de la sonde, il est impératif de garder l'échantillion aussi prés que possible de la pointe. Les liquides sont facilement traités car les cellules libres circulent sans cesse sous la sonde. Les matériaux solides, cependant, ont tendance à être repoussés par les ultrasons, et doivent être traités dans des récipients suffisamment larges pour contenir la sonde, mais également suffisamment petits pour restreindre le mouvement de l'échantillon. Pour les petits échantillons, nous conseillons d'utiliser des tubes à essai de forme conique. Bien que les tubes plastiques fonctionnent bien, les tubes en verre et en acier inoxydable sont un peu plus efficaces que ceux en plastique car ils n'absorbent pas les vibrations.

Le contact de la sonde avec le récipient diminue la puissance délivrée, et entraîne la migration de toutes petites particules de verre dans le liquide. Même si ces particules de verre n'affectent pas la composition chimique de l'échantillon, elles formeront une fine couche grise lors de la centrifugation. Si la sonde doit entrer en contact avec un

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échantillon solide, utiliser un tube de centrifugation en acier in oxydable standard de 20 mm (¾") de diamètre coupé à une longueur de 70 mm (3"). Les micropointes ne doivent jamais entrer en contact avec autre chose que le liquide, car la friction résultante au point de contact avec le récipient briserait la micropointe. Même se les sondes plus grandes ne se brisent pas si elles entrent en contact avec le récipient de traitement, elles peuvent cependant briser le récipient.

Avant chaque expérience, placer la pointe de la sonde dans l'eau ou l'alcool et mettre l'alimentation sous tension pendant quelques secondes pour retirer tout résidu.

Pour éviter la perte d'échantillon pouvant s'accrocher à la paroi du tube à essai, enduire le tube de silicone de la façon suivante : laver et sécher soigneusement le tube à essai, enduire de silicone puis sécher à l'air.

Les sondes peuvent être autoclavées ou stérilisées en les immergeant soit dans l'eau bouillante soit dans un détergent bactéricide et un désinfectant.

Une viscosité et une concentration élevées sont problématiques. 5000 cp et une concentration de 15% en poids constituent les limites maximales. Si l'échantillon est trop éspais pour être versé ou circuler facilement, il est trop épais et ne peut pas être traité par ultrasons.

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CHAPITRE III – REPARATIONS

SURCHARGE

Le(s) fusible(s) protége(nt) le processeur ultrasonique contre une mauvaise utilisation, ou un mauvais fonctionnement. Si un fusible saute, procéder de la façon suivante :

1. S'assurer que la sonde et/ou la pointe sont correctement fixées.
2. Remplacer le fusible.
3. Régler la commande d'AMPLITUDE sur 100 et le commutateur PULSE/CONTINUOUS (pulsion/continu) sur CONTINUOUS. Avec la sonde à l'air (hors de l'échantillons), I'indicateur de puissance doit indiquer une valeur inférieure à 20 watts. Si la lecture dépasse 20 watts, régler la commande d'AMPLITUDE sur OFF (arrêt), et débrancher la sonde du convertisseur.
4. Régler la commande d'AMPLITUDE sur 100. Si I'indicateur de puissance indique une valeur inférieure à 10 watts, la sonde es défaillante, et doit être remplacée. Si I'indicateur de puissance indique une valeur supérieure à 10 watts, soit le convertisseur soit le generateur sont défillants et doit être renvoyés pour réparation.

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Cliquetez Pour Sommaire Des Guides Francais

SONIFICATEUR HAUTE INTENITÉ
SÉRIE AUTOTUNE

Modéle 500 watts
Modéle 750 watts

Références 75041

GUIDE D'UTILISATION

Rev. 01 6/28/02

SOMMAIRE

Le sonificateur levré avec ce manuel d'instructions est fabriqué avec les meilleurs matériaux et la transformation répond aux normes de fabrication les plus élevées. Il a été soigneusement testé et inspecté avant de quitter l'usine et il assurera à l'utilisateur de nombreuses années de fonctionnement fiable et en toute sécurité s'il est utilisé en respectant les procédures décrites dans ce manuel.

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MESURES DE SECURITE IMPORTANTES

LIRE ATENTIVEMENT AVANT D'INSTALLER OU D'UTILISER CET APPAREIL

Ce sonificateur a été conçu pour assurer un maximum de sécurité à l'utilisateur. Cependant, aucune conception ne peut assurer une protection totale en cas de mauvaise utilisation qui peut entraîner des blessures corporelles et/ou des dommages matériels. Pour la protection de l'utilisateur et de l'appareil, respecter les avertissiments suivants à tout monent, lire attentivement les instructions de fonctionnement avant de tenter de faire fonctionner l'appareil, et conserver ce manuel d'instructions pour le consulter plus tard. Si le sonificateur est utilisé d'une maniére contraire à celle précisée dans ce manuel d'instructions, les protections conçues dans l'appareil peuvent être altérées.

- Vérifier que le sonificateur est correctement relié à la terre avec une fiche à 3 broches.
- Une haute tension est présente au niveau de l'alimentation. Le capot ne peut être retiré que par une personne qualifiée.
- Pour éviter les chocs électriques, débrancher le cordon d'alimentation avant de retirer le capot pour effectuer une réparation.
- Ne jamais faire fonctionner le générateur s'il n'est pas connecté au convertisseur.
- Ne rien fixer sur la sonde.
- Ne jamais toucher une sonde vibrante.
- Ne jamais laisser une microsonde ou un prolongateur vibrer à l'air libre pendant plus de 10 secondes.
- En cas d'utilisation d'une microsonde, conserver toujours l'amplitude en dessous de 40.
- Ne jamais faire fonctionner une sonde à extrémité filetée sans pointe, prolangateur ou microsonde.
- Refroidir le convertisseur avec de l'air lorsque la température de l'échantillon dépasse 100°C, et pour utilisarion à haute intensité pendant plus de 30 minutes.
- Nous conseillons l'utilisation d'une cabine anti-bruit ou d'une protection auriculaire pendant le fonctionnement du sonificateur.

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LIQUIDES A FAIBLE TENSION DE SURFACE • SOLVANT ORGANIQUES

Toutes les sondes, y compris celles avec pointes remplaçables, sont ajestées pour résonner à une cetaine fréquence. Si le bout de remplacement est retirée ou isolée du reste de la sonde, l'élément ne résonnera plus à cette fréquence, et le sonificateur sera défaillante. Les liquides à faible tension de surface pénètrent dans l'interface entre la sonde et le bout de remplacement, et amènent des particules dans la partie filetée, isolant le bout de remplacement de la sonde. TOUJOURS ultiliser une sond solide pour traiter les liquides à faible tension de surface avec une sonde de 13 mm.

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CHAPITRE I – INSTALLATION

INSPECTION

Avant d'installer le sonificateur, inspecter visuellement le colis et relever toute trace de dommage qui aurait pu survenir pendant le transport. Avant de jeter l'emballage, vérifier soigneusement qu'il ne contient pas de petites pièces.

En cas de dommage, contacter le transporteur dans les 48 heures à compter de la date de livraison. NE PAS FAIRE FONCTIONNER UN APPAREIL ENDOMMAGE. Conserver tous les matériaux d'emballage pour une future expédition.

INSTALLATION DU SONIFICATEUR

Le sonificateur doit être installé installé dans un endroit à l'bri d'un poussière, de saleté, de vapeurs explosives et corrosives, et des conditions extrêmes de température et d'humidité.

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CHAPITRE II – FONCTIONNEMENT

PRINCIPE DE DESINTEGRATION ULTRASONIQUE

Le générateur ultrasonque convertit la tension du secteur 50/60 Hz en énergie électrique de haute fréquence. Cette énergie électrique de haute frequence est transmise à un transducteur piézo-électrique dans le convertisseur, où elle est changée en vibrations mécaniques. Les vibrations du convertisseur sont intensifiées par la sonde, créant de ondes de compression dans le liquide. Cette action génère des millions de bulles microscopiques qui se propagent pendant la phase de pression négative, et qui implosent violemment pendant la phase de pression positive. C'est ce phénomène, appelé cavitation, qui dissipe une énergie considérable au niveau du point d'implosion, permettant ainsi une agitation intense à la pointe de la sonde.

Plus la pointe de sonde est large, plus le volume pouvant être traité, mais à une intensité plus faible. Pour obtenir des informations concermamt le capacité de traitement de chaque sonde, consulter les tableaux ci-dessous.

	MICROSONDES CONIQUES			MICROSONDES A ETAGES
DIAMETRE DE LA SONDE	3 mm	5 mm	6,5 mm	3 mm
INTENSITE	ultra haute	très haute	haute	très haute
VOLUME (échantillon)	1-10 ml	3-20 ml	5-50 ml	250 µl –10 ml

	SONDES STANDARDS		
DIAMETRE DE LA SONDE	13 mm	19 mm	25 mm
INTENSITE	haute	moyenne	basse
VOLUME (échantillon)	10-250 ml	25-500 ml	500-1000 ml

SONDE HAUTE INTENSITE		
DIAMETRE DE LA SONDE	19 mm	25 mm
INTENSITE	haute	moyenne
VOLUME (échantillon)	25-500 ml	500-1000 ml

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FONCTION DES TOUCHES, COMMANDES, INDICTEURS ET CONNECTEURS

PANNEAU FRONTAL	
Ecran LCD	Affiche les messages et paramétres de contrôle suivants : • amplitude sélectionnée • puissance de sortie délivrée à la sonde en watts, en joule, et en pourcentage de la puissance totale • durée de traitement sélectionnée • temps écoulé • temps de traitement effectif • durée de sonification/relaxation du cycle de pulsation
Touches 0-9	Saisie des chiffres.
Touche CLEAR	(effacer) Efface la saisie précédente.
Touche ENTER/REVIEW	(entrer/visualiser) Saisit les données dans le programme et sélectionne différents paramétres pour l'aichage sur l'écran LCD.
Touche TIMER	(minuteric) Utilisée avec les touches numériques pour régler la durée de l'application des ultrasons – de 1 seconde à 9 heures, 59 minutes, 59 secondes.
Touche TEMP	(température) Utilisée avec les touches numériques pour régler la limite supérieure de température – de 1ºC à 99ºC. L'indicateur rouge s'allume lorsque la limite de température a été atteinte.
Touche PULSER	(pulseur) Utilisée avec les touches numériques pour régler les paramétres de pulsation. Le cycle ON (sonification) et le cycle OFF (relaxation) peuvent être réglés indépendamment de 0.1 seconde à 9.9 secondes. L'indicateur rouge s'allume dans la partie OFF du cycle.
Touche START/STOP	(démarrer/arrêter) Démarre un cycle programmé ou arrête un cycle en cours d'exécution. En mode STOP, le programe est terminé et l'indicateur rouge s'éteint.
Touche PAUSE	Suspend le fonctionnement. L'indicateur rouge s'allume lorque le cycle de traitement est interrompu.
Touche RECALL	(rappel) Utilisée avec les touches numériques pour rappeler n'importe lequel des 10 programmes en mémoire. L'indicateur roughe allumé signale à l'utilisateur qu'il doit saisir un numéro d'identification de programme.
Touche SAVE	(enregistrer) Utilisée avec les touches numérique pour attribuer un numéro à un programme et enregistrer ce programme dans la mémoire. Un maximum de 10 programmes (0-9) peuvent être enrigistrés. L'indicateur rouge allumé signale à l'utilisateur qu'l doit saisir un numéro d'identification de programme.
Commutateur ON/OFF (situé sous le panneau de commande)	(marche/arrêt) Permet de metre l'apparcil sous tension (ON) ou hors tension (OFF).
Commande d'AMPLITUDE (située sous le panneau de commande)	Contrôle l'amplitude des vibrations à la pointe de la sonde. ATTENTION *Pendant l'utilisation d'une microsonde, ne jamais laisser l'amplitude dépasser 40%..*

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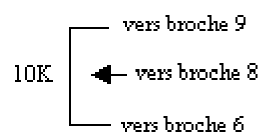
	PANNEAU ARRIERE
Sub connecteur D 9 brouches	Se connecte au dispositif de commande externe, et permet l'activation et le contrôle de la fréquence.
Jack pour pédale	Se connecte au càble de la pédale.
Connecteur coaxial	Se connecte au convertisseur.
Module d'alimentation	Se connecte au cordon d'alimentation électrique et abrite le(s) fusible(s).

SUB CONNECTEUR D 9 BROCHES

Broche Nº	Description
1	Protection contre surcharge externe.
2	Restauration de surcharge externe.
3	Non connectée.
4	Permet une connexion à un compteur de fréquences.
5	Permet une connexion à un contrôleur de puissance exerne (5 mV = 1 watt).
6	Terre.
7	Active les ultrasons quand connecté à la terre.
8 et 9	Permet de régler l'intensité à distance à l'aide d'un potentiométre 10K externe.



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REMARQUE

Pour modifier l'intensité à distance à l'aide de (0-5V) à la place d'un potentionétre 10K, connecter le positif sur la broche 8 et le négatif sur la broche 6.

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PREPARATION AVANT UTILISATION

ATTENTION

Si le sonificateur a été laissé dans un environnement trés froid ou trés chaud pendant une période prolongée, ne pas le faire fonctionner avant qu'il ait atteint la température de la pièce.

1. S'assurer que le commutateur d'alimentation ON/OFF (marche/arrêt) est réglé sur OFF (arrêt).

2. Brancher le cordon d'alimentation électrique dans la prise de courant.

3. Si la pédale optionnelle est utilisée, insérer la fiche de la pédale dans la prise jack sur le panneau arriére. S'assurer que la fiche est entièrement et fermement insérée.

4. Si le montage convertisseur/ sonde n'est pas déjà assemblé, voir et suivre les étapes 5, 6 et 7.

ATTENTION

Ne jamais monter ou démonter une sonde en maintenant le convertisseur dans un étau.
Ne jamais mettre de rondelle entre la sonde et le convertisseur.
Ne jamais appliquer de graisse sur les surfaces de jonction ou les filetages du convertisseur, de la sonde, des bouts de Remplacement ou des microsondes.

5. Vérifier la propreté des surfaces de jonction du convertisseur et de la sonde ou des microsondes à étages, ainsi que du coupleur et du trou filetés.

6. Monter la sonde ou la microsonde à étages (constituée d'un coupleur et d'une sonde à étage) à la main sur le convertisseur. Utiliser les clés fournies et serrer correctement.

7. Pour fixer un bouts de Remplacement, un prolongateur ou une microsonde conique sur une sonde, utiliser une clé à ergots et une clé ouverte.

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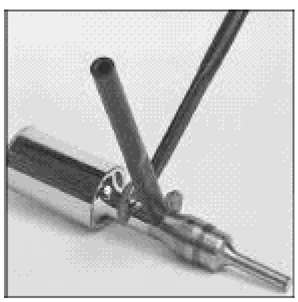
REMARQUE

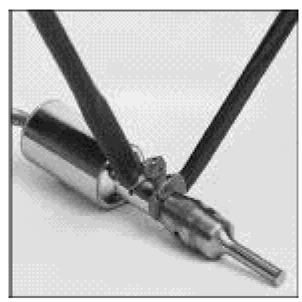
S'il devient nécessaire de retirer une sonde, utiliser les clés à ergots fournies. Si la sonde est fixée sur le convertisseur depuis longtemps, il peut être nécessaire d'utiliser un étau. S'assurer que l'étau est équipé de mâchoires tendres ou d'un autre système pour éviter les raures. Fixer la partie de la sonde présentant le plus grand diamètre dans les mâchoire de l'étau. Ne jamais serrer le convertisseur pour le séparer de la sonde. Il est possible d'utiliser un marteau sur l'extrémité de la clé à ergots. Ne jamais essayer de retirer la sonde du convertisseur en tournant le logement du convertisseur, car cela peut endommager les connexions électriques à l'intérieur du logement.

8. Connecter le câble du convertisseur sur l'alimentation électrique.

9. Installer le montage convertisseur/sonde sur un statif. Fixer la pince uniquement sur la carrosserie du convertisseur de 63 mm de diamétre. Ne pas fixer la pince sur une autre partie du montage convertisseur/sonde.

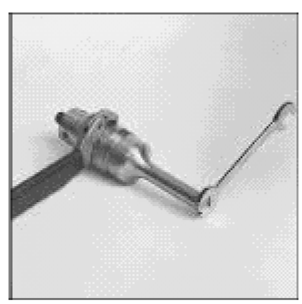


ENLEVEMENT



SERRAGE

ENLEVEMENT DE LA SONDE



SERRAGE DE LA SONDE

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UTILISATION DU SONIFICATEUR

Un régulateur de vitesse sur une automoble peut, dans une certaine mesure, être comparé à un sonificateur. Ce dispositif est conçu pour maintenir le véhicule à une vitesse constante. Lorsque le terrain change, les nécessités de puissance changent également. Le régulateur de vitesse détecte ces nécessités, et ajuste automatiquement la quantité de puissance délivrée par le moteur, pour compenser ces conditions sans cesse changeantes. Plus l'inclinaison est importante, plus la résistance du véhicule au mouvement augmente, et plus importante sera la puissance délivrée par le moteur pour compenser cette résistance.

Le sonificateur est conçu pour délivrer une amplitude constante. Lorsque la résistance au mouvement de la sonde augmente, les exigences de puissance augmentent également. L'alimentation en puissance détecte ces nécessités, et augmente automatiquiment la puissance délivrée afin de maintenir constante le déplacement de la sonde. Dans des conditions de charge identiques, la quantité de watts délivrée par deux sonificateur avec des puissances differentes sera identique (à condition que les deux disposent d'une capacité de puissance suffisante).

La commande d'AMPLITUDE permet de régler les vibrations ultrasoniques à la pointe de la sonde sur le niveau désiré. Bien que le degré de cavitation nécessaire pour traiter l'échantillon puisse aisément être déterminé à l'oeil nu, la puissance nécessaire ne peut pas être prédéterminée. Un réseau sensible contrôle en continu les exigences de sortie, et ajuste automatiquement la puissance pour maintenir l'amplitude sur le niveau présélectionné. Plus la résistance au mouvement de la sonde due à une forte viscosité, plus la sonde est immergée profondément dans l'échantillon, plus la diamétre de la sonde est élevé, ou plus la pression est élevée, plus de puissance délivré à la sonde sera importante. Le réglage de la commande d'AMPLITUDE entiérement dans le sens horaire n'entraînera pas la distribution de la puissace maximale à l'échantillon. La puissance maximale que le sonificateur est capable de délivrer sera uniquement délivrée lorsque la résistance au mouvement de la sonde est suffisamment élevée pour soutirer la quantité de watt maximale.

Ce phénoméne peut être démontré de la façon suivante. Appuyer la sonde contre un morceau de bois. Plus la pression exercée vers le bas est importante, et par conséquent plus la résistance au mouvement de la sonde est élevée, plus la quantité de délivrée.

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ATTENTION

- Ne pas faire fonctionner le générateur sans l'avoir branché sur le convertisseur.
- Ne jamais laisser de liquide couler dans le convertisseur. Ne pas utiliser la chambre Cup-Horn sans protection contre le liquid.
- Ne jamais laisser une microsonde ou un prolongateur vibrer à l'air libre pendant plus de 10 seconds. Pendant l'utilisation d'une microsonde, ou un prolongateur ne jamais régler la commande d'AMPLITUDE au-dessus de la limite de 40%.
- Ne pas laisser une sonde vibrante entrer en contact avec autre chose que l'échantillon.

REMARQUE

Pour des conseils de fonctionnement général et des techniques de traitement ultrasonique, se reporter aux pages 18-20.

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1. Régler le commutateur d'alimentation ON/OFF (marche/arrêt) sur ON (marche). Le commutateur s'allume et l'écran LCD affiche la puissance nominale du sonificateur, les message d'avertissement et les paramètres de contrôle suivants.

TIME __:__:__	TEMP __ __°C
PULSE__:__:__	AMPL __ __%

REMARQUE
Si le maessage "OVERLOAD" (surcharge) apparaît sur l'écran LCD, se reporter a' la page 17.

2. Immerger la sonde d'environ 5 cm dans l'échantillon. En cas d'utilisation d'une microsonde, immerger la microsonde d'environ 1 cm dans l'échantillon.

REMARQUE
La sonde doit être immergée suffisamment profondément pour empêcher l'injection d'air dans l'échantillon, et pour inhiber la formation d'aérosols ou de mousse.

AMPLITUDE L'amplitude est le seul paramétre devant être réglé pour rendre le sonificateur opérationnel. Les autres paramétres de contrôle – Time (temps) et Pulse (impulsion) – n'ont pas besoin d'être réglés pour un fonctionnement en continu.

AMPL. affiche le pourcentage du maximum d'amplitude, par exemple 40%, réglé avec la commande AMPLITUDE.

Tourner le bouton d'AMPLITUDE pour obtenir un affichage de 40% sur l'écran LCD – Ampl. 40%.

L'écran LCD affiche :

TIME __:__:__	TEMP __ __°C
PULSE__:__:__	AMPL 40 %

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Le sonificateur est à présent prêt à fonctionner en continu. Pour activer le ultrasons, appuyer sur la touche START ou sur la pédale. Pour désactiver les ultrason, appuyer sur la touche STOP ou relâcher la pédale. Pour utiliser les fonctions de temps, de température, d'impulsion, d'enregistrement, de rappel ou d'enegie, se reporter aus paragraphes correspondants cedessous.

REMARQUE

Il est possible de combiner n'importe quelles fonctions dans n'importe quel ordre. Pour effacer une mauvaise saisie, appuyer sur la touche CLEAR.

REMARQUE

Si l'utilisateur appuie sur la touche START et qu'aucune limite de temps n'a été réglée, le traitement continuera jusqu'a ce que la touche STOP soît actionnée.

Si l'utilisateur appuie sur la touche START et que la limite de temps a été réglée, le traitement continuera jusqu'a expiration du temps réglé, ou si la touche STOP est pressée – quelque soit le primier événement survenu.

En cas d'utilisation d'une pédale, et si aucune limite de temps n'a été réglée, le traitement continuera tant quw l'utilisateur appuie sur la pédale.

En cas d'utilisation d'une pédale, et si aucune limite de temps n'a été réglée, le traitement continuera jusqu'à l'expiration de la limite de temps, ou si la pédale est relâchée – quelque soit le premier événement survenu.

La touche START et la pédale sont mutuellenent exclusives. Si le traitement est démarré avec la touche START, la pédale devient inopérante. Si la sonification est démarrée à l'aide de la pédale, la touche STOP devient inopérante.

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REMARQUE

La sonde est syntonisée pur vibrer à une fréquence spécifique. Si la fréquence de résonance de la sonde a changé, du fait de l'érosion par cavitation ou d'une rupture, une lecture minimum ne pourra pas être obtenue. En cas de condition de surcharge, ou se une lecture minimum ne peut pas être obtenue (moins de 20%) avec la sonde hors de l'échantillon, vérifier l'appareil sans sonde pour déterminer le composant pouvant être défectueux. Si une lecture minimum est obtenue avec le convertisseur sans sonde, la sonde est défectueuse et doit être remplacée.

Une sonde mal fixée engendre généralement un bruit de perceuse intense

En cas de condition de surcharge, se reporter à la page 18.

Immerger la sonde d'environ 5 cm dans l'echantillon. En cas d'utilisation d'une microsonde, immerger la microsonde d'environ 1 cm dans l'echantillon. L'amplitude nécessaire étant dépendante de l'application et fonction du volume et de la composition de l'echantillon, nous conseillons d'optimiser l'amplitude pendant le traitement de l'echantillon.

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MINUTERIE : En mode pulsé, la durée du traitement est différente du temps écoulé car la fonction de temps de traitement et contrôle uniquement les portions de sonification du cycle. Par exemple, pour 1 heure de traitement, le temps écoulé sera de 2 heures si les cycles de sonification et de relaxation sont tous les deux réglés sur 1 seconde. Pour régler le temps de traitement, appuyer sur la touche TIMER.

L'écran LCD affiche :

Time Setting
Hrs:__ Min:_ _ Sec:_ _

(réglage du temps)

A l'aide des touches numéroques, régler le temps de traitement sur la valeur désirée :

par example :

Time Setting
Hrs: 5 Min: 30 Sec: 25

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Appuyer sur la touche ENTER/REVIEW

L'écran LCD affiche :

TIME 5:30:25	TEMP __ __°C
PULSE__:__:__	AMPL 40 %

PULSER : En inhibant l'accumulation de chaleur dans l'echantillon, la fonction de pulsation permet un traitement en toute sécurité des échantillons thermosensibles à haute intensité. De plus, les pulsations améliorent le traitement en permettant au matériaux de revenir sous la sonde aprés chaque décharge. Les durées des sonifications (ON) et relaxation (OFF) peuvent être réglées indépendamment de 0,1 seconde à 9,9 secondes. Pendant la phase de relaxation du cycle, l'indicateur rouge sur la touche PULSER s'allume. Si la phase de relaxation du cycle dépasse deux secondes, un message d'avertissement – CAUTION – PROBE ON STANDBY – (attention –sonde en attente) apparaît sur l'écran pour avertir l'utilisateur qu'il ne doit pas toucher la sonde ultrasonique. Pour régler le pulser, appuyer sur la touche PULSER.

L'écran LCD affiche :

Pulse on __.__sec	(sonificaion__.__sec)
Pulse off __.__sec	(relaxation__.__sec)

A l'aide de touches numérique, régler la phase de sonicication (ON) du cycle et appuyer la touche ENTER/REVIEW.

L'écran LCD affiche :

par example :

Pulse on 2.5 sec	(sonification 2,5 sec)
Pulse off __.__sec	(relaxation__.__sec)

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A l'aide des touches numériques, régler la phase de relaxation (OFF) du cycle.

L'écran LCD affiche :

par example :	Pulse on 2.5 sec Pulse off 1.0 sec	(sonification 2,5 sec) (relaxation 1,0 sec)

Appuyer sur la touche ENTER/REVIEW.

L'écran LCD affiche :

TIME 5:30:25	TEMP __ __°C
PULSE 2.5 : 1.0	AMPL 40 %

TEMPERATURE

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CHAPITRE III – MAINTENANCE

CONDITIONS DE SURCHARGE

Le fusible et la protection anti-surcharge protègent le sonificateur contre une mauvaise utilisation, ou ou mauvais fonctionnement. Si un fusible saute, ou si le circuit de surcharge électronique s'active, procéder de la façon suivante :

ALIMENTATION ELECTRIQUE

Pour les exigences électriques, se référer à l'etiquette à l'arriére de l'appareil.

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S’il est nécessaire de remplacer le (s) fusible (s), procéder de la façon suivante :

1. Déconnecter le cordon d’alimentation

2. Ouvrir le support de fusibles en utilisant un petit tournevis plat.

3. Retirer le support de fusibles rouge de son logement.

4. Pour les appareils 110/115 volts, remplacer les deux fusibles à action lente de type MDL de 15 A 6 mm x 6 mm. Pour les appareils 220/240 volts, remplacer les deux fusibles à action lente de type GDC de 7,5 A de 5 x 20 mm.

5. Rebrancher le cordon d’alimentation.

6. S’assurer que la sonde et/ou la pointe sont correctement fixées.

7. Vérifier les fusibles et les remplacer si nécessair

8. Régler la commande d’AMPLITUDE sur 50 et le commutateur d’alimentation sur ON (marche). Avec la sonde à l’air (hors de l’échantillons), le wattmétre doit indiquer une valeur inférieure à 20 watts. Si la lecture dépasse 20 watts, régler le commutateur d’alimentation sur OFF (arrêt) et débrancher la sonde du convertisseur.

9. Remettre le commutateur d’alimentation sur ON (marche). Si le wattmétre indique une valeur inférieure à 20 watts, la sonde est défaillante ou n’est plus ajustée du fait d’une érosion excessive, et doit être remplacée.

RETOUR DE L’APPAREIL

Nous conseillons de retourner un appareil nécessitant une réparation à l’usine. Afin de bénéficier d’une réparation rapide, contacter toujours l’usine avant de retourner un appareil. Préciser la date d’achat, le numéro du modéle et le numéro de série. Faire attention à emballer soigneusement l’appareil pour éviter tout dommage éventuel pendant le transport.

Les sonificateurs doivent toujours être renvoyés accompagnés de leur convertisseur et de leur sonde.

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IMPORTANT

JE CERTIFIE QUE LE(S) SONIFICATEUR(S) ET OU LES ACCESSOIRES RETOURNES POUR REPARATION SONT EXEMPTS DE MATIERES RADIOACTIVES OU SUSCEPTIBLES DE PRESENTER UN DANGER BIOLOGIQUE ET QU'ILS PEUVENT ETRE MANIPULES EN TOUTE SECURITE.

NE RETOURNER AUCUN APPAREIL SI CETTE CERTIFICATION NE PEUT PAS ETRE APPORTEE

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CHAPITRE IV
CONSEILS ET TECHNIQUES D'UTILISATION

DESINTEGRATION DES CELLULES

Les organismes unicellulaires (micro-oranismes) sont constitués d'une paroi cellulaire externe semi-perméable, solide et rigide entourant la membrane protoplasmique (cytoplasmique) et le cytoplasme. Le cytoplasme est constitué d'acides nucléiques, de

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protéines, de glucides, de lipides, d'enzymes, d'ions inorganiques, de vitamines, de pigments, d'inclusions et d'environ 80% d'eau. Pour isoler et extraire n'importe quelle de ces substances de l'intérieur de la cellule, il est nécessaire de briser la paroi cellulaire et la membrane protoplasmique. Dans certains cas, les cellules peuvent sécréter la substance désirée, mais dans la plupart des cas la paroi cellulaire doit être désintégrée par ultraons pour libérer ces substances.

Les micro-organismes sont très différents dans leur sensibilité à la désintégration ultrasonique. Par exemple, les plus facilement désintégrés sont ceux en forme de bâtonnet (bacilles), alors que les organismes sphériques (coques) sont beaucoup plus résistants. Le groupe des mycobactérs, auquel appartient le micro-organisme responsable de la tuberculose est particulièrement difficile à désintégrer. Généralement, les cellules animales sont plus facilement désintégrées que les cellules végétales, et les globules rouges sont plus facilement désintégrés que les cellules musculaires car ces cellules ne possédent pas de paroi cellulaire.

Avec le traitement par ultrasons, l'agitation moléculaire dans l'échantillon provoque généralement une élévation de température – surtout avec de petits volumes. Les températures élevées réduisant la cavitation, la température de l'échantillon doit être conservée aussi basse que possible – de préférence juste au-dessus de son point de congélation. Ceci peut être réalisé en immergeant le récipient contenant l'échantillon san un bain de glace et d'eau salée. L'élévation de température peut également être réduite en utilisant le pulseur ou en soumettant l'échantillon à plusieurs séries de courtes sonications.

La désintégration des cellules peut être améliorée en augmentant la pression hydrostatique habituellement 1 à 4 bar et la viscosité. Pour les micro-organismes, l'addition de billes de verre d'une taille comprise entre 0.05 et 0.5 mm favorise la désintégration des cellules en concentrant l'énergie relâchée par la cavitation, et par écrasement physique. Les billes sont pratiquement indispensables pour la désintégration de spores ou de levures. Le bon dosage est de un volume de billes pour deux volumes de liquide.

Pour le traitement de cellules difficiles, un prétraitement par une enzyme comme le lysozyme ou la hyaluronidase peut être bénéfique. La glycosidase est efficace sur la levure, la lysostaphine sur les Staphylocoques, la collagénase sur la peau et le cartilage, et la trypsine hyaluronidase avec des tissues de foie et de reins.

Si l'utilisation d'enzyme n'est pas possible, les procédures suivantes peuvent être essayées : congélation de l'échantillon à -70ºC pendant la nuit, puis décongélation dans un mélange eau glace immédiatement avant la sonication.

Chaque fois que cela est possible, les tissus doivent être coupés en tout petits morceaux pour permettre leur mouvement dans le liquide. Les tissus résistants comme la peau et les muscles doivent d'abord être liquéfiés dans un mixer ou un équivalent pendant environ 10 secondes, et transvasés dans un petit récipient pendant le traitement ultrasonique. La

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congélation suivie d'une réduction en poudre peut également être tilisée se cette procédure ne perturbe pas l'expérience. Si des particules subcellulaires inactes sont désirées, la commande d'amplitude doit être réglée assez bas et le temps de traitement augumenté.

Insérer la sonde suffisamment profondément en-dessous de la surface de l'échantillon pour éviter la formation d'aérosol ou de mousse. La mousse diminue considérablement la cavitation et peut entraîner une dénaturation des protéines. Un traitement à une puissance plus faible sans mousse est beaucoup plus efficace qu'un traitement à une puissance plus élevée avec sans mousse. La diminution de la puissance, láugmentation de la température du liquide empêchent généralement l'apparition d'aérosol et de mousse. Ne pas utiliser d'agent anti-moussant ou de surfactant.

Des radicaux libres se forment pendant la cavitation. Si on laisse ces radicaux libres s'accumuler, ceux-ci peuvent affecter de façon importante l'intégrité biologique de l'échantillion en réagissant avec les protéines, les polysaccharides ou les acides nucléiques. La formation de radicaux libres au cours de traitements de traitements de courte durée n'est normalement pas considérée comme un probléme. Pour des traitements prolongés, il peut être bénéfique d'ajouter des fixateurs de radicaux libres comme le N_20, la cystéine, la glutathione réduite, le dithiothréitol ou d'autres composés SH. La saturation de l'echantillon par une atmosphere protectrice d'helium ou d'hydrogéne gazeux, ou l'ajout d'un petit bout de glace carbonique dans l'échantillon diminue souvent la formation de radicaux libres.

La plus grande concentration d'énergie étant à proximité immediate de la sonde, il est impératif de garder l'échantillion aussi prés que possible de la pointe. Les liquides sont facilement traités car les cellules libres circulent sans cesse sous la sonde. Les matériaux solides, cependant, ont tendance à être repoussés par les ultrasons, et doivent être traités dans des récipients suffisamment larges pour contenir la sonde, mais également suffisamment petits pour restreindre le mouvement de l'échantillon. Pour les petits échantillons, nous conseillons d'utiliser des tubes à essai de forme conique. Bien que les tubes plastiques fonctionnent bien, les tubes en verre et en acier inoxydable sont un peu plus efficaces que ceux en plastique car ils n'absorbent pas les vibrations.

Le contact de la sonde avec le récipient diminue la puissance délivrée, et entraîne la migration de toutes petites particules de verre dans le liquide. Même si ces particules de verre n'affectent pas la composition chimique de l'échantillon, elles formeront une fine couche grise lors de la centrifugation. Si la sonde doit entrer en contact avec un échantillon solide, utiliser un tube de centrifugation en acier in oxydable standard de 20 mm (¾") de diamètre coupé à une longueur de 70 mm (3"). Les micropointes ne doivent jamais entrer en contact avec autre chose que le liquide, car la friction résultante au point de contact avec le récipient briserait la micropointe. Même se les sondes plus grandes ne se brisent pas si elles entrent en contact avec le récipient de traitement, elles peuvent cependant briser le récipient.

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Avant chaque expérience, placer la pointe de la sonde dans l'eau ou l'alcool et mettre l'alimentation sous tension pendant quelques secondes pour retirer tout résidu.

Pour éviter la perte d'échantillon pouvant s'accrocher à la paroi du tube à essai, enduire le tube de silicone de la façon suivante : laver et sécher soigneusement le tube à essai, enduire de silicone puis sécher à l'air.

Les sondes peuvent être autoclavées ou stérilisées en les immergeant soit dans l'eau bouillante soit dans un détergent bactéricide et un désinfectant.

Une viscosité et une concentration élevées sont problématiques. 5000 cp et une concentration de 15% en poids constituent les limites maximales. Si l'échantillon est trop éspais pour être versé ou circuler facilement, il est trop épais et ne peut pas être traité par ultrasons.

Utiliser la chambre à atmosphere étanche pour le traitement déchantillons pathogénes ou présentant un danger biologique.

Utiliser une cellule à flux continu pour le traitement de grands volumes. Pour le traitement d'échantillons thermosensibles, faire circuler l'échantillon dans un tube torsadé immergé dans un bain de glace salé pour minimiser l'élévation de la température.

Utiliser une chambre Cup Horn pour le traitement d'échantillons pathogénes, radioactifs et présentant un risque biologique, en isolement complet sans introduction de sonde. Les tubes plastiques ayant tendance à absorber les vibrations, il est préférable d'utiliser des tubes en acier inoxydable ou en verre pour travailler avec une chambre Cup Horn. Pour activer le traitement, ajouter des billes de verre à l'échantillon. Si l'utilisateur le désire, il peut ajouter de la glace pilée dans l'eau à l'intérieur de la chamber Cup Horn pour optimiser le refroidissement.

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SONIFICATEUR HAUTE INTENITÉ
SÉRIE AUTOTUNE

Piloté par microprocesseur

Modéle 500 watts
Modéle 750 watts

Références 75042 et 75043

GUIDE D’UTILISATION

Rev. 01 6/28/02

SOMMAIRE

Le sonificateur levré avec ce guide d'utilisation est fabriqué avec les meilleurs matériaux et la transformation répond aux normes de fabrication les plus élevées. Il a été soigneusement testé et inspecté avant de quitter l'usine et il assurera à l'utilisateur de nombreuses années de fonctionnement fiable et en toute sécurité s'il est utilisé en respectant les procédures décrites dans ce guide.

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MESURES DE SECURITE IMPORTANTES

LIRE ATENTIVEMENT AVANT D'INSTALLER OU
D'UTILISER CET APPAREIL

Ce sonificateur a été conçu pour assurer un maximum de sécurité à l'utilisateur. Cependant, aucune conception ne peut assurer une protection totale en cas de mauvaise utilisation qui peut entraîner des blessures corporelles et/ou des dommages matériels. Pour la protection de l'utilisateur et de l'appareil, respecter les avertissiments suivants à tout monent, lire attentivement les instructions de fonctionnement avant de tenter de faire fonctionner l'appareil, et conserver ce guide d'utilisation pour le consulter plus tard. Si le sonificateur est utilisé d'une maniére contraire à celle précisée dans ce guide d'instructions, les protections conçues dans l'appareil peuvent être altérées.

- Vérifier que le sonificateur est correctement relié à la terre avec une fiche à 3 broches.
- Une haute tension est présente au niveau de l'alimentation. Le capot ne peut être retiré que par une personne qualifiée.
- Pour éviter les chocs électriques, débrancher le cordon d'alimentation avant de retirer le capot pour effectuer une réparation.
- Ne jamais faire fonctionner le générateur s'il n'est pas connecté au convertisseur.
- Ne rien fixer sur la sonde.
- Ne jamais toucher une sonde vibrante.
- Ne jamais laisser une microsonde ou un prolongateur vibrer à l'air libre pendant plus de 10 secondes.
- En cas d'utilisation d'une microsonde, conserver toujours l'amplitude en dessous de 40.
- Ne jamais faire fonctionner une sonde à extrémité filetée sans embout de Rechange, prolangateur ou microsonde.
- Refroidir le convertisseur avec de l'air lorsque la température de l'échantillon dépasse 100°C.
- Nous conseillons l'utilisation d'une cabine anti-bruit ou d'une protection auriculaire pendant le fonctionnement du sonificateur.

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LIQUIDES A FAIBLE TENSION DE SURFACE • SOLVANT ORGANIQUES

Toutes les sondes, y compris celles avec embout de Rechange, sont ajestées pour résonner à une cetaine fréquence. Si l'embout de Rechange est retirée ou isolée du reste de la sonde, l'élément ne résonnera plus à cette fréquence, et le sonificateur sera défaillante. Les liquides à faible tension de surface pénètrent dans l'interface entre la sonde et l'embout de Rechange, et amènent des particules dans la partie filetée, isolant l'embout de Rechange de la sonde. TOUJOURS ultiliser une sonde solide pour traiter les liquides à faible tension de surface.

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CHAPITRE I – INSTALLATION

INSPECTION

Avant d'installer le sonificateur, inspecter visuellement le colis et relever toute trace de dommage qui aurait pu survenir pendant le transport. Avant de jeter l'emballage, vérifier soigneusement qu'il ne contient pas de petites pièces.

En cas de dommage, contacter le transporteur dans les 48 heures à compter de la date de livraison. NE PAS FAIRE FONCTIONNER UN APPAREIL ENDOMMAGE. Conserver tous les matériaux d'emballage pour une future expédition.

INSTALLATION DU SONIFICATEUR

Le sonificateur doit être installé installé dans un endroit à l'abri de poussière, de saleté, de vapeurs explosives et corrosives, et des conditions extrêmes de température et d'humidité.

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CHAPITRE II – FONCTIONNEMENT

PRINCIPE DE DESINTEGRATION ULTRASONIQUE

Le générateur ultrasonique convertit la tension du secteur 50/60 Hz en énergie électrique de haute fréquence. Cette énergie électrique de haute frequence est transmise à un transducteur piézo-électrique dans le convertisseur, où elle est changée en vibrations mécaniques. Les vibrations du convertisseur sont intensifiées par la sonde, créant de ondes de compression dans le liquide. Cette action génère des millions de bulles microscopiques qui se propagent pendant la phase de pression négative, et qui implosent violemment pendant la phase de pression positive. C'est ce phénomène, appelé cavitation, qui dissipe une énergie considérable au niveau du point d'implosion, permettant ainsi une agitation intense à la pointe de la sonde.

Plus la pointe de sonde est large, plus le volume pouvant être traité, mais à une intensité plus faible. Pour obtenir des informations concermamt la capacité de traitement de chaque sonde, consulter les tableaux ci-dessous.

	MICROSONDES CONIQUES			MICROSONDES A ETAGES
DIAMETRE DE LA SONDE	3 mm	5 mm	6.5 mm	3 mm
INTENSITE	ultra haute	très haute	haute	très haute
VOLUME (échantillon)	1-10 ml	3-20 ml	5-50 ml	250 µl –10 ml

	SONDES STANDARDS		
DIAMETRE DE LA SONDE	13 mm	19 mm	25 mm
INTENSITE	haute	moyenne	basse
VOLUME (échantillon)	10-250 ml	25-500 ml	500-1000 ml

SONDE HAUTE INTENSITE		
DIAMETRE DE LA SONDE	19 mm	25 mm
INTENSITE	haute	moyenne
VOLUME (échantillon)	25-500 ml	500-1000 ml

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FONCTION DES TOUCHES, COMMANDES, INDICTEURS ET CONNECTEURS

PANNEAU FRONTAL	
Ecran LCD	Affiche les messages et paramétres de contrôle suivants : • amplitude sélectionnée • puissance de sortie délivrée à la sonde en watts, en joule, et en pourcentage de la puissance totale • durée de traitement sélectionnée • temps écoulé • temps de traitement effectif • durée de sonification/relaxation du cycle de pulsation
Touches 0-9	Saisie des chiffres.
Touche CLEAR	(effacer) Efface la saisie précédente.
Touche ENTER/REVIEW	(entrer/visualiser) Saisit les données dans le programme et sélectionne différents paramétres pour l'aichage sur l'écran LCD.
Touche TIMER	(minuteric) Utilisée avec les touches numériques pour régler la durée de l'application des ultrasons – de 1 seconde à 9 heures, 59 minutes, 59 secondes.
Touche PULSER	(pulseur) Utilisée avec les touches numériques pour régler les paramétres de pulsation. Le cycle ON (sonification) et le cycle OFF (relaxation) peuvent être réglés indépendamment de 0.1 seconde à 9.9 secondes. L'indicateur rouge s'allume dans la partie OFF du cycle.
Touche START/STOP	(démarrer/arrêter) Démarre un cycle programmé ou arrête un cycle en cours d'exécution. En mode STOP, le programe est terminé et l'indicateur rouge s'éteint.
Commutateur ON/OFF (situé sous le panneau de commande)	(marche/arrêt) Permet de metre l'apparcil sous tension (ON) ou hors tension (OFF).
Commande d'AMPLITUDE (située sous le panneau de commande)	Contrôle l'amplitude des vibrations à la pointe de la sonde. ATTENTION *Pendant l'utilisation d'une microsonde, ne jamais laisser l'amplitude dépasser 40%..*

	PANNEAU ARRIERE
Sub connecteur D 9 brouches	Se connecte au dispositif de commande externe, et permet l'activation et le contrôle de la fréquence.
Jack pour pédale	Se connecte au càble de la pédale.
Connecteur coaxial	Se connecte au convertisseur.
Module d'alimentation	Se connecte au cordon d'alimentation électrique et abrite le(s) fusible(s).

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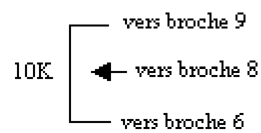
SUB CONNECTEUR D 9 BROCHES

Broche Nº	Description
1	Protection contre surcharge externe.
2	Restauration de surcharge externe.
3	Non connectée.
4	Permet une connexion à un compteur de fréquences.
5	Permet une connexion à un contrôleur de puissance exerne (5 mV = 1 watt).
6	Terre.
7	Active les ultrasons quand connecté à la terre.
8 et 9	Permet de régler l'intensité à distance à l'aide d'un potentiométre 10K externe.



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REMARQUE

Pour modifier l'intensité à distance à l'aide de (0-5V) à la place d'un potentiométre 10K, connecter le positif sur la broche 8 et le négatif sur la broche 6.

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PREPARATION AVANT UTILISATION

> **ATTENTION**
> Si le sonificateur a été laissé dans un environnement trés froid ou trés chaud pendant une période prolongée, ne pas le faire fonctionner avant qu'il ait atteint la température de la pièce.

1. S'assurer que le commutateur d'alimentation ON/OFF (marche/arrêt) est réglé sur OFF (arrêt).

2. Brancher le cordon d'alimentation électrique dans la prise de courant.

3. Si la pédale optionnelle est utilisée, insérer la fiche de la pédale dans la prise jack sur le panneau arriére. S'assurer que la fiche est entièrement et fermement insérée.

4. Si le montage convertisseur/ sonde n'est pas déjà assemblé, voir et suivre les étapes 5, 6 et 7.

> **ATTENTION**
> Ne jamais monter ou démonter une sonde en maintenant le convertisseur dans un étau.
> Ne jamais mettre de rondelle entre la sonde et le convertisseur.
> Ne jamais appliquer de graisse sur les surfaces de jonction ou les filetages du convertisseur, de la sonde, des bouts de remplacement ou des microsondes.

5. Vérifier la propreté des surfaces de jonction du convertisseur et de la sonde ou des microsondes à étages, ainsi que du coupleur et du trou filetés.

6. Monter la sonde ou la microsonde à étages (constituée d'un coupleur et d'une sonde à étage) à la main sur le convertisseur. Utiliser les clés fournies et serrer fortement.

7. Pour fixer un bouts de remplacement, un prolongateur ou une microsonde conique sur une sonde, utiliser une clé à ergots et une clé ouverte.

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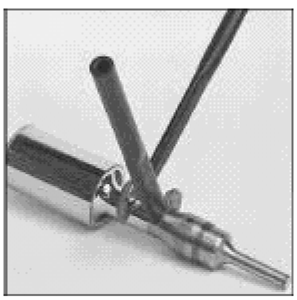
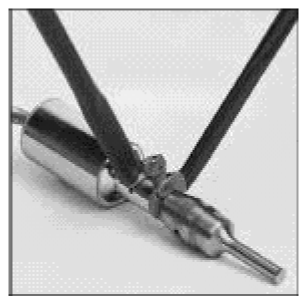
REMARQUE

S'il devient nécessaire de retirer une sonde, utiliser les clés à ergots fournies. Si la sonde est fixée sur le convertisseur depuis longtemps, il peut être nécessaire d'utiliser un étau. S'assurer que l'étau est équipé de mâchoires tendres ou d'un autre système pour éviter les raures. Fixer la partie de la sonde présentant le plus grand diamètre dans les mâchoire de l'étau. Ne jamais serrer le convertisseur pour le séparer de la sonde. Il est possible d'utiliser un marteau sur l'extrémité de la clé à ergots. Ne jamais essayer de retirer la sonde du convertisseur en tournant le logement du convertisseur, car cela peut endommager les connexions électriques à l'intérieur du logement.

8. Connecter le câble du convertisseur sur l'alimentation électrique.
9. Installer le montage convertisseur/sonde sur un statif. Fixer la pince uniquement sur la carrosserie du convertisseur de 63 mm de diamétre. Ne pas fixer la pince sur une autre partie du montage convertisseur/sonde.

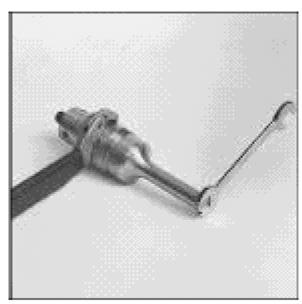


ENLEVEMENT



SERRAGE

ENLEVEMENT DE LA SONDE



SERRAGE DE LA SONDE

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UTILISATION DU SONIFICATEUR

Un régulateur de vitesse sur une automoble peut, dans une certaine mesure, être comparé à un sonificateur. Ce dispositif est conçu pour maintenir le véhicule à une vitesse constante. Lorsque le terrain change, les nécessités de puissance changent également. Le régulateur de vitesse détecte ces nécessités, et ajuste automatiquement la puissance délivrée par le moteur, pour compenser ces conditions sans cesse changeantes. Plus l'inclinaison est importante, plus la résistance du véhicule au mouvement augmente, et plus importante sera la puissance délivrée par le moteur pour compenser cette résistance.

Le sonificateur est conçu pour délivrer une amplitude constante. Lorsque la résistance au mouvement de la sonde augmente, les exigences de puissance augmentent également. L'alimentation en puissance détecte ces nécessités, et augmente automatiquiment la puissance délivrée afin de maintenir constante le déplacement de la sonde. Dans des conditions de charge identiques, la quantité de watts délivrée par deux sonificateur avec des puissances differentes sera identique (à condition que les deux disposent d'une capacité de puissance suffisante).

La commande d'AMPLITUDE permet de régler les vibrations ultrasoniques à la pointe de la sonde sur le niveau désiré. Bien que le degré de cavitation nécessaire pour traiter l'échantillon puisse aisément être déterminé à l'oeil nu, la puissance nécessaire ne peut pas être prédéterminée. Un réseau sensible contrôle en continu les exigences de sortie, et ajuste automatiquement la puissance pour maintenir l'amplitude sur le niveau présélectionné. Plus la résistance au mouvement de la sonde due à une forte viscosité, plus la sonde est immergée profondément dans l'échantillon, plus la diamétre de la sonde est élevé, ou plus la pression est élevée, plus de puissance délivré à la sonde sera importante. Le réglage de la commande d'AMPLITUDE entiérement dans le sens horaire n'entraînera pas la distribution de la puissace maximale à l'échantillon. La puissance maximale que le sonificateur est capable de délivrer sera uniquement délivrée lorsque la résistance au mouvement de la sonde est suffisamment élevée pour soutirer la quantité de watt maximale.

Ce phénoméne peut être démontré de la façon suivante. Appuyer la sonde contre un morceau de bois. Plus la pression exercée vers le bas est importante, et par conséquent plus la résistance au mouvement de la sonde est élevée, plus de puissance serra délivrée.

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ATTENTION

- Ne pas faire fonctionner le générateur sans l'avoir branché sur le convertisseur.
- Ne jamais laisser de liquide couler dans le convertisseur. Ne pas utiliser la chambre Cup-Horn sans protection contre le liquid.
- Ne jamais laisser une microsonde ou un prolongateur vibrer à l'air libre pendant plus de 10 seconds. Pendant l'utilisation d'une microsonde, ou un prolongateur ne jamais régler la commande d'AMPLITUDE au-dessus de la limite de 40%.
- Ne pas laisser une sonde vibrante entrer en contact avec autre chose que l'échantillon.

REMARQUE

Pour des conseils de fonctionnement général et des techniques de traitement ultrasonique, se reporter aux pages 23-25.

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1. Régler le commutateur d'alimentation ON/OFF (marche/arrêt) sur ON (marche). Le commutateur s'allume et l'écran LCD affiche la puissance nominale du sonificateur, les message d'avertissement et les paramètres de contrôle suivants.

TIME __:__:__	TEMP __ __°C
PULSE__:__:__	AMPL __ __%

REMARQUE

Si le maessage "OVERLOAD" (surcharge) apparaît sur l'écran LCD, se reporter a' la page 20.

2. Immerger la sonde d'environ 5 cm dans l'échantillon. En cas d'utilisation d'une microsonde, immerger la microsonde d'environ 1 cm dans l'échantillon.

REMARQUE

La sonde doit être immergée suffisamment profondément pour empêcher l'injection d'air dans l'échantillon, et pour inhiber la formation d'aérosols ou de mousse.

AMPLITUDE L'amplitude est le seul paramétre devant être réglé pour rendre le sonificateur opérationnel. Les autres paramétres de contrôle – Time (temps) et Pulse (impulsion) – n'ont pas besoin d'être réglés pour un fonctionnement en continu.

AMPL. affiche le pourcentage du maximum d'amplitude, par exemple 75%, réglé avec la commande AMPLITUDE. Régler l'amplitude sur la valeur. ATTENTION – Ne pas dépasser 40% pour l'utilisation d'une microsonde ou d'un prolongateur.

L'écran LCD affiche :

TIME __:__:__	TEMP __ __°C
PULSE__:__:__	AMPL 40 %

Pour activer les ultrasons, appuyer sur la touche START ou sur la pédale. Pour déactiver les ultrasons, appuyer sur la touche STOP ou relâcher la pédale. Pour utiliser les fonctions de temps ou d'implusion se reporter aux pages 14-16.

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REMARQUE

Si l'utilisateur appuie sur la touche START et qu'aucune limite de temps n'a été réglée, le traitement continuera jusqu'a ce que la touche STOP soît actionnée.

Si l'utilisateur appuie sur la touche START et que la limite de temps a été réglée, le traitement continuera jusqu'a expiration du temps réglé, ou si la touche STOP est pressée – quelque soit le primier événement survenu.

En cas d'utilisation d'une pédale, et si aucune limite de temps n'a été réglée, le traitement continuera tant que l'utilisateur appuie sur la pédale.

En cas d'utilisation d'une pédale, et si aucune limite de temps n'a été réglée, le traitement continuera jusqu'à l'expiration de la limite de temps, ou si la pédale est relâchée – quelque soit le premier événement survenu.

La touche START et la pédale sont mutuellenent exclusives. Si le traitement est démarré avec la touche START, la pédale devient inopérante. Si la sonification est démarrée à l'aide de la pédale, la touche STOP devient inopérante.

REMARQUE

Pour effacer une mauvaise saisie, appuyer sur la touche CLEAR.

MINUTERIE : En mode pulsé, la durée du traitement est différente du temps écoulé car la fonction de temps de traitement et contrôle uniquement les portions de sonification du cycle. Par exemple, pour 1 heure de traitement, le temps écoulé sera de 2 heures si les cycles de sonification et de relaxation sont tous les deux réglés sur 1 seconde. Pour régler le temps de traitement, appuyer sur la touche TIMER.

L'écran LCD affiche :

Time Setting Hrs:__ Min:_ _ Sec:_ _	(réglage du temps)

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A l'aide des touches numériques, régler le temps de traitement sur la valeur désirée :

par exemple :

Time Setting Hrs: 5 Min: 30 Sec: 25

Appuyer sur la touche ENTER/REVIEW

L'écran LCD affiche :

TIME 5:30:25	TEMP __ __°C
PULSE__:__:__	AMPL 40 %

PULSEUR : En inhibant l'accumulation de chaleur dans l'echantillon, la fonction de pulsation permet un traitement en sécurité des échantillons thermosensibles à haute intensité. De plus, les pulsations améliorent le traitement en permettant au matériaux de revenir sous la sonde aprés chaque décharge. Les durées des sonifications (ON) et relaxation (OFF) peuvent être réglées indépendamment de 0,1 seconde à 9,9 secondes. Pendant la phase de relaxation du cycle, l'indicateur rouge sur la touche PULSER s'allume. Si la phase de relaxation du cycle dépasse deux secondes, un message d'avertissement – CAUTION – PROBE ON STANDBY – (attention –sonde en attente) apparaît sur l'écran pour avertir l'utilisateur qu'il ne doit pas toucher la sonde ultrasonique. Pour régler le pulser, appuyer sur la touche PULSER.

L'écran LCD affiche :

Pulse on __.__sec Pulse off __.__sec	(sonificaion__.__sec) (relaxation__.__sec)

A l'aide de touches numérique, régler la phase de sonicication (ON) du cycle et appuyer la touche ENTER/REVIEW.

L'écran LCD affiche :

par exemple :

Pulse on 2.5 sec Pulse off __.__sec	(sonification 2,5 sec) (relaxation__.__sec)

A l'aide des touches numériques, régler la phase de relaxation (OFF) du cycle, L'écran LCD affiche :

par exemple :

Pulse on 2.5 sec Pulse off 1.0 sec	(sonification 2,5 sec) (relaxation 1,0 sec)

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Appuyer sur la touche ENTER/REVIEW.

L'écran LCD affiche :

TIME 5:30:25	TEMP __ __°C
PULSE 2.5 : 1.0	AMPL 40 %

TEMPERATURE : la fonction du control de température empêhe la surchauffe de l'échantillon en contrôlant en permanence la température de l'échantillon, et en arrêtant les ultrasons lorque la température atteint une valeur de consigne préréglée. Les ultrasons sont automatiquement rétablies lorsque la température retombe en dessous de la consigne. Si la température de l'échantillon doit être surveillée et/ou contrôlée, insérer fermement la sonde de température optionelle dans la petite prise Jack sur le panneau arriére, immerger la sonde de température dans l'échantillon, et appuyer sur la touche TEMP.

L'écran LCD affiche :

par exemple :

Probe Temperature 27° C
Temperature Setpoint __° C

(température de la sonde 27° C)
(consigne de température __° C)

A l'aide des touches numériques, régler la limite de température supérieure (valeur de consigne).

L'écran LCD affiche :

par exemple :

Probe Temperature 27° C
Temperature Setpoint 35° C

(température de la sonde 27° C)
(consigne de température 35° C)

Appuyer sur la touche ENTER/REVIEW .

L'écran LCD affiche :

TIME 5:30:25	TEMP 35° C
PULSE 2.5 : 1.0	AMPL 40 %

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VISUALISER : la fonction REVIEW (visualiser) mer à la disposition de l'utilisateur une "fenêtre" ouvant sur le processus en affichant différents paramètres de fonctionnement sans interrompre le processus. Appuyer plusieurs fois sur la touche ENTER/REVIEW pendant le taitement pour afficher à la suite les informations suivantes.

a. Amplitude choisie :
   par exemple : Amplitude Control 40% *(contrôle d'amplitude 40%)*

b. Température réglée et mesurée :
   par exemple : Temp Set 35˚C Probe 27˚C *(température réglée 35˚C, Sonde 27˚C)*

c. Temps de traitement réglé et temps de traitment écoulé :
   par exemple : Set 5:30:25 Time 0:57:03 *(réglé 5:30:25 Ecoulé 0:57:03)*

d. Cycle de pulsation choisie et cycle de pulsation réel :
   par exemple : Pulse 2.5 1.0/1.5 .5 *(pulsation 2,5 1,0/1,5 0,5)*

e. Puissance en watts et quantité d'énergie accumulée en JOULES délivrés à la sonde :
   par exemple : 20 watts 0000000 Joules

f. Temps écoulé depuis le début du traitement : par exemple : Elapsed time 1:27:33 *(temps écoulé 1:27:33)*

g. Quantité d'énergie accumulée en JOULES délivrée à la sonde pendant le dernier cycle.*

*L'énergie ne s'accumule que sur un cycle, et revient automatiquement à zéro lorsqu'un nouveau cycle démarre.

ENREGISTRER : la fonction d'enregistrement garde en mémoire jusqu'a 10 paramétres de contrôle (0-9) sous un numéro d'identification de mémoire (ID). Pour enregistrer les parmétres sous un numéro d'ID, appuyer sur la touche SAVE. L'indicateur lumineux présent sur la touche SAVE s'allume et,

L'écran LCD affiche :

Par exemple :

ID	TIME 5:30:25	TEMP 35° C
# __	PULSE On 2.5	Off 1.0

(sonication 2,5) (relaxation 1,0)

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A l'aide des touches numériques, régler la limite supérieure de température (consigne).

L'écran LCD affiche :

ID TIME 5:30:25	TEMP 35° C
# __ PULSE On 2.5	Off 1.0

Appuyer sur la touche ENTER/REVIEW pour enregistrer les paramétres de contrôle sous le numéro d'identification (ID) attribué. L'indicateur lumineux de la touche SAVE s'éteint, et l'écran LCD affiche les paramétres enregistrés sous ce numéro ID :

TIME 5:30:25	TEMP 35° C
PULSE 2.5 : 1.0	AMPL 40 %

RAPPEL : la fonction de rappel permet de récupérer dans la mémoire n'importe quel paramétre de contrôle parmi les 10 enregistrés pour les vérifier ou les utiliser. Pour rappeler n'importe quel paramétre, appuyer sur la touche RECALL. L'indicateur lumineux présent sur la touche RECALL s'allume.

L'écran LCD affiche :

Par exemple :

ID TIME __:__:__	TEMP _ _° C
# __ PULSE On __:__	Off __:__

A l'aide du numéro d'ID et des touches numériques, sélectionner les paramétres que l'utilisateur désire récupérer.

L'écran LCD affiche :

Par exemple :

ID TIME 5:30:25	TEMP 35° C
# 7 PULSE On 2.5	Off 1.0

Appuyer sur la touche ENTER/REVIEW pour rappeler de la mémoire les paramétres sous ce numéro d'ID.

L'écran LCD affiche :

TIME 5:30:25	TEMP 35° C
PULSE 2.5 : 1.0	AMPL 40 %

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REMARQUE

Pour visualiser toutes les informations ayant été enregistrées, appuyer consécutivement sur toutes les touches numériques.

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IMPORTANT

Il est essentiel d’apporter un soin particulier à la sonde pour assurir un fonctionnement fiable. Une cavitation intense entraînera après une période prolongée une érosion de la pointe, et provoquera une baisse de puissance sans que cela soit visible sur l’indicateur de puissance. Plus la pointe est lisse et propre, plus grande sera la puissance transmise à l’échantillon. Une érosion de la pointe de la sonde accélère l’érosion. Nous conseillons pour cette raison d’examiner la pointe aprés 5 ou 6 heures d’utilisation, et si nécessaire de la polir avec de la toile émeri ou avec une meule. La sonde étant syntonisée pour vibrer à une fréquence spécifique, il est trés important d’éliminer uniquement la surface contaminée. Cette procédure peut être répétée jusqu’à ce que I’indicateur de puissance indique moins de 20 watts lorsque la sonde est hors de l’échantillon si l’indicateur de puissance indique plus de 20 watts ; il est alors nécessaire de changer la sonde ou l’embout de rechange.

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CHAPITRE III – MAINTENANCE

CONDITIONS DE SURCHARGE

Le fusible et la protection anti-surcharge protègent le sonificateur contre une mauvaise utilisation, ou ou mauvais fonctionnement. Si un fusible saute, ou si le circuit de surcharge électronique s'active, procéder de la façon suivante :

1. S'assurer que la sonde l'embout de rechange ou la microsonde sont correctement fixées.

2. Vérifier le(s) fusible et le(s) remplacer si nécessaire.

3. Régler la commande d'AMPLITUDE sur 50 et le commutateur d'alimentation sur ON (marche). Avec la sonde ou la microsonde à l'air (hors de l'échanillons), le wattmétre doit indiquer une valeur inférieure à 20 watts. Si la lecture dépasse 20 watts, régler le commutateur d'alimentation sur OFF (arrêt) et débrancher la sonde du convertisseur.

4. Remettre le commutateur d'alimentation sur ON (marche). Si le wattmétre indique une valeur inférieure à 20 watts, la sonde ou la microsonde est défaillante ou n'est plus ajustée du fait d'une érosion excessive, et doit être remplacée. Si le wattmètre indique une valeur supérieure à 20 watts, soit le convertisseur soit le generateur sont défaillants et l'appareil complet doit être renvoyé pour réparation.

ETALONNAGE DE LA SONDE DE TEMPERATURE

Les sonificateurs expédiés avec la sonde de température optionelle ont été étalonnés comme un ensemble. Si la sonde de température a été acquise séparément, l'utilisateur doit l'étalonner conformément à la procedure décrite ce-dessous.

IMPORTANT

Pour obtenir une précision maximale, la sonde de température et le sonificateur doivent être étalonnés ensemble.

Pour étalonner le sonificateur, procéder comme suit :

1. Remplir un récipient de 500 ml avec environ 50% de glace et 50% d'eau. Laisser la température de l'eau se stabiliser pendant environ 5 minutes.
2. Remplir un autre récipient de 500 ml d'eau bouillante, et maintenir cete eau à ébullition avec un thermoplongeur ou un autre dispositif de chauffage.
3. Insérer fermement la sonde de température dans la petite prise Jack sur le panneau arriére.

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4. Tout en maintenant enfoncée la touche TEMP, mettre le commutateur d'alimentation ON/OFF sur ON (marche).

Le commutateur s'allume et l'écran LCD affiche le message suivant :

TEMPERATURE PROBE CALIBRATION PLACE TEMPERATURE PROBE INTO ICE WATER BATH

(Etalonnage de la sonde de tempéature. Placer la sonde de température dans un bain d'eau et de glace).

5. Immerger la sonde de température au centre du bain d'eau et de glace pendant 40 secondes. Ne pas laisser la sonde entrer en contact avec le récipient. Lorseque l'étalonnage automatique sur la température basse est terminé, l'écran LCD affiche le message le message suivant :

PLACE TEMPERATURE PROBE INTO BOILING WATER

(Placer la sonde de température dans l'eau bouillante).

6. Immerger la sonde de température au centre de l'eau bouillante pendant 40 secondes. Ne pas laisser la sonde entrer en contact avec le récipient.

Lorsque l'étalonnage automatique sur la température haute est terminé, l'écran LCD afiche le message suivant :

TEMPERATURE PROBE CALIBRATION COMPLETED

(Etalonnage de la sonde de température terminé).

RETOUR DE L'APPAREIL

Nous consellons de retourner un appareil nécessitant une réparation à l'usine. Afin de bénéficier d'une réparation rapide, contacter toujours l'usine avant de retourner un appareil. Faire attention à emballer soigneusement l'appareil pour éviter tout dommage éventuel pendant le transport.

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IMPORTANT

JE CERTIFIE QUE LE(S) SONIFICATEUR(S) ET/OU LES ACCESSOIRES RETOURNES POUR REPARATION SONT EXEMPTS DE MATIERES RADIOACTIVES OU SUSCEPTIBLES DE PRESENTER UN DANGER BIOLOGIQUE, ET QU'ILS PEUVENT ETRE MANIPULES EN TOUTE SECURITE.

NE RETOURNER AUCUN APPAREIL SI CETTE CERTIFICATION NE PEUT PAS ETRE APPORTEE.

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ALIMENTATION ELECTRIQUE

Pour les exigences électriques, se référer à l'etiquette à l'arriére de l'appareil.

S'il est nécessaire de remplacer le (s) fusible (s), procéder de la façon suivante :

1. Déconnecter le cordon d'alimentation

2. Ouvrir le support de fusibles en utilisant un petit tournevis plat.

3. Retirer le support de fusibles rouge de son logement.

4. Pour les appareils 110/115 volts, remplacer les deux fusibles à action lente de type MDL de 15 A 6 mm x 6 mm. Pour les appareils 220/240 volts, remplacer les deux fusibles à action lente de type GDC de 7,5 A de 5 x 20 mm.

5. Rebrancher le cordon d'alimentation.

6. S'assurer que la sonde et/ou l'embout de rechange sont correctement fixées.

7. Vérifier les fusibles et les remplacer si nécessair

8. Régler la commande d'AMPLITUDE sur 50 et le commutateur d'alimentation sur ON (marche). Avec la sonde à l'air (hors de l'échantillons), le wattmétre doit indiquer une valeur inférieure à 20 watts. Si la lecture dépasse 20 watts, régler le commutateur d'alimentation sur OFF (arrêt) et débrancher la sonde du convertisseur.

9. Remettre le commutateur d'alimentation sur ON (marche). Si le wattmétre indique une valeur inférieure à 20 watts, la sonde est défaillante ou n'est plus ajustée du fait d'une érosion excessive, et doit être remplacée.

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CHAPITRE IV
CONSEILS ET TECHNIQUES D'UTILISATION

DESINTEGRATION DES CELLULES

Les organismes unicellulaires (micro-oranismes) sont constitués d'une paroi cellulaire externe semi-perméable, solide et rigide entourant la membrane protoplasmique (cytoplasmique) et le cytoplasme. Le cytoplasme est constitué d'acides nucléiques, de protéines, de glucides, de lipides, d'enzymes, d'ions inorganiques, de vitamines, de pigments, d'inclusions et d'environ 80% d'eau. Pour isoler et extraire n'importe quelle de ces substances de l'intérieur de la cellule, il est nécessaire de briser la paroi cellulaire et la membrane protoplasmique. Dans certains cas, les cellules peuvent sécréter la substance désirée, mais dans la plupart des cas la paroi cellulaire doit être désintégrée par ultraons pour libérer ces substances.

Les micro-organismes sont très différents dans leur sensibilité à la désintégration ultrasonique. Par exemple, les plus facilement désintégrés sont ceux en forme de bâtonnet (bacilles), alors que les organismes sphériques (coques) sont beaucoup plus résistants. Le groupe des mycobactérs, auquel appartient le micro-organisme responsable de la tuberculose est particulièrement difficile à désintégrer. Généralement, les cellules animales sont plus facilement désintégrées que les cellules végétales, et les globules rouges sont plus facilement désintégrés que les cellules musculaires car ces cellules ne possédent pas de paroi cellulaire.

Avec le traitement par ultrasons, l'agitation moléculaire dans l'échantillon provoque généralement une élévation de température – surtout avec de petits volumes. Les températures élevées réduisant la cavitation, la température de l'échantillon doit être conservée aussi basse que possible – de préférence juste au-dessus de son point de congélation. Ceci peut être réalisé en immergeant le récipient contenant l'échantillon san un bain de glace et d'eau salée. L'élévation de température peut également être réduite en utilisant le pulseur ou en soumettant l'échantillon à plusieurs séries de courtes sonications.

La désintégration des cellules peut être améliorée en augmentant la pression hydrostatique habituellement 1 à 4 bar et la viscosité. Pour les micro-organismes, l'addition de billes de verre d'une taille comprise entre 0.05 et 0.5 mm favorise la désintégration des cellules en concentrant l'énergie relâchée par la cavitation, et par écrasement physique. Les billes sont pratiquement indispensables pour la désintégration de spores ou de levures. Le bon dosage est de un volume de billes pour deux volumes de liquide.

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Pour le traitement de cellules difficiles, un prétraitement par une enzyme comme le lysozyme ou la hyaluronidase peut être bénéfique. La glycosidase est efficace sur la levure, la lysostaphine sur les Staphylocoques, la collagénase sur la peau et le cartilage, et la trypsine hyaluronidase avec des tissues de foie et de reins.

Si l'utilisation d'enzyme n'est pas possible, les procédures suivantes peuvent être essayées : congélation de l'échantillon à -70ºC pendant la nuit, puis décongélation dans un mélange eau glace immédiatement avant la sonication.

Chaque fois que cela est possible, les tissus doivent être coupés en tout petits morceaux pour permettre leur mouvement dans le liquide. Les tissus résistants comme la peau et les muscles doivent d'abord être liquéfiés dans un mixer ou un équivalent pendant environ 10 secondes, et transvasés dans un petit récipient pendant le traitement ultrasonique. La congélation suivie d'une réduction en poudre peut également être tilisée se cette procédure ne perturbe pas l'expérience. Si des particules subcellulaires inactes sont désirées, la commande d'amplitude doit être réglée assez bas et le temps de traitement augumenté.

Insérer la sonde suffisamment profondément en-dessous de la surface de l'échantillon pour éviter la formation d'aérosol ou de mousse. La mousse diminue considérablement la cavitation et peut entraîner une dénaturation des protéines. Un traitement à une puissance plus faible sans mousse est beaucoup plus efficace qu'un traitement à une puissance plus élevée avec sans mousse. La diminution de la puissance, láugmentation de la température du liquide empêchent généralement l'apparition d'aérosol et de mousse. Ne pas utiliser d'agent anti-moussant ou de surfactant.

Des radicaux libres se forment pendant la cavitation. Si on laisse ces radicaux libres s'accumuler, ceux-ci peuvent affecter de façon importante l'intégrité biologique de l'échantillion en réagissant avec les protéines, les polysaccharides ou les acides nucléiques. La formation de radicaux libres au cours de traitements de traitements de courte durée n'est normalement pas considérée comme un probléme. Pour des traitements prolongés, il peut être bénéfique d'ajouter des fixateurs de radicaux libres comme le N_20, la cystéine, la glutathione réduite, le dithiothréitol ou d'autres composés SH. La saturation de l'echantillon par une atmosphere protectrice d'helium ou d'hydrogéne gazeux, ou l'ajout d'un petit bout de glace carbonique dans l'échantillon diminue souvent la formation de radicaux libres.

La plus grande concentration d'énergie étant à proximité immediate de la sonde, il est impératif de garder l'échantillion aussi prés que possible de la pointe. Les liquides sont facilement traités car les cellules libres circulent sans cesse sous la sonde. Les matériaux solides, cependant, ont tendance à être repoussés par les ultrasons, et doivent être traités dans des récipients suffisamment larges pour contenir la sonde, mais également suffisamment petits pour restreindre le mouvement de l'échantillon. Pour les petits échantillons, nous conseillons d'utiliser des tubes à essai de forme conique. Bien que les tubes plastiques fonctionnent bien, les tubes en verre et en acier inoxydable sont un peu plus efficaces que ceux en plastique car ils n'absorbent pas les vibrations.

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Le contact de la sonde avec le récipient diminue la puissance délivrée, et entraîne la migration de toutes petites particules de verre dans le liquide. Même si ces particules de verre n'affectent pas la composition chimique de l'échantillon, elles formeront une fine couche grise lors de la centrifugation. Si la sonde doit entrer en contact avec un échantillon solide, utiliser un tube de centrifugation en acier in oxydable standard de 20 mm (¾") de diamètre coupé à une longueur de 70 mm (3"). Les micropointes ne doivent jamais entrer en contact avec autre chose que le liquide, car la friction résultante au point de contact avec le récipient briserait la micropointe. Même se les sondes plus grandes ne se brisent pas si elles entrent en contact avec le récipient de traitement, elles peuvent cependant briser le récipient.

Avant chaque expérience, placer la pointe de la sonde dans l'eau ou l'alcool et mettre l'alimentation sous tension pendant quelques secondes pour retirer tout résidu.

Pour éviter la perte d'échantillon pouvant s'accrocher à la paroi du tube à essai, enduire le tube de silicone de la façon suivante : laver et sécher soigneusement le tube à essai, enduire de silicone puis sécher à l'air.

Les sondes peuvent être autoclavées ou stérilisées en les immergeant soit dans l'eau bouillante soit dans un détergent bactéricide et un désinfectant.

Une viscosité et une concentration élevées sont problématiques. 5000 cp et une concentration de 15% en poids constituent les limites maximales. Si l'échantillon est trop éspais pour être versé ou circuler facilement, il est trop épais et ne peut pas être traité par ultrasons.

Utiliser la chambre à atmosphere étanche pour le traitement déchantillons pathogénes ou présentant un danger biologique.

Utiliser une cellule à flux continu pour le traitement de grands volumes. Pour le traitement d'échantillons thermosensibles, faire circuler l'échantillon dans un tube torsadé immergé dans un bain de glace salé pour minimiser l'élévation de la température.

Utiliser une chambre Cup Horn pour le traitement d'échantillons pathogénes, radioactifs et présentant un risque biologique, en isolement complet sans introduction de sonde. Les tubes plastiques ayant tendance à absorber les vibrations, il est préférable d'utiliser des tubes en acier inoxydable ou en verre pour travailler avec une chambre Cup Horn. Pour activer le traitement, ajouter des billes de verre à l'échantillon. Si l'utilisateur le désire, il peut ajouter de la glace pilée dans l'eau à l'intérieur de la chamber Cup Horn pour optimiser le refroidissement.

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USER'S GUIDE

HIGH INTENSITY ULTRASONIC PROCESSOR

40 Watt Model

TABLE OF CONTENTS

The Ultrasonic Processor supplied with this instruction manual is constructed of the finest material and the workmanship meets the highest 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.

Rev. 2003

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 equipment damage. Please 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.

When mounting the probe, always clamp the upper portion of the converter housing. Never clamp the probe.

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. Refer all servicing to qualified service personnel.

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 nodal point (point of no activity).

Never touch a vibrating probe.

Never allow a microtip to vibrate in air for more than 10 seconds.

It is recommended that a sound abating enclosure or ear protection be used when operating the Ultrasonic Processor.

WARNING or CAUTION

Where you see this alert symbol and WARNING or CAUTION heading, strictly follow the warning instructions to avoid personal injury or equipment failure.

SECTION 1 – INSTALLATION

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 phrase 3-terminal grounding type electrical outlet capable of supplying 50/ 60 Hz at 100 volts, 115 volts, 220 volts, or 240 volts, depending on the voltage option selected. 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.

SECTION II – OPERATION

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. This phenomenon, referred to as cavitation, creates millions of shock waves in the liquid, as well as elevated pressures and temperatures at the implosion sites. Although the cavitational collapse last but a few microseconds, and the amount of energy released by each individual bubble is minute, the cumulative effect causes extremely high levels of energy to be released into the liquid. The larger the probe tip, the larger the volume that can be processed but at a lesser intensity. For information regarding the processing capability of each probe, consult the tables below.

FUNCTIONS OF KEYS, CONTROLS, INDICATORS, AND CONNECTORS

ON / OFF SWITCH	ON position – energizes the power supply.
POWER INDICATOR	Illuminates when the power supply is energized.
OUTPUT CONTROL	Controls the amplitude of vibrations at the probe tip.
POWER MONITOR	Indicates in watts the amount of ultrasonic power delivered to the probe.
TUNE CONTROL	Optimizes power supply performance by tuning the power supply to the converter / probe assembly.
20-40 POWER MONITOR SCALE SELECT SWITCH	In the 20 position the POWER MONITOR indicates the percentage of ultrasonic power delivered to the probe up to 20 watts. In the 40 position the POWER MONITOR indicates the percentage of the ultrasonic power delivered to the probe up to 40 watts.
FOOTSWITCH CONNECTOR	Connects to footswitch cable.
PROBE CONNECTOR	Connects to converter / probe assembly
POWER CORD – Rear Panel -	Connects to power supply to electrical outlet.
FUSE(S) – Rear Panel -	Protects against electrical overload.

PREPARATION FOR USE

CAUTION

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

1. Ensure that the AMPLITUDE 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; using the wrenches provided, screw securely the probe into the converter.

CAUTION

Never place a washer between the probe and the converter.
Never apply grease to the mating surfaces or threads of the converter, probe, or microtip.

5. Mount the converter / probe assembly in a laboratory stand, secure the clamp to the upper section of the converter housing only. Do not secure the clamp to any other portion of the converter / probe assembly.
6. Connect the converter cable to the power supply.

NOTE

Should it become necessary to remove a probe, use the wrenches supplied. If the probe has been attached to the converter for a long period of 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 wrench, twist the converter off the probe. A tap of a hammer may be applied to the end of the wrench. Never attempt to remove the probe by twisting the converter housing, as this may damage the electrical connections within the housing.

TUNING

Tune the power supply in accordance with the following procedures each time a new converter or probe is used.

1. Ensure that the probe is not immersed in the liquid and that it does not come in contact with anything.

2. Set OUTPUT CONTROL TO “60”.

3. Set 20-40 POWER MONITOR SCALE SELECT SWITCH to “20”.

4. Set POWER SWITCH to ON, and rotate the TUNE CONTROL clockwise or counterclockwise until **minimum** (not maximum) reading (usually less than 30) is obtained on the POWER MONITOR. If minimum reading cannot be obtained, make certain that the probe is tight. A loose probe will usually generate a loud piercing sound.

5. Repeat step 4 with OUTPUT CONTROL set to “100”.

6. Set OUTPUT CONTROL to “60”.

7. Set POWER SWITCH to OFF.

CAUTION

The power supply should be tuned after the probe has reached operating temperature. When working with low or high temperature liquids, immerse the probe in the liquid for a few minutes, withdraw the probe out of the liquid, and **then,** tune the power supply.

Ensure that the optional micro cup horn does not contain any liquid when tuning the power supply.

USING THE ULTRASONIC PROCESSOR

The speed control on an automobile, can, to a certain extent, be compared to an Ultrasonic Processor. The speed control is designed to maintain the vehicles 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 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.

The Ultrasonic Processor is designed to deliver constant amplitude. As the resistance to the movement of the probe increases, additional power will be delivered by the power supply to ensure that the excursion at the probe tip remains constant. Using a more powerful power supply will not deliver more power into the liquid. Rather, it is the resistance to the movement of the probe that determines how much power will be delivered into the sample.

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 draw maximum wattage.

This phenomenon can be demonstrated as follows: depress the probe down against a piece of wood. The greater the down 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.

CAUTION

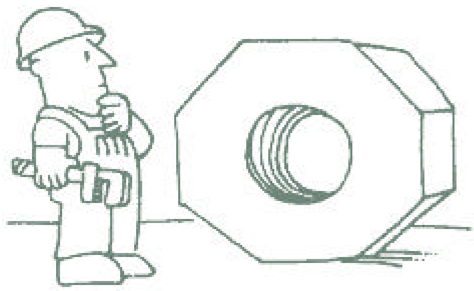
Do not operate the power supply unless it is connected to the converter.
Never allow a microtip to vibrate in air for more than 10 seconds.
Do not allow the vibrating probe to come in contact with anything but the sample.

1. Ensure that the power supply is properly tuned.
2. Immerse the probe ½” (1 cm) into the liquid.
3. Set POWER SUPPLY to ON, if footswitch is used, depress footswitch. To use the TIMER, select the time sequence desired, set TIMER ON/OFF switch to ON, and depress TIMER START BUTTON. To energize the PULSER, select the pulse duration desired.
4. Using OUTPUT CONTROL increase or decrease intensity as required.

IMPORTANT

Proper care of the probe is essential for dependable operation. The intense cavitation will, after a prolonged period of time, cause the tip to erode, and the power output to decrease without showing up on the wattmeter. 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 most important that only the contaminated surface be removed. This procedure can be repeated as long as the wattmeter reads less than 20 watts with the probe out of the sample, when the AMPLITUDE control is set at 100. If the wattmeter reads over 20 watts the probe or replaceable tip should be changed.

SECTION III – SERVICE INFORMATION



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, or that it will stop working all together. The most probable causes for malfunction are listed below and should be investigated.

The unit was plugged into an electrical outlet that provides a different voltage from that required. See *Electrical Requirements.*

The probe is not secured properly.

If the probe has a replaceable tip, the tip is not secured properly, or the probe has been used with low surface tension liquids.

A fuse(s) has failed. If a fuse(s) has failed, proceed as follows:

1. Ensure that the power switch is set to OFF.
2. Open the fuse holder cover(s).
3. Replace the fuse(s).
4. Set the AMPLITUDE control to 50 and the power switch to ON. With the probe in air (out of sample), the wattmeter should read below 20 watts. If the reading exceeds 20 watts, set the power switch to OFF, and disconnect the probe from the converter.
5. Set the power switch back to ON. If the wattmeter reads below 20 watts, the probe has failed or is out of tune due to excessive erosion, and should be replaced. If the wattmeter reads above 20 watts, either the converter or power supply has failed and the complete Ultrasonic Processor should be returned for repair.

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 the factory before returning any instrument. Include date of purchase, model number and serial number. For instruments not covered by the warranty, a purchase order should be forwarded to avoid unnecessary delay. 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.

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

IMPORTANT

I CERTIFY THAT THE ULTRASONIC PROCESSOR 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 CERTICATION CAN BE MADE.

OPERATING SUGGESTIONS AND TECHNIQUES

DISRUPTING CELLS

The disruption of cells is an important stage in the isolation and preparation of intracellular products. From research levels through to production, many areas of biotechnology, particularly recombinant technology, necessitate the use of ultrasonics for cell disruption. Although some biological products are secreted from the cell or released during autolysis, many others require sonication to release intracellular material. Cell disruption focuses on obtaining the desired product from within the cell, and it is the cell wall that must be disrupted to allow cell contents extraction.

Single-cell organisms (micro-organisms) consist of a semipermeable, tough, rigid outer cell wall surrounding the protoplasmic membrane and cytoplasm. The cytoplasm is made up of nucleic acid, protein, 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 lysed and sonicated in order for these substances to be released. Breaking cell membranes and releasing the contents present significant challenges. The process must be fast and thorough to maximize the protein yield. Because the energy applied must be great enough to break the cell membranes or walls, yet gentle enough to avoid physically or chemically damaging cell contents, the Vibra-Cell with its variable intensity capability is ideally suited for this application.

The level of intensity that should be used is application dependent. For example high intensity might be recommended for the break up of cells, but should never be used when the release of intracellular components might be objectionable e.g. Organelle isolation.

The ability to control the amplitude at the probe tip is a prerequisite for process optimization. And because each application requires its own set of processing parameters, due to variation in volume and composition, the optimum amplitude can only be determined empirically. When processing a new sample, it is recommended that the amplitude be set first at 50% (30% with a microtip) and then increased of decreased as required.

Yeast, gram-positive bacteria, and to a lesser extent, gram-negative bacteria have considerably harder cell walls in comparison to animal cells, and require relatively high power for cell disruption.

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

Microorganisms 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 that plant cells, and red blood cells are more readily disintegrated than muscle cells because they lack a protective cell wall.

Cellular disruption is the first step in RNA isolation and one of the most critical steps affecting yield and quality of the isolated RNA. Typically, cell disruption needs to be fast and thorough. Slow disruption, for example placing cells or tissue in guanidinium isothiocyanate (GITC) lysis solution for a long time prior to sonication, may result in RNA degradation by endogenous RNases released internally. This is especially a concern when working with tissues high in endogenous RNase such as spleen and pancreas.

Disrupting frozen tissue is more time consuming and cumbersome that processing fresh tissue, but freezing samples is sometimes necessary. Samples are usually frozen when, 1) they are collected over a period of time and thus, cannot be processed simultaneously; 2) there are many samples, 3) samples are collected in the field, or 4) mechanical processing of fresh samples is insufficient for thorough disruption. A mortar and pestle or bag and hammer are typically used when the starting material is frozen. RNA will remain intact in tissues for a day at 37ºC, a week at 25ºC a month at 4ºC and indefinitely at subzero temperatures.

Ultrasonic processing will typically cause the temperature of the sample to increase especially with small volumes. Since high temperatures inhibit 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.

Increasing hydrostatic pressure (typically 15-60 psi) and viscosity can enhance cell disruption. For microorganisms, the addition of glass beads in the 0.5 to 1mm 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.

When processing difficult cells such as yeast, pretreatment with an enzyme is beneficial. Lysozyme, byaluronidase, glycosidase, glucalase, lyticase, zymolase and lysostaphin digestion are among the enzymatic methods frequently used with yeast and Lysozyme with bacteria. Enzymatic treatment is usually followed by sonication in a GITC lysis buffer. Collogenase may be used with collogen, lysostaphin with staphylococcus, 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.

Most animal tissues can be processed fresh (unfrozen). It is important to keep fresh tissue cold and to process it quickly (within 30 minutes) after dissection. When working with fresh tissue, the cells must be sonicated immediately at the time the GITC lysis solution is added. This can be done by dispensing the lysing solution in the tube, adding the tissue and immediately sonicating. Samples should never be left sitting in lysis solution, undisrupted. Large samples of hard tissues should be first treated in a blender or a mechanical homogenizer.

Animal tissues that have been frozen after collection should be disrupted by grinding in liquid nitrogen with a mortar and pestle. During this process, it is important that the equipment and tissue remain at cryogenic temperatures. The tissue should be dry and powdery after grinding. Grinding should be followed by thorough sonication in a GITC lysis buffer. Processing frozen tissue in this way is cumbersome and time consuming, but effective.

Cultured cells are normally easy to disrupt. Cells grown in suspension are collected by centrifugation, rinsed with PBS to remove culture medium, and then lysed by sonicating in a GITC lysis buffer. Placement of the vessel on ice while washing and lysing the cells will further protect the RNA from endogenous RNases released during the disruption process.

Soft, fresh plant tissue can often be disrupted by sonicating in a lysis buffer. Other plant tissues, like pine needles, need to be ground dry, without liquid nitrogen. Some hard, woody plant materials require freezing and grinding in liquid nitrogen prior to being ultrasonically processed. Plant cell suspension cultures and calluses can typically be sonicated in a lysis buffer within 2 minutes. The diversity of plants and plant tissue make it impossible to give a single recommendation for all. However, most plant tissues typically contain polysaccharides and polyphenols that can coprecipitate with RNA and inhibit downstream assays. Treating a plant tissue lysate with polyvinylpyrrolidone (PVP) will precipitate such problematic components from the lysate before the actual RNA isolation is carried out.

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. If sub-cellular particles are desired intact, the amplitude should be kept low, and the processing time increased.

Yeast can be extremely difficult to disrupt because their cell walls may form capsules or nearly indestructible spores. To process yeast, sonicate in a tube containing the sample, guanidinium-based lysis buffer and small glass beads (0.5 – 1 mm). Pretreatment with

zymolase, glucalase and / or lyticase to produce spheroplasts that are readily lysed may also be useful.

To disrupt filamentous fungi, scrape the mycelial mat into a cold mortar, add liquid nitrogen and grind to a fine powder with a pestle. The powder can then be thoroughly sonicated in lysis buffer to solubilize completely. As fungi may also be rich in polysaccharides, pretreatment with polyvinylpyrrolidone (PVP) may be beneficial.

Bacteria, like plants, are extremely diverse; therefore, it is difficult to make one recommendation for all bacteria. Ultrasonic processing will lyse most Gram positive and Gram negative bacteria, including mycobacteria. Although it is recommended that glass beads and lysis solution be used; it is possible to lyse some Gram negative bacteria by sonicating in lysis solution without beads. Bacteria cell walls can be digested with lysozyme to form spheroplasts. Gram positive bacteria usually require more rigorous digestion and longer processing time. The spheroplasts are then lysed with sonication in GITC lysis buffer.

Disruption of cells found in soil and sediments is accomplished one of two ways. One technique isolates the bacterial cells from the material prior to the RNA isolation procedure. This is accomplished by homogenization of wet soil in a mechanical blender followed by a slow speed centrifugation to remove fungal biomass and soil debris. The supernatant is centrifuged again at a higher speed to pellet the bacteria cells. Cells can then be lysed as described above for bacteria. Other techniques describe RNA isolation from the soil or sediment directly. For example, one method requires soil to be added to a diatomaceous earth and lysis buffer, and then sonicated. The sample is then centrifuged to remove solid debris.

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 much 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, carbon dioxide, N_2O, cysteine, reduced glutahione, dithiothreitol or other SH compounds, might be beneficial. Saturating the sample with a protective atmosphere of helium or nitrogen gas, or dropping a small pellet of dry ice in the sample, will also inhibit free radical formation. 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.

Various methods can be used to measure the efficiency of the disruption. For example, a visual count can be made using a microscope.
For greater accuracy, a protein assay could be used. This procedure is widely recognized as a good method for measuring cell disruption by taking into account the amount of protein released after disruption. The disrupted cells are then tested and checked against this number for percentage breakage.
There are several types of protein assays. One commonly used is the Folin Reaction (Lowry Assay) method, as it is comparatively simple and provides consistent results. This colorimetric method has a sensitivity to protein of around 8 µg / mL in the assay solution.
The assay turns blue in the presence of proteins due to the reaction of copper ions in the alkaline solution with protein and the reduction of phosphomolybdate- phosphotungstic acid in the Folin reagent by aromatic amino acids in the treated protein.
Fractional protein release, Rp, is calculated using the following equation and multiplying the result by 100:

$$\mathbf{Rp = \frac{Cf - Cb}{Ct - Cb}}$$

Cf = Free protein
Ct = total protein
Cb = Background protein

This gives the actual disruption percentage, taking into account the background levels of protein before disruption.

Since the greatest concentration of energy is 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.

Allowing the probe to contact the vessel will decrease the power output, and cause minute grey glass particles to migrate into the sample. 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 20mm (3/4”) diameter stainless steel centrifuge tube cut to 70mm (3”) length. Do not use a glass tube. Microtips must never 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 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 about contamination from previous use, clean the probe with a 20% Virkon solution and rinse with distilled water. For critical application, probes may be autoclaved.

To inhibit sample loss in test tube due to sticking, siliconize the test tube as follows: Wash and dry the test tube thoroughly, coat with silicone, then air dry. “Sigmacote” manufactured by Sigma Chemical Co., 3050 Spruce Street, St. Louis, Missouri 63103, USA, phone (314) 771-5765, is ideally suited for that purpose.

High viscosity and concentration are problematic. 2,000 cps and 15% concentration by weight are maximum limits. Because with ultrasonics the sound waves are propagated through the sample, if the sample is so thick that it will not pour or circulate easily, it is too thick for ultrasonic processing.

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, whenever possible, to contain the sample in a 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 also be added to the water inside the cup horn, in order to optimize cooling. Processing samples in a Cup Horn will usually take 4 times longer than processing with the direct probe intrusion method

USER'S GUIDE

HIGH INTENSITY ULTRASONIC PROCESSOR

50 Watt Model

TABLE OF CONTENTS

The Ultrasonic Processor supplied with this instruction manual is constructed of the finest material and the workmanship meets the highest 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.

Rev. 2003

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 equipment damage. Please 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.

When mounting the probe, always clamp the upper portion of the converter housing. Never clamp the probe.

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. Refer all servicing to qualified service personnel.

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 nodal point (point of no activity).

Never touch a vibrating probe.

Never allow a microtip to vibrate in air for more than 10 seconds.

It is recommended that a sound abating enclosure or ear protection be used when operating the Ultrasonic Processor.

WARNING or CAUTION

Where you see this alert symbol and WARNING or CAUTION heading, strictly follow the warning instructions to avoid personal injury or equipment failure.

SECTION 1 – INSTALLATION

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 phrase 3-terminal grounding type electrical outlet capable of supplying 50/ 60 Hz at 100 volts, 115 volts, 220 volts, or 240 volts, depending on the voltage option selected. 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.

SECTION II – OPERATION

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. This phenomenon, referred to as cavitation, creates millions of shock waves in the liquid, as well as elevated pressures and temperatures at the implosion sites. Although the cavitational collapse last but a few microseconds, and the amount of energy released by each individual bubble is minute, the cumulative effect causes extremely high levels of energy to be released into the liquid. The larger the probe tip, the larger the volume that can be processed but at a lesser intensity. For information regarding the processing capability of each probe, consult the tables below.

NOTE

The Ultrasonic Processor is available with three probes. A 2mm (5/64”) microtip, a 3mm (1/8”) microtip, and a 6mm (1/4”) microtip. All probes are fabricated from titanium and are autoclavable.
The standard 3mm microtip can process between 250 microliters and 10 milliliters.
The 2mm microtip is optional and can process between 100 microliters and 5 milliliters.
The 6mm microtip is optional and can process between 10 milliliters and 25 milliliters.

FUNCTIONS OF KEYS, CONTROLS, INDICATORS, AND CONNECTORS

POWER SWITCH	ON position – energizes the power supply. OFF position – de-energizes the power supply. Illuminates when the power supply is energized.
OUTPUT CONTROL	Controls the amplitude of vibrations at the probe tip.
POWER MONITOR (METER)	Indicates in watts the amount of ultrasonic power delivered to the probe.
TUNE CONTROL	Optimizes power supply performance by tuning the power supply to the converter / probe assembly.
20-50 SCALE SELECT SWITCH Increases or decreases the POWER MONITOR sensitivity	In the 25 position the POWER MONITOR indicates the percentage of ultrasonic power delivered to the probe up to 25 watts. In the 50 position the POWER MONITOR indicates the percentage of the ultrasonic power delivered to the probe up to 50 watts.
FOOTSWITCH CONNECTOR	Connects to footswitch cable.
OUTPUT CONNECTOR	Connects to converter cable.
POWER CORD	Connects to power supply to electrical outlet.
FUSE(S)	Protects against electrical overload.

FUNCTION OF TIMER CONTROL AND INDICATORS*

ON/OFF SWITCH	In the ON position places the timer on standby. In the OFF position inhibits the timer.
TIMER	Sets the duration of ultrasonic application from 0 minute to 20 minutes.
START BUTTON	When depressed, activates the ultrasonic for the duration set on the timer.
INDICATOR LIGHT	Illuminates when the timer is energized.

* Applies only to Ultrasonic Processors equipped with a timer.

PREPARATION FOR USE

CAUTION

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

1. Ensure that the AMPLITUDE 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; using the wrenches provided, screw securely the probe into the converter.

CAUTION

Never place a washer between the probe and the converter.
Never apply grease to the mating surfaces or threads of the converter or microtip.

5. Mount the converter / probe assembly in a laboratory stand, secure the clamp to the upper section of the converter housing only. Do not secure the clamp to any other portion of the converter / probe assembly.
6. Connect the converter cable to the power supply.

NOTE

Should it become necessary to remove a probe, use the wrenches supplied. If the probe has been attached to the converter for a long period of 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 wrench, twist the converter off the probe. A tap of a hammer may be applied to the end of the wrench. Never attempt to remove the probe by twisting the converter housing, as this may damage the electrical connections within the housing.

TUNING

Tune the power supply in accordance with the following procedures each time a new converter or probe is used.

1. Ensure that the probe is not immersed in the liquid and that it does not come in contact with anything.

2. Set OUTPUT CONTROL TO "100". (to "60" with the 2mm (5/64") probe).

3. Set 25-50 POWER MONITOR SCALE SELECT SWITCH to "25".

4. Set POWER SWITCH to ON, and rotate the TUNE CONTROL clockwise or counterclockwise until **minimum** (not maximum) reading (usually less than 30) is obtained on the POWER MONITOR. If minimum reading cannot be obtained, make certain that the probe is tight. A loose probe will usually generate a loud piercing sound.

5. Set OUTPUT CONTROL to "60". (to "40" with the 2mm (5/64") probe).

6. Set POWER SWITCH to OFF.

7. If a footswitch is used, plug into the FOOTSWITCH CONNECTOR. Make sure that the plug is inserted forcefully all the way in.

CAUTION

The power supply should be tuned after the probe has reached operating temperature. When working with low or high temperature liquids, immerse the probe in the liquid for a few minutes, withdraw the probe out of the liquid, and **then,** tune the power supply.

Ensure that the optional micro cup horn does not contain any liquid when tuning the power supply.

USING THE ULTRASONIC PROCESSOR

The speed control on an automobile, can, to a certain extent, be compared to an Ultrasonic Processor. The speed control is designed to maintain the vehicles 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 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.

The Ultrasonic Processor is designed to deliver constant amplitude. As the resistance to the movement of the probe increases, additional power will be delivered by the power supply to ensure that the excursion at the probe tip remains constant. Using a more powerful power supply will not deliver more power into the liquid. Rather, it is the resistance to the movement of the probe that determines how much power will be delivered into the sample.

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 draw maximum wattage.

This phenomenon can be demonstrated as follows: depress the probe down against a piece of wood. The greater the down 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.

CAUTION

Do not operate the power supply unless it is connected to the converter.
Never allow a microtip to vibrate in air for more than 10 seconds.
Do not allow the vibrating probe to come in contact with anything but the sample.

1. Ensure that the power supply is properly tuned.

2. Immerse the probe ½" (1 cm) into the liquid.

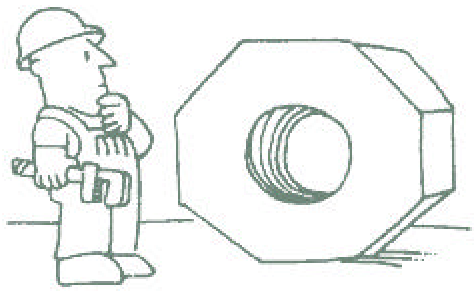
3. Set POWER SUPPLY to ON, if footswitch is used, depress footswitch. To use the TIMER, select the time sequence desired, set TIMER ON/OFF switch to ON, and depress TIMER START BUTTON. To energize the PULSER, select the pulse duration desired.

4. Using OUTPUT CONTROL increase or decrease intensity as required.

IMPORTANT

Proper care of the probe is essential for dependable operation. The intense cavitation will, after a prolonged period of time, cause the tip to erode, and the power output to decrease without showing up on the wattmeter. 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 most important that only the contaminated surface be removed. This procedure can be repeated as long as the wattmeter reads less than 20 watts with the probe out of the sample, when the AMPLITUDE control is set at 100. If the wattmeter reads over 20 watts the probe or replaceable tip should be changed.

SECTION III – SERVICE INFORMATION



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, or that it will stop working all together. The most probable causes for malfunction are listed below and should be investigated.

The unit was plugged into an electrical outlet that provides a different voltage from that required. See *Electrical Requirements.*

The probe is not secured properly.

If the probe has a replaceable tip, the tip is not secured properly, or the probe has been used with low surface tension liquids.

A fuse(s) has failed. If a fuse(s) has failed, proceed as follows:

1. Ensure that the power switch is set to OFF.
2. Open the fuse holder cover(s).
3. Replace the fuse(s).
4. Set the AMPLITUDE control to 50 and the power switch to ON. With the probe in air (out of sample), the wattmeter should read below 20 watts. If the reading exceeds 20 watts, set the power switch to OFF, and disconnect the probe from the converter.
5. Set the power switch back to ON. If the wattmeter reads below 20 watts, the probe has failed or is out of tune due to excessive erosion, and should be replaced. If the wattmeter reads above 20 watts, either the converter or power supply has failed and the complete Ultrasonic Processor should be returned for repair.

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 the factory before returning any instrument. Include date of purchase, model number and serial number. For instruments not covered by the warranty, a purchase order should be forwarded to avoid unnecessary delay. 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.

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

IMPORTANT

I CERTIFY THAT THE ULTRASONIC PROCESSOR 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 CERTICATION CAN BE MADE.

OPERATING SUGGESTIONS AND TECHNIQUES

DISRUPTING CELLS

The disruption of cells is an important stage in the isolation and preparation of intracellular products. From research levels through to production, many areas of biotechnology, particularly recombinant technology, necessitate the use of ultrasonics for cell disruption. Although some biological products are secreted from the cell or released during autolysis, many others require sonication to release intracellular material. Cell disruption focuses on obtaining the desired product from within the cell, and it is the cell wall that must be disrupted to allow cell contents extraction.

Single-cell organisms (micro-organisms) consist of a semipermeable, tough, rigid outer cell wall surrounding the protoplasmic membrane and cytoplasm. The cytoplasm is made up of nucleic acid, protein, 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 lysed and sonicated in order for these substances to be released. Breaking cell membranes and releasing the contents present significant challenges. The process must be fast and thorough to maximize the protein yield. Because the energy applied must be great enough to break the cell membranes or walls, yet gentle enough to avoid physically or chemically damaging cell contents, the Vibra-Cell with its variable intensity capability is ideally suited for this application.

The level of intensity that should be used is application dependent. For example high intensity might be recommended for the break up of cells, but should never be used when the release of intracellular components might be objectionable e.g. Organelle isolation.

The ability to control the amplitude at the probe tip is a prerequisite for process optimization. And because each application requires its own set of processing parameters, due to variation in volume and composition, the optimum amplitude can only be determined empirically. When processing a new sample, it is recommended that the amplitude be set first at 50% (30% with a microtip) and then increased of decreased as required.

Yeast, gram-positive bacteria, and to a lesser extent, gram-negative bacteria have considerably harder cell walls in comparison to animal cells, and require relatively high power for cell disruption.

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

Microorganisms 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 that plant cells, and red blood cells are more readily disintegrated than muscle cells because they lack a protective cell wall.

Cellular disruption is the first step in RNA isolation and one of the most critical steps affecting yield and quality of the isolated RNA. Typically, cell disruption needs to be fast and thorough. Slow disruption, for example placing cells or tissue in guanidinium isothiocyanate (GITC) lysis solution for a long time prior to sonication, may result in RNA degradation by endogenous RNases released internally. This is especially a concern when working with tissues high in endogenous RNase such as spleen and pancreas.

Disrupting frozen tissue is more time consuming and cumbersome that processing fresh tissue, but freezing samples is sometimes necessary. Samples are usually frozen when, 1) they are collected over a period of time and thus, cannot be processed simultaneously; 2) there are many samples, 3) samples are collected in the field, or 4) mechanical processing of fresh samples is insufficient for thorough disruption. A mortar and pestle or bag and hammer are typically used when the starting material is frozen. RNA will remain intact in tissues for a day at 37ºC, a week at 25ºC a month at 4ºC and indefinitely at subzero temperatures.

Ultrasonic processing will typically cause the temperature of the sample to increase especially with small volumes. Since high temperatures inhibit 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.

Increasing hydrostatic pressure (typically 15-60 psi) and viscosity can enhance cell disruption. For microorganisms, the addition of glass beads in the 0.5 to 1mm 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.

When processing difficult cells such as yeast, pretreatment with an enzyme is beneficial. Lysozyme, byaluronidase, glycosidase, glucalase, lyticase, zymolase and lysostaphin digestion are among the enzymatic methods frequently used with yeast and Lysozyme with bacteria. Enzymatic treatment is usually followed by sonication in a GITC lysis buffer. Collogenase may be used with collogen, lysostaphin with staphylococcus, 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.

Most animal tissues can be processed fresh (unfrozen). It is important to keep fresh tissue cold and to process it quickly (within 30 minutes) after dissection. When working with fresh tissue, the cells must be sonicated immediately at the time the GITC lysis solution is added. This can be done by dispensing the lysing solution in the tube, adding the tissue and immediately sonicating. Samples should never be left sitting in lysis solution, undisrupted. Large samples of hard tissues should be first treated in a blender or a mechanical homogenizer.

Animal tissues that have been frozen after collection should be disrupted by grinding in liquid nitrogen with a mortar and pestle. During this process, it is important that the equipment and tissue remain at cryogenic temperatures. The tissue should be dry and powdery after grinding. Grinding should be followed by thorough sonication in a GITC lysis buffer. Processing frozen tissue in this way is cumbersome and time consuming, but effective.

Cultured cells are normally easy to disrupt. Cells grown in suspension are collected by centrifugation, rinsed with PBS to remove culture medium, and then lysed by sonicating in a GITC lysis buffer. Placement of the vessel on ice while washing and lysing the cells will further protect the RNA from endogenous RNases released during the disruption process.

Soft, fresh plant tissue can often be disrupted by sonicating in a lysis buffer. Other plant tissues, like pine needles, need to be ground dry, without liquid nitrogen. Some hard, woody plant materials require freezing and grinding in liquid nitrogen prior to being ultrasonically processed. Plant cell suspension cultures and calluses can typically be sonicated in a lysis buffer within 2 minutes. The diversity of plants and plant tissue make it impossible to give a single recommendation for all. However, most plant tissues typically contain polysaccharides and polyphenols that can coprecipitate with RNA and inhibit downstream assays. Treating a plant tissue lysate with polyvinylpyrrolidone (PVP) will precipitate such problematic components from the lysate before the actual RNA isolation is carried out.

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. If sub-cellular particles are desired intact, the amplitude should be kept low, and the processing time increased.

Yeast can be extremely difficult to disrupt because their cell walls may form capsules or nearly indestructible spores. To process yeast, sonicate in a tube containing the sample, guanidinium-based lysis buffer and small glass beads (0.5 – 1 mm). Pretreatment with

zymolase, glucalase and / or lyticase to produce spheroplasts that are readily lysed may also be useful.

To disrupt filamentous fungi, scrape the mycelial mat into a cold mortar, add liquid nitrogen and grind to a fine powder with a pestle. The powder can then be thoroughly sonicated in lysis buffer to solubilize completely. As fungi may also be rich in polysaccharides, pretreatment with polyvinylpyrrolidone (PVP) may be beneficial.

Bacteria, like plants, are extremely diverse; therefore, it is difficult to make one recommendation for all bacteria. Ultrasonic processing will lyse most Gram positive and Gram negative bacteria, including mycobacteria. Although it is recommended that glass beads and lysis solution be used; it is possible to lyse some Gram negative bacteria by sonicating in lysis solution without beads. Bacteria cell walls can be digested with lysozyme to form spheroplasts. Gram positive bacteria usually require more rigorous digestion and longer processing time. The spheroplasts are then lysed with sonication in GITC lysis buffer.

Disruption of cells found in soil and sediments is accomplished one of two ways. One technique isolates the bacterial cells from the material prior to the RNA isolation procedure. This is accomplished by homogenization of wet soil in a mechanical blender followed by a slow speed centrifugation to remove fungal biomass and soil debris. The supernatant is centrifuged again at a higher speed to pellet the bacteria cells. Cells can then be lysed as described above for bacteria. Other techniques describe RNA isolation from the soil or sediment directly. For example, one method requires soil to be added to a diatomaceous earth and lysis buffer, and then sonicated. The sample is then centrifuged to remove solid debris.

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 much 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, carbon dioxide, N_2O, cysteine, reduced glutahione, dithiothreitol or other SH compounds, might be beneficial. Saturating the sample with a protective atmosphere of helium or nitrogen gas, or dropping a small pellet of dry ice in the sample, will also inhibit free radical formation. 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.

Various methods can be used to measure the efficiency of the disruption. For example, a visual count can be made using a microscope.
For greater accuracy, a protein assay could be used. This procedure is widely recognized as a good method for measuring cell disruption by taking into account the amount of protein released after disruption. The disrupted cells are then tested and checked against this number for percentage breakage.
There are several types of protein assays. One commonly used is the Folin Reaction (Lowry Assay) method, as it is comparatively simple and provides consistent results. This colorimetric method has a sensitivity to protein of around 8 µg / mL in the assay solution.
The assay turns blue in the presence of proteins due to the reaction of copper ions in the alkaline solution with protein and the reduction of phosphomolybdate- phosphotungstic acid in the Folin reagent by aromatic amino acids in the treated protein.
Fractional protein release, Rp, is calculated using the following equation and multiplying the result by 100:

$$\mathbf{Rp = \frac{Cf - Cb}{Ct - Cb}}$$

Cf = Free protein
Ct = total protein
Cb = Background protein

This gives the actual disruption percentage, taking into account the background levels of protein before disruption.

Since the greatest concentration of energy is 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.

Allowing the probe to contact the vessel will decrease the power output, and cause minute grey glass particles to migrate into the sample. 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 20mm (3/4") diameter stainless steel centrifuge tube cut to 70mm (3") length. Do not use a glass tube. Microtips must never 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 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 about contamination from previous use, clean the probe with a 20% Virkon solution and rinse with distilled water. For critical application, probes may be autoclaved.

To inhibit sample loss in test tube due to sticking, siliconize the test tube as follows: Wash and dry the test tube thoroughly, coat with silicone, then air dry. "Sigmacote" manufactured by Sigma Chemical Co., 3050 Spruce Street, St. Louis, Missouri 63103, USA, phone (314) 771-5765, is ideally suited for that purpose.

High viscosity and concentration are problematic. 2,000 cps and 15% concentration by weight are maximum limits. Because with ultrasonics the sound waves are propagated through the sample, if the sample is so thick that it will not pour or circulate easily, it is too thick for ultrasonic processing.

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, whenever possible, to contain the sample in a 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 also be added to the water inside the cup horn, in order to optimize cooling. Processing samples in a Cup Horn will usually take 4 times longer than processing with the direct probe intrusion method

USER'S GUIDE

HIGH INTENSITY ULTRASONIC PROCESSOR

Model VC50AT

TABLE OF CONTENTS

The Ultrasonic Atomizer supplied with this instruction manual is constructed of the finest material and the workmanship meets the highest 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.

Rev. 2003

IMPORTANT SAFEGUARDS

READ BEFORE INSTALLING OR USING THE EQUIPMENT

Your Ultrasonic Atomizer has been designed with safety in mind. However, no design can completely protect against improper usage, which may result in bodily injury and/or equipment damage. Please 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 Atomizer is used in a manner contrary to that specified in this instruction manual, the protection features designed into the unit may be impaired.

When mounting the probe, always clamp the upper portion of the converter housing. Never clamp the probe.

Make sure the Ultrasonic Atomizer is properly grounded via a 3-prong outlet.

High voltage is present in the power supply. Do not remove the cover. Refer all servicing to qualified service personnel.

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 nodal point (point of no activity).

Never touch a vibrating probe.

Never allow a microtip to vibrate in air for more than 10 seconds.

It is recommended that a sound abating enclosure or ear protection be used when operating the Ultrasonic Atomizer.

WARNING or CAUTION

Where you see this alert symbol and WARNING or CAUTION heading, strictly follow the warning instructions to avoid personal injury or equipment failure.

SECTION 1 – INSTALLATION

INSPECTION

Prior to installing the Ultrasonic Atomizer, 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 Atomizer 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 Atomizer requires a fused, single phrase 3-terminal grounding type electrical outlet capable of supplying 50/ 60 Hz at 100 volts, 115 volts, 220 volts, or 240 volts, depending on the voltage option selected. 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 Atomizer should be installed in an area that is free from excessive dust, dirt, explosive and corrosive fumes, and extremes of temperature and humidity.

SECTION II – OPERATION

PRINCIPLES OF ULTRASONIC ATOMIZATION

The ultrasonic power supply converts 50/60 Hz line voltage to high frequency 20 kHz (20,000 cycles per second) electrical energy. His electrical energy is transmitted to the piezoelectric transducer with in the converter, where it is changed to mechanical vibrations. The ultrasonic vibration are intensified by the nozzle and focused at the tip where the atomization takes place. The liquid travels through the nozzle, and spreads out as a thin film on the atomizing surface. The oscillations at the tip disintegrate the liquid into micro-droplets, and then eject them to form a gentle, low velocity spray.

Unlike conventional atomizing nozzles that rely on pressure and high-velocity notion to shear a fluid into small drops, the Ultrasonic Atomizer does not require any pressure, and instead uses only low ultrasonic vibrational energy for atomization. The liquid can be dispensed to the nozzle by either gravity feed or a small metering pump, and atomized continuously or intermittently. In contrast to pressurized systems, the velocity of the droplets generated is very low-only 0.2 to 0.4 m/sec., compared with 5 to 20 m/sec.

FUNCTIONS OF KEYS, CONTROLS, INDICATORS, AND CONNECTORS

POWER SWITCH	ON position – energizes the power supply. OFF position – de-energizes the power supply. Illuminates when the power supply is energized.
OUTPUT CONTROL	Controls the amplitude of vibrations at the probe tip.
POWER MONITOR (METER)	Indicates in watts the amount of ultrasonic power delivered to the probe.
TUNE CONTROL	Optimizes power supply performance by tuning the power supply to the converter / probe assembly.
25-50 SCALE SELECT SWITCH Increases or decreases the POWER MONITOR sensitivity	In the 25 position the POWER MONITOR indicates the percentage of ultrasonic power delivered to the probe up to 25 watts. In the 50 position the POWER MONITOR indicates the percentage of the ultrasonic power delivered to the probe up to 50 watts.

REAR PANEL	
FOOTSWITCH CONNECTOR	Connects to footswitch cable.
OUTPUT CONNECTOR	Connects to converter cable.
POWER CORD	Connects to power supply to electrical outlet.
FUSE(S)	Protects against electrical overload.

PREPARATION FOR USE

CAUTION

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

1. Ensure that the AMPLITUDE 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; using the wrenches provided, screw securely the probe into the converter.

CAUTION

Never place a washer between the probe and the converter.
Never apply grease to the mating surfaces or threads of the converter or microtip.

5. Mount the converter / probe assembly in a laboratory stand, secure the clamp to the upper section of the converter housing only. Do not secure the clamp to any other portion of the converter / probe assembly.
6. Push in the 1/8” (3.2 mm) liquid carrying plastic tubing into the nozzle liquid inlet.
7. Connect the converter cable to the power supply.

NOTE

Should it become necessary to remove a probe, use the wrenches supplied. If the probe has been attached to the converter for a long period of 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 wrench, twist the converter off the probe. A tap of a hammer may be applied to the end of the wrench. Never attempt to remove the probe by twisting the converter housing, as this may damage the electrical connections within the housing.

TUNING

Tune the power supply in accordance with the following procedures each time a new converter or probe is used.

1. Ensure that the probe is not immersed in the liquid and that it does not come in contact with anything.

2. Set OUTPUT CONTROL TO “100”.

3. Set 25-50 POWER MONITOR SCALE SELECT SWITCH to “25”.

4. Set POWER SWITCH to ON, and rotate the TUNE CONTROL clockwise or counterclockwise until **minimum** (not maximum) reading (usually less than 30) is obtained on the POWER MONITOR. If minimum reading cannot be obtained, make certain that the probe is tight. A loose probe will usually generate a loud piercing sound.

5. Set OUTPUT CONTROL to “60”.

6. Set POWER SWITCH to OFF.

CAUTION

The power supply should be tuned after the probe has reached operating temperature. When working with low or high temperature liquids, immerse the probe in the liquid for a few minutes, withdraw the probe out of the liquid, and **then,** tune the power supply.

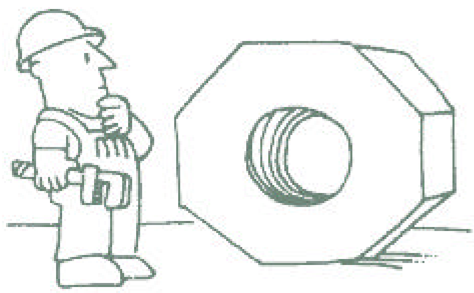
USING THE ULTRASONIC PROCESSOR

CAUTION

Do not operate the power supply unless it is connected to the converter.
High voltage is present in the power supply – do not operate with the cover off.

1. Ensure that the power supply is properly tuned.
2. Feed the liquid to the nozzle.
3. Set POWER SUPPLY to ON, if footswitch is used, depress footswitch.
4. Using OUTPUT CONTROL increase or decrease intensity as required.
5. Adjust liquid flow rate as desired.

SECTION III – SERVICE INFORMATION



Your Ultrasonic Atomizer 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, or that it will stop working all together. The most probable causes for malfunction are listed below and should be investigated.

The unit was plugged into an electrical outlet that provides a different voltage from that required. See *Electrical Requirements.*

The probe is not secured properly.

A fuse(s) has failed. If a fuse(s) has failed, proceed as follows:

1. Ensure that the power switch is set to OFF.
2. Open the fuse holder cover(s).
3. Replace the fuse(s).
4. Set the AMPLITUDE control to 50 and the power switch to ON. With the probe in air (out of sample), the wattmeter should read below 20 watts. If the reading exceeds 20 watts, set the power switch to OFF, and disconnect the probe from the converter.
5. Set the power switch back to ON. If the wattmeter reads below 20 watts, the probe has failed or is out of tune due to excessive erosion, and should be replaced. If the wattmeter reads above 20 watts, either the converter or power supply has failed and the complete Ultrasonic Atomizer should be returned for repair.

NOZZLE CLEANING

Whenever possible, flush the nozzle with water or an appropriate solvent after use.

Ensure that there is no material build-up on the atomizing surface. If material build-up is present, clean the atomizing surface with steel wool.

Clean the inside of the atomizing nozzle with a pipe cleaner or a small round brush. Do not under any circumstance use a drill to remove material build-up.

RETURN OF EQUIPMENT

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

In order to receive prompt service; always contact the factory before returning any instrument. Include date of purchase, model number and serial number. For instruments not covered by the warranty, a purchase order should be forwarded to avoid unnecessary delay. Care should be exercised to provide adequate packing to insure against possible damage in shipment. The Ultrasonic Atomizer should be sent to the "Service Department" with all transportation charges prepaid and return of shipment indicated.

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

IMPORTANT

I CERTIFY THAT THE ULTRASONIC ATOMIZER 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 CERTICATION CAN BE MADE.

USER'S GUIDE

HIGH INTENSITY ULTRASONIC PROCESSOR

50 Watt Model
50 Watt Model with Timer

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The Ultrasonic Processor supplied with this instruction manual is constructed of the finest material and the workmanship meets the highest 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.

Rev. 2003

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 equipment damage. Please 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.

When mounting the probe, always clamp the upper portion of the converter housing. Never clamp the probe.

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. Refer all servicing to qualified service personnel.

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 nodal point (point of no activity).

Never touch a vibrating probe.

Never allow a microtip to vibrate in air for more than 10 seconds.

It is recommended that a sound abating enclosure or ear protection be used when operating the Ultrasonic Processor.

WARNING or CAUTION

Where you see this alert symbol and WARNING or CAUTION heading, strictly follow the warning instructions to avoid personal injury or equipment failure.

SECTION 1 – INSTALLATION

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 phrase 3-terminal grounding type electrical outlet capable of supplying 50/ 60 Hz at 100 volts, 115 volts, 220 volts, or 240 volts, depending on the voltage option selected. 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.

SECTION II – OPERATION

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. This phenomenon, referred to as cavitation, creates millions of shock waves in the liquid, as well as elevated pressures and temperatures at the implosion sites. Although the cavitational collapse last but a few microseconds, and the amount of energy released by each individual bubble is minute, the cumulative effect causes extremely high levels of energy to be released into the liquid. The larger the probe tip, the larger the volume that can be processed but at a lesser intensity. For information regarding the processing capability of each probe, consult the tables below.

NOTE

The Ultrasonic Processor is available with four probes. A 2mm (5/64") microtip, a 3mm (1/8") microtip, a 6mm (1/4") microtip, and a 9.5mm (3/8") microtip. All probes are fabricated from titanium and are autoclavable. The standard 3mm microtip can process between 200 microliters and 10 milliliters.
The 2mm microtip is optional and can process between 100 microliters and 5 milliliters.
The 6mm microtip is optional and can process between 10 milliliters and 25 milliliters.
The 9.5mm microtip is optional and can process between 25 milliliters and 50 milliliters.

FUNCTIONS OF KEYS, CONTROLS, INDICATORS, AND CONNECTORS

POWER SWITCH	ON position – energizes the power supply. OFF position – de-energizes the power supply. Illuminates when the power supply is energized.
AMPLITUDE CONTROL	Controls the amplitude of vibrations at the probe tip.
POWER MONITOR (METER)	Indicates in watts the amount of ultrasonic power delivered to the probe.
TUNE CONTROL	Optimizes power supply performance by tuning the power supply to the converter / probe assembly.
20-50 SCALE SELECT SWITCH Increases or decreases the POWER MONITOR sensitivity	In the 25 position the POWER MONITOR indicates the percentage of ultrasonic power delivered to the probe up to 25 watts. (100% deflection = 25 watts, 50% deflection = 12.5 watts.) In the 50 position the POWER MONITOR indicates the percentage of the ultrasonic power delivered to the probe up to 50 watts. (100% deflection = 50 watts, 50% deflection = 25 watts.)
FOOTSWITCH CONNECTOR	Connects to footswitch cable.
OUTPUT CONNECTOR	Connects to converter cable.
POWER CORD	Connects to power supply to electrical outlet.
FUSE(S)	Protects against electrical overload.

FUNCTION OF TIMER CONTROL AND INDICATORS*

ON/OFF SWITCH	In the ON position places the timer on standby. In the OFF position inhibits the timer.
TIMER	Sets the duration of ultrasonic application from 0 minute to 20 minutes.
START BUTTON	When depressed, activates the ultrasonic for the duration set on the timer.
INDICATOR LIGHT	Illuminates when the timer is energized.

* Applies only to Ultrasonic Processors equipped with a timer.

PREPARATION FOR USE

CAUTION

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

1. Ensure that the AMPLITUDE 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; using the wrenches provided, screw securely the probe into the converter.

CAUTION

Never place a washer between the probe and the converter.
Never apply grease to the mating surfaces or threads of the converter or microtip.

5. Mount the converter / probe assembly in a laboratory stand, secure the clamp to the upper section of the converter housing only. Do not secure the clamp to any other portion of the converter / probe assembly.
6. Connect the converter cable to the power supply.

NOTE

Should it become necessary to remove a probe, use the wrenches supplied. If the probe has been attached to the converter for a long period of 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 wrench, twist the converter off the probe. A tap of a hammer may be applied to the end of the wrench. Never attempt to remove the probe by twisting the converter housing, as this may damage the electrical connections within the housing.

TUNING

Tune the power supply in accordance with the following procedures each time a new converter or probe is used.

1. Ensure that the probe is not immersed in the liquid and that it does not come in contact with anything.
2. Set OUTPUT CONTROL TO "100". (to "60" with the 2mm (5/64") probe).
3. Set 25-50 POWER MONITOR SCALE SELECT SWITCH to "25".

> NOTE
>
> The amount of power delivered to the sample is unaffected by the 25-50 switch setting. The switch only increases – in the "25" position, and decreases in the "50" position, the sensitivity of the meter. When tuning in air, or when working with a small sample, it is recommended that the switch be set at the "25" position in order to obtain optimum reading.

4. Set POWER SWITCH to ON, if Ultrasonic Processor is equipped with a timer, set timer ON/OFF switch to OFF, and rotate the TUNE CONTROL clockwise or counterclockwise until **minimum** (not maximum) reading (usually less than 30) is obtained on the POWER MONITOR. If minimum reading cannot be obtained, make certain that the probe is tight.

> NOTE
>
> 1. The probe is tuned to vibrate at a specific frequency – 20 kHz ±50Hz. If the resonate frequency of the probe has changed, due to cavitation erosion or fracturing, minimum reading will not be obtained. If minimum reading cannot be obtained, check the instrument without the probe to determine which component might be defective and should be changed.
> 2. A loose probe will usually generate a loud piercing sound.
> 3. Since the amplitude required is application dependent, and subject to the volume and composition of the sample, it is recommended that the amplitude be first set at mid-range, then empirically determined and optimized while the sample is being processed.

5. Set OUTPUT CONTROL to "60". (to "40" with the 2mm (5/64") probe).
6. Set POWER SWITCH to OFF.
7. If a footswitch is used, plug into the FOOTSWITCH CONNECTOR. Make sure that the plug is inserted forcefully all the way in. Prior to inserting or removing the footswitch plug, ALWAYS set the POWER SWITCH to OFF to prevent fuse failure.

> **CAUTION**
>
> The power supply should be tuned after the probe has reached operating temperature. When working with low or high temperature liquids, immerse the probe in the liquid for a few minutes, withdraw the probe out of the liquid, and **then,** tune the power supply.
>
> Ensure that the optional micro cup horn does not contain any liquid when tuning the power supply.

USING THE ULTRASONIC PROCESSOR

The speed control on an automobile, can, to a certain extent, be compared to an Ultrasonic Processor. The speed control is designed to maintain the vehicles 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 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.

The Ultrasonic Processor is designed to deliver constant amplitude. As the resistance to the movement of the probe increases, additional power will be delivered by the power supply to ensure that the excursion at the probe tip remains constant. Using a more powerful power supply will not deliver more power into the liquid. Rather, it is the resistance to the movement of the probe that determines how much power will be delivered into the sample.

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 draw maximum wattage.

This phenomenon can be demonstrated as follows: depress the probe down against a piece of wood. The greater the down 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.

CAUTION

Do not operate the power supply unless it is connected to the converter.

Never allow a microtip to vibrate in air for more than 10 seconds.

Do not allow the vibrating probe to come in contact with anything but the sample.

1. Ensure that the power supply is properly tuned.

2. Immerse the probe ½" (1 cm) into the liquid.

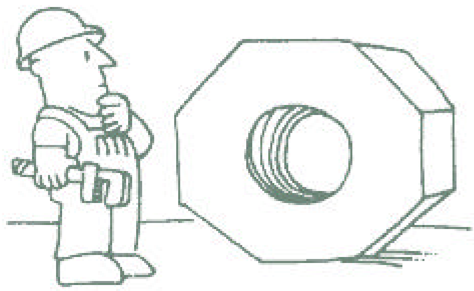
3. Set POWER SUPPLY to ON, if footswitch is used, depress footswitch. To use the TIMER, select the time sequence desired, set TIMER ON/OFF switch to ON, and depress TIMER START BUTTON. To energize the PULSER, select the pulse duration desired.

4. Using OUTPUT CONTROL increase or decrease intensity as required.

IMPORTANT

Proper care of the probe is essential for dependable operation. The intense cavitation will, after a prolonged period of time, cause the tip to erode, and the power output to decrease without showing up on the wattmeter. 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 most important that only the contaminated surface be removed. This procedure can be repeated as long as the wattmeter reads less than 20 watts with the probe out of the sample, when the AMPLITUDE control is set at 100. If the wattmeter reads over 20 watts the probe or replaceable tip should be changed.

SECTION III – SERVICE INFORMATION



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, or that it will stop working all together. The most probable causes for malfunction are listed below and should be investigated.

The unit was plugged into an electrical outlet that provides a different voltage from that required. See *Electrical Requirements.*

The probe is not secured properly.

If the probe has a replaceable tip, the tip is not secured properly, or the probe has been used with low surface tension liquids.

A fuse(s) has failed. If a fuse(s) has failed, proceed as follows:

1. Ensure that the power switch is set to OFF.
2. Open the fuse holder cover(s).
3. Replace the fuse(s).
4. Set the AMPLITUDE control to 50 and the power switch to ON. With the probe in air (out of sample), the wattmeter should read below 20 watts. If the reading exceeds 20 watts, set the power switch to OFF, and disconnect the probe from the converter.
5. Set the power switch back to ON. If the wattmeter reads below 20 watts, the probe has failed or is out of tune due to excessive erosion, and should be replaced. If the wattmeter reads above 20 watts, either the converter or power supply has failed and the complete Ultrasonic Processor should be returned for repair.

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 the factory before returning any instrument. Include date of purchase, model number and serial number. For instruments not covered by the warranty, a purchase order should be forwarded to avoid unnecessary delay. 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.

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

IMPORTANT

I CERTIFY THAT THE ULTRASONIC PROCESSOR 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 CERTICATION CAN BE MADE.

OPERATING SUGGESTIONS AND TECHNIQUES

DISRUPTING CELLS

The disruption of cells is an important stage in the isolation and preparation of intracellular products. From research levels through to production, many areas of biotechnology, particularly recombinant technology, necessitate the use of ultrasonics for cell disruption. Although some biological products are secreted from the cell or released during autolysis, many others require sonication to release intracellular material. Cell disruption focuses on obtaining the desired product from within the cell, and it is the cell wall that must be disrupted to allow cell contents extraction.

Single-cell organisms (micro-organisms) consist of a semipermeable, tough, rigid outer cell wall surrounding the protoplasmic membrane and cytoplasm. The cytoplasm is made up of nucleic acid, protein, 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 lysed and sonicated in order for these substances to be released. Breaking cell membranes and releasing the contents present significant challenges. The process must be fast and thorough to maximize the protein yield. Because the energy applied must be great enough to break the cell membranes or walls, yet gentle enough to avoid physically or chemically damaging cell contents, the Vibra-Cell with its variable intensity capability is ideally suited for this application.

The level of intensity that should be used is application dependent. For example high intensity might be recommended for the break up of cells, but should never be used when the release of intracellular components might be objectionable e.g. Organelle isolation.

The ability to control the amplitude at the probe tip is a prerequisite for process optimization. And because each application requires its own set of processing parameters, due to variation in volume and composition, the optimum amplitude can only be determined empirically. When processing a new sample, it is recommended that the amplitude be set first at 50% (30% with a microtip) and then increased of decreased as required.

Yeast, gram-positive bacteria, and to a lesser extent, gram-negative bacteria have considerably harder cell walls in comparison to animal cells, and require relatively high power for cell disruption.

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

Microorganisms 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 that plant cells, and red blood cells are more readily disintegrated than muscle cells because they lack a protective cell wall.

Cellular disruption is the first step in RNA isolation and one of the most critical steps affecting yield and quality of the isolated RNA. Typically, cell disruption needs to be fast and thorough. Slow disruption, for example placing cells or tissue in guanidinium isothiocyanate (GITC) lysis solution for a long time prior to sonication, may result in RNA degradation by endogenous RNases released internally. This is especially a concern when working with tissues high in endogenous RNase such as spleen and pancreas.

Disrupting frozen tissue is more time consuming and cumbersome that processing fresh tissue, but freezing samples is sometimes necessary. Samples are usually frozen when, 1) they are collected over a period of time and thus, cannot be processed simultaneously; 2) there are many samples, 3) samples are collected in the field, or 4) mechanical processing of fresh samples is insufficient for thorough disruption. A mortar and pestle or bag and hammer are typically used when the starting material is frozen. RNA will remain intact in tissues for a day at 37ºC, a week at 25ºC a month at 4ºC and indefinitely at subzero temperatures.

Ultrasonic processing will typically cause the temperature of the sample to increase especially with small volumes. Since high temperatures inhibit 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.

Increasing hydrostatic pressure (typically 15-60 psi) and viscosity can enhance cell disruption. For microorganisms, the addition of glass beads in the 0.5 to 1mm 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.

When processing difficult cells such as yeast, pretreatment with an enzyme is beneficial. Lysozyme, byaluronidase, glycosidase, glucalase, lyticase, zymolase and lysostaphin digestion are among the enzymatic methods frequently used with yeast and Lysozyme with bacteria. Enzymatic treatment is usually followed by sonication in a GITC lysis buffer. Collogenase may be used with collogen, lysostaphin with staphylococcus, 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.

Most animal tissues can be processed fresh (unfrozen). It is important to keep fresh tissue cold and to process it quickly (within 30 minutes) after dissection. When working with fresh tissue, the cells must be sonicated immediately at the time the GITC lysis solution is added. This can be done by dispensing the lysing solution in the tube, adding the tissue and immediately sonicating. Samples should never be left sitting in lysis solution, undisrupted. Large samples of hard tissues should be first treated in a blender or a mechanical homogenizer.

Animal tissues that have been frozen after collection should be disrupted by grinding in liquid nitrogen with a mortar and pestle. During this process, it is important that the equipment and tissue remain at cryogenic temperatures. The tissue should be dry and powdery after grinding. Grinding should be followed by thorough sonication in a GITC lysis buffer. Processing frozen tissue in this way is cumbersome and time consuming, but effective.

Cultured cells are normally easy to disrupt. Cells grown in suspension are collected by centrifugation, rinsed with PBS to remove culture medium, and then lysed by sonicating in a GITC lysis buffer. Placement of the vessel on ice while washing and lysing the cells will further protect the RNA from endogenous RNases released during the disruption process.

Soft, fresh plant tissue can often be disrupted by sonicating in a lysis buffer. Other plant tissues, like pine needles, need to be ground dry, without liquid nitrogen. Some hard, woody plant materials require freezing and grinding in liquid nitrogen prior to being ultrasonically processed. Plant cell suspension cultures and calluses can typically be sonicated in a lysis buffer within 2 minutes. The diversity of plants and plant tissue make it impossible to give a single recommendation for all. However, most plant tissues typically contain polysaccharides and polyphenols that can coprecipitate with RNA and inhibit downstream assays. Treating a plant tissue lysate with polyvinylpyrrolidone (PVP) will precipitate such problematic components from the lysate before the actual RNA isolation is carried out.

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. If sub-cellular particles are desired intact, the amplitude should be kept low, and the processing time increased.

Yeast can be extremely difficult to disrupt because their cell walls may form capsules or nearly indestructible spores. To process yeast, sonicate in a tube containing the sample, guanidinium-based lysis buffer and small glass beads (0.5 – 1 mm). Pretreatment with

zymolase, glucalase and / or lyticase to produce spheroplasts that are readily lysed may also be useful.

To disrupt filamentous fungi, scrape the mycelial mat into a cold mortar, add liquid nitrogen and grind to a fine powder with a pestle. The powder can then be thoroughly sonicated in lysis buffer to solubilize completely. As fungi may also be rich in polysaccharides, pretreatment with polyvinylpyrrolidone (PVP) may be beneficial.

Bacteria, like plants, are extremely diverse; therefore, it is difficult to make one recommendation for all bacteria. Ultrasonic processing will lyse most Gram positive and Gram negative bacteria, including mycobacteria. Although it is recommended that glass beads and lysis solution be used; it is possible to lyse some Gram negative bacteria by sonicating in lysis solution without beads. Bacteria cell walls can be digested with lysozyme to form spheroplasts. Gram positive bacteria usually require more rigorous digestion and longer processing time. The spheroplasts are then lysed with sonication in GITC lysis buffer.

Disruption of cells found in soil and sediments is accomplished one of two ways. One technique isolates the bacterial cells from the material prior to the RNA isolation procedure. This is accomplished by homogenization of wet soil in a mechanical blender followed by a slow speed centrifugation to remove fungal biomass and soil debris. The supernatant is centrifuged again at a higher speed to pellet the bacteria cells. Cells can then be lysed as described above for bacteria. Other techniques describe RNA isolation from the soil or sediment directly. For example, one method requires soil to be added to a diatomaceous earth and lysis buffer, and then sonicated. The sample is then centrifuged to remove solid debris.

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 much 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, carbon dioxide, N_2O, cysteine, reduced glutahione, dithiothreitol or other SH compounds, might be beneficial. Saturating the sample with a protective atmosphere of helium or nitrogen gas, or dropping a small pellet of dry ice in the sample, will also inhibit free radical formation. 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.

Various methods can be used to measure the efficiency of the disruption. For example, a visual count can be made using a microscope.

For greater accuracy, a protein assay could be used. This procedure is widely recognized as a good method for measuring cell disruption by taking into account the amount of protein released after disruption. The disrupted cells are then tested and checked against this number for percentage breakage.

There are several types of protein assays. One commonly used is the Folin Reaction (Lowry Assay) method, as it is comparatively simple and provides consistent results. This colorimetric method has a sensitivity to protein of around 8 µg / mL in the assay solution.

The assay turns blue in the presence of proteins due to the reaction of copper ions in the alkaline solution with protein and the reduction of phosphomolybdate- phosphotungstic acid in the Folin reagent by aromatic amino acids in the treated protein.

Fractional protein release, Rp, is calculated using the following equation and multiplying the result by 100:

$$\mathbf{Rp = \frac{Cf - Cb}{Ct - Cb}}$$

Cf = Free protein
Ct = total protein
Cb = Background protein

This gives the actual disruption percentage, taking into account the background levels of protein before disruption.

Since the greatest concentration of energy is 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.

Allowing the probe to contact the vessel will decrease the power output, and cause minute grey glass particles to migrate into the sample. 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 20mm (3/4”) diameter stainless steel centrifuge tube cut to 70mm (3”) length. Do not use a glass tube. Microtips must never 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 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 about contamination from previous use, clean the probe with a 20% Virkon solution and rinse with distilled water. For critical application, probes may be autoclaved.

To inhibit sample loss in test tube due to sticking, siliconize the test tube as follows: Wash and dry the test tube thoroughly, coat with silicone, then air dry. “Sigmacote” manufactured by Sigma Chemical Co., 3050 Spruce Street, St. Louis, Missouri 63103, USA, phone (314) 771-5765, is ideally suited for that purpose.

High viscosity and concentration are problematic. 2,000 cps and 15% concentration by weight are maximum limits. Because with ultrasonics the sound waves are propagated through the sample, if the sample is so thick that it will not pour or circulate easily, it is too thick for ultrasonic processing.

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, whenever possible, to contain the sample in a 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 also be added to the water inside the cup horn, in order to optimize cooling. Processing samples in a Cup Horn will usually take 4 times longer than processing with the direct probe intrusion method

USER'S GUIDE

HIGH INTENSITY ULTRASONIC PROCESSOR

High Tech Model
60-Watt

TABLE OF CONTENTS

The Ultrasonic Processor supplied with this instruction manual is constructed of the finest material and the workmanship meets the highest 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.

Rev. 2003

WARRANTY

Your Ultrasonic Processor is warranted and backed by the manufacturer for a period of **three 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.

This warranty is in lieu of any other warranties, either express, implied, or statutory. 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.

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 equipment damage. Please 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.

When mounting the probe, always clamp the upper portion of the converter housing. Never clamp the probe.

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. Refer all servicing to qualified service personnel.

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 nodal point (point of no activity).

Never touch a vibrating probe.

It is recommended that a sound abating enclosure or ear protection be used when operating the Ultrasonic Processor.

WARNING or CAUTION

Where you see this alert symbol and WARNING or CAUTION heading, strictly follow the warning instructions to avoid personal injury or equipment failure.

SECTION 1 – INSTALLATION

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 phrase 3-terminal grounding type electrical outlet capable of supplying 50/ 60 Hz at 100 volts, 115 volts, 220 volts, or 240 volts, depending on the voltage option selected. 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.

SECTION II – OPERATION

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. This phenomenon, referred to as cavitation, creates millions of shock waves in the liquid, as well as elevated pressures and temperatures at the implosion sites. Although the cavitational collapse last but a few microseconds, and the amount of energy released by each individual bubble is minute, the cumulative effect causes extremely high levels of energy to be released into the liquid. The larger the probe tip, the larger the volume that can be processed but at a lesser intensity. For information regarding the processing capability of each probe, consult the tables below.

NOTE

The Ultrasonic Processor is available with four probes – a 2mm (5/64”), a 3mm ($^1/_8$”) microtip, a 6mm ($^1/_4$”) microtip, and 13mm ($^1/_2$”) probe. All probes are fabricated from titanium and are autoclavable.

The standard 3mm microtip can process between 250 microliters and 10 milliliters.
The 2mm microtip is optional and can process between 100 microliters and 5 milliliters.
The 6mm microtip is optional and can process between 10 and 25 milliliters.

FUNCTIONS OF KEYS, CONTROLS, INDICATORS, AND CONNECTORS

POWER SWITCH	Applies power to the instrument. Illuminates when power is on.
START BUTTON	When depressed, activates the ultrasonics. Also resets the TIMER and ENERGY CONTROLLER to zero.
STOP BUTTON	When depressed, de-activates the ultrasonics.
TEST BUTTON	When depressed, allows the power supply to be tuned. When released, automatically subtracts power consumed by the transducer and horn to ensure that the power displayed on the wattmeter is the net ultrasonic power delivered to the sample.
TUNE CONTROL	Optimizes power supply performance by tuning the power supply to the converter/probe assembly. To adjust, use only a non-magnetic, flat-blade screwdriver.
TIMER ON/OFF	Enables/disables the timer function.
TIMER	Sets the duration of ultrasonic application in minutes and seconds.
PULSER	Sets the duty cycle. In the OFF position, the ultrasonic is continuous. In the ON position the ultrasonics intermittent. The ON cycle and OFF cycle are independent of each other and can be adjusted from .1 second to 5 seconds. Intermittent operation inhibits heat build-up in the liquid and provides more efficient processing by allowing the material to settle back under the probe tip after each burst.
WATTMETER	Indicates the net amount of watts being delivered to the liquid.
ENERGY CONTROLLER	Controls and monitors the net amount of energy (joules) (watts-sec) delivered to the liquid. In the ON position the energy controller is energized. In the OFF position, the energy controller is de-energized.
OUTPUT CONTROL	Controls the amplitude of vibrations at the probe tip. **CAUTION: when using a 2mm (5/64") probe, never exceed "60" on output control**

REAR PANEL	
OUTPUT CONNECTOR	Connects to converter cable
FOOTSWITCH CONNECTOR	Connects to footswitch cable.
FUSE(S)	Protects against electrical overload.
ELECTRICAL CONNECTOR	Connect to electrical power cord.

PREPARATION FOR USE

CAUTION

If the Ultrasonic Processor has been left in a very cold environment for a prolonged period of time, do not operate until it has reached room temperature.

To safeguard the fuse against failure, always switch the power supply off before connecting or disconnecting the footswitch plug.

1. Ensure that the POWER SWITCH, TIMER SWITCH, PULSER SWITCH and ENERGY CONTROLLER SWITCH set to OFF.
2. Plug the electrical line cord into the electrical outlet.
3. If the probe is not already assembled, observe step 4.
4. If the converter / probe assembly is not already assembled; using the wrenches provided, screw securely the probe into the converter.

CAUTION

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. Mount the converter / probe assembly in a laboratory stand, secure the clamp to the upper section of the converter housing only. Do not secure the clamp to any other portion of the converter / probe assembly.
6. Connect the converter cable to the power supply.

NOTE

Should it become necessary to remove a probe, use the wrenches supplied. If the probe has been attached to the converter for a long period of 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 wrench, twist the converter off the probe. A tap of a hammer may be applied to the end of the wrench. Never attempt to remove the probe by twisting the converter housing, as this may damage the electrical connections within the housing.

TUNING

Tune the power supply in accordance with the following procedures each time a new converter or probe is used.

1. Ensure that the probe is not immersed in the liquid and that it does not come in contact with anything.

2. Set OUTPUT CONTROL TO “100”. (to “60” with the 2mm (5/64”) probe)

3. Set TIMER ON / OFF SWITCH to OFF.

4. Set POWER SWITCH to ON, and rotate the TUNE CONTROL clockwise or counterclockwise until **minimum** (not maximum) reading (usually less than 30) is obtained on the POWER MONITOR. If minimum reading cannot be obtained, make certain that the probe is tight. A loose probe will usually generate a loud piercing sound.

5. Set OUTPUT CONTROL to “60”. (to “40” with the 2mm (5/64”) probe)

6. Set POWER SWITCH to OFF.

CAUTION

The power supply should be tuned after the probe has reached operating temperature. When working with low or high temperature liquids, immerse the probe in the liquid for a few minutes, withdraw the probe out of the liquid, and **then,** tune the power supply.

Ensure that the optional micro cup horn does not contain any liquid when tuning the power supply.

USING THE ULTRASONIC PROCESSOR

The speed control on an automobile, can, to a certain extent, be compared to an Ultrasonic Processor. The speed control is designed to maintain the vehicles 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 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.

The Ultrasonic Processor is designed to deliver constant amplitude. As the resistance to the movement of the probe increases, additional power will be delivered by the power supply to ensure that the excursion at the probe tip remains constant. Using a more powerful power supply will not deliver more power into the liquid. Rather, it is the resistance to the movement of the probe that determines how much power will be delivered into the sample.

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 draw maximum wattage.

This phenomenon can be demonstrated as follows: depress the probe down against a piece of wood. The greater the down 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.

CAUTION

Do not operate the power supply unless it is connected to the converter.
High voltage is present in the power supply – Do not operate with the cover off.
Never allow liquid to spill into the converter.
Never allow a microtip to vibrate in air for more than 20 seconds.
When using a 2mm (5/64") probe, never exceed "60" on OUTPUT CONTROL.
Do not allow the vibrating probe to come in contact with anything but the sample.
Do not operate the converter in an explosive, humid, or caustic atmosphere.

1. Set TIMER, PULSER, and ENERGY CONTROLLER switches to OFF.
2. If a footswitch is to be used, plug the footswitch cable into the FOOTSWITCH CONNECTOR (rear panel). Make sure that the plug is inserted forcefully all the way in.
3. Set POWER SWITCH to ON. The switch will illuminate.
4. Ensure that the power supply is properly tuned.
5. Activate the ultrasonics by depressing the START button. If the footswitch is used, depress the footswitch.
6. Set OUTPUT CONTROL as required.
7. Depress the STOP button.
8. With the probe in air (not immersed in a liquid, or touching anything), depress the TEST button. This step automatically subtracts the power consumed by the probe and the transducer from the total power; to ensure that the power displayed on the wattmeter is the net ultrasonic power delivered to the sample.
9. Set TIMER as required. If the timer is not going to be used, set timer ON/OFF switch to OFF.
10. Set PULSER as required. If the pulser is not going to be used, set pulser ON/OFF switch to OFF.
11. Set ENERGY CONTROLLER as required. If the energy controller is not going to be used, set energy controller ON/OFF switch to OFF.
12. Activate the unit by depressing the START switch. If the footswitch is used, depress the footswitch.
13. Using OUTPUT CONTROL, increase or decrease intensity as required, then depress the TEST button.

IMPORTANT

To ensure repeatability and accuracy, always depress the TEST button after changing the OUTPUT CONTROL setting.

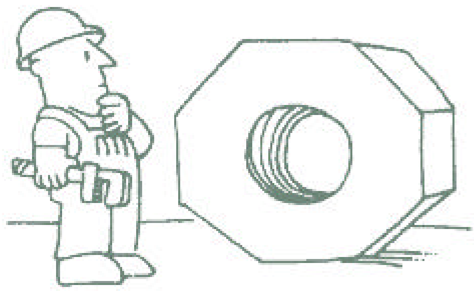
NOTE

Whenever the pulser is used, the TIMER and ENERGY CONTROLLER will accumulate and register the time that has elapsed and the energy that has been delivered to the sample ONLY during the ON cycle. When working with a new application, or when time and energy settings are unknown, proceed as follows:

a. Set TIMER to maximum (99 minutes / 59 seconds).
b. Set ENERGY CONTROLLER to maximum (99999).
c. Activate the unit by depressing the START switch. If the footswitch is used, depress the footswitch.
d. When desired results are obtained, stop the ultrasonics and record the time displayed on the TIMER, and the amount of energy displayed on the ENERGY CONTROLLER.

The ultrasonics will automatically de-activate when the duration set on the TIMER has elapsed, or when the energy level set on the ENERGY CONTROLLER has been reached. The ultrasonics can also be de-activated at any time by depressing the STOP button.
As the volume or viscosity increases, so does the need for higher power output. A sensing network continuously monitors the output requirements, and automatically adjusts the power output in order to satisfy the needs of the application. The actual power delivered will only be that required by the application. The greater the resistant to the movement of the probe (resulting from higher viscosity or larger volume) the greater the reading on the WATTMETER.

SECTION III – SERVICE INFORMATION



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, or that it will stop working all together. The most probable causes for malfunction are listed below and should be investigated.

The unit was plugged into an electrical outlet that provides a different voltage from that required. See *Electrical Requirements.*

The probe is not secured properly.

If the probe has a replaceable tip, the tip is not secured properly, or the probe has been used with low surface tension liquids.

A fuse(s) has failed. If a fuse(s) has failed, proceed as follows:

1. Ensure that the power switch is set to OFF.
2. Open the fuse holder cover(s).
3. Replace the fuse(s).
4. Set the AMPLITUDE control to 50 and the power switch to ON. With the probe in air (out of sample), the wattmeter should read below 20 watts. If the reading exceeds 20 watts, set the power switch to OFF, and disconnect the probe from the converter.
5. Set the power switch back to ON. If the wattmeter reads below 20 watts, the probe has failed or is out of tune due to excessive erosion, and should be replaced. If the wattmeter reads above 20 watts, either the converter or power supply has failed and the complete Ultrasonic Processor should be returned for repair.

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In order to receive prompt service; always contact the factory before returning any instrument. Include date of purchase, model number and serial number. For instruments not covered by the warranty, a purchase order should be forwarded to avoid unnecessary delay. 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.

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IMPORTANT

I CERTIFY THAT THE ULTRASONIC PROCESSOR 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 CERTICATION CAN BE MADE.

OPERATING SUGGESTIONS AND TECHNIQUES

DISRUPTING CELLS

The disruption of cells is an important stage in the isolation and preparation of intracellular products. From research levels through to production, many areas of biotechnology, particularly recombinant technology, necessitate the use of ultrasonics for cell disruption. Although some biological products are secreted from the cell or released during autolysis, many others require sonication to release intracellular material. Cell disruption focuses on obtaining the desired product from within the cell, and it is the cell wall that must be disrupted to allow cell contents extraction.

Single-cell organisms (micro-organisms) consist of a semipermeable, tough, rigid outer cell wall surrounding the protoplasmic membrane and cytoplasm. The cytoplasm is made up of nucleic acid, protein, 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 lysed and sonicated in order for these substances to be released. Breaking cell membranes and releasing the contents present significant challenges. The process must be fast and thorough to maximize the protein yield. Because the energy applied must be great enough to break the cell membranes or walls, yet gentle enough to avoid physically or chemically damaging cell contents, the Vibra-Cell with its variable intensity capability is ideally suited for this application.

The level of intensity that should be used is application dependent. For example high intensity might be recommended for the break up of cells, but should never be used when the release of intracellular components might be objectionable e.g. Organelle isolation.

The ability to control the amplitude at the probe tip is a prerequisite for process optimization. And because each application requires its own set of processing parameters, due to variation in volume and composition, the optimum amplitude can only be determined empirically. When processing a new sample, it is recommended that the amplitude be set first at 50% (30% with a microtip) and then increased of decreased as required.

Yeast, gram-positive bacteria, and to a lesser extent, gram-negative bacteria have considerably harder cell walls in comparison to animal cells, and require relatively high power for cell disruption.

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

Microorganisms 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 that plant cells, and red blood cells are more readily disintegrated than muscle cells because they lack a protective cell wall.

Cellular disruption is the first step in RNA isolation and one of the most critical steps affecting yield and quality of the isolated RNA. Typically, cell disruption needs to be fast and thorough. Slow disruption, for example placing cells or tissue in guanidinium isothiocyanate (GITC) lysis solution for a long time prior to sonication, may result in RNA degradation by endogenous RNases released internally. This is especially a concern when working with tissues high in endogenous RNase such as spleen and pancreas.

Disrupting frozen tissue is more time consuming and cumbersome that processing fresh tissue, but freezing samples is sometimes necessary. Samples are usually frozen when, 1) they are collected over a period of time and thus, cannot be processed simultaneously; 2) there are many samples, 3) samples are collected in the field, or 4) mechanical processing of fresh samples is insufficient for thorough disruption. A mortar and pestle or bag and hammer are typically used when the starting material is frozen. RNA will remain intact in tissues for a day at 37ºC, a week at 25ºC a month at 4ºC and indefinitely at subzero temperatures.

Ultrasonic processing will typically cause the temperature of the sample to increase especially with small volumes. Since high temperatures inhibit 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.

Increasing hydrostatic pressure (typically 15-60 psi) and viscosity can enhance cell disruption. For microorganisms, the addition of glass beads in the 0.5 to 1mm 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.

When processing difficult cells such as yeast, pretreatment with an enzyme is beneficial. Lysozyme, byaluronidase, glycosidase, glucalase, lyticase, zymolase and lysostaphin digestion are among the enzymatic methods frequently used with yeast and Lysozyme with bacteria. Enzymatic treatment is usually followed by sonication in a GITC lysis buffer. Collogenase may be used with collogen, lysostaphin with staphylococcus, 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.

Most animal tissues can be processed fresh (unfrozen). It is important to keep fresh tissue cold and to process it quickly (within 30 minutes) after dissection. When working with fresh tissue, the cells must be sonicated immediately at the time the GITC lysis solution is added. This can be done by dispensing the lysing solution in the tube, adding the tissue and immediately sonicating. Samples should never be left sitting in lysis solution, undisrupted. Large samples of hard tissues should be first treated in a blender or a mechanical homogenizer.

Animal tissues that have been frozen after collection should be disrupted by grinding in liquid nitrogen with a mortar and pestle. During this process, it is important that the equipment and tissue remain at cryogenic temperatures. The tissue should be dry and powdery after grinding. Grinding should be followed by thorough sonication in a GITC lysis buffer. Processing frozen tissue in this way is cumbersome and time consuming, but effective.

Cultured cells are normally easy to disrupt. Cells grown in suspension are collected by centrifugation, rinsed with PBS to remove culture medium, and then lysed by sonicating in a GITC lysis buffer. Placement of the vessel on ice while washing and lysing the cells will further protect the RNA from endogenous RNases released during the disruption process.

Soft, fresh plant tissue can often be disrupted by sonicating in a lysis buffer. Other plant tissues, like pine needles, need to be ground dry, without liquid nitrogen. Some hard, woody plant materials require freezing and grinding in liquid nitrogen prior to being ultrasonically processed. Plant cell suspension cultures and calluses can typically be sonicated in a lysis buffer within 2 minutes. The diversity of plants and plant tissue make it impossible to give a single recommendation for all. However, most plant tissues typically contain polysaccharides and polyphenols that can coprecipitate with RNA and inhibit downstream assays. Treating a plant tissue lysate with polyvinylpyrrolidone (PVP) will precipitate such problematic components from the lysate before the actual RNA isolation is carried out.

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. If sub-cellular particles are desired intact, the amplitude should be kept low, and the processing time increased.

Yeast can be extremely difficult to disrupt because their cell walls may form capsules or nearly indestructible spores. To process yeast, sonicate in a tube containing the sample, guanidinium-based lysis buffer and small glass beads (0.5 – 1 mm). Pretreatment with

zymolase, glucalase and / or lyticase to produce spheroplasts that are readily lysed may also be useful.

To disrupt filamentous fungi, scrape the mycelial mat into a cold mortar, add liquid nitrogen and grind to a fine powder with a pestle. The powder can then be thoroughly sonicated in lysis buffer to solubilize completely. As fungi may also be rich in polysaccharides, pretreatment with polyvinylpyrrolidone (PVP) may be beneficial.

Bacteria, like plants, are extremely diverse; therefore, it is difficult to make one recommendation for all bacteria. Ultrasonic processing will lyse most Gram positive and Gram negative bacteria, including mycobacteria. Although it is recommended that glass beads and lysis solution be used; it is possible to lyse some Gram negative bacteria by sonicating in lysis solution without beads. Bacteria cell walls can be digested with lysozyme to form spheroplasts. Gram positive bacteria usually require more rigorous digestion and longer processing time. The spheroplasts are then lysed with sonication in GITC lysis buffer.

Disruption of cells found in soil and sediments is accomplished one of two ways. One technique isolates the bacterial cells from the material prior to the RNA isolation procedure. This is accomplished by homogenization of wet soil in a mechanical blender followed by a slow speed centrifugation to remove fungal biomass and soil debris. The supernatant is centrifuged again at a higher speed to pellet the bacteria cells. Cells can then be lysed as described above for bacteria. Other techniques describe RNA isolation from the soil or sediment directly. For example, one method requires soil to be added to a diatomaceous earth and lysis buffer, and then sonicated. The sample is then centrifuged to remove solid debris.

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 much 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, carbon dioxide, N_2O, cysteine, reduced glutahione, dithiothreitol or other SH compounds, might be beneficial. Saturating the sample with a protective atmosphere of helium or nitrogen gas, or dropping a small pellet of dry ice in the sample, will also inhibit free radical formation. 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.

Various methods can be used to measure the efficiency of the disruption. For example, a visual count can be made using a microscope.
For greater accuracy, a protein assay could be used. This procedure is widely recognized as a good method for measuring cell disruption by taking into account the amount of protein released after disruption. The disrupted cells are then tested and checked against this number for percentage breakage.
There are several types of protein assays. One commonly used is the Folin Reaction (Lowry Assay) method, as it is comparatively simple and provides consistent results. This colorimetric method has a sensitivity to protein of around 8 µg / mL in the assay solution.
The assay turns blue in the presence of proteins due to the reaction of copper ions in the alkaline solution with protein and the reduction of phosphomolybdate- phosphotungstic acid in the Folin reagent by aromatic amino acids in the treated protein.
Fractional protein release, Rp, is calculated using the following equation and multiplying the result by 100:

$$\mathbf{Rp = \frac{Cf - Cb}{Ct - Cb}}$$

Cf = Free protein
Ct = total protein
Cb = Background protein

This gives the actual disruption percentage, taking into account the background levels of protein before disruption.

Since the greatest concentration of energy is 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.

Allowing the probe to contact the vessel will decrease the power output, and cause minute grey glass particles to migrate into the sample. 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 20mm (3/4”) diameter stainless steel centrifuge tube cut to 70mm (3”) length. Do not use a glass tube. Microtips must never 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 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 about contamination from previous use, clean the probe with a 20% Virkon solution and rinse with distilled water. For critical application, probes may be autoclaved.

To inhibit sample loss in test tube due to sticking, siliconize the test tube as follows: Wash and dry the test tube thoroughly, coat with silicone, then air dry. “Sigmacote” manufactured by Sigma Chemical Co., 3050 Spruce Street, St. Louis, Missouri 63103, USA, phone (314) 771-5765, is ideally suited for that purpose.

High viscosity and concentration are problematic. 2,000 cps and 15% concentration by weight are maximum limits. Because with ultrasonics the sound waves are propagated through the sample, if the sample is so thick that it will not pour or circulate easily, it is too thick for ultrasonic processing.

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, whenever possible, to contain the sample in a 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 also be added to the water inside the cup horn, in order to optimize cooling. Processing samples in a Cup Horn will usually take 4 times longer than processing with the direct probe intrusion method

USER'S GUIDE

HIGH INTENSITY ULTRASONIC PROCESSOR

100 Watt Model

TABLE OF CONTENTS

The Ultrasonic Processor supplied with this instruction manual is constructed of the finest material and the workmanship meets the highest 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.

Rev. 2003

WARRANTY

Your Ultrasonic Processor is warranted and backed by the manufacturer for a period of **three 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.

This warranty is in lieu of any other warranties, either express, implied, or statutory. 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.

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 equipment damage. Please 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.

When mounting the probe, always clamp the upper portion of the converter housing. Never clamp the probe.

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. Refer all servicing to qualified service personnel.

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 nodal point (point of no activity).

Never touch a vibrating probe.

Never allow a microtip to vibrate in air for more than 10 seconds.

Never operate a probe with threaded end without a replaceable tip.

It is recommended that a sound abating enclosure or ear protection be used when operating the Ultrasonic Processor.

WARNING or CAUTION

Where you see this alert symbol and WARNING or CAUTION heading, strictly follow the warning instructions to avoid personal injury or equipment failure.

CAUTION
LOW SURFACE TENSION LIQUIDS – ORGANIC SOLVENTS

The probes (solid or with a replaceable tip) are tuned elements that resonate at a specific frequency. When working with the ½" (13mm) probe with replaceable tip, if the replaceable tip is removed or isolated from the rest of the probe, the probe will no longer resonate at the desired 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

SECTION 1 – INSTALLATION

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 phrase 3-terminal grounding type electrical outlet capable of supplying 50/ 60 Hz at 100 volts, 115 volts, 220 volts, or 240 volts, depending on the voltage option selected. 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.

SECTION II – OPERATION

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. This phenomenon, referred to as cavitation, creates millions of shock waves in the liquid, as well as elevated pressures and temperatures at the implosion sites. Although the cavitational collapse last but a few microseconds, and the amount of energy released by each individual bubble is minute, the cumulative effect causes extremely high levels of energy to be released into the liquid. The larger the probe tip, the larger the volume that can be processed but at a lesser intensity. For information regarding the processing capability of each probe, consult the tables below.

NOTE

The Ultrasonic Processor is available with four probes – a 3mm ($^1/_8$”) microtip, a 6mm ($^1/_4$”) microtip, and two 13mm ($^1/_2$”) probe.

The 3mm microtip is standard with some models, and can process between 250 microliters and 10 milliliters.

The 6mm microtip is standard with some models, and can process between 10 and 25 milliliters.

The 13mm probe is optional, available with or without replaceable tip, and can process between 20 and 100 milliliters.

FUNCTIONS OF KEYS, CONTROLS, INDICATORS, AND CONNECTORS

POWER SWITCH	ON position – energizes the power supply. OFF position – de-energizes the power supply. Illuminates when the power supply is energized.
OUTPUT CONTROL	Controls the amplitude of vibrations at the probe tip.
TIMER	Sets the duration of ultrasonic application from 0 minute to 10 minutes.
TIMER START BUTTON	Illuminates when the timer or pulser is energized
TIMER ON/OFF SWITCH	In the ON position places the timer on standby. In the OFF position inhibits the timer.
TIMER INDICATOR LIGHT	Illuminates when the timer is energized.
PULSER	Applies the ultrasonic energy on a pulsed mode. Pulse duration can, be varied from 1 second OFF/ .5 seconds ON to 1second OFF / 10 seconds ON. OFF cycle is always 1 second On cycle is variable from.5 second to 10 second In the OFF position the ultrasonic is continuous In the ON position the ultrasonics is intermittent. Intermittent operation inhibits heat build-up in the liquid and provides more efficient processing by allowing the material to settle back under the probe tip after each burst.
PULSER INDICATOR LIGHT	Illuminates when the pulser is energized
POWER MONITOR (OUTPUT WATTS)	Indicates in watts the amount of ultrasonic power delivered to the probe.
TUNE CONTROL	Optimizes power supply performance by tuning the power supply to the converter / probe assembly.
FOOTSWITCH CONNECTOR	Connects to footswitch cable.
OUTPUT CONNECTOR	Connects to converter cable
POWER CORD – Rear Panel -	Connects to power supply to electrical outlet.
FUSE(S) – Rear Panel -	Protects against electrical overload.

PREPARATION FOR USE

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

1. Ensure that the AMPLITUDE 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; using the wrenches provided, screw securely the probe into the converter.

> **CAUTION**
>
> 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. Mount the converter / probe assembly in a laboratory stand, secure the clamp to the upper section of the converter housing only. Do not secure the clamp to any other portion of the converter / probe assembly.
6. Connect the converter cable to the power supply.

> **NOTE**
>
> Should it become necessary to remove a probe, use the wrenches supplied. If the probe has been attached to the converter for a long period of 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 wrench, twist the converter off the probe. A tap of a hammer may be applied to the end of the wrench. Never attempt to remove the probe by twisting the converter housing, as this may damage the electrical connections within the housing.

TUNING

Tune the power supply in accordance with the following procedures each time a new converter or probe is used.

1. Ensure that the probe is not immersed in the liquid and that it does not come in contact with anything.

2. Set OUTPUT CONTROL TO “100”.

3. Set TIMER ON / OFF SWITCH to OFF.

4. Set PULSER to OFF.

5. Set POWER SWITCH to ON, and rotate the TUNE CONTROL clockwise or counterclockwise until **minimum** (not maximum) reading (usually less than 30) is obtained on the POWER MONITOR. If minimum reading cannot be obtained, make certain that the probe is tight. A loose probe will usually generate a loud piercing sound.

6. Set OUTPUT CONTROL to “60”.

7. Set POWER SWITCH to OFF.

8. If a footswitch is used, plug into the FOOTSWITCH CONNECTOR. Make sure that the plug is inserted forcefully all the way in.

CAUTION

The power supply should be tuned after the probe has reached operating temperature. When working with low or high temperature liquids, immerse the probe in the liquid for a few minutes, withdraw the probe out of the liquid, and **then,** tune the power supply.

Ensure that the optional micro cup horn does not contain any liquid when tuning the power supply.

USING THE ULTRASONIC PROCESSOR

The speed control on an automobile, can, to a certain extent, be compared to an Ultrasonic Processor. The speed control is designed to maintain the vehicles 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 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.

The Ultrasonic Processor is designed to deliver constant amplitude. As the resistance to the movement of the probe increases, additional power will be delivered by the power supply to ensure that the excursion at the probe tip remains constant. Using a more powerful power supply will not deliver more power into the liquid. Rather, it is the resistance to the movement of the probe that determines how much power will be delivered into the sample.

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 draw maximum wattage.

This phenomenon can be demonstrated as follows: depress the probe down against a piece of wood. The greater the down 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.

CAUTION

Do not operate the power supply unless it is connected to the converter.
Never allow a microtip to vibrate in air for more than 10 seconds.
Do not allow the vibrating probe to come in contact with anything but the sample.

1. Ensure that the power supply is properly tuned.

2. Immerse the probe ½" (1 cm) into the liquid.

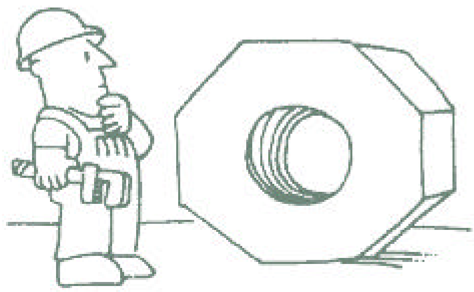
3. Set POWER SUPPLY to ON, if footswitch is used, depress footswitch. To use the TIMER, select the time sequence desired, set TIMER ON/OFF switch to ON, and depress TIMER START BUTTON. To energize the PULSER, select the pulse duration desired.

4. Using OUTPUT CONTROL increase or decrease intensity as required.

IMPORTANT

Proper care of the probe is essential for dependable operation. The intense cavitation will, after a prolonged period of time, cause the tip to erode, and the power output to decrease without showing up on the wattmeter. 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 most important that only the contaminated surface be removed. This procedure can be repeated as long as the wattmeter reads less than 20 watts with the probe out of the sample, when the AMPLITUDE control is set at 100. If the wattmeter reads over 20 watts the probe or replaceable tip should be changed.

SECTION III – SERVICE INFORMATION



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, or that it will stop working all together. The most probable causes for malfunction are listed below and should be investigated.

The unit was plugged into an electrical outlet that provides a different voltage from that required. See *Electrical Requirements.*

The probe is not secured properly.

If the probe has a replaceable tip, the tip is not secured properly, or the probe has been used with low surface tension liquids.

A fuse(s) has failed. If a fuse(s) has failed, proceed as follows:

1. Ensure that the power switch is set to OFF.
2. Open the fuse holder cover(s).
3. Replace the fuse(s).
4. Set the AMPLITUDE control to 50 and the power switch to ON. With the probe in air (out of sample), the wattmeter should read below 20 watts. If the reading exceeds 20 watts, set the power switch to OFF, and disconnect the probe from the converter.
5. Set the power switch back to ON. If the wattmeter reads below 20 watts, the probe has failed or is out of tune due to excessive erosion, and should be replaced. If the wattmeter reads above 20 watts, either the converter or power supply has failed and the complete Ultrasonic Processor should be returned for repair.

RETURN OF EQUIPMENT

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

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DISRUPTING CELLS

The disruption of cells is an important stage in the isolation and preparation of intracellular products. From research levels through to production, many areas of biotechnology, particularly recombinant technology, necessitate the use of ultrasonics for cell disruption. Although some biological products are secreted from the cell or released during autolysis, many others require sonication to release intracellular material. Cell disruption focuses on obtaining the desired product from within the cell, and it is the cell wall that must be disrupted to allow cell contents extraction.

Single-cell organisms (micro-organisms) consist of a semipermeable, tough, rigid outer cell wall surrounding the protoplasmic membrane and cytoplasm. The cytoplasm is made up of nucleic acid, protein, 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 lysed and sonicated in order for these substances to be released. Breaking cell membranes and releasing the contents present significant challenges. The process must be fast and thorough to maximize the protein yield. Because the energy applied must be great enough to break the cell membranes or walls, yet gentle enough to avoid physically or chemically damaging cell contents, the Vibra-Cell with its variable intensity capability is ideally suited for this application.

The level of intensity that should be used is application dependent. For example high intensity might be recommended for the break up of cells, but should never be used when the release of intracellular components might be objectionable e.g. Organelle isolation.

The ability to control the amplitude at the probe tip is a prerequisite for process optimization. And because each application requires its own set of processing parameters, due to variation in volume and composition, the optimum amplitude can only be determined empirically. When processing a new sample, it is recommended that the amplitude be set first at 50% (30% with a microtip) and then increased of decreased as required.

Yeast, gram-positive bacteria, and to a lesser extent, gram-negative bacteria have considerably harder cell walls in comparison to animal cells, and require relatively high power for cell disruption.

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

Microorganisms 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 that plant cells, and red blood cells are more readily disintegrated than muscle cells because they lack a protective cell wall.

Cellular disruption is the first step in RNA isolation and one of the most critical steps affecting yield and quality of the isolated RNA. Typically, cell disruption needs to be fast and thorough. Slow disruption, for example placing cells or tissue in guanidinium isothiocyanate (GITC) lysis solution for a long time prior to sonication, may result in RNA degradation by endogenous RNases released internally. This is especially a concern when working with tissues high in endogenous RNase such as spleen and pancreas.

Disrupting frozen tissue is more time consuming and cumbersome that processing fresh tissue, but freezing samples is sometimes necessary. Samples are usually frozen when, 1) they are collected over a period of time and thus, cannot be processed simultaneously; 2) there are many samples, 3) samples are collected in the field, or 4) mechanical processing of fresh samples is insufficient for thorough disruption. A mortar and pestle or bag and hammer are typically used when the starting material is frozen. RNA will remain intact in tissues for a day at 37ºC, a week at 25ºC a month at 4ºC and indefinitely at subzero temperatures.

Ultrasonic processing will typically cause the temperature of the sample to increase especially with small volumes. Since high temperatures inhibit 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.

Increasing hydrostatic pressure (typically 15-60 psi) and viscosity can enhance cell disruption. For microorganisms, the addition of glass beads in the 0.5 to 1mm 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.

When processing difficult cells such as yeast, pretreatment with an enzyme is beneficial. Lysozyme, byaluronidase, glycosidase, glucalase, lyticase, zymolase and lysostaphin digestion are among the enzymatic methods frequently used with yeast and Lysozyme with bacteria. Enzymatic treatment is usually followed by sonication in a GITC lysis buffer. Collogenase may be used with collogen, lysostaphin with staphylococcus, 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.

Most animal tissues can be processed fresh (unfrozen). It is important to keep fresh tissue cold and to process it quickly (within 30 minutes) after dissection. When working with fresh tissue, the cells must be sonicated immediately at the time the GITC lysis solution is added. This can be done by dispensing the lysing solution in the tube, adding the tissue and immediately sonicating. Samples should never be left sitting in lysis solution, undisrupted. Large samples of hard tissues should be first treated in a blender or a mechanical homogenizer.

Animal tissues that have been frozen after collection should be disrupted by grinding in liquid nitrogen with a mortar and pestle. During this process, it is important that the equipment and tissue remain at cryogenic temperatures. The tissue should be dry and powdery after grinding. Grinding should be followed by thorough sonication in a GITC lysis buffer. Processing frozen tissue in this way is cumbersome and time consuming, but effective.

Cultured cells are normally easy to disrupt. Cells grown in suspension are collected by centrifugation, rinsed with PBS to remove culture medium, and then lysed by sonicating in a GITC lysis buffer. Placement of the vessel on ice while washing and lysing the cells will further protect the RNA from endogenous RNases released during the disruption process.

Soft, fresh plant tissue can often be disrupted by sonicating in a lysis buffer. Other plant tissues, like pine needles, need to be ground dry, without liquid nitrogen. Some hard, woody plant materials require freezing and grinding in liquid nitrogen prior to being ultrasonically processed. Plant cell suspension cultures and calluses can typically be sonicated in a lysis buffer within 2 minutes. The diversity of plants and plant tissue make it impossible to give a single recommendation for all. However, most plant tissues typically contain polysaccharides and polyphenols that can coprecipitate with RNA and inhibit downstream assays. Treating a plant tissue lysate with polyvinylpyrrolidone (PVP) will precipitate such problematic components from the lysate before the actual RNA isolation is carried out.

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. If sub-cellular particles are desired intact, the amplitude should be kept low, and the processing time increased.

Yeast can be extremely difficult to disrupt because their cell walls may form capsules or nearly indestructible spores. To process yeast, sonicate in a tube containing the sample, guanidinium-based lysis buffer and small glass beads (0.5 – 1 mm). Pretreatment with

zymolase, glucalase and / or lyticase to produce spheroplasts that are readily lysed may also be useful.

To disrupt filamentous fungi, scrape the mycelial mat into a cold mortar, add liquid nitrogen and grind to a fine powder with a pestle. The powder can then be thoroughly sonicated in lysis buffer to solubilize completely. As fungi may also be rich in polysaccharides, pretreatment with polyvinylpyrrolidone (PVP) may be beneficial.

Bacteria, like plants, are extremely diverse; therefore, it is difficult to make one recommendation for all bacteria. Ultrasonic processing will lyse most Gram positive and Gram negative bacteria, including mycobacteria. Although it is recommended that glass beads and lysis solution be used; it is possible to lyse some Gram negative bacteria by sonicating in lysis solution without beads. Bacteria cell walls can be digested with lysozyme to form spheroplasts. Gram positive bacteria usually require more rigorous digestion and longer processing time. The spheroplasts are then lysed with sonication in GITC lysis buffer.

Disruption of cells found in soil and sediments is accomplished one of two ways. One technique isolates the bacterial cells from the material prior to the RNA isolation procedure. This is accomplished by homogenization of wet soil in a mechanical blender followed by a slow speed centrifugation to remove fungal biomass and soil debris. The supernatant is centrifuged again at a higher speed to pellet the bacteria cells. Cells can then be lysed as described above for bacteria. Other techniques describe RNA isolation from the soil or sediment directly. For example, one method requires soil to be added to a diatomaceous earth and lysis buffer, and then sonicated. The sample is then centrifuged to remove solid debris.

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 much 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, carbon dioxide, N_2O, cysteine, reduced glutahione, dithiothreitol or other SH compounds, might be beneficial. Saturating the sample with a protective atmosphere of helium or nitrogen gas, or dropping a small pellet of dry ice in the sample, will also inhibit free radical formation. 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.

Various methods can be used to measure the efficiency of the disruption. For example, a visual count can be made using a microscope.
For greater accuracy, a protein assay could be used. This procedure is widely recognized as a good method for measuring cell disruption by taking into account the amount of protein released after disruption. The disrupted cells are then tested and checked against this number for percentage breakage.
There are several types of protein assays. One commonly used is the Folin Reaction (Lowry Assay) method, as it is comparatively simple and provides consistent results. This colorimetric method has a sensitivity to protein of around 8 µg / mL in the assay solution.
The assay turns blue in the presence of proteins due to the reaction of copper ions in the alkaline solution with protein and the reduction of phosphomolybdate- phosphotungstic acid in the Folin reagent by aromatic amino acids in the treated protein.
Fractional protein release, Rp, is calculated using the following equation and multiplying the result by 100:

$$\mathbf{Rp = \frac{Cf - Cb}{Ct - Cb}}$$

Cf = Free protein
Ct = total protein
Cb = Background protein

This gives the actual disruption percentage, taking into account the background levels of protein before disruption.

Since the greatest concentration of energy is 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.

Allowing the probe to contact the vessel will decrease the power output, and cause minute grey glass particles to migrate into the sample. 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 20mm (3/4") diameter stainless steel centrifuge tube cut to 70mm (3") length. Do not use a glass tube. Microtips must never 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 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 about contamination from previous use, clean the probe with a 20% Virkon solution and rinse with distilled water. For critical application, probes may be autoclaved.

To inhibit sample loss in test tube due to sticking, siliconize the test tube as follows: Wash and dry the test tube thoroughly, coat with silicone, then air dry. “Sigmacote” manufactured by Sigma Chemical Co., 3050 Spruce Street, St. Louis, Missouri 63103, USA, phone (314) 771-5765, is ideally suited for that purpose.

High viscosity and concentration are problematic. 2,000 cps and 15% concentration by weight are maximum limits. Because with ultrasonics the sound waves are propagated through the sample, if the sample is so thick that it will not pour or circulate easily, it is too thick for ultrasonic processing.

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, whenever possible, to contain the sample in a 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 also be added to the water inside the cup horn, in order to optimize cooling. Processing samples in a Cup Horn will usually take 4 times longer than processing with the direct probe intrusion method

USER'S GUIDE

HIGH INTENSITY ULTRASONIC PROCESSOR
Microprocessor Controlled
250-Watt Model
500-Watt Model

TABLE OF CONTENTS

The Ultrasonic Processor supplied with this instruction manual is constructed of the finest material and the workmanship meets the highest 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.

Rev. 2003

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.

When mounting the probe, always clamp the converter housing. Never clamp the probe.

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. Refer all servicing to qualified service personnel.

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 nodal 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.

It is recommended that ear protection be used when operating the Ultrasonic Processor.

WARNING or CAUTION

Where you see this alert symbol and WARNING or CAUTION heading, strictly follow the warning instructions to avoid personal injury or equipment failure.

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

SECTION 1 – INSTALLATION

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 phrase 3-terminal grounding type electrical outlet capable of supplying 50/60 Hz at 100 volts, 115 volts, 220 volts, or 240 volts, depending on the voltage option selected. 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.

SECTION II – OPERATION

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. This phenomenon, referred to as cavitation, creates millions of shock waves in the liquid, as well as elevated pressures and temperatures at the implosion sites. Although the cavitational collapse last but a few microseconds, and the amount of energy released by each individual bubble is minute, the cumulative effect causes extremely high levels of energy to be released into the liquid. The larger the probe tip, the larger the volume that can be processed but at a lesser intensity. For information regarding the processing capability of each probe, consult the tables below.

	TAPERED MICROTIPS			STEPPED MICROTIP
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	3-15 ml	5-25 ml	250ul-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	50-1000 ml

FUNCTIONS OF KEYS, CONTROLS, INDICATIONS, AND CONNECTORS

1	**On / Off / Tune Switch**	ON position - energizes the power supply. OFF position - de-energizes the power supply. TUNE position - energizes the power supply momentarily for tuning purposes.
2	**Pilot Light**	Illuminates when the power supply is energized.
3	**Continuous / Pulsed ***	Sets the duty cycle to continuous or pulsed mode.
4	**% Duty Cycle Selector ***	Sets the pulse rate when CONTINUOUS / PULSED Switch is set to pulsed. Intermittent operation inhibits heat build-up in the solution and provides more efficient processing by allowing the material to settle back under the probe tip after each burst.
5	**Timer**	Sets the duration of ultrasonic application (up to 15 minutes). In the HOLD position, the timing mode is uninhibited and the ultrasonic energy is applied indefinitely.
6	**Output Control**	Controls the amplitude of vibration at the probe tip. CAUTION *When using a microtip, never allow the Output control to exceed MICROTIP LIMIT "5".*
7	**Power Monitor**	Indicates the percentage of ultrasonic power delivered to the probe.
8	**3 Pin Connector**	Connects to the converter cable.
9	**3 Pin Connector ****	Connects to the converter cable (available only with 500 watt dual output units).
10	**Tuning Control**	Optimizes performance by matching the frequency of the power supply to that of the converter / probe assembly
11	**Fuse**	Protects against electrical overload.
12	**Electrical Line Cord**	Connects the power supply to the electrical outlet.

***** Available only with Ultrasonic Processors equipped with pulsers.

** Available only with dual output 500 watt Ultrasonic Processors.

PREPARATION FOR USE

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

1. Ensure that the AMPLITUDE dial is set fully counter-clockwise.
2. Plug the electrical line cord into the electrical outlet.
3. If the converter / probe assembly is not already assembled, check for cleanliness the mating surface of the converter and probe or stepped microtip (consisting of coupler and stepped tip), and using the wrenches provided, screw them securely to the converter.
4. To attach a tapered microtip or extender to a probe, remove the replaceable tip from the ½" (13mm) probe, and using the wrenches provided, screw them securely to the probe.

CAUTION
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.

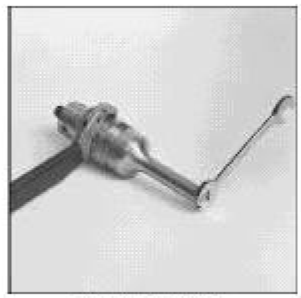
5. Mount the converter / probe assembly in a laboratory stand. Secure the clamp to the 2½" (63mm) diameter converter housing only. Do not secure the clamp to the probe.
6. Connect the converter cable to the power supply. With a dual output 500 watt ultrasonic processor, if two converters are going to be used simultaneously, **do not** connect the second converter at this time.

NOTE
Should it become necessary to remove a probe, use the wrenches supplied. If the probe has been attached to the converter for a long period of 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 wrench, twist the converter off the probe. A tap of a hammer may be applied to the end of the wrench. Never attempt to remove the probe by twisting the converter housing, as this may damage the electrical connections within the housing.

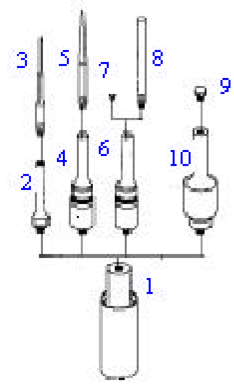
REMOVAL

TIGHTENING

TIP REMOVAL



TIP TIGHTENING



No	DESCRIPTION	Order Number
1	Converter Model CV17	CV00017
2	Coupler	630-0421
3	Stepped tip 1/8” (3mm	630-0422
4	Probe ½” (13mm) solid	630-0219
	Probe ½” (13mm) with threaded end and replaceable tip	630-0220
	Probe ¾” (19mm) solid	630-0208
	Probe ¾” (19mm) with threaded end and replaceable tip	630-0207
	Probe 1” (25mm) solid	630-0209
	Probe 1” (25mm) with threaded end and replaceable tip	630-0210
5	Tapered microtip $^{1}/_{8}$” (3mm)	630-0418
	Tapered microtip $^{3}/_{16}$” (5mm)	630-0419
	Tapered microtip ¼” (6mm)	630-0420
6	Same as 4	
7	Replaceable tip ½” (13mm)	630-0406
	Replaceable tip ¾” (19mm)	630-0407
	Replaceable tip 1” (25mm)	630-0408
8	Extender ½” (13mm)	630-0410
	Extender ¾” (19mm)	630-0409
	Extender 1” (25mm)	630-0444
9	Same as 7	
10	High gain probe ¾” (19mm) – solid	630-0306
	High gain probe 1” (25mm) – solid	630-0310

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

TUNING

Tuning optimizes performance and insures maximum transfer of energy by matching the frequency of the power supply to that of converter/probe assembly. The power supply should be tuned 1) every time a new probe or accessory is used, 2) on occasions to compensate for the frequency variation caused by cavitation erosion 3) following 10 minutes of continuous operation and 4) when the sample temperature is significantly higher or lower than room temperature.

The piezoelectric crystal within the converter is part of the circuitry, which controls the frequency at 20kHz. Any changes in t the crystal's capacitance resulting from a variation in temperature, will cause the equipment to operate in an out-of-tune condition. For reliable performance, and equipment protection, it is important that the unit be tuned after the probe temperature has had a chance to stabilize. When relocating the ultrasonic processor from a very cold or very hot environment, allow 30 minutes for the unit temperature to stabilize before operating. Continuous operation causes temperature elevation in the sample. This increase in temperature is transmitted through the probe to the crystal assembly. Always tune the power supply after the probe has reached operating temperature. When working with low or high temperature samples, immerse the probe in the sample for a few minutes, withdraw the probe from the sample, then tune the power supply.

IMPORTANT

Tuning must be performed in air with the probe out of the sample. While tuning, do not allow the probe to contact anything.

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 TIMER to HOLD.

3. SET output control to "10" (to "4" when using a microtip of extender).

CAUTION

When using a microtip, never allow the tip to vibrate in air for more than 10 seconds and do not set the OUTPUT CONTROL above "5". Ignoring these instructions will cause the microtip to fracture.

4. Momentarily hold down On/OFF/TUNE switch to TUNE and rotate the tuning control clockwise or counterclockwise until a **minimum** (not maximum) reading (usually less than 20) is obtained on the power monitor. If minimum reading (sometimes referred to as null) cannot be obtained, the probe, cup horn, tip, microtip, or accessory is loose or out of resonance, or the power supply or converter require servicing. A loose probe will usually generate a loud piercing sound.

NOTE

If minimum reading cannot be obtained, check unit without the probe to ascertain whether the power supply or probe is at fault.

5. Set OUTPUT CONTROL to “4”.

6. Release ON/OFF/TUNE Switch.

7. With a dual output 500 watt Ultrasonic Processor, if two converters are going to be used simultaneously, connect the second converter cable to connector.

CAUTION

On dual output 500 watt Ultrasonic Processors manufactured prior to June 1985, a switch is located above the tuning control.
Check that the switch is in the down position.

USING THE ULTRASONIC PROCESSOR

The speed control on an automobile, can, to a certain extent, be compared to an Ultrasonic Processor. The speed control is designed to maintain the vehicles 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 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.

The Ultrasonic Processor is designed to deliver constant amplitude. As the resistance to the movement of the probe increases, additional power will be delivered by the power supply to ensure that the excursion at the probe tip remains constant. Using a more powerful power supply will not deliver more power into the liquid. Rather, it is the resistance to the movement of the probe that determines how much power will be delivered into the sample.

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 draw maximum wattage.

This phenomenon can be demonstrated as follows: depress the probe down against a piece of wood. The greater the down 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.

OPERATING INSTRUCTIONS

CAUTION

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 OUTPUT CONTROL to be set above the microtip limit “5”. Ignoring these instructions will cause the microtip 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.

1. Ensure that the power supply is properly tuned. Tuning optimizes performance and insures maximum transfer of energy by matching the frequency of the power supply to that of the converter / probe assembly
2. If a standard probe is used, immerse the probe approximately 2 inches (5 cm) into the sample. If a microtip is used, immerse the microtip approximately ½” (1 cm) into the sample.

NOTE

The probe should be immersed to a sufficient depth to preclude air from being injected into the sample, and inhibit aerosoling and foaming.

3. Set ON/OFF/TUNE switch to ON.

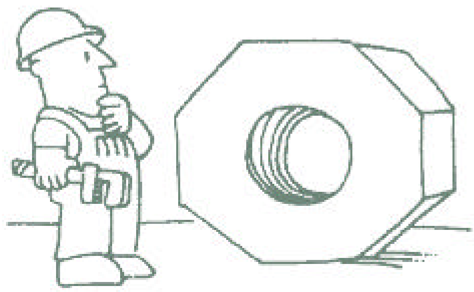
4. Set CONTINUOUS/PULSED switch, % DUTY CYCLE SELECTOR, TIMER, and OUTPUT CONTROL as desired.

IMPORTANT

Although the Ultrasonic Processor is capable of delivering maximum power to the probe, the actual power delivered, as read on the power monitor, will only be that required by the application

Full meter deflection will only take place when the Ultrasonic Processor is called upon to deliver maximum output.

SECTION III – SERVICE INFORMATION



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 due to an overload condition or that it will stop working all together. The most probable causes for malfunction are listed below and should be investigated.

The unit was plugged into an electrical outlet that provides a different voltage from that required. See *Electrical Requirements.*

The probe and/or microtip is not secured properly.

If the probe has a replaceable tip, the tip is not secured properly, or the probe has been used with low surface tension liquids.

A fuse(s) has failed. If a fuse(s) has failed, proceed as follows:

1. Ensure that the power switch is set to OFF.
2. Replace the fuse(s).
3. Set the OUTPUT CONTROL to "5" and the power switch to ON. With the probe in air (out of sample), the wattmeter should read below 20 watts. If the reading exceeds 20 watts, set the power switch to OFF, and disconnect the probe from the converter.
4. Set the power switch back to ON. If the wattmeter reads below 20 watts, the probe has failed or is out of tune due to excessive erosion, and should be replayed, if the wattmeter reads above 20 watts, either the converter or power supply has failed and the complete Ultrasonic Processor should be returned for repair.

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 the factory before returning any instrument. Include date of purchase, model number and serial number. For instruments not covered by the warranty, a purchase order should be forwarded to avoid unnecessary delay. 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.

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

IMPORTANT

I CERTIFY THAT THE ULTRASONIC PROCESSOR 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 CERTICATION CAN BE MADE.

SECTION IV - OPERATING SUGGESTIONS AND TECHNIQUES

DISRUPTING CELLS

The disruption of cells is an important stage in the isolation and preparation of intracellular products. From research levels through to production, many areas of biotechnology, particularly recombinant technology, necessitate the use of ultrasonics for cell disruption. Although some biological products are secreted from the cell or released during autolysis, many others require sonication to release intracellular material. Cell disruption focuses on obtaining the desired product from within the cell, and it is the cell wall that must be disrupted to allow cell contents extraction.

Single-cell organisms (micro-organisms) consist of a semipermeable, tough, rigid outer cell wall surrounding the protoplasmic membrane and cytoplasm. The cytoplasm is made up of nucleic acid, protein, 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 lysed and sonicated in order for these substances to be released. Breaking cell membranes and releasing the contents present significant challenges. The process must be fast and thorough to maximize the protein yield. Because the energy applied must be great enough to break the cell membranes or walls, yet gentle enough to avoid physically or chemically damaging cell contents, the Vibra-Cell with its variable intensity capability is ideally suited for this application.

The level of intensity that should be used is application dependent. For example high intensity might be recommended for the break up of cells, but should never be used when the release of intracellular components might be objectionable e.g. Organelle isolation.

The ability to control the amplitude at the probe tip is a prerequisite for process optimization. And because each application requires its own set of processing parameters, due to variation in volume and composition, the optimum amplitude can only be determined empirically. When processing a new sample, it is recommended that the amplitude be set first at 50% (30% with a microtip) and then increased of decreased as required.

Yeast, gram-positive bacteria, and to a lesser extent, gram-negative bacteria have considerably harder cell walls in comparison to animal cells, and require relatively high power for cell disruption.

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

Microorganisms 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 that plant cells, and red blood cells are more readily disintegrated than muscle cells because they lack a protective cell wall.

Cellular disruption is the first step in RNA isolation and one of the most critical steps affecting yield and quality of the isolated RNA. Typically, cell disruption needs to be fast and thorough. Slow disruption, for example placing cells or tissue in guanidinium isothiocyanate (GITC) lysis solution for a long time prior to sonication, may result in RNA degradation by endogenous RNases released internally. This is especially a concern when working with tissues high in endogenous RNase such as spleen and pancreas.

Disrupting frozen tissue is more time consuming and cumbersome that processing fresh tissue, but freezing samples is sometimes necessary. Samples are usually frozen when, 1) they are collected over a period of time and thus, cannot be processed simultaneously; 2) there are many samples, 3) samples are collected in the field, or 4) mechanical processing of fresh samples is insufficient for thorough disruption. A mortar and pestle or bag and hammer are typically used when the starting material is frozen. RNA will remain intact in tissues for a day at 37ºC, a week at 25ºC a month at 4ºC and indefinitely at subzero temperatures.

Ultrasonic processing will typically cause the temperature of the sample to increase especially with small volumes. Since high temperatures inhibit 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.

Increasing hydrostatic pressure (typically 15-60 psi) and viscosity can enhance cell disruption. For microorganisms, the addition of glass beads in the 0.5 to 1mm 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.

When processing difficult cells such as yeast, pretreatment with an enzyme is beneficial. Lysozyme, byaluronidase, glycosidase, glucalase, lyticase, zymolase and lysostaphin digestion are among the enzymatic methods frequently used with yeast and Lysozyme with bacteria. Enzymatic treatment is usually followed by sonication in a GITC lysis buffer. Collogenase may be used with collogen, lysostaphin with staphylococcus, 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.

Most animal tissues can be processed fresh (unfrozen). It is important to keep fresh tissue cold and to process it quickly (within 30 minutes) after dissection. When working with fresh tissue, the cells must be sonicated immediately at the time the GITC lysis solution is added. This can be done by dispensing the lysing solution in the tube, adding the tissue and immediately sonicating. Samples should never be left sitting in lysis solution, undisrupted. Large samples of hard tissues should be first treated in a blender or a mechanical homogenizer.

Animal tissues that have been frozen after collection should be disrupted by grinding in liquid nitrogen with a mortar and pestle. During this process, it is important that the equipment and tissue remain at cryogenic temperatures. The tissue should be dry and powdery after grinding. Grinding should be followed by thorough sonication in a GITC lysis buffer. Processing frozen tissue in this way is cumbersome and time consuming, but effective.

Cultured cells are normally easy to disrupt. Cells grown in suspension are collected by centrifugation, rinsed with PBS to remove culture medium, and then lysed by sonicating in a GITC lysis buffer. Placement of the vessel on ice while washing and lysing the cells will further protect the RNA from endogenous RNases released during the disruption process.

Soft, fresh plant tissue can often be disrupted by sonicating in a lysis buffer. Other plant tissues, like pine needles, need to be ground dry, without liquid nitrogen. Some hard, woody plant materials require freezing and grinding in liquid nitrogen prior to being ultrasonically processed. Plant cell suspension cultures and calluses can typically be sonicated in a lysis buffer within 2 minutes. The diversity of plants and plant tissue make it impossible to give a single recommendation for all. However, most plant tissues typically contain polysaccharides and polyphenols that can coprecipitate with RNA and inhibit downstream assays. Treating a plant tissue lysate with polyvinylpyrrolidone (PVP) will precipitate such problematic components from the lysate before the actual RNA isolation is carried out.

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. If sub-cellular particles are desired intact, the amplitude should be kept low, and the processing time increased.

Yeast can be extremely difficult to disrupt because their cell walls may form capsules or nearly indestructible spores. To process yeast, sonicate in a tube containing the sample, guanidinium-based lysis buffer and small glass beads (0.5 – 1 mm). Pretreatment with

zymolase, glucalase and / or lyticase to produce spheroplasts that are readily lysed may also be useful.

To disrupt filamentous fungi, scrape the mycelial mat into a cold mortar, add liquid nitrogen and grind to a fine powder with a pestle. The powder can then be thoroughly sonicated in lysis buffer to solubilize completely. As fungi may also be rich in polysaccharides, pretreatment with polyvinylpyrrolidone (PVP) may be beneficial.

Bacteria, like plants, are extremely diverse; therefore, it is difficult to make one recommendation for all bacteria. Ultrasonic processing will lyse most Gram positive and Gram negative bacteria, including mycobacteria. Although it is recommended that glass beads and lysis solution be used; it is possible to lyse some Gram negative bacteria by sonicating in lysis solution without beads. Bacteria cell walls can be digested with lysozyme to form spheroplasts. Gram positive bacteria usually require more rigorous digestion and longer processing time. The spheroplasts are then lysed with sonication in GITC lysis buffer.

Disruption of cells found in soil and sediments is accomplished one of two ways. One technique isolates the bacterial cells from the material prior to the RNA isolation procedure. This is accomplished by homogenization of wet soil in a mechanical blender followed by a slow speed centrifugation to remove fungal biomass and soil debris. The supernatant is centrifuged again at a higher speed to pellet the bacteria cells. Cells can then be lysed as described above for bacteria. Other techniques describe RNA isolation from the soil or sediment directly. For example, one method requires soil to be added to a diatomaceous earth and lysis buffer, and then sonicated. The sample is then centrifuged to remove solid debris.

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 much 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, carbon dioxide, N_2O, cysteine, reduced glutahione, dithiothreitol or other SH compounds, might be beneficial. Saturating the sample with a protective atmosphere of helium or nitrogen gas, or dropping a small pellet of dry ice in the sample, will also inhibit free radical formation. 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.

Various methods can be used to measure the efficiency of the disruption. For example, a visual count can be made using a microscope.

For greater accuracy, a protein assay could be used. This procedure is widely recognized as a good method for measuring cell disruption by taking into account the amount of protein released after disruption. The disrupted cells are then tested and checked against this number for percentage breakage.

There are several types of protein assays. One commonly used is the Folin Reaction (Lowry Assay) method, as it is comparatively simple and provides consistent results. This colorimetric method has a sensitivity to protein of around 8 μg / mL in the assay solution.

The assay turns blue in the presence of proteins due to the reaction of copper ions in the alkaline solution with protein and the reduction of phosphomolybdate- phosphotungstic acid in the Folin reagent by aromatic amino acids in the treated protein.

Fractional protein release, Rp, is calculated using the following equation and multiplying the result by 100:

$$Rp = \frac{Cf - Cb}{Ct - Cb}$$

Cf = Free protein
Ct = total protein
Cb = Background protein

This gives the actual disruption percentage, taking into account the background levels of protein before disruption.

Since the greatest concentration of energy is 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.

Allowing the probe to contact the vessel will decrease the power output, and cause minute grey glass particles to migrate into the sample. 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 20mm (3/4”) diameter stainless steel centrifuge tube cut to 70mm (3”) length. Do not use a glass tube. Microtips must never 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 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 about contamination from previous use, clean the probe with a 20% Virkon solution and rinse with distilled water. For critical application, probes may be autoclaved.

To inhibit sample loss in test tube due to sticking, siliconize the test tube as follows: Wash and dry the test tube thoroughly, coat with silicone, then air dry. "Sigmacote" manufactured by Sigma Chemical Co., 3050 Spruce Street, St. Louis, Missouri 63103, USA, phone (314) 771-5765, is ideally suited for that purpose.

High viscosity and concentration are problematic. 2,000 cps and 15% concentration by weight are maximum limits. Because with ultrasonics the sound waves are propagated through the sample, if the sample is so thick that it will not pour or circulate easily, it is too thick for ultrasonic processing.

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, whenever possible, to contain the sample in a 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 also be added to the water inside the cup horn, in order to optimize cooling. Processing samples in a Cup Horn will usually take 4 times longer than processing with the direct probe intrusion method.

USER'S GUIDE

HIGH INTENSITY ULTRASONIC PROCESSOR
Microprocessor Controlled
300-Watt Model ? 375-Watt Model
600-Watt Model
600-Watt Model Dual Output

TABLE OF CONTENTS

The Ultrasonic Processor supplied with this instruction manual is constructed of the finest material and the workmanship meets the highest 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.

Rev. 2003

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.

When mounting the probe, always clamp the converter housing. Never clamp the probe.

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. Refer all servicing to qualified service personnel.

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 nodal point (point of no activity).

Never touch a vibrating probe.

When using a microtip, never allow the OUTPUT CONTROL setting to exceed MICROTIP LIMIT “5”.

Never operate a probe with threaded end without a tip, extender or microtip.

It is recommended that ear protection be used when operating the Ultrasonic Processor.

WARNING or CAUTION

Where you see this alert symbol and WARNING or CAUTION heading, strictly follow the warning instructions to avoid personal injury or equipment failure.

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

SECTION 1 – INSTALLATION

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 phrase 3-terminal grounding type electrical outlet capable of supplying 50/60 Hz at 100 volts, 115 volts, 220 volts, or 240 volts, depending on the voltage option selected. 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.

SECTION II – OPERATION

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. This phenomenon, referred to as cavitation, creates millions of shock waves in the liquid, as well as elevated pressures and temperatures at the implosion sites. Although the cavitational collapse last but a few microseconds, and the amount of energy released by each individual bubble is minute, the cumulative effect causes extremely high levels of energy to be released into the liquid. The larger the probe tip, the larger the volume that can be processed but at a lesser intensity. For information regarding the processing capability of each probe, consult the tables below.

	TAPERED MICROTIPS			STEPPED MICROTIP
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	3-15 ml	5-25 ml	250ul-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	50-1000 ml

HIGH GAIN PROBES		
TIP DIAMETER	3/4" (19 mm)	1" (25 mm)
INTENSITY	high	medium
VOLUME (batch)	25-500 ml	50-1000 ml

FUNCTIONS OF KEYS, CONTROLS, INDICATIONS, AND CONNECTORS

FRONT PANEL	
POWER MONITOR (METER)	Indicates the percentage of maximum available ultrasonic power delivered to the probe. 300 watt unit: 100% = 300 watts, 50% = 150 watts. 375 watt unit: 100% = 375 watts, 50% = 187.5 watts. 600 watt unit*: 100% = 600 watts, 50% = 300 watts. * When using two probes with the dual output unit, the power delivered to each probe is half that displayed on the power monitor.
POWER SWITCH	ON position – energizes the power supply. OFF position – de-energizes the power supply. Illuminates when the power supply is energized.
TUNE SWITCH	When depressed, allows the power supply to be tuned.
TIMER	Sets the duration of ultrasonic application from .1 second to 999 hours. The right hand push button selects the timing option as follows: .S=tenth of seconds, S=seconds, .M=tenth of minutes, M= minutes .H=tenth of hours, H=hours. The other three push buttons select the timing increments
START BUTTON	When depressed, energizes the ultrasonic.
RESET BUTTON	When depressed, de-energizes the ultrasonic and resets the timer.
TUNER	Optimizes performance by matching the frequency of the power supply to that of the converter / probe assembly.
FOOTSWITCH CONNECTOR	Connects to footswitch cable.
PULSER	Applies the ultrasonic energy on a pulsed mode. In the OFF position the ultrasonic is continuous. In the ON position the ultrasonics is intermittent. The % DUTY CYCLE SELECTOR sets the pulse rate. Intermittent operation inhibits heat build-up in the liquid and provides more efficient processing by allowing the material to settle back under the probe tip after each burst.
OUTPUT CONTROL	Controls the amplitude of vibration at the probe tip. CAUTION *When using a microtip, never allow the OUTPUT CONTROL setting to exceed MICROTIP LIMIT "5".*

REAR PANEL	
3 PIN CONNECTOR (3)	Connects to the converter cable(s).
FUSE(S)	Protects against electrical overload
ELECTRICAL LINE CORD	Connects the power supply to the electrical outlet.

PREPARATION FOR USE

CAUTION

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

1. Ensure that the 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, check for cleanliness the mating surface of the converter and probe or stepped microtip (consisting of coupler and stepped tip), and using the wrenches provided, screw them securely to the converter.
5. To attach a tapered microtip or extender to a probe, remove the replaceable tip from the ½” (13mm) probe, and using the wrenches provided, screw them securely to the probe.

CAUTION

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.

6. Mount the converter / probe assembly in a laboratory stand. Secure the clamp to the 2½” (63mm) diameter converter housing only. Do not secure the clamp to the probe.
7. Connect the converter cable to the power supply.

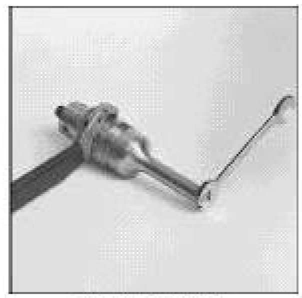
NOTE

Should it become necessary to remove a probe, use the wrenches supplied. If the probe has been attached to the converter for a long period of 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 wrench, twist the converter off the probe. A tap of a hammer may be applied to the end of the wrench. Never attempt to remove the probe by twisting the converter housing, as this may damage the electrical connections within the housing.

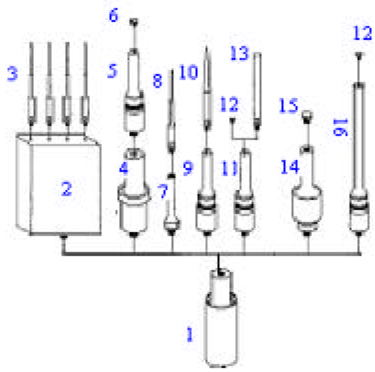
REMOVAL

TIGHTENING

TIP REMOVAL



TIP TIGHTENING



No	DESCRIPTION	Order Number
1	Converter Model CV17	CV00017
2	Four element coupler	630-0425
3	Stepped microtip 1/8" (3mm)	630-0422
4	Booster	BHNVCGD
5	Probe ½" (13mm) solid	630-0219
	Probe ½" (13mm) with threaded end and replaceable tip	630-0220
	Probe ¾" (19mm) solid	630-0208
	Probe ¾" (19mm) with threaded end and replaceable tip	630-0207
	Probe 1" (25mm) solid	630-0209
	Probe 1" (25mm) with threaded end and replaceable tip	630-0210
6	Replaceable tip ½" (13mm)	630-0406
	Replaceable tip ¾" (19mm)	630-0407
	Replaceable tip 1" (25mm)	630-0408
7	Coupler	630-0421
8	Stepped tip 1/8" (3mm)	630-0422
9	Same as 5	
10	Tapered microtip $^{1}/_{8}$" (3mm)	630-0418
	Tapered microtip $^{3}/_{16}$" (5mm)	630-0419
	Tapered microtip ¼" (6mm)	630-0420
11	Same as 5	
12	Same as 6	
13	Extender ½" (13mm)	630-0410
	Extender ¾" (19mm)	630-0409
	Extender 1" (25mm)	630-0444
14	High gain probe ¾" (19mm) – solid	630-0306
	High gain probe 1" (25mm) – solid	630-0310
15	Same as 6	
16	Full wave ½" (13mm)- 10" (254 mm) long probe w/ replaceable tip	630-0218

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

TUNING

Tuning optimizes performance and insures maximum transfer of energy by matching the frequency of the power supply to that of converter/probe assembly. The power supply should be tuned 1) every time a new probe or accessory is used, 2) on occasions to compensate for the frequency variation caused by cavitation erosion 3) following 10 minutes of continuous operation and 4) when the sample temperature is significantly higher or lower than room temperature.

The piezoelectric crystal within the converter is part of the circuitry, which controls the frequency at 20kHz. Any changes in t the crystal's capacitance resulting from a variation in temperature, will cause the equipment to operate in an out-of-tune condition. For reliable performance, and equipment protection, it is important that the unit be tuned after the probe temperature has had a chance to stabilize. When relocating the ultrasonic processor from a very cold or very hot environment, allow 30 minutes for the unit temperature to stabilize before operating. Continuous operation causes temperature elevation in the sample. This increase in temperature is transmitted through the probe to the crystal assembly. Always tune the power supply after the probe has reached operating temperature. When working with low or high temperature samples, immerse the probe in the sample for a few minutes, withdraw the probe from the sample, then tune the power supply.

> IMPORTANT
> Tuning must be performed in air with the probe out of the sample. While tuning, do not allow the probe to contact anything.

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 PULSER to OFF.

3. SET output control to "10" (to "5" when using a microtip of extender).

> CAUTION
> When using a microtip, never allow the tip to vibrate in air for more than 10 seconds and do not set the OUTPUT CONTROL above "5". Ignoring these instructions will cause the microtip to fracture.

4. Set POWER SWITCH to ON. The switch will illuminate.
5. **Momentarily** depress TUNE SWITCH and rotate the tuner clockwise or counterclockwise until a **minimum** (not maximum) reading (usually less than 20) is obtained on the POWER MONITOR. If a minimum reading (sometimes referred to as null) cannot be obtained, the probe, cup horn, tip, microtip, or accessory is loose or out of resonance, or the power supply or converter require servicing. A loose probe will usually generate a loud piercing sound.

> NOTE
>
> If minimum reading cannot be obtained, check unit without the probe to ascertain whether the power supply or probe is at fault.

6. Set OUTPUT CONTROL to “4”.

7. Set POWER SWITCH to OFF.

8. With a dual output 600 watt Ultrasonic Processor, if two converters are going to be used simultaneously, connect the second converter cable to the top connector.

USING THE ULTRASONIC PROCESSOR

The speed control on an automobile, can, to a certain extent, be compared to an Ultrasonic Processor. The speed control is designed to maintain the vehicles 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 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.

The Ultrasonic Processor is designed to deliver constant amplitude. As the resistance to the movement of the probe increases, additional power will be delivered by the power supply to ensure that the excursion at the probe tip remains constant. Using a more powerful power supply will not deliver more power into the liquid. Rather, it is the resistance to the movement of the probe that determines how much power will be delivered into the sample.

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 draw maximum wattage.

This phenomenon can be demonstrated as follows: depress the probe down against a piece of wood. The greater the down 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.

CAUTION

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 “5”. Ignoring these instructions will cause the microtip 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.

OPERATING INSTRUCTIONS

1. Ensure that the power supply is properly tuned. Tuning optimizes performance and insures maximum transfer of energy by matching the frequency of the power supply to that of the converter / probe assembly
2. If a standard probe is used, immerse the probe approximately 2 inches (5 cm) into the sample. If a microtip is used, immerse the microtip approximately ½” (1 cm) into the sample.

NOTE

The probe should be immersed to a sufficient depth to preclude air from being injected into the sample, and inhibit aerosoling and foaming.

3. Set TIMER as required. If the footswitch is used, set TIMER to 999 hours. Depressing the footswitch will not energize the power supply, unless the TIMER is activated.

4. Set PULSER as required. If the pulsing mode is not required, set PULSER to OFF.

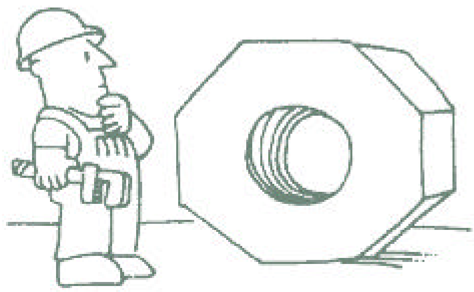
5. Set POWER SWITCH to ON. The switch will illuminate.

6. Activate the timer by depressing the START button.

7. If the footswitch is used, depress footswitch.

8. Using the OUTPUT CONTROL increase or decrease the intensity as required

SECTION IV – SERVICE INFORMATION



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 due to an overload condition or that it will stop working all together. The most probable causes for malfunction are listed below and should be investigated.

The unit was plugged into an electrical outlet that provides a different voltage from that required. See *Electrical Requirements.*

The probe and/or microtip is not secured properly.

If the probe has a replaceable tip, the tip is not secured properly, or the probe has been used with low surface tension liquids.

A fuse(s) has failed. If a fuse(s) has failed, proceed as follows:

1. Ensure that the power switch is set to OFF.
2. Replace the fuse(s).
3. Set the OUTPUT CONTROL to “10” and the power switch to ON. With the probe in air (out of sample), the wattmeter should read below 20 watts. If the reading exceeds 20 watts, set the power switch to OFF, and disconnect the probe from the converter.
4. Set the power switch back to ON. If the wattmeter reads below 20 watts, the probe has failed or is out of tune due to excessive erosion, and should be replayed, if the wattmeter reads above 20 watts, either the converter or power supply has failed and the complete Ultrasonic Processor should be returned for repair.
5. If the Ultrasonic Processor stops working investigate and remedy the problem.

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 the factory before returning any instrument. Include date of purchase, model number and serial number. For instruments not covered by the warranty, a purchase order should be forwarded to avoid unnecessary delay. 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.

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

IMPORTANT

I CERTIFY THAT THE ULTRASONIC PROCESSOR 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 CERTICATION CAN BE MADE.

SECTION V - OPERATING SUGGESTIONS AND TECHNIQUES

DISRUPTING CELLS

The disruption of cells is an important stage in the isolation and preparation of intracellular products. From research levels through to production, many areas of biotechnology, particularly recombinant technology, necessitate the use of ultrasonics for cell disruption. Although some biological products are secreted from the cell or released during autolysis, many others require sonication to release intracellular material. Cell disruption focuses on obtaining the desired product from within the cell, and it is the cell wall that must be disrupted to allow cell contents extraction.

Single-cell organisms (micro-organisms) consist of a semipermeable, tough, rigid outer cell wall surrounding the protoplasmic membrane and cytoplasm. The cytoplasm is made up of nucleic acid, protein, 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 lysed and sonicated in order for these substances to be released. Breaking cell membranes and releasing the contents present significant challenges. The process must be fast and thorough to maximize the protein yield. Because the energy applied must be great enough to break the cell membranes or walls, yet gentle enough to avoid physically or chemically damaging cell contents, the Vibra-Cell with its variable intensity capability is ideally suited for this application.

The level of intensity that should be used is application dependent. For example high intensity might be recommended for the break up of cells, but should never be used when the release of intracellular components might be objectionable e.g. Organelle isolation.

The ability to control the amplitude at the probe tip is a prerequisite for process optimization. And because each application requires its own set of processing parameters, due to variation in volume and composition, the optimum amplitude can only be determined empirically. When processing a new sample, it is recommended that the amplitude be set first at 50% (30% with a microtip) and then increased of decreased as required.

Yeast, gram-positive bacteria, and to a lesser extent, gram-negative bacteria have considerably harder cell walls in comparison to animal cells, and require relatively high power for cell disruption.

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

Microorganisms 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 that plant cells, and red blood cells are more readily disintegrated than muscle cells because they lack a protective cell wall.

Cellular disruption is the first step in RNA isolation and one of the most critical steps affecting yield and quality of the isolated RNA. Typically, cell disruption needs to be fast and thorough. Slow disruption, for example placing cells or tissue in guanidinium isothiocyanate (GITC) lysis solution for a long time prior to sonication, may result in RNA degradation by endogenous RNases released internally. This is especially a concern when working with tissues high in endogenous RNase such as spleen and pancreas.

Disrupting frozen tissue is more time consuming and cumbersome that processing fresh tissue, but freezing samples is sometimes necessary. Samples are usually frozen when, 1) they are collected over a period of time and thus, cannot be processed simultaneously; 2) there are many samples, 3) samples are collected in the field, or 4) mechanical processing of fresh samples is insufficient for thorough disruption. A mortar and pestle or bag and hammer are typically used when the starting material is frozen. RNA will remain intact in tissues for a day at 37ºC, a week at 25ºC a month at 4ºC and indefinitely at subzero temperatures.

Ultrasonic processing will typically cause the temperature of the sample to increase especially with small volumes. Since high temperatures inhibit 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.

Increasing hydrostatic pressure (typically 15-60 psi) and viscosity can enhance cell disruption. For microorganisms, the addition of glass beads in the 0.5 to 1mm 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.

When processing difficult cells such as yeast, pretreatment with an enzyme is beneficial. Lysozyme, byaluronidase, glycosidase, glucalase, lyticase, zymolase and lysostaphin digestion are among the enzymatic methods frequently used with yeast and Lysozyme with bacteria. Enzymatic treatment is usually followed by sonication in a GITC lysis buffer. Collogenase may be used with collogen, lysostaphin with staphylococcus, 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.

Most animal tissues can be processed fresh (unfrozen). It is important to keep fresh tissue cold and to process it quickly (within 30 minutes) after dissection. When working with fresh tissue, the cells must be sonicated immediately at the time the GITC lysis solution is added. This can be done by dispensing the lysing solution in the tube, adding the tissue and immediately sonicating. Samples should never be left sitting in lysis solution, undisrupted. Large samples of hard tissues should be first treated in a blender or a mechanical homogenizer.

Animal tissues that have been frozen after collection should be disrupted by grinding in liquid nitrogen with a mortar and pestle. During this process, it is important that the equipment and tissue remain at cryogenic temperatures. The tissue should be dry and powdery after grinding. Grinding should be followed by thorough sonication in a GITC lysis buffer. Processing frozen tissue in this way is cumbersome and time consuming, but effective.

Cultured cells are normally easy to disrupt. Cells grown in suspension are collected by centrifugation, rinsed with PBS to remove culture medium, and then lysed by sonicating in a GITC lysis buffer. Placement of the vessel on ice while washing and lysing the cells will further protect the RNA from endogenous RNases released during the disruption process.

Soft, fresh plant tissue can often be disrupted by sonicating in a lysis buffer. Other plant tissues, like pine needles, need to be ground dry, without liquid nitrogen. Some hard, woody plant materials require freezing and grinding in liquid nitrogen prior to being ultrasonically processed. Plant cell suspension cultures and calluses can typically be sonicated in a lysis buffer within 2 minutes. The diversity of plants and plant tissue make it impossible to give a single recommendation for all. However, most plant tissues typically contain polysaccharides and polyphenols that can coprecipitate with RNA and inhibit downstream assays. Treating a plant tissue lysate with polyvinylpyrrolidone (PVP) will precipitate such problematic components from the lysate before the actual RNA isolation is carried out.

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. If sub-cellular particles are desired intact, the amplitude should be kept low, and the processing time increased.

Yeast can be extremely difficult to disrupt because their cell walls may form capsules or nearly indestructible spores. To process yeast, sonicate in a tube containing the sample, guanidinium-based lysis buffer and small glass beads (0.5 – 1 mm). Pretreatment with

zymolase, glucalase and / or lyticase to produce spheroplasts that are readily lysed may also be useful.

To disrupt filamentous fungi, scrape the mycelial mat into a cold mortar, add liquid nitrogen and grind to a fine powder with a pestle. The powder can then be thoroughly sonicated in lysis buffer to solubilize completely. As fungi may also be rich in polysaccharides, pretreatment with polyvinylpyrrolidone (PVP) may be beneficial.

Bacteria, like plants, are extremely diverse; therefore, it is difficult to make one recommendation for all bacteria. Ultrasonic processing will lyse most Gram positive and Gram negative bacteria, including mycobacteria. Although it is recommended that glass beads and lysis solution be used; it is possible to lyse some Gram negative bacteria by sonicating in lysis solution without beads. Bacteria cell walls can be digested with lysozyme to form spheroplasts. Gram positive bacteria usually require more rigorous digestion and longer processing time. The spheroplasts are then lysed with sonication in GITC lysis buffer.

Disruption of cells found in soil and sediments is accomplished one of two ways. One technique isolates the bacterial cells from the material prior to the RNA isolation procedure. This is accomplished by homogenization of wet soil in a mechanical blender followed by a slow speed centrifugation to remove fungal biomass and soil debris. The supernatant is centrifuged again at a higher speed to pellet the bacteria cells. Cells can then be lysed as described above for bacteria. Other techniques describe RNA isolation from the soil or sediment directly. For example, one method requires soil to be added to a diatomaceous earth and lysis buffer, and then sonicated. The sample is then centrifuged to remove solid debris.

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 much 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, carbon dioxide, N_2O, cysteine, reduced glutahione, dithiothreitol or other SH compounds, might be beneficial. Saturating the sample with a protective atmosphere of helium or nitrogen gas, or dropping a small pellet of dry ice in the sample, will also inhibit free radical formation. 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.

Various methods can be used to measure the efficiency of the disruption. For example, a visual count can be made using a microscope.
For greater accuracy, a protein assay could be used. This procedure is widely recognized as a good method for measuring cell disruption by taking into account the amount of protein released after disruption. The disrupted cells are then tested and checked against this number for percentage breakage.
There are several types of protein assays. One commonly used is the Folin Reaction (Lowry Assay) method, as it is comparatively simple and provides consistent results. This colorimetric method has a sensitivity to protein of around 8 μg / mL in the assay solution.
The assay turns blue in the presence of proteins due to the reaction of copper ions in the alkaline solution with protein and the reduction of phosphomolybdate- phosphotungstic acid in the Folin reagent by aromatic amino acids in the treated protein.
Fractional protein release, Rp, is calculated using the following equation and multiplying the result by 100:

$$\mathbf{Rp = \frac{Cf - Cb}{Ct - Cb}}$$

Cf = Free protein
Ct = total protein
Cb = Background protein

This gives the actual disruption percentage, taking into account the background levels of protein before disruption.

Since the greatest concentration of energy is 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.

Allowing the probe to contact the vessel will decrease the power output, and cause minute grey glass particles to migrate into the sample. 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 20mm (3/4”) diameter stainless steel centrifuge tube cut to 70mm (3”) length. Do not use a glass tube. Microtips must never 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 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 about contamination from previous use, clean the probe with a 20% Virkon solution and rinse with distilled water. For critical application, probes may be autoclaved.

To inhibit sample loss in test tube due to sticking, siliconize the test tube as follows: Wash and dry the test tube thoroughly, coat with silicone, then air dry. "Sigmacote" manufactured by Sigma Chemical Co., 3050 Spruce Street, St. Louis, Missouri 63103, USA, phone (314) 771-5765, is ideally suited for that purpose.

High viscosity and concentration are problematic. 2,000 cps and 15% concentration by weight are maximum limits. Because with ultrasonics the sound waves are propagated through the sample, if the sample is so thick that it will not pour or circulate easily, it is too thick for ultrasonic processing.

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, whenever possible, to contain the sample in a 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 also be added to the water inside the cup horn, in order to optimize cooling. Processing samples in a Cup Horn will usually take 4 times longer than processing with the direct probe intrusion method.

USER’S GUIDE

HIGH INTENSITY ULTRASONIC PROCESSOR
Microprocessor Controlled
500 Watts – Model 501
600 Watt – Dual Output – Model 602

TABLE OF CONTENTS

The Ultrasonic Processor supplied with this instruction manual is constructed of the finest material and the workmanship meets the highest 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.

Rev. 2003

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.

When mounting the probe, always clamp the converter housing. Never clamp the probe.

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. Refer all servicing to qualified service personnel.

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 nodal point (point of no activity).

Never touch a vibrating probe.

When using a microtip, never allow the AMPLITUDE control setting to exceed MICROTIP LIMIT "40".

Never operate a probe with threaded end without a tip, extender or microtip.

It is recommended that ear protection be used when operating the Ultrasonic Processor.

WARNING or CAUTION

Where you see this alert symbol and WARNING or CAUTION heading, strictly follow the warning instructions to avoid personal injury or equipment failure.

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

SECTION 1 – INSTALLATION

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 phrase 3-terminal grounding type electrical outlet capable of supplying 50/60 Hz at 100 volts, 115 volts, 220 volts, or 240 volts, depending on the voltage option selected. 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.

SECTION II – OPERATION

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. This phenomenon, referred to as cavitation, creates millions of shock waves in the liquid, as well as elevated pressures and temperatures at the implosion sites. Although the cavitational collapse last but a few microseconds, and the amount of energy released by each individual bubble is minute, the cumulative effect causes extremely high levels of energy to be released into the liquid. The larger the probe tip, the larger the volume that can be processed but at a lesser intensity. For information regarding the processing capability of each probe, consult the tables below.

	TAPERED MICROTIPS			STEPPED MICROTIP
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	3-15 ml	5-25 ml	250ul-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	50-1000 ml

	HIGH GAIN PROBES	
TIP DIAMETER	3/4" (19 mm)	1" (25 mm)
INTENSITY	high	medium
VOLUME (batch)	25-500 ml	50-1000 ml

FUNCTIONS OF KEYS, CONTROLS, INDICATIONS, AND CONNECTORS

FRONT PANEL	
TIMER	Sets the duration of ultrasonic application from .1 second to 999 hours. The right hand push button selects the timing option as follows: .S=tenth of seconds, S=seconds, .M=tenth of minutes, M= minutes .H=tenth of hours, H=hours. The other three push buttons select the timing increments
START BUTTON	When depressed, energizes the ultrasonic.
RESET BUTTON	When depressed, de-energizes the ultrasonic and resets the timer.
POWER MONITOR (METER)	Indicates the percentage of maximum available ultrasonic power delivered to the probe. 500 watt unit: 100% = 500 watts, 50% = 250 watts. 600 watt unit*: 100% = 600 watts, 50% = 300 watts. * When using two probes with the dual output unit, the power delivered to each probe is half that displayed on the power monitor.
PULSER	Applies the ultrasonic energy on a pulsed mode. Pulse duration can be varied from 1 second OFF / .5 second ON, to 1 second OFF / 6 seconds ON. OFF cycle is always 1 second. ON cycle is variable from .5 seconds to 6 seconds. In the OFF position the ultrasonic is continuous. In the ON position the ultrasonics is intermittent. Intermittent operation inhibits heat build-up in the sample and provides more efficient processing by allowing the material to settle back under the probe tip after each burst.
AMPLITUDE control	Controls the amplitude of vibration at the probe tip. CAUTION *When using a microtip, never allow the AMPLITUDE control setting to exceed MICROTIP LIMIT.*
ON / OFF power switch (located below the control panel)	Switches the main power on or off.
TUNER	Optimizes performance by matching the frequency of the power supply to that of the converter / probe assembly.
TUNE SWITCH	When depressed, activates the ultrasonics for tuning purposes. Tuning must be performed in air with probe out of the sample. The power supply should be tuned every time a new converter or probe is used, and following 10 minutes of continuous operation.

REAR PANEL	
CONVERTER Connector(s)	Connects to the converter cable(s).
Jack	Connects to footswitch cable.
Power Connector	Connects the power supply to the electrical outlet.

PREPARATION FOR USE

CAUTION

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

1. Ensure that the 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, check for cleanliness the mating surface of the converter and probe or stepped microtip (consisting of coupler and stepped tip), and using the wrenches provided, screw them securely to the converter.
5. To attach a tapered microtip or extender to a probe, remove the replaceable tip from the ½" (13mm) probe, and using the wrenches provided, screw them securely to the probe.

CAUTION

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.

6. Mount the converter / probe assembly in a laboratory stand. Secure the clamp to the 2½" (63mm) diameter converter housing only. Do not secure the clamp to the probe.
7. Connect the converter cable to the left converter connector. With a dual output 600 watt Ultrasonic Processor, if two converters are going to be used simultaneously, do not connect the second converter at this time.

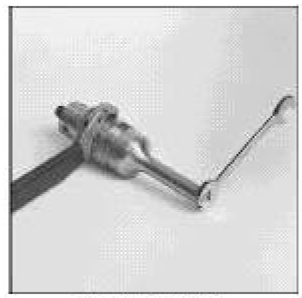
NOTE

Should it become necessary to remove a probe, use the wrenches supplied. If the probe has been attached to the converter for a long period of 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 wrench, twist the converter off the probe. A tap of a hammer may be applied to the end of the wrench. Never attempt to remove the probe by twisting the converter housing, as this may damage the electrical connections within the housing.

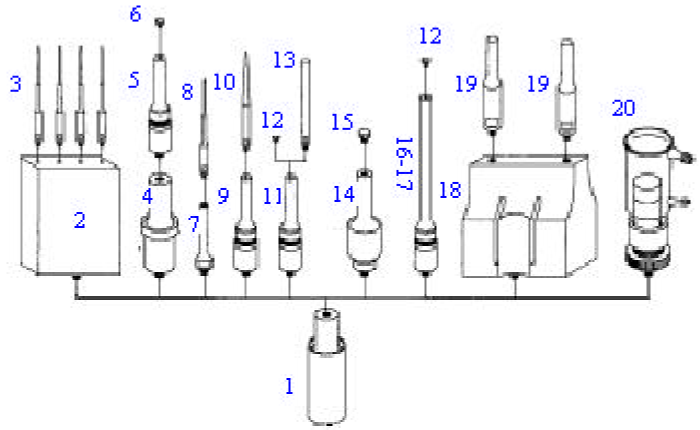
REMOVAL

TIGHTENING

TIP REMOVAL



TIP TIGHTENING



No	DESCRIPTION	Order Number
1	Converter Model CV26	CV00026
2	Four element coupler	630-0558
3	Stepped t ip(s) 1/8" (3mm)	630-0535
4	Booster	BHNVCGD
5	Probe ½" (13mm) solid	630-0219
	Probe ½" (13mm) with threaded end and replaceable tip	630-0220
	Probe ¾" (19mm) solid	630-0208
	Probe ¾" (19mm) with threaded end and replaceable tip	630-0207
	Probe 1" (25mm) solid	630-0209
	Probe 1" (25mm) with threaded end and replaceable tip	630-0210
6	Replaceable tip ½" (13mm)	630-0406
	Replaceable tip ¾" (19mm)	630-0407
	Replaceable tip 1" (25mm)	630-0408
7	Coupler	630-0421
8	Stepped tip 1/8" (3mm)	630-0422
9	Probe ½" (13mm) with threaded end and replaceable tip	630-0220
10	Tapered microtip 1/8" (3mm)	630-0418
	Tapered microtip 3/16" (5mm)	630-0419
	Tapered microtip ¼" (6mm)	630-0420
11	Probe – solid or with threaded end and replaceable tip – same as 5	
12	Replaceable tip – same as 6	
13	Extender ½" (13mm)	630-0410
	Extender ¾" (19mm)	630-0409
	Extender 1" (25mm)	630-0444
	Full wave extender ¾" (19mm) – 10" (254mm) long	630-0518
	Full wave extender 1" (25mm) – 10" (254mm) long	630-0519
14	High gain probe ¾" (19mm) – solid	630-0306
	High gain probe ¾" (19mm) with threaded and replaceable tip	630-0305
	High gain probe 1" (25mm) – solid	630-0310
	High gain probe 1" (25mm) with threaded and replaceable tip	630-0311
15	Replaceable tip ¾" (19mm) or 1" (25mm) – same as 6	
16	Full wave probe ½" (13mm) solid – 10" (254mm) long	630-0217
17	Full wave probe ½" (13mm) – 10" (254mm) long with threaded and replaceable tip	630-0218
18	Aluminum coupler	630-0562
19	¾" (19mm) solid probe	630-0208
20	Cup horn 1 ½" (38mm)	630-0503
	Cup horn 2 ½" (64mm)	630-0431
	Cup horn 3" (76mm)	630-0496

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

TUNING

Tuning optimizes performance and insures maximum transfer of energy by matching the frequency of the power supply to that of converter/probe assembly. The power supply should be tuned 1) every time a new probe or accessory is used, 2) on occasions to compensate for the frequency variation caused by cavitation erosion 3) following 10 minutes of continuous operation and 4) when the sample temperature is significantly higher or lower than room temperature.

The piezoelectric crystal within the converter is part of the circuitry, which controls the frequency at 20kHz. Any changes in the crystal's capacitance resulting from a variation in temperature, will cause the equipment to operate in an out-of-tune condition. For reliable performance, and equipment protection, it is important that the unit be tuned after the probe temperature has had a chance to stabilize. When relocating the ultrasonic processor from a very cold or very hot environment, allow 30 minutes for the unit temperature to stabilize before operating. Continuous operation causes temperature elevation in the sample. This increase in temperature is transmitted through the probe to the crystal assembly. Always tune the power supply after the probe has reached operating temperature. When working with low or high temperature samples, immerse the probe in the sample for a few minutes, withdraw the probe from the sample, then tune the power supply.

> IMPORTANT
>
> Tuning must be performed in air with the probe out of the sample. While tuning, do not allow the probe to contact anything.

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 PULSER to OFF.

3. SET AMPLITUDE control to "100" (to "40" when using a microtip).

> CAUTION
>
> When using a microtip, never allow the tip to vibrate in air for more than 10 seconds and do not set the AMPLITUDE control above "40". Ignoring these instructions will cause the microtip to fracture.

4. Set POWER SWITCH to ON. The switch will illuminate.

5. **Momentarily** depress TUNE SWITCH and rotate the tuner clockwise or counterclockwise until a **minimum** (not maximum) reading (usually less than 20) is obtained on the POWER MONITOR. If a minimum reading (sometimes referred to as null) cannot be obtained, the probe, cup horn, tip, microtip, or accessory is loose or out of resonance, or the power supply or converter require servicing. A loose probe will usually generate a loud piercing sound.

NOTE

1. The probe is tuned to vibrate at a specific frequency – 20 kHz +/- 50 Hz. If the resonant frequency of the probe has changed, due to cavitation erosion or fracturing, minimum reading will not be obtained. If minimum reading cannot be obtained, check the instrument without the probe to determine which component might be defective. If proper tuning is obtained using the converter without the probe, the probe is defective and should be changed.
2. A loose probe will usually generate a loud piercing sound.
3. Since the amplitude required is application dependent, and subject to the volume and composition of the sample, it is recommended that the amplitude be first set at mid-range, then empirically determined and optimized while the sample is being processed.

6. Set AMPLITUDE control to “20” when working with a microtip, and to “50” when working with any other probe or accessory.
7. With a dual output 600 watt Ultrasonic Processor, if two converters are going to be used simultaneously, connect the second converter cable to the top connector.

USING THE ULTRASONIC PROCESSOR

The speed control on an automobile, can, to a certain extent, be compared to an Ultrasonic Processor. The speed control is designed to maintain the vehicles 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 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.

The Ultrasonic Processor is designed to deliver constant amplitude. As the resistance to the movement of the probe increases, additional power will be delivered by the power supply to ensure that the excursion at the probe tip remains constant. Using a more powerful power supply will not deliver more power into the liquid. Rather, it is the resistance to the movement of the probe that determines how much power will be delivered into the sample.

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 draw maximum wattage.

This phenomenon can be demonstrated as follows: depress the probe down against a piece of wood. The greater the down 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.

CAUTION

Never allow liquid to spill into the converter. Do not use the cup horn without a splash shield
Do not allow a mic rotip 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 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.

OPERATING INSTRUCTIONS

1. Ensure that the power supply is properly tuned. Tuning optimizes performance and insures maximum transfer of energy by matching the frequency of the power supply to that of the converter / probe assembly
2. If a standard probe is used, immerse the probe approximately 2 inches (5 cm) into the sample. If a microtip is used, immerse the microtip approximately ½” (1 cm) into the sample.

NOTE

The probe should be immersed to a sufficient depth to preclude air from being injected into the sample, and inhibit aerosoling and foaming.

3. Set TIMER as required. If the footswitch is used, set TIMER to 999 hours. Depressing the footswitch will not energize the power supply, unless the TIMER is activated.

4. Set PULSER as required. If the pulsing mode is not required, set PULSER to OFF.

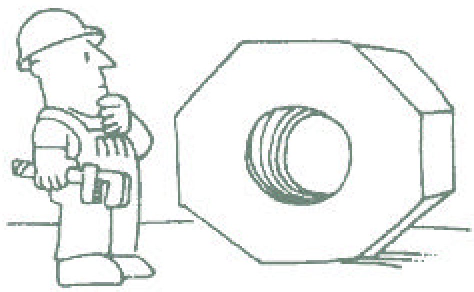
5. Set POWER SWITCH to ON. The switch will illuminate.

6. Activate the timer by depressing the START button.

7. If the footswitch is used, depress footswitch.

8. Using the AMPLITUDE control increase or decrease the intensity as required

SECTION IV – SERVICE INFORMATION



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 due to an overload condition or that it will stop working all together. The most probable causes for malfunction are listed below and should be investigated.

The unit was plugged into an electrical outlet that provides a different voltage from that required. See *Electrical Requirements.*

The probe and/or microtip is not secured properly.

If the probe has a replaceable tip, the tip is not secured properly, or the probe has been used with low surface tension liquids.

A fuse(s) has failed. If a fuse(s) has failed, proceed as follows:

1. Ensure that the power switch is set to OFF.
2. Replace the fuse(s).
3. Set the AMPLITUDE control to "10" and the power switch to ON. With the probe in air (out of sample), the wattmeter should read below 20 watts. If the reading exceeds 20 watts, set the power switch to OFF, and disconnect the probe from the converter.
4. Set the power switch back to ON. If the wattmeter reads below 20 watts, the probe has failed or is out of tune due to excessive erosion, and should be replayed, if the wattmeter reads above 20 watts, either the converter or power supply has failed and the complete Ultrasonic Processor should be returned for repair.
5. If the Ultrasonic Processor stops working investigate and remedy the problem.

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 the factory before returning any instrument. Include date of purchase, model number and serial number. For instruments not covered by the warranty, a purchase order should be forwarded to avoid unnecessary delay. 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.

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

IMPORTANT

I CERTIFY THAT THE ULTRASONIC PROCESSOR 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 CERTICATION CAN BE MADE.

SECTION V - OPERATING SUGGESTIONS AND TECHNIQUES

DISRUPTING CELLS

The disruption of cells is an important stage in the isolation and preparation of intracellular products. From research levels through to production, many areas of biotechnology, particularly recombinant technology, necessitate the use of ultrasonics for cell disruption. Although some biological products are secreted from the cell or released during autolysis, many others require sonication to release intracellular material. Cell disruption focuses on obtaining the desired product from within the cell, and it is the cell wall that must be disrupted to allow cell contents extraction.

Single-cell organisms (micro-organisms) consist of a semipermeable, tough, rigid outer cell wall surrounding the protoplasmic membrane and cytoplasm. The cytoplasm is made up of nucleic acid, protein, 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 lysed and sonicated in order for these substances to be released. Breaking cell membranes and releasing the contents present significant challenges. The process must be fast and thorough to maximize the protein yield. Because the energy applied must be great enough to break the cell membranes or walls, yet gentle enough to avoid physically or chemically damaging cell contents, the Vibra-Cell with its variable intensity capability is ideally suited for this application.

The level of intensity that should be used is application dependent. For example high intensity might be recommended for the break up of cells, but should never be used when the release of intracellular components might be objectionable e.g. Organelle isolation.

The ability to control the amplitude at the probe tip is a prerequisite for process optimization. And because each application requires its own set of processing parameters, due to variation in volume and composition, the optimum amplitude can only be determined empirically. When processing a new sample, it is recommended that the amplitude be set first at 50% (30% with a microtip) and then increased of decreased as required.

Yeast, gram-positive bacteria, and to a lesser extent, gram-negative bacteria have considerably harder cell walls in comparison to animal cells, and require relatively high power for cell disruption.

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

Microorganisms 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 that plant cells, and red blood cells are more readily disintegrated than muscle cells because they lack a protective cell wall.

Cellular disruption is the first step in RNA isolation and one of the most critical steps affecting yield and quality of the isolated RNA. Typically, cell disruption needs to be fast and thorough. Slow disruption, for example placing cells or tissue in guanidinium isothiocyanate (GITC) lysis solution for a long time prior to sonication, may result in RNA degradation by endogenous RNases released internally. This is especially a concern when working with tissues high in endogenous RNase such as spleen and pancreas.

Disrupting frozen tissue is more time consuming and cumbersome that processing fresh tissue, but freezing samples is sometimes necessary. Samples are usually frozen when, 1) they are collected over a period of time and thus, cannot be processed simultaneously; 2) there are many samples, 3) samples are collected in the field, or 4) mechanical processing of fresh samples is insufficient for thorough disruption. A mortar and pestle or bag and hammer are typically used when the starting material is frozen. RNA will remain intact in tissues for a day at 37ºC, a week at 25ºC a month at 4ºC and indefinitely at subzero temperatures.

Ultrasonic processing will typically cause the temperature of the sample to increase especially with small volumes. Since high temperatures inhibit 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.

Increasing hydrostatic pressure (typically 15-60 psi) and viscosity can enhance cell disruption. For microorganisms, the addition of glass beads in the 0.5 to 1mm 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.

When processing difficult cells such as yeast, pretreatment with an enzyme is beneficial. Lysozyme, byaluronidase, glycosidase, glucalase, lyticase, zymolase and lysostaphin digestion are among the enzymatic methods frequently used with yeast and Lysozyme with bacteria. Enzymatic treatment is usually followed by sonication in a GITC lysis buffer. Collogenase may be used with collogen, lysostaphin with staphylococcus, 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.

Most animal tissues can be processed fresh (unfrozen). It is important to keep fresh tissue cold and to process it quickly (within 30 minutes) after dissection. When working with fresh tissue, the cells must be sonicated immediately at the time the GITC lysis solution is added. This can be done by dispensing the lysing solution in the tube, adding the tissue and immediately sonicating. Samples should never be left sitting in lysis solution, undisrupted. Large samples of hard tissues should be first treated in a blender or a mechanical homogenizer.

Animal tissues that have been frozen after collection should be disrupted by grinding in liquid nitrogen with a mortar and pestle. During this process, it is important that the equipment and tissue remain at cryogenic temperatures. The tissue should be dry and powdery after grinding. Grinding should be followed by thorough sonication in a GITC lysis buffer. Processing frozen tissue in this way is cumbersome and time consuming, but effective.

Cultured cells are normally easy to disrupt. Cells grown in suspension are collected by centrifugation, rinsed with PBS to remove culture medium, and then lysed by sonicating in a GITC lysis buffer. Placement of the vessel on ice while washing and lysing the cells will further protect the RNA from endogenous RNases released during the disruption process.

Soft, fresh plant tissue can often be disrupted by sonicating in a lysis buffer. Other plant tissues, like pine needles, need to be ground dry, without liquid nitrogen. Some hard, woody plant materials require freezing and grinding in liquid nitrogen prior to being ultrasonically processed. Plant cell suspension cultures and calluses can typically be sonicated in a lysis buffer within 2 minutes. The diversity of plants and plant tissue make it impossible to give a single recommendation for all. However, most plant tissues typically contain polysaccharides and polyphenols that can coprecipitate with RNA and inhibit downstream assays. Treating a plant tissue lysate with polyvinylpyrrolidone (PVP) will precipitate such problematic components from the lysate before the actual RNA isolation is carried out.

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. If sub-cellular particles are desired intact, the amplitude should be kept low, and the processing time increased.

Yeast can be extremely difficult to disrupt because their cell walls may form capsules or nearly indestructible spores. To process yeast, sonicate in a tube containing the sample, guanidinium-based lysis buffer and small glass beads (0.5 – 1 mm). Pretreatment with

zymolase, glucalase and / or lyticase to produce spheroplasts that are readily lysed may also be useful.

To disrupt filamentous fungi, scrape the mycelial mat into a cold mortar, add liquid nitrogen and grind to a fine powder with a pestle. The powder can then be thoroughly sonicated in lysis buffer to solubilize completely. As fungi may also be rich in polysaccharides, pretreatment with polyvinylpyrrolidone (PVP) may be beneficial.

Bacteria, like plants, are extremely diverse; therefore, it is difficult to make one recommendation for all bacteria. Ultrasonic processing will lyse most Gram positive and Gram negative bacteria, including mycobacteria. Although it is recommended that glass beads and lysis solution be used; it is possible to lyse some Gram negative bacteria by sonicating in lysis solution without beads. Bacteria cell walls can be digested with lysozyme to form spheroplasts. Gram positive bacteria usually require more rigorous digestion and longer processing time. The spheroplasts are then lysed with sonication in GITC lysis buffer.

Disruption of cells found in soil and sediments is accomplished one of two ways. One technique isolates the bacterial cells from the material prior to the RNA isolation procedure. This is accomplished by homogenization of wet soil in a mechanical blender followed by a slow speed centrifugation to remove fungal biomass and soil debris. The supernatant is centrifuged again at a higher speed to pellet the bacteria cells. Cells can then be lysed as described above for bacteria. Other techniques describe RNA isolation from the soil or sediment directly. For example, one method requires soil to be added to a diatomaceous earth and lysis buffer, and then sonicated. The sample is then centrifuged to remove solid debris.

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 much 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, carbon dioxide, N_2O, cysteine, reduced glutahione, dithiothreitol or other SH compounds, might be beneficial. Saturating the sample with a protective atmosphere of helium or nitrogen gas, or dropping a small pellet of dry ice in the sample, will also inhibit free radical formation. 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.

Various methods can be used to measure the efficiency of the disruption. For example, a visual count can be made using a microscope.
For greater accuracy, a protein assay could be used. This procedure is widely recognized as a good method for measuring cell disruption by taking into account the amount of protein released after disruption. The disrupted cells are then tested and checked against this number for percentage breakage.
There are several types of protein assays. One commonly used is the Folin Reaction (Lowry Assay) method, as it is comparatively simple and provides consistent results.
This colorimetric method has a sensitivity to protein of around 8 μg / mL in the assay solution.
The assay turns blue in the presence of proteins due to the reaction of copper ions in the alkaline solution with protein and the reduction of phosphomolybdate- phosphotungstic acid in the Folin reagent by aromatic amino acids in the treated protein.
Fractional protein release, Rp, is calculated using the following equation and multiplying the result by 100:

$$\mathbf{Rp} = \frac{\mathbf{Cf - Cb}}{\mathbf{Ct - Cb}}$$

Cf = Free protein
Ct = total protein
Cb = Background protein

This gives the actual disruption percentage, taking into account the background levels of protein before disruption.

Since the greatest concentration of energy is 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.

Allowing the probe to contact the vessel will decrease the power output, and cause minute grey glass particles to migrate into the sample. 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 20mm (3/4”) diameter stainless steel centrifuge tube cut to 70mm (3”) length. Do not use a glass tube. Microtips must never 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 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 about contamination from previous use, clean the probe with a 20% Virkon solution and rinse with distilled water. For critical application, probes may be autoclaved.

To inhibit sample loss in test tube due to sticking, siliconize the test tube as follows: Wash and dry the test tube thoroughly, coat with silicone, then air dry. “Sigmacote” manufactured by Sigma Chemical Co., 3050 Spruce Street, St. Louis, Missouri 63103, USA, phone (314) 771-5765, is ideally suited for that purpose.

High viscosity and concentration are problematic. 2,000 cps and 15% concentration by weight are maximum limits. Because with ultrasonics the sound waves are propagated through the sample, if the sample is so thick that it will not pour or circulate easily, it is too thick for ultrasonic processing.

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, whenever possible, to contain the sample in a 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 also be added to the water inside the cup horn, in order to optimize cooling. Processing samples in a Cup Horn will usually take 4 times longer than processing with the direct probe intrusion method.

USER'S GUIDE

HIGH INTENSITY ULTRASONIC PROCESSOR
Microprocessor Controlled
400-Watt Model
600-Watt Model

TABLE OF CONTENTS

The Ultrasonic Processor supplied with this instruction manual is constructed of the finest material and the workmanship meets the highest 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.

Rev. 2003

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.

When mounting the probe, always clamp the converter housing. Never clamp the probe.

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. Refer all servicing to qualified service personnel.

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 nodal point (point of no activity).

Never touch a vibrating probe.

When using a microtip, always keep the OUTPUT CONTROL below "5"

Never operate a probe with threaded end without a tip, extender or microtip.

It is recommended that ear protection be used when operating the Ultrasonic Processor.

WARNING or CAUTION

Where you see this alert symbol and WARNING or CAUTION heading, strictly follow the warning instructions to avoid personal injury or equipment failure.

SPECIFICATIONS

POWER SUPPLY

Dimensions……7 ½” x 13 ½” x 8 ½” (19 x 34 x 21.6 cm)
Weight……………………………………..18 lbs (8 kg)
Power (watts continuous)……………………400 and 600
Frequency………………………………………… 20 kHz
Power Requirements…….. 100V, 117V or 220V 50/60Hz
Monitor…………… Alpha-numeric liquid crystal display
Power Control…… Continuous variable amplitude output
Timer……………………………… 1 second to 10 hours
Pulser…………………. On/Off-0.1 second to 10 seconds
Temperature Controller……………..1ºC to 100ºC ± 1ºC
Temperature Probe (optional)……………. Stainless Steel

CONVERTER

Dimensions… diameter 2 ½” (6.35 cm) length 7 ¼” (18 cm) with probe approximately 12 ½” (31.75 cm)
Weight …………………………………… 2 lbs. (925g)
Crystals ……… …………Lead Zirconate Titanate (PZT)

PROBE

Standard Probe (titanium alloy) … 1 ½” (38 mm) body diameter stepped to ½” (13 mm) radiating diameter
Weight …………………………………… ¾ lb (340g)

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

SECTION 1 – INSTALLATION

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 phrase 3-terminal grounding type electrical outlet capable of supplying 50/60 Hz at 100 volts, 115 volts, 220 volts, or 240 volts, depending on the voltage option selected. 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.

SECTION II – OPERATION

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. This phenomenon, referred to as cavitation, creates millions of shock waves in the liquid, as well as elevated pressures and temperatures at the implosion sites. Although the cavitational collapse last but a few microseconds, and the amount of energy released by each individual bubble is minute, the cumulative effect causes extremely high levels of energy to be released into the liquid. The larger the probe tip, the larger the volume that can be processed but at a lesser intensity. For information regarding the processing capability of each probe, consult the tables below.

	TAPERED MICROTIPS			STEPPED MICROTIP
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	3-15 ml	5-25 ml	250ul-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	50-1000 ml

	HIGH GAIN PROBES	
TIP DIAMETER	3/4" (19 mm)	1" (25 mm)
INTENSITY	high	medium
VOLUME (batch)	25-500 ml	50-1000 ml

FUNCTIONS OF KEYS, CONTROLS, INDICATIONS, AND CONNECTORS

FRONT PANEL	
LCD screen	Displays prompts and the following control parameters: **A**mplitude selected **O**utput power delivered to the probe in watts, and as percentage of the total power **S**elected duration of processing **A**ctual processing time **E**lapsed time **S**et and read temperature **P**ulse duration
0 – 9 key	Input 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.
TEMP key	Used with the numeric keys to set the high temperature limit – from 1?C to 99?C. Red indicator lights when the temperature limit has been reached.
PULSE key	Used with the numeric keys to set the pulse mode. The ON cycle and OFF cycle can be set independently from .1 second to 9.9 seconds. Red indicator lights when pulser is in the OFF portion of the cycle.
SAVE key	Used with the numeric keys to assign a number to a program and store that program in memory. Up to 10 programs (0-9) can be stored. Lit red indicator signals that a program identification number must be entered.
RECALL key	Used with numeric keys to recall any of 10 stored programs. Lit red indicator signals that a program identification number must be entered.
HOLD key	Suspends operation. Red indicator lights when the processing cycle is interrupted.
TUNE key	Activates the ultrasonics for tuning purposes. Red indicator lights when the power supply is set for tuning. Tuning must be performed in air wit the probe out of the sample. The power supply should be tuned every time a new converter or probe is used and following 10 minutes of continuous operation.
START/STOP key	Starts or stops the ultrasonics. In the STOP mode the red indicator goes off.
ON/OFF power switch (located below the control panel)	Switches the main power on or off.
TUNER (located below the control panel)	Optimizes performance by matching the frequency of the power supply to that of the converter / probe assembly
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%*

FUNCTIONS OF KEYS, CONTROLS, INDICATIONS, AND CONNECTORS (cont.)

REAR PANEL	
Large Jack	Connects to the footswitch cable.
Small Jack	Connects to the temperature probe.
Connector	Connects to the converter.
Fuse(s)	Protects against electrical overload
Power Connector	Connects to the electrical line cord.

PREPARATION FOR USE

CAUTION

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

1. Ensure that the AMPLITUDE dial is set fully counter-clockwise.
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, check for cleanliness the mating surface of the converter and probe or stepped microtip (consisting of coupler and stepped tip), and using the wrenches provided, screw them securely to the converter.
5. To attach a tapered microtip or extender to a probe, remove the replaceable tip from the ½" (13mm) probe, and using the wrenches provided, screw them securely to the probe.

CAUTION

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.

6. Mount the converter / probe assembly in a laboratory stand. Secure the clamp to the 2½" (63mm) diameter converter housing only. Do not secure the clamp to the probe.
7. Connect the converter cable to the power supply.

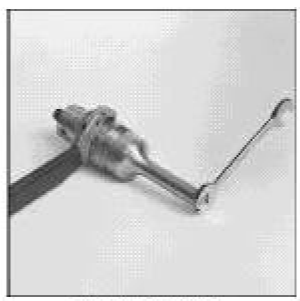
NOTE

Should it become necessary to remove a probe, use the wrenches supplied. If the probe has been attached to the converter for a long period of 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 wrench, twist the converter off the probe. A tap of a hammer may be applied to the end of the wrench. Never attempt to remove the probe by twisting the converter housing, as this may damage the electrical connections within the housing.

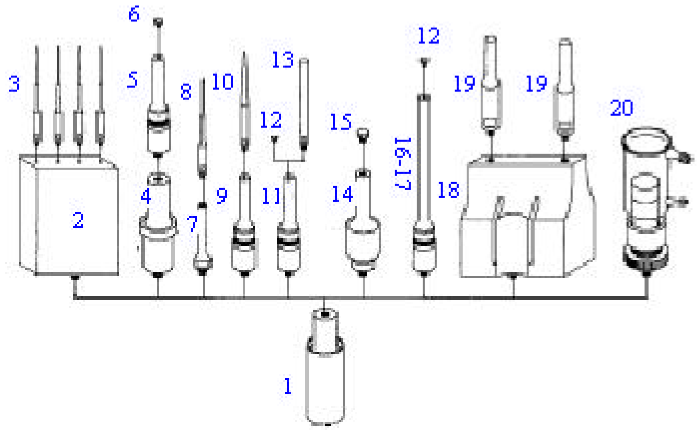
REMOVAL

TIGHTENING

TIP REMOVAL



TIP TIGHTENING



No	DESCRIPTION	Order Number
1	Converter Model CV26	CV00026
2	Four element coupler	630-0558
3	Stepped top(s) $^1/_8$" (3mm)	630-0535
4	Booster	BHNVCGD
5	Probe ½" (13mm) solid	630-0219
	Probe ½" (13mm) with threaded end and replaceable tip	630-0220
	Probe ¾" (19mm) solid	630-0208
	Probe ¾" (19mm) with threaded end and replaceable tip	630-0207
	Probe 1" (25mm) solid	630-0209
	Probe 1" (25mm) with threaded end and replaceable tip	630-0210
6	Replaceable tip ½" (13mm)	630-0406
	Replaceable tip ¾" (19mm)	630-0407
	Replaceable tip 1" (25mm)	630-0408
7	Coupler	630-0421
8	Stepped tip 1/8" (3mm)	630-0422
9	Probe ½" (13mm) with threaded end and replaceable tip	630-0220
10	Tapered microtip $^1/_8$" (3mm)	630-0418
	Tapered microtip $^3/_{16}$" (5mm)	630-0419
	Tapered microtip ¼" (6mm)	630-0420
11	Probe – solid or with threaded end and replaceable tip – same as 5	
12	Replaceable tip – same as 6	
13	Extender ½" (13mm)	630-0410
	Extender ¾" (19mm)	630-0409
	Extender 1" (25mm)	630-0444
	Full wave extender ¾" (19mm) – 10" (254mm) long	630-0518
	Full wave extender 1" (25mm) – 10" (254mm) long	630-0519
14	High gain probe ¾" (19mm) – solid	630-0306
	High gain probe ¾" (19mm) with threaded and replaceable tip	630-0305
	High gain probe 1" (25mm) – solid	630-0310
	High gain probe 1" (25mm) with threaded and replaceable tip	630-0311
15	Replaceable tip ¾" (19mm) or 1" (25mm) – same as 6	
16	Full wave probe ½" (13mm) solid – 10" (254mm) long	630-0217
17	Full wave probe ½" (13mm) – 10" (254mm) long with threaded and replaceable tip	630-0218
18	Aluminum coupler	630-0562
19	¾" (19mm) solid probe	630-0208
20	Cup horn 1 ½" (38mm)	630-0503
	Cup horn 2 ½" (64mm)	630-0431
	Cup horn 3" (76mm)	630-0496

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

TUNING

Tuning optimizes performance and insures maximum transfer of energy by matching the frequency of the power supply to that of converter/probe assembly. The power supply should be tuned 1) every time a new probe or accessory is used, 2) on occasions to compensate for the frequency variation caused by cavitation erosion 3) following 10 minutes of continuous operation and 4) when the sample temperature is significantly higher or lower than room temperature.
The piezoelectric crystal within the converter is part of the circuitry, which controls the frequency at 20kHz. Any changes in t the crystal's capacitance resulting from a variation in temperature, will cause the equipment to operate in an out-of-tune condition. For reliable performance, and equipment protection, it is important that the unit be tuned after the probe temperature has had a chance to stabilize. When relocating the ultrasonic processor from a very cold or very hot environment, allow 30 minutes for the unit temperature to stabilize before operating. Continuous operation causes temperature elevation in the sample. This increase in temperature is transmitted through the probe to the crystal assembly. Always tune the power supply after the probe has reached operating temperature. When working with low or high temperature samples, immerse the probe in the sample for a few minutes, withdraw the probe from the sample, then tune the power supply. When working with temperatures in excess of 100?, contact the factory for recommendations on how to air-cool the converter.

> IMPORTANT
> Tuning must be performed in air with the probe out of the sample. While tuning, do not allow the probe to contact anything.

<u>To tune the instrument before processing, proceed as follows:</u>

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 instrument, cautionary notices and functional prompts.

> CAUTION
> When tuning with a microtip or extender, never allow vibration in air for more than 10 seconds or the amplitude to exceed 40%. Ignoring these instructions will cause the microtip or extender to fracture.

3. With a microtip, rotate the AMPLITUDE control for a 20% reading on the LCD screen – Ampl 20%. With any other probe, rotate the AMPLITUDE control for a 50% reading on the LCD screen – Ampl 50 %.

4. Press the TUNE key, and rotate the TUNER clockwise or counterclockwise until a **minimum** (not maximum) reading – usually less than 35 – is displayed on the POWER MONITOR bar graft. If a reading, of less than “35” cannot be obtained, the probe, cup horn, tip, microtip, extender or accessory is loose or out of resonance, or the power supply or converter require servicing. Note: Depressing the TUNE key energizes the ultrasonics for only 10 seconds.

NOTE

1. The probe is tuned to vibrate at a specific frequency – 20 kHz ? 50Hz. If the resonant frequency of the probe has changed, due to cavitation erosion or fracturing, a minimum reading will not be obtained. If minimum reading cannot be obtained, check the instrument without the probe to determine which component might be defective. If proper tuning is obtained using the converter without the probe, the probe is defective and should be changed.
2. A loose probe will usually generate a loud piercing sound.
3. Since the amplitude required is application dependent, and subject to the volume and composition of the sample, it is recommended tat the amplitude be first set at mid-range, then empirically determined and optimized while the sample is being processed.

5. With a microtip, rotate the AMPLITUDE control for a 40% reading on the LCD screen – Ampl 40%. With any other probe, rotate the AMPLITUDE control for a 100% reading on the LCD screen – Ampl 100%.

6. Repeat step 4.

7. Since the amplitude required is application dependent and subject to he volume and composition of the sample, it is recommended that the amplitude be first set at mid-range, then empirically determined and optimized while the sample is being processed.

To tune the instrument while processing, proceed as follows:

1. Press the HOLD key to suspend processing. The red indicator will illuminate, signaling that the processing cycle has been interrupted.
2. Withdraw the probe from the sample.
3. With a microtip rotate the AMPLITUDE control until the display reads 40% (100% for any other probe).
4. Press the TUNE key (the ultrasonics will be energized for only 10 seconds), and rotate the TUNER clockwise or counterclockwise until a **minimum** (not Maximum) reading – usually less than 35 is displayed on the POWER MONITOR bargraph.
5. Reset the AMPLITUDE control as required.
6. Place the probe back into the sample.
7. Press the HOLD key to resume processing.

USING THE ULTRASONIC PROCESSOR

The speed control on an automobile, can, to a certain extent, be compared to an Ultrasonic Processor. The speed control is designed to maintain the vehicles 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 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.

The Ultrasonic Processor is designed to deliver constant amplitude. As the resistance to the movement of the probe increases, additional power will be delivered by the power supply to ensure that the excursion at the probe tip remains constant. Using a more powerful power supply will not deliver more power into the liquid. Rather, it is the resistance to the movement of the probe that determines how much power will be delivered into the sample.

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 amo unt 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 draw maximum wattage.

This phenomenon can be demonstrated as follows: depress the probe down against a piece of wood. The greater the down 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.

CAUTION

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 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.

OPERATING INSTRUCTIONS

NOTE

Refer to Section IV, for general operating suggestions and ultrasonic processing techniques.

1. Set ON/OFF power switch to ON. The switch will illuminate and the screen will display the power rating of the Ultrasonic Processor, cautionary notices, and the following control parameters.

TIME __:__:__	TEMP __ __?C
PULSE__:__:__	AMPL __ __%

2. Ensure that the power supply is properly tuned. Tuning optimizes performance and insures maximum transfer of energy by matching the frequency of the power supply to that of the converter / probe assembly
3. If a standard probe is used, immerse the probe approximately 2 inches (5 cm) into the sample. If a microtip is used, immerse the microtip approximately ½" (1 cm) into the sample.

NOTE

The probe should be immersed to a sufficient depth to preclude air from being injected into the sample, and inhibit aerosoling and foaming.

4. Using the AMPLITUDE control, increase or decrease the intensity as required.

5. If the function control parameters have been previously stored for a particular application, use the RECALL key to retrieve the control settings for that application.
6. To energize the ultrasonics, press the START key or the optional footswitch. To de-energize the ultrasonics, press the STOP key or release the footswitch.

> **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 uninterrupted 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.

7. Following 10 minutes of continuous operation, check the sample temperature. If the temperature has increased, retune the power supply in accordance with the procedure outlined.

> NOTE
>
> If the processing time has been set, processing can be suspended for tuning purposes by pressing the HOLD key before and after tuning the power supply. In the hold mode, the red indicator on the HOLD key will illuminate, signaling that the processing cycle has been interrupted.

8. 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.
   a) Selected amplitude:
      e.g. Amplitude Control 10%
   b) Set and read temperature:
      e.g. Temp Set 35?C Probe 27?C
   c) Set processing time and elapsed processing time:
      e.g. Set 5:30:25 Time 0:57:03
   d) Selected pulsing cycle, and actual pulsing cycle:
      e.g. Pulse 2.2 2.2/1.7 2.2
   e) Amount of power in watts delivered to the probe:
      e.g. 123 watts
   f) Elapsed time since processing was initiated:
      e.g. Elapsed time 1:27:33

PROGRAM SET UP

Set ON/OFF power switch to ON. The switch will illuminate and the screen will display the power rating of the Ultrasonic Processor, cautionary notices, and the following control parameters.

TIME __:__:__	TEMP __ __?C
PULSE__:__:__	AMPL __ __%

AMPLITUDE: 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. 75%, set by the AMPLITUDE control.
Using the AMPLITUDE control, set the amplitude as required. CAUTION – Do not exceed 40% when using a microtip.

The screen will display:

TIME __:__:__	TEMP __ __?C
PULSE__:__:__	AMPL 75 %

The Ultrasonic Processor is now ready for continuous operation. To energize ultrasonics, press the START key or the footswitch. To de-energize ultrasonics, press the STOP key or release the footswitch. If the Time, Temperature, Pulse, Save, or Recall functions must be used, refer to the appropriate paragraph(s) below.

NOTE

Any combination of functions can be selected in any order. To clear an erroneous entry press the CLEAR key.

Immerse the probe approximately 2 inches (5cm) into the sample. If a microtip is used, immerse the microtip approximately ½" (1cm) into the sample. If the probe is immersed to an insufficient depth, air will be injected into the sample, causing the sample to foam. Since the amplitude required is application dependent and subject to the volume and composition of the sample, it is recommended that the amplitude be increased or decreased as required as the sample is being processed.

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 exits, or if minimum reading cannot be obtained (less than 20%) with the probe out of the sample, check the instrument without the prove 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.

Refer to Section III if an overload condition exists.

TIME: To set the processing time, press the TIME key.

The screen will display:

Time Setting
Hrs:__ Min:_ _ Sec:_ _

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

e.g

Time Setting
Hrs: 5 Min: 30 Sec: 25

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

TIME 5:30:25	TEMP __ __?C
PULSE__:__:__	AMPL 40 %

TEMPERATURE: The temperature function prevents overheating of the sample by continuously monitoring the sample temperature, and terminating the ultrasonics when the temperature reaches a predetermined setpoint. The ultrasonics is automatically reinstated when the temperature drops below the setpoint. If the temperature of the sample must be monitored and /or controlled, insert the optional Temperature Probe forcefully into the small jack on the rear panel, immerse the Temperature Probe in the sample and Press the TEMP key.

The screen will display:

e.g.

Probe Temperature 27 ? C Temperature Setpoint __? C

Using the numeric keys set the high temperature limit (setpoint).

The screen will display:

e.g.

Probe Temperature 27 ? C Temperature Setpoint 35? C

Press the ENTER/REVIEW key.

The screen will display:

TIME 5:30:25	TEMP 35? C
PULSE _._ : _._	AMPL 40 %

NOTE

When the temperature of the sample reaches the high temperature limit, 1) the ultrasonics will automatically be placed on stand-by, 2) the red indicator on the TEMP key will illuminate, and 3) a cautionary message on the LCD screen will warn the operator against touching the ultrasonic probe.

Ultrasonic Processors shipped with the Temperature Probe have been factory calibrated as a set. If the Temperature Probe is acquired separately, it is recommended that calibration be performed. This calibration procedure need be performed only once, and does not have to be repeated unless the Temperature Probe is changed.

PULSE: 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 duration can be set independently from .1 second to 9.9 seconds. During the OFF portion of the cycle, the red indicator on the PULSE key will illuminate. If the OFF portion of the cycle exceeds two seconds, a cautionary message - CAUTION – PROBE ON STANDBY – will warn the operator against touching the ultrasonic probe. To set the pulser, press PULSE key.

The screen will display:

Pulse on __.__sec
Pulse off __.__sec

Using the numeric keys, set the ON portion of the cycle, and press the ENTER/REVIEW key.

The 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 screen will display:

e.g.

Pulse on 2.5 sec
Pulse off 1.0 sec

Press the ENTER/REVIEW key.

The screen will display:

TIME 5:30:25	TEMP 35°C
PULSE 2.5 : 1.0	AMPL 40 %

SAVE: The save function retains in memory up to 10 control parameters under a storage identification (ID) number. To store the parameters under an ID number, (0-9) press the SAVE key. The indicator light on the SAVE key will illuminate and the screen will display.

e.g.

```
TIME  5:30:25              TEMP  35? C
#__ PULSE On 2.5           AMPL   40 %
```

Using the numeric keys, enter the ID number.

e.g.

```
TIME  5:30:25              TEMP  35? C
# 7  PULSE On 2.5          AMPL   40 %
```

Press the ENTER/REVIEW key to store the control parameters under the assigned ID number. The indicator light on the SAVE key will go out, and the screen will display the parameters stored under that ID number:

```
TIME  5:30:25              TEMP  35? C
PULSE 2.5 : 1.0            AMPL   40 %
```

RECALL: The recall function can retrieve from memory; any of the 10 stored control parameters for verification or usage. To retrieve any parameters press the RECALL key. The indicator light on the RECALL key will illuminate, and the screen will display:

e.g.

```
ID    TIME  __:__:__       TEMP  _ _? C
# __  PULSE On __:__        Off __:__
```

Using the ID number and the numeric keys, select the desired parameters, which must be retrieved. The screen will display:

e.g.

```
ID    TIME  5:30:25      TEMP  35? C
# 7   PULSE On 2.5       Off 1.0
```

To retrieve from memory the parameters stored under that ID number, press the ENTER/REVIEW key. The screen will display:

TIME 5:30:25	TEMP 35? C
PULSE 2.5 : 1.0	AMPL 40 %

NOTE

To review all the information that has been stored, press keys 0 to 9 one at a time.

IMPORTANT

Proper care of the probe is essential for dependable operation. The intense cavitation will, after a prolonged period of time, cause the tip to erode, and the power output to decrease without showing up on the wattmeter. 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 most important that only the contaminated surface be removed. This procedure can be repeated as long as the wattmeter reads less than 20 watts with the probe out of the sample, when the AMPLITUDE control is set at 100. If the wattmeter reads over 20 watts the probe or replaceable tip should be replaced with a new one.

SECTION III – CALIBRATION

TEMPERATURE PROBE CALIBRATION

Ultrasonic Processors shipped with the optional Temperature Probe have been calibrated as a set. If the Temperature Probe is acquired separately, calibration should be performed in accordance with the procedure outlined below.

> **NOTE**
> For optimum accuracy, the Temperature Probe and ultrasonic Processor should be calibrated as a set.

To calibrate the Ultrasonic Processor, proceed as follows:

1. Fill a 500 ml vessel with approximately 50% ice and 50% water. Allow 5 minutes for the water temperature to stabilize.
2. Fill another 500ml vessel with boiling water, and maintain boiling condition with an immersion heater or other heating device.
3. Forcefully insert the Temperature Probe into the small jack on the rear panel.
4. While holding the TEMP key depress, set the ON/OFF power switch to ON.

The switch will illuminate and the screen will display the following message:

> TEMPERATURE PROBE CALIBRATION
> PLACE TEMPERATURE PROBE
> INTO ICE WATER BATH

5. Immerse the temperature Probe in the center of the ice water bath for a period of 40 seconds. Do not allow the probe to contact the vessel. When the self-calibration for low temperature is complete, the screen will display the following message:

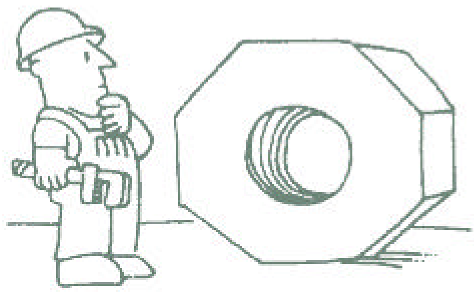
> PLACE TEMPERATURE PROBE
> INTO BOILING WATER

6. Immerse the Temperature Probe in the center of the boiling water for a period of 40 second. Do not allow the probe to contact the vessel.

When the calibration for high temperature is complete, the screen will display the following message:

> TEMPERATURE PROBE
> CALIBRATION COMPLETED

SECTION IV – SERVICE INFORMATION



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 due to an overload condition or that it will stop working all together. The most probable causes for malfunction are listed below and should be investigated.

The unit was plugged into an electrical outlet that provides a different voltage from that required. See *Electrical Requirements.*

The probe and/or microtip is not secured properly.

If the probe has a replaceable tip, the tip is not secured properly, or the probe has been used with low surface tension liquids.

A fuse(s) has failed. If a fuse(s) has failed, proceed as follows:

1. Ensure that the power switch is set to OFF.
2. Open the fuse holder cover using a small screwdriver, and pull out the red fuse holder from its housing.
3. Replace the fuse(s).
4. Set the AMPLITUDE control to 50 and the power switch to ON. With the probe in air (out of sample), the wattmeter should read below 20 watts. If the reading exceeds 20 watts, set the power switch to OFF, and disconnect the probe from the converter.
5. Set the power switch back to ON. If the wattmeter reads below 20 watts, the probe has failed or is out of tune due to excessive erosion, and should be replayed, if the wattmeter reads above 20 watts, either the converter or power supply has failed and the complete Ultrasonic Processor should be returned for repair.
6. If the Ultrasonic Processor stops working due to an overload condition as indicated on the display, investigate and remedy the problem, then set the power switch to OFF then back to ON to reset the instrument.

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 the factory before returning any instrument. Include date of purchase, model number and serial number. For instruments not covered by the warranty, a purchase order should be forwarded to avoid unnecessary delay. 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.

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

IMPORTANT

I CERTIFY THAT THE ULTRASONIC PROCESSOR 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 CERTICATION CAN BE MADE.

SECTION V - OPERATING SUGGESTIONS AND TECHNIQUES

DISRUPTING CELLS

The disruption of cells is an important stage in the isolation and preparation of intracellular products. From research levels through to production, many areas of biotechnology, particularly recombinant technology, necessitate the use of ultrasonics for cell disruption. Although some biological products are secreted from the cell or released during autolysis, many others require sonication to release intracellular material. Cell disruption focuses on obtaining the desired product from within the cell, and it is the cell wall that must be disrupted to allow cell contents extraction.

Single-cell organisms (micro-organisms) consist of a semipermeable, tough, rigid outer cell wall surrounding the protoplasmic membrane and cytoplasm. The cytoplasm is made up of nucleic acid, protein, 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 lysed and sonicated in order for these substances to be released. Breaking cell membranes and releasing the contents present significant challenges. The process must be fast and thorough to maximize the protein yield. Because the energy applied must be great enough to break the cell membranes or walls, yet gentle enough to avoid physically or chemically damaging cell contents, the Vibra-Cell with its variable intensity capability is ideally suited for this application.

The level of intensity that should be used is application dependent. For example high intensity might be recommended for the break up of cells, but should never be used when the release of intracellular components might be objectionable e.g. Organelle isolation.

The ability to control the amplitude at the probe tip is a prerequisite for process optimization. And because each application requires its own set of processing parameters, due to variation in volume and composition, the optimum amplitude can only be determined empirically. When processing a new sample, it is recommended that the amplitude be set first at 50% (30% with a microtip) and then increased of decreased as required.

Yeast, gram-positive bacteria, and to a lesser extent, gram-negative bacteria have considerably harder cell walls in comparison to animal cells, and require relatively high power for cell disruption.

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

Microorganisms 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 that plant cells, and red blood cells are more readily disintegrated than muscle cells because they lack a protective cell wall.

Cellular disruption is the first step in RNA isolation and one of the most critical steps affecting yield and quality of the isolated RNA. Typically, cell disruption needs to be fast and thorough. Slow disruption, for example placing cells or tissue in guanidinium isothiocyanate (GITC) lysis solution for a long time prior to sonication, may result in RNA degradation by endogenous RNases released internally. This is especially a concern when working with tissues high in endogenous RNase such as spleen and pancreas.

Disrupting frozen tissue is more time consuming and cumbersome that processing fresh tissue, but freezing samples is sometimes necessary. Samples are usually frozen when, 1) they are collected over a period of time and thus, cannot be processed simultaneously; 2) there are many samples, 3) samples are collected in the field, or 4) mechanical processing of fresh samples is insufficient for thorough disruption. A mortar and pestle or bag and hammer are typically used when the starting material is frozen. RNA will remain intact in tissues for a day at 37ºC, a week at 25ºC a month at 4ºC and indefinitely at subzero temperatures.

Ultrasonic processing will typically cause the temperature of the sample to increase especially with small volumes. Since high temperatures inhibit 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.

Increasing hydrostatic pressure (typically 15-60 psi) and viscosity can enhance cell disruption. For microorganisms, the addition of glass beads in the 0.5 to 1mm 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.

When processing difficult cells such as yeast, pretreatment with an enzyme is beneficial. Lysozyme, byaluronidase, glycosidase, glucalase, lyticase, zymolase and lysostaphin digestion are among the enzymatic methods frequently used with yeast and Lysozyme with bacteria. Enzymatic treatment is usually followed by sonication in a GITC lysis buffer. Collogenase may be used with collogen, lysostaphin with staphylococcus, 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.

Most animal tissues can be processed fresh (unfrozen). It is important to keep fresh tissue cold and to process it quickly (within 30 minutes) after dissection. When working with fresh tissue, the cells must be sonicated immediately at the time the GITC lysis solution is added. This can be done by dispensing the lysing solution in the tube, adding the tissue and immediately sonicating. Samples should never be left sitting in lysis solution, undisrupted. Large samples of hard tissues should be first treated in a blender or a mechanical homogenizer.

Animal tissues that have been frozen after collection should be disrupted by grinding in liquid nitrogen with a mortar and pestle. During this process, it is important that the equipment and tissue remain at cryogenic temperatures. The tissue should be dry and powdery after grinding. Grinding should be followed by thorough sonication in a GITC lysis buffer. Processing frozen tissue in this way is cumbersome and time consuming, but effective.

Cultured cells are normally easy to disrupt. Cells grown in suspension are collected by centrifugation, rinsed with PBS to remove culture medium, and then lysed by sonicating in a GITC lysis buffer. Placement of the vessel on ice while washing and lysing the cells will further protect the RNA from endogenous RNases released during the disruption process.

Soft, fresh plant tissue can often be disrupted by sonicating in a lysis buffer. Other plant tissues, like pine needles, need to be ground dry, without liquid nitrogen. Some hard, woody plant materials require freezing and grinding in liquid nitrogen prior to being ultrasonically processed. Plant cell suspension cultures and calluses can typically be sonicated in a lysis buffer within 2 minutes. The diversity of plants and plant tissue make it impossible to give a single recommendation for all. However, most plant tissues typically contain polysaccharides and polyphenols that can coprecipitate with RNA and inhibit downstream assays. Treating a plant tissue lysate with polyvinylpyrrolidone (PVP) will precipitate such problematic components from the lysate before the actual RNA isolation is carried out.

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. If sub-cellular particles are desired intact, the amplitude should be kept low, and the processing time increased.

Yeast can be extremely difficult to disrupt because their cell walls may form capsules or nearly indestructible spores. To process yeast, sonicate in a tube containing the sample, guanidinium-based lysis buffer and small glass beads (0.5 – 1 mm). Pretreatment with

zymolase, glucalase and / or lyticase to produce spheroplasts that are readily lysed may also be useful.

To disrupt filamentous fungi, scrape the mycelial mat into a cold mortar, add liquid nitrogen and grind to a fine powder with a pestle. The powder can then be thoroughly sonicated in lysis buffer to solubilize completely. As fungi may also be rich in polysaccharides, pretreatment with polyvinylpyrrolidone (PVP) may be beneficial.

Bacteria, like plants, are extremely diverse; therefore, it is difficult to make one recommendation for all bacteria. Ultrasonic processing will lyse most Gram positive and Gram negative bacteria, including mycobacteria. Although it is recommended that glass beads and lysis solution be used; it is possible to lyse some Gram negative bacteria by sonicating in lysis solution without beads. Bacteria cell walls can be digested with lysozyme to form spheroplasts. Gram positive bacteria usually require more rigorous digestion and longer processing time. The spheroplasts are then lysed with sonication in GITC lysis buffer.

Disruption of cells found in soil and sediments is accomplished one of two ways. One technique isolates the bacterial cells from the material prior to the RNA isolation procedure. This is accomplished by homogenization of wet soil in a mechanical blender followed by a slow speed centrifugation to remove fungal biomass and soil debris. The supernatant is centrifuged again at a higher speed to pellet the bacteria cells. Cells can then be lysed as described above for bacteria. Other techniques describe RNA isolation from the soil or sediment directly. For example, one method requires soil to be added to a diatomaceous earth and lysis buffer, and then sonicated. The sample is then centrifuged to remove solid debris.

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 much 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, carbon dioxide, N_2O, cysteine, reduced glutahione, dithiothreitol or other SH compounds, might be beneficial. Saturating the sample with a protective atmosphere of helium or nitrogen gas, or dropping a small pellet of dry ice in the sample, will also inhibit free radical formation. 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.

Various methods can be used to measure the efficiency of the disruption. For example, a visual count can be made using a microscope.
For greater accuracy, a protein assay could be used. This procedure is widely recognized as a good method for measuring cell disruption by taking into account the amount of protein released after disruption. The disrupted cells are then tested and checked against this number for percentage breakage.
There are several types of protein assays. One commonly used is the Folin Reaction (Lowry Assay) method, as it is comparatively simple and provides consistent results. This colorimetric method has a sensitivity to protein of around 8 μg / mL in the assay solution.
The assay turns blue in the presence of proteins due to the reaction of copper ions in the alkaline solution with protein and the reduction of phosphomolybdate- phosphotungstic acid in the Folin reagent by aromatic amino acids in the treated protein.
Fractional protein release, Rp, is calculated using the following equation and multiplying the result by 100:

$$Rp = \frac{Cf - Cb}{Ct - Cb}$$

Cf = Free protein
Ct = total protein
Cb = Background protein

This gives the actual disruption percentage, taking into account the background levels of protein before disruption.

Since the greatest concentration of energy is 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.

Allowing the probe to contact the vessel will decrease the power output, and cause minute grey glass particles to migrate into the sample. 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 20mm (3/4”) diameter stainless steel centrifuge tube cut to 70mm (3”) length. Do not use a glass tube. Microtips must never 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 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 about contamination from previous use, clean the probe with a 20% Virkon solution and rinse with distilled water. For critical application, probes may be autoclaved.

To inhibit sample loss in test tube due to sticking, siliconize the test tube as follows: Wash and dry the test tube thoroughly, coat with silicone, then air dry. "Sigmacote" manufactured by Sigma Chemical Co., 3050 Spruce Street, St. Louis, Missouri 63103, USA, phone (314) 771-5765, is ideally suited for that purpose.

High viscosity and concentration are problematic. 2,000 cps and 15% concentration by weight are maximum limits. Because with ultrasonics the sound waves are propagated through the sample, if the sample is so thick that it will not pour or circulate easily, it is too thick for ultrasonic processing.

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, whenever possible, to contain the sample in a 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 also be added to the water inside the cup horn, in order to optimize cooling. Processing samples in a Cup Horn will usually take 4 times longer than processing with the direct probe intrusion method.

What are

ULTRASONICS *and* **ULTRASONIC PROCESSING?**

SONICS

INTRODUCTION

High-Intensity Ultrasonic Liquid Processing is being explored and applied in various fields, across many industries. It is replacing many standard methodologies in application areas as diverse as sample prep and analysis, research and development, and even manufacturing. To date, the growing list of markets utilizing Ultrasonics includes biotechnology, analytical chemistry, environmental testing, industrial processing, pharmaceuticals and many others.

To better understand this technology, ***Sonics*** has compiled this backgrounder on what Ultrasonics is and what **High-Intensity Ultrasonic Liquid Processing** can do.

ABOUT ULTRASONICS

Although sound is the sensation perceived by the sense of hearing, it's not always audible. **Ultrasound, often referred to as Ultrasonics, literally means beyond sound, or above the human audible spectrum.** The human ear is most sensitive to frequencies in the 1 to 5 kHz range, with lower and upper limits of 0.3 and 19 kHz, respectively. Ultrasonics refers to sound above 19 kHz.

Around 1915, Langevin – a pioneer in the field of Ultrasonics – designed, built and experimented with high-power, magnetostrictive Ultrasonic equipment. In the decade that followed progress was relatively slow, and it was not until 1927 that significant developments came about. That year, Wood and Loomis, both chemists, recognized **the effects of intense sound waves traveling through a liquid**, and published their observations regarding the effects of Ultrasonics on emulsification, dispersion of colloids, fragmentation of small and fragile bodies, destruction of red blood corpuscles, and various effects due to frictional heating. Although their work generated great interest, it was not until the 1950s, when high-efficiency piezoelectric transducers were mass-produced, that high-power, low-cost Ultrasonic equipment became readily available for research and industrial applications.

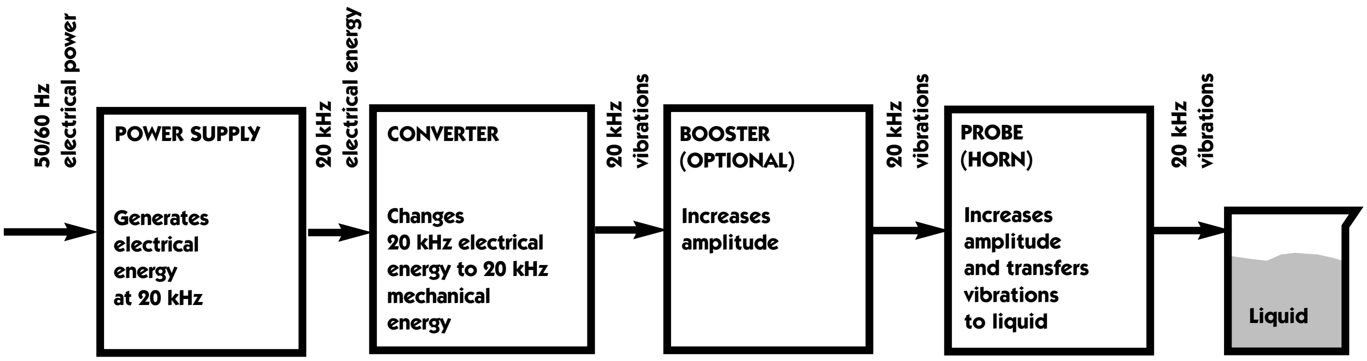
The two main products to use piezoelectric technology for high-intensity ultrasonic applications are ultrasonic baths and Ultrasonic Liquid Processors. Baths work well for most cleaning applications, however their low, fixed and uneven intensity somewhat limits their utilization. Ultrasonic Processors, on the other hand, are more versatile and are the instruments of choice for applications requiring high-intensity Ultrasonic energy.

ULTRASONIC PROCESSORS

Ultrasonic Processors consist of three major components:

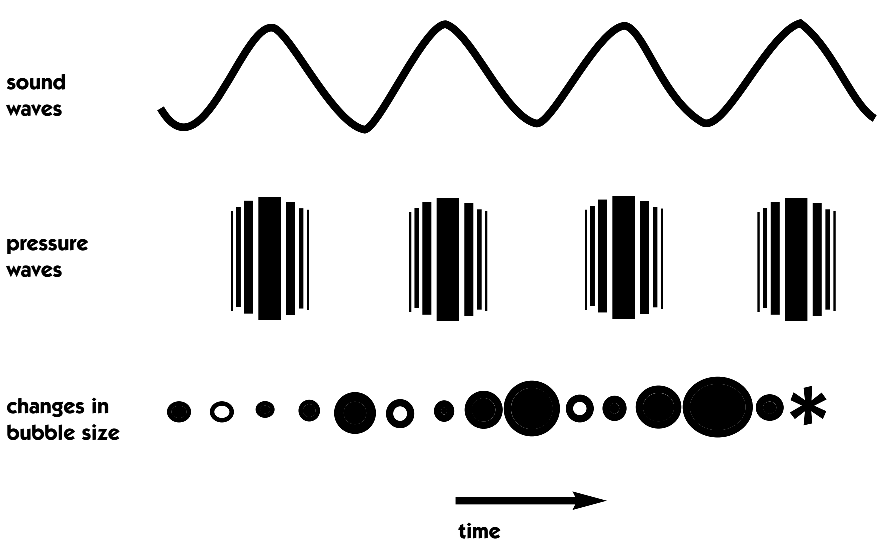
an Ultrasonic Power Supply (generator), a Converter (transducer) and a Probe (horn).

Additionally, a variety of accessories can be used to expand the capabilities of Ultrasonic Processors.



The ultrasonic power supply converts 50/60 Hz voltage to high-frequency (20 kHz) electrical energy. This voltage is applied to the piezoelectric crystals within the converter, where it is changed to small mechanical vibrations. The converter's longitudinal vibrations are amplified by the probe and transmitted to the liquid as Ultrasonic waves consisting of alternate compressions and rarefactions. These pressure fluctuations cause the liquid to fracture or tear into the rarefaction stage due to negative pressures, creating millions of microscopic bubbles (cavities). As the wave front passes and the bubbles are subjected to positive pressures in the compression stage, they oscillate and eventually grow to an unstable size (up to 100 microns in diameter). Finally the bubbles implode, creating millions of shock waves and eddies to radiate outwardly from the site of collapse, as well as generating extremes in pressures and temperatures at the implosion sites. During cavitational collapse, intense heating of the bubbles occurs. The localized hot spots have temperatures in the range of 5,000 ºC, pressures approaching 500 atmospheres, lifetimes of a few microseconds, and heating and cooling rates greater than 10^9 K/s. **Although this phenomenon, know as cavitation, lasts but a few microseconds, and the amount of energy released by each individual bubble is minimal, the cumulative amount of energy generated is extremely high.**

THE CAVITATION CYCLE



POWER SUPPLY

The power supply transforms conventional 50/60 Hz electrical power into high-frequency electrical power at 20,000 Hz. Power supplies are typically rated in watts of output power. It should be noted that using a power supply with a higher wattage rating does not mean that more power will automatically be transmitted to the liquid. Rather, it is the resistance to the movement of the probe (horn) that determines how much power will be delivered into the liquid. Load is determined by three factors: sample volumes, sample viscosity, probe size; and, in some cases, a pressurized environment. Under identical loading conditions, the wattage delivered by two power supplies with different power ratings will be the same (provided both have sufficient power capability).

The speed control on an automobile, can, to a certain extent, be compared to an Ultrasonic Processor. The speed control 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 resistance to the movement of the vehicle, and 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 (peak-to-peak displacement at the probe tip). 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 excursion at the probe tip constant.

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 could 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. Negligible power is required to keep an Ultrasonic probe resonating when operated in air. 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 any Ultrasonic Processor is capable of delivering is only delivered when resistance to the movement of the probe is high enough to draw maximum wattage.

This phenomenon can be demonstrated as follows: Depress a probe down against a piece of wood while observing the power monitor; as the down pressure (resistance) is increased, the amount of power delivered by the power supply will increase accordingly.

CONVERTER

The converter changes the high-frequency electrical energy from the power supply into mechanical vibrations. Converters contain lead zirconate titanate piezoelectric ceramic discs. When an alternating voltage is applied to the opposing faces of the discs, they expand and contract with the change in polarity. As the alternating high frequency voltage is applied to the discs, they vibrate at that frequency. The entire assembly is designed to resonate at a predetermined frequency, and its length is typically equal to one-half wavelength of the applied frequency – about 5 inches (130 mm) at 20 kHz.

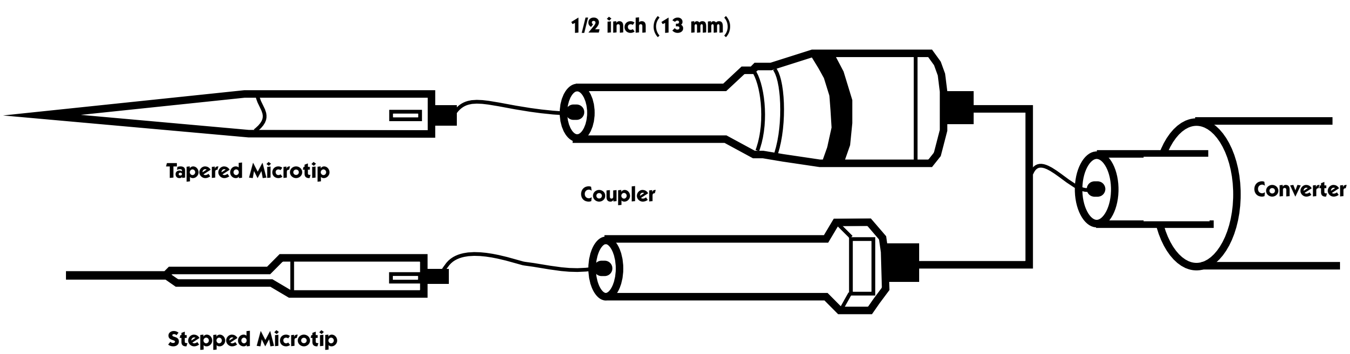
ULTRASONIC PROBES

Probes are also one-half-wavelength-long sections that act as mechanical transformers to increase the amplitude of vibration generated by the converter. The greater the mass ratio between the upper section and the lower section (tip), the greater the amplification factor. Probes with smaller tip diameters produce greater intensity of cavitation, but the energy released is restricted to a narrower, more concentrated field immediately below the tip. Conversely, probes with larger tip diameters produce lesser intensity, but the energy is released over a greater area. The larger the tip diameter, the larger the volume that can be processed, but at lower intensity. High-gain probes produce higher intensity than standard probes, and are usually recommended for processing larger volumes or difficult applications. Probes are fabricated from high-grade titanium alloy TI-6AL-4V because of its high strength-to-weight ratio, good acoustical properties at ultrasonic frequencies, high resistance to corrosion, low toxicity and excellent resistance to cavitation erosion. They are autoclavable, and are available with threaded ends to accept replaceable tips, microtips and extenders.

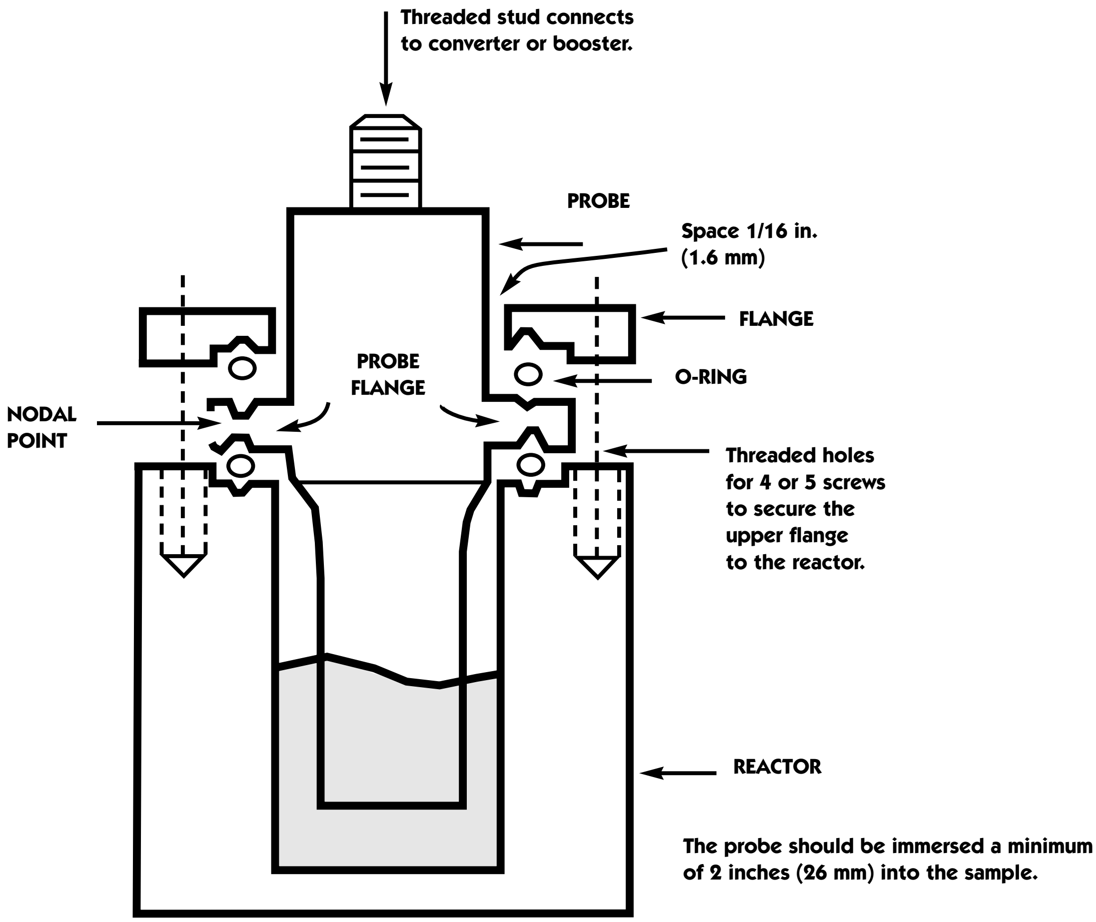
All probes, including those with replaceable tips, are tuned to resonate at 20 kHz ± 100 Hz. If the replaceable tip is removed or isolated from the rest of the probe, that element will no longer resonate at 20 kHz and the power supply will fail. Low-surface tension liquids penetrate the interface between the probe and the replaceable tip, and carry the particulates into the threaded section, isolating the tip from the probe. When working with low-surface tension liquids, such as solvents, ***always*** use a solid probe.

Microtips can process small samples at very high intensity. The tapered microtip screws into the 1/2 inch (13 mm) threaded end probe in place of the replaceable tip. The stepped microtip assembly consists of two parts, and screws into the converter in place of the probe. Capable of reaching into narrower vessels than the tapered microtip, the stepped microtip assembly can process volumes as small as 250 microliters. Microtips are fabricated from titanium alloy TI-6AL-4V and are autoclavable.

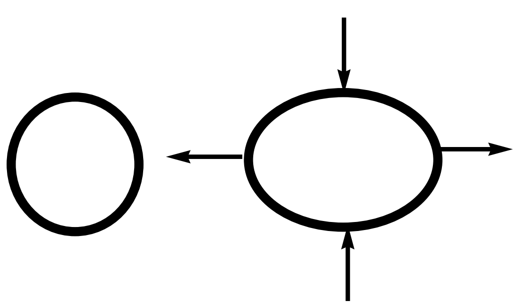
CAUTION: DO NOT exceed the "MICROTIP LIMIT" on the Power Supply when using a Microtip!



NODAL POINT / FLANGED PROBES



With Ultrasonics, nothing can come in contact with the probe, except at the point of no activity – the nodal point. A flange or threaded section can be machined onto the probe at the nodal point so it can be affixed to a pressure vessel. For leak-proof operation and safety considerations when working with high-pressure applications, probes are commonly flanged instead of threaded. During operation, the top and bottom of the probe expand and contract longitudinally about the nodal point causing the diameter of the probe around the flange to expand and contract radically (same as a water-filled balloon).



For that reason the inside diameter of the reactor, where the flange is located, should be made slightly larger than the probe's outside diameter (~1/16 in. [1.6 mm]), to preclude the possibility of the probe flange contacting the reactor as it expands and contracts during operation. The flange is isolated from the reactor with O-rings, which isolate the probe from the reactor and help center the probe into the reactor. When the flange is bolted down, it contacts the reactor and slightly compresses the O-rings. Compressing the O-rings too much – so as to cause them to deform – will eventually cause the system to fail.

BOOSTERS

When working with a difficult application, the use of a booster may be recommended. When interposed between the converter and the probe, the booster will increase the amplitude of vibration at the probe tip. Boosters should not be used with microtips, cup horns or high-gain probes.

COMMONLY ASKED QUESTIONS

What is Ultrasonics?

Everything that makes a sound vibrates, and everything that vibrates makes a sound. However, not all sounds are audible. Ultrasound literally means beyond sound; sound above the human audible spectrum. Using 19,000 Hertz (cycles per second) as the approximate limit of human hearing, Ultrasonics refers to sound above that frequency.

What are the differences between an Ultrasonic Processor and an Ultrasonic Bath?

The intensity within a bath is fixed, low, location-dependent and inconsistent, due to the fluctuation in the level and temperature of the liquid. With an Ultrasonic Processor, processing is fast and highly reproducible. The energy at the probe tip is high (at least 50 times that produced in a bath), focused and adjustable.

At what frequency does an Ultrasonic Processor operate?

Standard Ultrasonic Processors operate at a nominal frequency of 20 kHz or 20,000 cycles per second (cps).
The auto-tune feature actually moves the frequency within a small range during operation to optimize performance.

20 kHz versus 40 kHz

40 kHz are often used for ultrasonic atomization because the droplet size at that frequency is half that generated at 20 kHz.
On the other hand, the frequency of choice for most Ultrasonic Liquid Processing applications is 20 kHz, because the amplitude at the probe tip and the resulting cavitation is twice that generated at 40 kHz.

With Ultrasonic Processing, are there any limitations?

Yes. Viscosity, temperature and liquid characteristics. As the viscosity of material increases, its ability to transmit vibrations decreases. Typically, the maximum viscosity at which a material can be processed effectively is 5,000 cps. With standard systems, the practical upper limit on temperature is approximately 100 ºC. Solid probes can safely be used with both aqueous solutions and low-surface tension liquids (e.g., solvents), however probes with replaceable tips should ***never*** be used with surface tension liquids.

Which instrument should I use?

The 500- and 750-watt units are the most versatile because they can process both large and small volumes on a batch basis, as little as 250 microliters (µL) with a microtip, and as much as 1 liter with a 1 in. (25 mm) probe. On a flow-through basis, up to 10 liters per hour. However, since every instrument will perform equally well up to a certain volume, we recommend the 130-watt unit for samples up to 150 mL.

Which probe is best suited for my application?

The larger the probe diameter, the larger the volume that can be processed, but at lesser intensity. ***Always*** use a solid probe when working with low-surface tension liquids.

Can probes be manufactured to any length?

No, they cannot. Probes are made to resonate at a specific frequency (half a wavelength or multiple thereof). 20 kHz probes are typically 5 in. (127 mm) long and can be made longer in 5-inch increments. 40 kHz probes are typically 2.5 in. (63.5 mm) long and can be made longer in 2.5-inch increments.

When should I change the replaceable tip on the probe?

Ultrasonic Processing causes probe erosion. This phenomenon is often referred to as "titanium migration into the sample". Over time, this results in light pitting. Tips can be polished with sandpaper or emery cloth – that is, until the probe no longer resonates at the right frequency. When this happens, the probe will be difficult to tune. As tips are relatively inexpensive, it is recommended that they be changed after several polishings.

Why must the amplitude (power) be set below 40% when a microtip is in use?

Microtips are used to process small volumes and are therefore quite thin, making them more susceptible to stress cracking at higher amplitudes.

What factors must I consider to effectively process my sample size?

The two primary factors for effective processing of a given sample size are probe diameter and volume.

What is a "booster" and when is it used?

A "booster" is a device that is inserted between the converter and the probe to mechanically increase the probe's amplitude. They are typically used in difficult applications or flow-through applications where exposure time is very limited.

Can I process more toxins or bio-hazardous materials safely?

Hazardous materials may be safely processed with a sealed atmosphere chamber. This device isolates the sample in a sealed chamber during the entire cycle and is available with a cooling jacket to inhibit temperature elevations.

How can I process large volumes of material?

For processing larger volumes, *Sonics* offers flow-through processing cells. These specialized chambers channel the continuous flow of material through a high-intensity Ultrasonic field. They are recommended for the treatment of low-viscosity samples, which do not require extended exposure to Ultrasonics.

Do all manufacturers rate their instruments the same way?

Unfortunately not. Unlike some other manufacturers, we at *Sonics* use the RMS rating – the amount of power, measured in watts, that a unit is capable of delivering continuously. Most of our competitors use a Peak Power rating – the maximum amount of power, measured in watts, that a unit is capable of delivering for only a short time.

ULTRASONICS AT WORK

Chemistry

Ultrasonics is used in analytical chemistry for many common procedures, including breaking of chemical bonds, formation of free radicals, polymersion and depolymerization of long-chain molecules, catalysis of reactions (e.g., reduction, alkylation, ester hydrolysis and acylation or aromatics), preparation of catalyst and activation of catalyst. The science of Sonochemistry is well characterized and employed throughout the world.

Biology

Ultrasonics is commonly used for the releasing of enzymes and proteins from cells. This method of extraction commonly produces more active material than other methods. Disruption is often very fast and complete. In biotechnology, the manufacturing of products such as enzymes, fine chemicals and therapeutic reagents requires the fermentation of microorganisms. The use of Ultrasonics has been used in these instances for cell disruption as well as enzyme purification. It helps in the lysing of bacteria, viruses, yeast and tissue cells for the extraction of protein, DNA, RNA, enzymes and other cellular components. The cup horns are high-intensity water baths that allow Ultrasonic Processing while preventing cross-contamination of samples.

Industrial

Many industrial applications require high volumes of liquids to be emulsified, dispersed or homogenized. This can be accomplished through the use of a continuous flow cell for in-line processing.

Pharmaceutical

The pharmaceutical industry routinely uses Ultrasonics for processes such as sample premixing, dispersion and suspension, crack enteric coatings for dissolution testing, tablet pressing operations to reduce tablet size, and degassing and homogenization of slurry in production. The continuous flow cell is a popular accessory for processing larger volumes up to 20 liters/hour.

Environmental

Environmental testing laboratories use Ultrasonic Processors to process soil and sediment samples according to U.S. EPA methods (U.S. EPA Test Method 3550). This is done in lieu of Soxhlet extraction methods due to significant time and material savings. Utilizing probe ultrasonics can save hours of costly sample extractions.

LEADING APPLICATIONS FOR ULTRASONIC PROCESSING

Sample Prep	**Cell Lysing**	**Disaggregation**	**Emulsification**
Communition	**Extraction**	**Dissolution**	**Sonochemistry**
Homogenization	**Mixing**	**Synthesis**	**Catalysis**
Microencapsulation	**Hydrolyzation**	**Degassing**	**Cleaning**
Dispersion	**Disruption**	**Atomization**	**OEM Applications**

TO LEARN MORE

about **High-Intensity Ultrasonic Liquid Processing**, please visit our website at **WWW.SONICS.BIZ**, call us toll-free at **1-800-745-1105** or send an e-mail inquiry to **INFO@SONICS.BIZ**.

SONICS

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REV. 120902 A

SONICS
Newtown, CT USA

Press Release

Date: October 1, 2003

NEW PRODUCT ANNOUNCEMENT

FOR PITTCON REVIEW ISSUE…

New Ultrasonic Probes For Processing In Microplate

Sonics & Materials meets the demands of today's laboratories by offering two unique multi-element probe systems specifically designed for processing up to 96 deep-well plates as well as 1.5 – 2.0 ml microtubes and 10 ml test tubes. Unlike ultrasonic baths, or microplate horns that act as ultrasonic baths, the probes deliver the intensity directly into the sample, not through the microplate walls where a great percentage of energy can be absorbed. And, unlike single probes with grooved protrusions, these composite probes act as mechanical amplifiers. With ultrasonics, the greater the mass ratio between the probe upper section and the lower section, the greater the intensity at the probe tip. These 20 kHz multi-element probes consist of a coupler and multiple 1/8" (3 mm) replaceable stepped microtips, spaced 23/32" (18 mm) apart. Prior to assembly, both the coupler and microtips are tested to ensure that their resonant frequency and length are as required. Once assembled, the probe is energized, and tested with fiber optic instrumentation to ascertain that the excursion at the tip of each element is within specified tolerance. The complete assembly is approximately 10" (260 mm) long. The probes can be mounted onto a laboratory stand or incorporated into an automated x-y positioning system to satisfy high-throughput requirements.

For more information on their full line of ultrasonic accessories, contact Sonics & Materials, Inc. at 1-800-745-1105 or visit www.sonics.biz

Sonics & Materials, Inc. -- Ultrasonic Liquid Processing

Newtown, CT USA

Press Release

Date: October 1, 2003

FOR IMMEDIATE RELEASE....

For more information, contact **Ed Neeb at (203) 270-4600 x316**

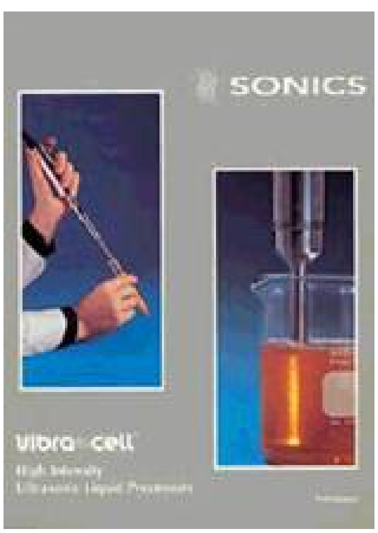
ULTRASONIC PROCESSING GUIDE

Sonics & Materials, Inc., Newtown, CT, USA

This comprehensive booklet from Sonics contains valuable information on the theory of ultrasonic liquid processing, instrument selection criteria, and answers to most asked questions about ultrasonic processing. Highly functional and versatile, these instruments can safely process a wide range of organic and inorganic materials, from microliters to liters. Typical applications include sample preparation, cell lysing, organelle isolation, desegregation, extraction, homogenization, particle size reduction, and acceleration of chemical reactions. Users of ultrasonics include biotechnology, pharmaceutical development, chemical, academic and in industrial research laboratories.

For more detailed information, please contact us at 1-800-745-1105 or www.sonics.biz

Guide to Ultrasonic Liquid Processing



Newtown, CT USA

Press Release

Date: October 1, 2003

FOR IMMEDIATE RELEASE....

For more information, contact **Ed Neeb at (203) 270-4600 x316**

FASTER ULTRASONIC PROCESSING

Sonics & Materials, Inc. introduces a multi-element probe that takes the place of your standard 20 kHz probe and processes four (250µl – 10 ml) samples simultaneously. The multi-element probe consists of a four-element coupler and four 3 mm stepped microtips. The energy delivered to each tip is identical. This valuable time saving tool maximizes productivity in mixing and lysing, and should be of particular interest to pharmaceutical researchers and others who must prepare and process a large number of samples. For more information on these and other ultrasonic accessories, call 1-800-745-1105 or visit www.sonics.biz

New Muli-Element Probe for Ultrasonic Liquid Processing

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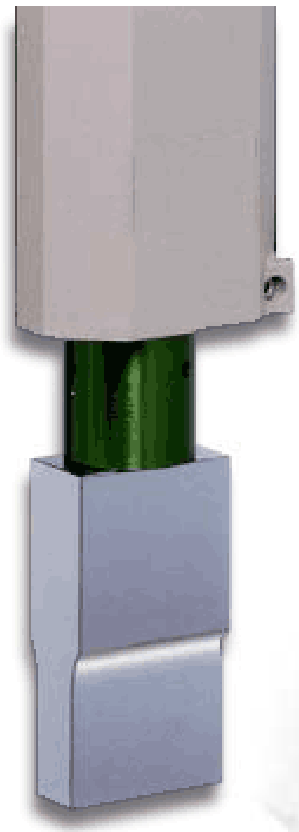
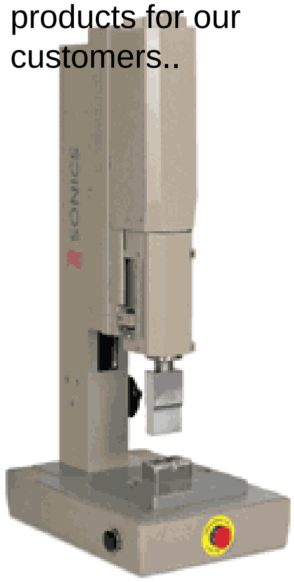
SONICS
Newtown, CT USA

Your Partner in Innovative Plastics Assembly

As a global leader in the plastics assembly industry, Sonics' goal has been to provide you with innovative, reliable, and cost-efficient ultrasonic plastics assembly solutions, for the simplest to the most demanding applications. Our philosophy has remained steadfast – to provide consistent support, technical innovations, unparalleled expertise, and the highest quality products for our customers..





Our product line includes ultrasonic, vibration, spin, hot plate bonding and heat staking equipment for the welding, joining and fastening of thermoplastic components, textiles, and other synthetic materials. Throughout Sonics' growth, our customer base has remained diverse, with its plastics assembly equipment being utilized in the automotive, medical, home entertainment, electronics, appliance, textile, packaging, toy and other industries. Some applications within these industries include automotive lenses, carpet welding, blower housings, carbon canisters, pumps and impellers, telephone handsets, smoke detectors, and waste containers.

Sonics recognizes that our customers are in an increasingly competitive global market place. That is why innovation has been the springboard of Sonics' growth – innovations in assembly stand construction, power supply design, controllers, as well as acoustic tooling and converters. The result is products that

Partners & Solutions

Sonics prides itself in designing, implementing, and maintaining real world manufacturing solutions. Therefore, time and resources will be expended to explore a new application or application modification for both our existing and potential customers. Sonics will not only supply you with quality products, but will also act as your partner to assure the offer state-of-the-art precision, economy, and control.

success of your applications.

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SONICS
Newtown, CT

OPTIONAL ACCESSORIES FOR VC 750, VCX 500 & VCX 750

Probes*

ORDER NO.	630-0220**	630-0219	630-0207***	630-0208	630-0210****	630-0209
TIP DIAMETER	1/2" (13mm)	1/2" (13mm)	3/4" (19mm)	3/4" (19mm)	1" (25mm)	1" (25mm)
TYPE	Threaded End	Solid	Threaded End	Solid	Threaded End	Solid
INTENSITY	High	High	Medium	Medium	Low	Low
VOLUME (BATCH)	10-250 ml	10-250 ml	25-500 ml	25-500 ml	50-1000 ml	50-1000 ml
AMPLITUDE † (in micro meter)	124	61	61	61	35	35
(in inch)	.0049	.0049	.0024	.0024	.0014	.0014

* Available with 3/8" - 24 adapter stepped stud for compatibility with other makes of 20 kHz ultrasonic processors.
** Required when using a tapered microtip. Can not be used with low surface tension liquids. Use a solid probe instead.
*** Required when using a 3/4" (19 mm) extender. Can not be used with low surface tension liquids. Use a solid probe instead.
**** Required when using a 1" (25 mm) extender. Can not be used with low surface tension liquids. Use a solid probe instead.
† With the amplitude control set at 100%. Amplitude at the converter tip: 15 micro-meter (.0006 inch).

High Gain Probes*

ORDER NO.	630-0306**	630-0310**
TIP DIAMETER	3/4" (19mm)	1" (25mm)
TYPE	Solid	Solid
INTENSITY	High	Medium
VOLUME (BATCH)	25-500 ml	50-1000 ml
AMPLITUDE † (in micro meter)	89	71
(in inch)	.0035	.0028

* Available with 3/8" - 24 adapter stepped stud for compatibility with other makes of 20 kHz ultrasonic processors.
** Do not use with a booster, sealed atmosphere treatment chamber, continuous flow cell, cup horn, extender, or microtips.

*** With the amplitude set at 100%. Amplitude at the converter tip: 15 micro-meter (.0006 inch).
† Do not use with low surface tension liquids. Use a solid probe instead. See caution below

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Dual Probe

The dual probe boosts productivity by processing two (25-500 ml) samples simultaneously. Consists of an aluminum coupler **Order No. 630-0562** and two 3/4” (19 mm) solid probes **Order No. 630-0208.** * Output power delivered to each probe is identical, and half that delivered by the power supply. Threaded stud 1/2 - 20. **Order No.630-0525**

The 750 Watt Ultrasonic Processor and dual probe combination is the only system in the industry capable of delivering up to 375 Watts per probe, meeting all EPA requirements specified in Method SW 846-3550.
Order No. BHNVCGD.

Booster

When interposed between the converter and the probe, the booster increases the amplitude of vibration at the probe tip by 100%. Used to process difficult applications. Do not use with a microtip, cup horn, or high gain probe.
Order No. BHNVCGD.

CAUTION: all probes, including those with replaceable tips, are tuned to resonate at 20 kHz ± 100 Hz. If the replaceable tip is removed or isolated from the rest of the probe, that element will no longer resonate at 20 kHz and the power supply will fail. Organic solvents (e.g. methylene chloride) and low surface tension liquids will penetrate the interface between the probe and the replaceable tip, thus carrying the particulates into the threaded section and isolating the tip from the probe. When working with organic solvents or low surface tension liquids, ALWAYS use a solid probe or as an alternate a full wave 10" (254 mm) probe or an extender. NEVER use a probe with a replaceable tip.

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SONICS
Newtown, CT

OPTIONAL ACCESSORIES FOR VC 750, VCX 500 & VCX 750

CAUTION
Do not exceed "MICROTIP LIMIT" on the power supply when using a microtip.

Microtips

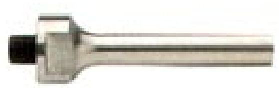
Microtips can process small samples at very high intensity.

The tapered microtip screws into the 1/2" (13 mm) threaded end probe in place of the replaceable tip.

The stepped microtip assembly consists of two parts, and screws into the converter in place of the probe. Capable of reaching into narrower vessels than the tapered microtip, the stepped microtip assembly can process volumes as small as 250 microliters.

Microtips are fabricated from titanium alloy TI-6AL-4V and are autoclavable.

TAPERED MICROTIP



COUPLER

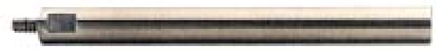
STEPPED MICROTIP

STEPPED MICROTIP ASSEMBLY

.	TAPERED MICROTIP			STEPPED MICROTIP ASSEMBLY†	
ORDER NO	630-0418*#	630-0419#	630-0420#	STEPPED TIP 630-0422	COUPLER 630-0421
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	250µl-10 ml	
AMPLITUDE** (in micro meter) (in inch)	228 .0090	203 .0080	178 .0070	211 .0083	

*Fits 5 ml test tubes. **With the amplitude control set at 40%.
#Screws into an 1/2" (13 mm) threaded end probe.
†Consists of a coupler and a stepped tip. Fits 0.7 ml microtubes.

Extenders



Extenders screw into threaded end probes of identical diameter in place of the replaceable tip. Recommended when working with tall narrow vessels. Extenders are fabricated from titanium alloy TI-6AL-4V and are autoclavable. Also available on special order with threaded ends to accept replaceable tips.*

1/2" (13 mm) half wave extender - 5" (127 mm) long - **Order No. 630-0410**.
3/4" (19 mm) half wave extender - 5" (127 mm) long - **Order No. 630-0409**.
1" (25 mm) half wave extender - 5" (127 mm) long - **Order No. 630-0444**.
3/4" (19 mm) full wave extender - 10" (254 mm) long- **Order No. 630-0518**.
1" (25 mm) full wave extender - 10" (254 mm) long - **Order No. 630-0519**.

*Do not use with low surface tension liquids. Use a solid extender instead. See caution below

Note: Longer extenders are available on special order.
Do not use with high gain probes.

Replaceable Tips

Replaceable tips are fabricated from titanium alloy TI-6AL-4V and are autoclavable.

	1/2" (13 mm)	3/4" (19 mm)	1" (25 mm)
ORDER NO.	630-0406	630-0407	630-0408

CAUTION: all probes, including those with replaceable tips, are tuned to resonate at 20 kHz ± 100 Hz. If the replaceable tip is removed or isolated from the rest of the probe, that element will no longer resonate at 20 kHz and the power supply will fail. Organic solvents (e.g. methylene chloride) and low surface tension liquids will penetrate the interface between the probe and the replaceable tip, thus carrying the particulates into the threaded section and isolating the tip from the probe. When working with organic solvents or low surface tension liquids, ALWAYS use a solid probe or as an alternate a full wave 10" (254 mm) probe or an extender. NEVER use a probe with a replaceable tip.

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SONICS
Newtown, CT

OPTIONAL ACCESSORIES FOR VC 750, VCX 500 & VCX 750

Multi-Element Probe

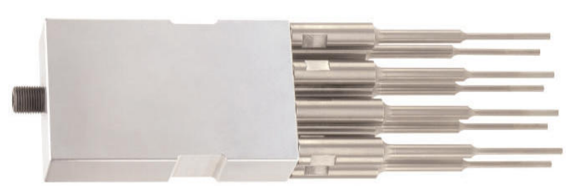
These valuable time saving tools maximize productivity and can be used either manually or with automated systems. The multi-element probes screw into the converter in place of the 1/2" (13 mm) probe. Within 2% variation, the energy delivered to each tip is uniform. With the four, eight, and twenty-four - element probes, the spacing between the tips is 23/32" (18 mm). Length: coupler and stepped microtips is 10 1/4" (260 mm). With the ninety six-element probe, the spacing between the tips is 23/64" (9 mm). Length: coupler and microtips is 7" (175 mm).

MULTI-ELEMENT PROBE	ORDER NO	ULTRASONIC PROCESSOR
20 kHz four-element probe Consists of aluminum coupler and 4 stepped microtips. Aluminum Coupler 1/8" (3 mm) stepped microtip (250 µl – 10 ml)	630-0559 630-0535	500 watt or 750 watt
20 kHz eight-element probe Consists of aluminum coupler and 8 stepped microtips. Aluminum Coupler 1/8" (3 mm) stepped microtip (250 µl – 10 ml)	630-0586 630-0535	500 watt or 750 watt
20 kHz twenty four-element probe Consists of aluminum coupler and 24 stepped microtips. Aluminum Coupler 1/8" (3 mm) stepped microtip (250 µl – 10 ml)	630-0579 630-0535	750 watt
20 kHz ninety six-element probe* Consists of aluminum coupler and 96 stepped microtips. Aluminum Coupler 1/8" (3 mm) microtip (250 µl – 2 ml)	630-0585 630-0584	750 watt

* Must be used with booster Order No. BHNVCGD when working with 2 ml microtubes.

20 kHz FOUR-ELEMENT PROBE

20 kHz EIGHT-ELEMENT PROBE



20 kHz TWENTY FOUR-ELEMENT PROBE

20 kHz NINETY SIX-ELEMENT PROBE

Cup Horns

Cup horns can process samples in isolation without probe intrusion, precluding any possibilities of cross-contamination or airborne pollution. Especially useful when working with radioactive, toxic, pathogenic, and biohazardous materials.

Typical applications include: gentle disruption of cells, lysing of blood cells and platelets, shearing radioactively labeled proteins and DNA, liposome preparation, and releasing cellular material from viruses.

The water-filled cup horn is screwed into the inverted converter in place of the probe. The vibrations produced within the cup induce cavitation inside a test tube(s) immersed in the water. Water can be circulated through the unit to inhibit heat build-up during extended operation. Glass cup facilitates disassembly for cleaning purposes, and in contrast to polycarbonate cup horn with removable plastic fittings is 100% leak proof. The probe is fabricated from titanium alloy TI-6AL-4V. Supplied with floating microtube holder.

Order No. 830-00238 and splash shield.

Note: The intensity of cavitation within the test tube is lower than with direct probe contact.

Order No.	Cup Com-position	Overall Height	Outside Diameter	Inside Diameter	Horn Radiating Face	Accom-modates	Connecting Stud
630-0503	Glass	5" (127 mm)	2" (51mm)	1 1/2" (38mm)	1 1/4" (32 mm)	50 ml Test Tube	1/2" -20. Avaliable with 3/8" -24 adaptor stepped stud to enable connection to other makes of 20 kHz ultrasonic processors
630-0431		6" (152 mm)	3" (76 mm)	2 1/2" (64 mm)	2" (51mm)	150 ml Griffin standard or 200 ml Berzelius tall form	
630-0496		6 1/2" (165 mm)	3 1/2" (89mm)	3" (76 mm)	2 1/2" (64mm)	250 ml Griffin standard or 300 ml Berzelius tall form	

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CE

SONICS
Newtown, CT

OPTIONAL ACCESSORIES FOR VC 750, VCX 500 & VCX 750

Floating Microtube Holder

The plastic microtube holder conveniently suspends 8 microtubes inside the 2 1/2" (64 mm) and 3" (76 mm) cup horn. Holder floats and keeps tubes at a constant depth inside the cup horn, regardless of the water level. Pressure plate holds tubes firmly in place.
Order No. 830-00238

Sealed Atmosphere Treatment Chamber

The sealed atmosphere treatment chamber screws onto the 1/2" (13 mm) probe. This accessory enables safe batch treatment of toxic, pathogenic, and biohazardous materials at high intensity. Ports located above the sample level permits purging with an inert gas, or capturing released gases. An integral cooling jacket, through which a suitable cooling liquid can be circulated, inhibits heat build up during extended operation. 50 ml capacity. Stainless steel. Autoclavable.
Order No. 830-00086

Continuous Flow Cell

The continuous flow cell screws onto the 1/2" (13 mm) probe. Recommended for the treatment of low viscosity samples, which do not require extended exposure to ultrasonics. Designed primarily for dispersing and homogenizing at rates up to to 20 liters/hour, 50 psi (345 kPa/3.45 bar). Fitting accepts 5/16" (8 mm) tubing. Stainless steel. Autoclavable.
Order No. 630-0495

Rosett Cooling Cell

The Rosett cooling cell enables uniform treatment at low temperatures. The cell is placed in a cooling bath. The liquid forced by the ultrasonic energy circulates repeatedly under the probe and throughout the cooling arms.
30 ml Rosett cooling cell.
Order No. 830-00003

Glass Cooling Cell

10 ml cooling cell with water jacket.
Order No. 839-00009

100 ml cooling cell with water jacket.
Order No. 830-00010

300 ml Rosett cooling cell
Order No. 830-00001

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SONICS
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OPTIONAL ACCESSORIES FOR VC 750, VCX 500 & VCX 750

Converter Clamp

The converter clamp is designed to securely support 2 1/2” (64 mm) diameter converter onto standard stands with 1/2” (13 mm) or smaller diameter support rod. Heavy duty black anodized clamp for industrial applications.
Order No. 830-00105

Light duty chemical-resistant reinforced plastic converter clamp.
Order No. 830-00116

Support Stand

Heavy black enameled cast-iron base and zinc-plated rod.
Base size: 51/2” x 9” (140 x 229 mm).
With 1/2” (13 mm) diameter – 24” (609 mm) long rod.
Order No. 830-00109

Footswitch

For hand-free remote operation
10´ (3 mm) cable
Order No. 830-00004

Sound Abating Enclosure

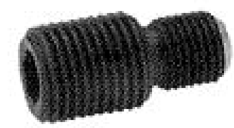
Even though ultrasonic vibrations are above the human audible range, ultrasonic processing produces high-pitched noise in the form of harmonics, which emanate from the vessel walls and the fluid surface. The sound abating enclosure permits extended processing without discomfort by reducing that noise by 35 dB. The converter cable is introduced through an opening in the top. Four side access ports accommodate the tubing delivering the coolant and the sample to the processing vessel while the door is closed. The unit is faced on the exterior with white laminate and on the interior with white waterproof noise abating material. The access door permits observation during treatment and protects the operator against accidental splashing. Support rod and converter clamp are included.

Outside dimensions (H x W x D): 30” x 14” x 14” (762 x 355 x 355 mm)
Order No. 630-0427

Laboratory Jack

Adjustable elevation from 2 1/2" (64 mm) to 10" (254 mm).
Top plate: 6" x 5" (152 x 127 mm).
Order No. 830-00113

Adapter Stepped Stud



3/8" - 24 to 1/2" - 20. Enables most other makes of 20kHz probes to be connected to our converters, and our probes to be connected to most other makes of 20 kHz converters.
Order No. 631-0101

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OPTIONAL ACCESSORIES FOR VC 130 AND VC 130PB

Rosett Cooling Cell

The Rosett cooling cell enables uniform treatment at low temperatures. The cell is placed in a cooling bath. The liquid forced by the ultrasonic energy circulates repeatedly under the probe and throughout the cooling arms.
30 ml Rosett cooling cell.
Order No. 830-00003

Glass Cooling Cell

10 ml cooling cell with water jacket.
Order No. 830-00009

100 ml cooling cell with water jacket.
Order No. 830-00010

Micro Cup Horn

The micro cup horn can process a sample in isolation without probe intrusion, precluding any possibilities of cross-contamination or airborn pollution. Especially useful when working with radioactive, toxic, pathogenic, and biohazardous materials. Typical applications include: gentle disruption of cells, lysing of blood cells and platelets, shearing radioactively labeled proteins and DNA, liposome preparation, and releasing cellular material from viruses.

The water-filled micro cup horn screws into the inverted converter in place of a probe. The vibrations produced within the cup induce cavitation inside a test tube(s) immersed in the water. Water can be circulated through the unit to prevent heat build-up during extended operation. Glass cup facilitates disassembly for cleaning purposes, and in contrast to polycarbonate cup horns with removable plastic fittings, is 100% leakproof. Note: The intensity of cavitation within the test tube is lower than with direct probe contact.

Inside diameter: 25 mm (1"). Probe: Titanium alloy: TI-6AL-4V.
Order No. 630-0447

Converter Clamp

Designed to securely support 1 1/4” (32 mm) diameter converter, this black chemical-resistant reinforced plastic converter clamp mounts onto standard stands with 1/2” (13 mm) or smaller diameter support rod.
Order No. 830-00118

Support Stand

Heavy black enameled cast-iron base and zinc-plated rod.
Base size: 51/2" x 9" (140 x 229 mm).
Rod size: 1/2" (13 mm) diameter - 24" (609 mm) long.
Order No. 830-00109

Footswitch

For hand-free remote operation
10´ (3 mm) cable
Order No. 830-00004

Not Compatible with VCX 130PB

Sound Abating Enclosure

Even though ultrasonic vibrations are above the human audible range, ultrasonic processing produces high pitch noise in the form of harmonics, which emanate from the vessel walls and the fluid surface. The sound abating enclosure permits extended processing without discomfort, by reducing the noise by 35dB. The probe assembly is mounted on a support rod and placed inside the enclosure. The converter cable is fed through an opening in the top. Four side access ports accommodate the tubing delivering the coolant and the sample to the processing vessel while the door is closed. The unit is faced on the exterior with white laminate, and lined on the interior with white waterproof noise abating material.

The access door permits observation during treatment, and protects the operator against accidental splashing.

Outside dimensions:12" W x 12" D x 20" H (300 x 300 x 510 mm). **Order No. 630-0451**

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Newtown, CT USA

Plastics Assembly Systems

Model 1098

Ultrasonic

Ultrasonic welding joins plastics by rapidly transmitting ultrasonic energy through a shaped tool or "horn". This ultrasonic energy, in the form of mechanical vibrations, creates friction between the two plastic parts which, in turn, generates heat to melt and permanently fuse the two parts with one another. This technique is fast, efficient, and reliable.

Since no adhesives, solvents or mechanical fasteners are used, ultrasonically welded thermoplastic parts can be readily identified as being recyclable.

The process eliminates employee health risks and added costs associated with the use of adhesives and solvents.

In addition to welding, ultrasonic systems can be used to insert, stake, and spot weld a wide range of materials in various sizes through 15 kHz, 20 kHz or 40 kHz.

Sonics' systems may be automated to synchronize with a moving assembly line or operated manually at a single station. Special systems can be designed with multiple heads or rotary index tables.

40 kHz 20 kHz 15 kHz

Sonics' ultrasonic equipment is supplied with a choice of several different power supplies. The power supplies are available with outputs of 700 watts at 40 kHz, 1000, 1500 and 2000 watts at 20 kHz, and 2500 and 4000 watts at 15 kHz.

These power supplies can be coupled with pneumatic presses or electric stepper motor presses.

Click here to learn more about Sonics' power supplies.

Sonics FD Power Supply

ISO 9001 Registered

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Services

More Than Innovative Equipment

Sonics designs, implements, and maintains real-world manufacturing solutions that can meet and exceed your standards. The fact that over 75% of our business is derived from our existing customer base is a clear indicator of our ability to seamlessly integrate superior technology with superior service and support.

But even that is not enough, which is why we are equally committed to your total satisfaction before, during, and especially after the sale.

Applications Lab

We maintain a fully equipped laboratory to test sample parts for their weldability and to determine the best process for assembly. Sonics' applications engineers will determine the optimal way to develop individual assembly stations and provide you with joint design recommendations, thus helping you avoid costly trial and error experimentation.

Technical Support

Our expert staff of plastics assembly engineers is always available for design consultation, equipment troubleshooting, application analysis, second opinions, or to answer any questions you may have. Their expertise is derived from continuous product improvements, enhancements, and technological breakthroughs.

Technical Seminars

Comprehensive educational seminars on the various plastics assembly processes are given regularly at our corporate headquarters in Newtown, CT, and in major cities around the world. These in-depth sessions are frequently updated to reflect the latest technological advances and can provide immediate as well as long-range benefits to participants and their companies. Alternatively, these seminars may be customized exclusively to your company's training needs.

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Industries Served

The following is a list of products and industries that utilize Sonics' equipment. If your application is not listed, call us or fill out the Information Request Form to explore the ways in which Sonics can enhance your processes.

Ultrasonics

- ***Housewares/Appliances***
  Coffee Makers
  Hair Dryers
  Washing Machines
  Dishwashers
  Clothes Dryers
  Vacuum Cleaners
  Insulated Cups & Cup Handles
  Tools
  Hot Plates
  Mops
  Brooms
  Toothbrushes
  Refrigerator Components
  Floats

- ***Novelties***
  Toys
  Ballpoint Pens
  Photo Albums
  Whistles
  Sporting Goods

- ***Medical***
  Catheters
  IV Components
  Valves
  Tubing
  Disposables
  Syringes
  Containers
  Instruments
  Cartridges

- ***Computer/Electronics/ Electrical***
  Housings
  Connectors
  Sockets
  Switches
  Inserts
  Calculators
  Flash Lights
  Telephones
  Batteries
  Toner Cartridges

- ***Textile & Apparel***
  Blankets
  Carpets
  Drapes
  Garments
  Pads
  Lingerie
  Roping
  Nets
  Belts
  Sheets

- ***Automotive***
  Instrument Clusters
  Tail Light
  Back Up Lights
  Side Markers
  Inner Door Panels
  Floor Carpeting
  Filters
  Sensors
  Tanks
  Battery Parts
  Hub Caps
  Cup Holders
  Shoddy Pad
  Speaker Grille
  HVAC Staking

- ***Home Entertainment***
  TV
  Stereos
  Radios
  Video Cassettes
  Audio Cassettes

- ***Packaging***
  Squeeze Tubes
  Zipper Bags
  Grocery Bags
  Plastic "Clamshells"
  Containers
  Pour Spouts

Spin Welding

- ***Automotive***
  Canister
  Radiator Core Plug
  Fuel Tank Cap
  Fuel Filter
  Hose Barb Fittings
  Motorcycle Fuel Tank
  Vacuum Hose Connector

- ***Appliance & General Consumer***
  Washing Machine Parts
  Thermal Mugs & Bowls
  5L Paint Can Lid Ring
  Pool Filtration Canister
  Serving Tray
  Vacuum Cleaner Tank
  Flush Valve

- ***Industrial***
  Vacuum Valve
  Underground Pipe Couplers
  Spray Mask Filter
  Waste Containers
  Brine Tank Flange
  Liquid Dispenser Cap
  Dispenser Nozzle

Hand Gun

- ***Packaging***
  Clamshell Packages

- ***Computers/Electronic***
  Install Inserts into Housings
  P.C. boards assemblies

- ***Textile and Apparel***
  Rug Trimming

- ***Automotive***
  Consoles
  Door Panels
  Instrument Clusters

- ***Agriculture***
  Repair of Conveyor Belts

Vibration Welder

- ***Automotive***
  Carpet to Door Panel
  Glove Box Doors
  Instrument Clusters
  Consoles
  Interior Trim
  Head Lamps
  Tail Lamps

- ***Appliances/Housewares***
  Dishwasher Spray Arms

- ***Medical***
  Chest Drainage Container

Application Evaluation Form

This is only a partial list of applications that utilize our equipment. Click the link above and fill out the Application Evaluation Form so that Sonics can assist you with your assembly process.

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Tooling

Sonics is a leader in the innovative design of tooling for ultrasonic, vibration, spin and hot plate welding. Using the customers' line drawings, CAD files or actual parts, our tooling is designed for optimum life and performance.

Carbide Slug Horns

Sonics accepts the following formats:

- AutoCad (DWG, DXF file formats)
- CATIA
- IGES Files (WireFrame, Surfaces, Solids) Mechanical Desktop
- ProCam
- ProE
- TekSoft

Files can be submitted to the following media:

- 8mm
- CD-ROM
- DAT Tape
- Iomega Zip (100 & 250 Megabytes)
- WinTar Format

Our Ultrasonic Horns Set the Industry Standard

- Ultrasonic horns are designed with an FEA (Finite Element Analysis) simulation program that allows our engineers to observe the vibratory action of the horn prior to fabrication
- Segmented and adjustable fixtures are built to ensure a secure fit with the molded plastic parts
- Contoured fixtures and tools for irregularly shaped parts
- Ultrasonic horns are inspected for even amplitude
- Multi-Element configurations for multiple stakes, spot welds, or insertions
- Fabrication materials include aluminum, titanium, hardened steel, stainless steel and cast polyurethanes
- For added strength and durability, carbide facing (*above*) or chrome plating is applied
- Peripheral devices to clamp, hold and align opposing parts

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Information Request

Thank you for visiting Sonics' Website. Please fill out the form below to receive more information on our plastics assembly equipment product line

Name

Title

Company Name

Address

Address

City **State** **Zip**

Phone **Fax**

E-mail

Are you a current customer of Sonics?

☐ Yes ☐ No ☐ Former Customer

Are you presently using plastics assembly equipment to assemble your plastic components?

☐ Yes ☐ No

If yes, what type and brand

What is your time frame for purchasing ultrasonic plastics assembly equipment?

☐ Immediate ☐ Weeks ☐ Months ☐ Gathering Information

What product(s) are you interested in learning more about? (Check all that apply)

Ultrasonic Welding

☐ 15 kHz ☐ 20 kHz ☐ 40 kHz ☐ Hand Gun ☐ Electropress

☐ Vibration Welding

☐ Spin Welding

☐ Other

How can Sonics assist you in your search for ultrasonic equipment?

- ☐ Have a Salesperson call
- ☐ Product Inquiry
- ☐ Pricing
- ☐ Application Question
- ☐ Service Request
- ☐ Schedule a Demonstration
- ☐ Other

Send Literature

☐ Brochure ☐ Data Sheets ☐ Manual ☐ Drawings

How were you referred to our web site?

☐ Advertisement	Name of Trade Magazine	
☐ Trade Show	Name of Conference or Exhibition	
☐ Internet Search	Name of Search Engine	
☐ Referral	By:	
☐ Other		

Special Comments or Inquiries

Submit

PLASTICS ASSEMBLY APPLICATION EVALUATION REQUEST FORM
Please fill out the form below to receive more accurate and detailed feedback from Sonics regarding your plastics assembly needs.

Click Here to Download Form

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Trade Show Schedule

2005			
Show & Location	**Date**	**Booth #**	**Web Site**
West Pack Anaheim, CA	January 10-12, 2005	4366	www. westpackshow.com
MD&M East New York, NY	June 13-15, 2005	1354	www.mdmeast.com
Pack Expo International Las Vegas, NV	September 26-28, 2005	N9206	www.packexpo.com
Assembly Technology Expo Chicago, IL	September 27-29, 2005	935	www.atexpo.com

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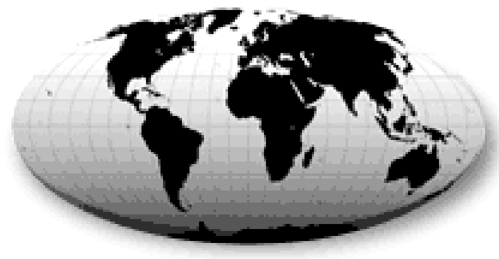
Technical Information

This page contains product information, manuals and brochures on Sonics Plastic Assembly Equipment. If you do not find what you are looking for please go to our Information Request page or call us.



Plastics Assembly Equipment Data Sheets

15 kHz Ultrasonic Assembly Systems

20 kHz Ultrasonic Assembly Systems

40 kHz Ultrasonic Assembly Systems

ElectroPress™ Plastics Assembly Systems

Hand Held Welders for Plastics Assembly

Vibration Welder

Spin Welder

Servo-Controlled Hot Plate Welder

New Model 2050 20kHz Welding System

New Model 2055 20kHz Welding System

Technical Bulletins

Microprocessor Technical Bulletin

Joint Designs for Ultrasonic Welding

Ultrasonic Staking & Spot Welding of Thermoplastic Assemblies

Ultrasonic Installation of Inserts in Thermoplastic Components

Characteristics of Thermoplastics for Ultrasonic Assembly Applications

Product Manuals

Model FC Power Supply

Model FM Power Supply

Model FD/FDL Power Supply

Model 1595 Press / 1596 Actuator 15 kHz

Model 4095 Press / 4096 Actuator 40 kHz

New Models 2050 / 2055 20kHz Welding Presses

Model 1098 Press 20 kHz

Model 1099 Press / 1096 Actuator 20 kHz

Model H520/H540 Hand Held Welders

ElectroPress™

Sonics' Plastics Assembly

Brochure

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News & Press

Press Releases

- Sonics Opens Sonics & Materials UK Ltd.
- Sonics Introduces New Rigid 20kHz Model 2055 Plastic Welding Press
- Sonics Expands Reach in U.S. and Overseas
- Sonics Introduces New Rigid 20 kHz Model 2050 Plastic Welding Press
- Sonics Offers New Rigid-Mount 30kHz and 40kHz Converters
- New Literature for 20 kHz Ultrasonic Plastics Assembly Systems
- New 6000 Watt 15 kHz Power Supply Design for Ultrasonic Plastics Assemblies
- Sonics Introduces an Ultrasonic 40 kHz Hand Held Welder, Model H-540
- New Wide Bed Vibration Welder for Large Thermoplastic Parts
- Sonics Features A Rainbow Effect Within Its New Corporate Brochure
- Sonics' Announces A Pistol Grip Attachment For Its Ultrasonic Hand Held Welder
- Sonics Announces a Patent For Producing Fabric Covered Plastics
- Sonics' Stapler Attachment Is Ideal For Sealing Clamshell Packages
- Sonics Announces New Windows Based Controls For Its Vibration Welder
- Sonics Introduces A Servo-Controlled HotPlate Welder
- Sonics Exhibits Remarkable Control
- Sonics Introduces an Enhanced Ultrasonic 20 kHz Hand Held Welder
- Sonics' Manual Press Offers Precision for Small Quantities of Plastics Assembly
- Sonics Offers a New Innovative Spin Welder Design for Thermoplastic Assembly

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URL

Include a short description of your site (200 max character length) 200 Characters left

Your contact information is required in case we need to get in touch with you

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Confirm password

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Business

Material Handling Exchange
Leading national suppliers of used material handling equipment including pallet rack, pallet jack, cantilever rack, forklifts, mezzanines, shelving, wire mesh decks, conveyor, carousels,walkie riders.

Omegasonics.com - Ultrasonic Cleaning Systems
We offer ultrasonic cleaning equipment varying from large industrial parts washers to table top cleaners.

PowerTech Services Generators, Inc.
New Jersey based power company, supporting the tri-state area. We deliver, install and maintain a wide scope of your power generators and equipment: from portable to industrial size.

Precision Cylinder, Inc.
An Industrial Leader in Hydraulic Repair. We are your one-stop machine-shop providing repair services for cylinders, pumps, valves, hoses, motors, rods, etc. PCI is here for all of your repair needs.

Used Pallet Racks
We are exchanging material handling equipment like Pallet Racks, Pallet Jacks, Shelving, Cantilver Rack, Forklift, Mezzanines, Wire Mesh Decks, Conveyors, Gravity Conveyors, Power Conveyors, Beams.

Used Shelving
Ace Overstock is your source for purchasing used shelving, new & used pallet rack, cantilever rack, wire shelving and industrial equipments at closeout prices!

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Metal Related

Feeler Gages

Eastern Industries - We've been manufacturing precision feeler gages since 1965. We offer custom feeler gages in a wide variety of sizes, shapes, materials and configurations...on time and at competitive prices.

Laser / Resistance Welding Equipment

Unitek Miyachi is the world leader in Equipment and Systems for Resistance and Laser Welding, Pulsed Heat Soldering, Microjoining, Wirebond Pull Testing, and Precision Metals Joining.

Metal Bellows

We are a premier manufacturer of metal and welded bellows for the aerospace, down hole, flight, electrical and switchgear, and transducer markets.

Plasma Cutter from Sheet-Metal-Supply.com

All the sheet metal fabrication information, tools and equipment you need to do the job right. A huge selection of brand name welders, plasma cutters, English wheels and more at unbeatable discounts.

Pull Carts By DJ Products, Inc.

DJ Products, Inc. manufacturers push pull carts, platform trucks, lift tables and more for the manufacturing, retail, health and automotive industries.

Punches

PUNCHES - Precision Punch Corporation is a premier manufacturer of punches, dies, perforators, forged pins, mold pins, die buttons, blanks, tool blanks, and hardened, precision ground cylindrical parts. In addition to a full line of standard products, Precision Punch manufactures high-precision components to customer specifications for a wide variety of applications and industries.

Quality Fabrications Inc

Fabrication company specializing in welding, fomring, shearing, sawing, fabrication, powder coating, heat treating, and many other services for stainless, steel, aluminum, and galvaneal.

Tungsten Carbide Balls

TRD Specialties can provide balls in any size in any machinable material to meet your requirements. Small or large quantities of uncommon sizes, materials, and tolerances are our specialty. Listed below are a few examples of materials we can produce to your specification. Some of the balls that we provide are chrome steel balls, tungsten carbide balls, and stainless steel balls.

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Plastics Related

Injection Blow Mould Machine
Introduces excellent products of China plastic industry throughout the world. Machinery for pc baby bottle.

Piper Plastics
Dip molding & plastic coating using Plastisol. We specialize in medical products, also fluid bed and Plastisol coatings

Rex Plastics, Inc.
Plastic injection molding, mold design, molds built in house, 12 machines with shot size from .1 grams (.003 oz.) to 26 oz., insert molding, over molding, 2 shot molding, pad printing and assembly.

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Misc.

Air Cleaners-Air Quality Engineering
Manufactures and distributes air cleaners and filtration systems for commercial, home and industrial use.

Ceramic Network
is a leading B2B website in the ceramic industry With the most authoritative, accurate and latest information sources!

Elyria Glassing
Reglassing and glass lining services for the chemical process industry.

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15 kHz Ultrasonic Welder

Low frequency yields impressive results

The 15 kHz system is designed for welding large assemblies at high amplitudes. The horns can be made 33% larger than 20 kHz horns and have a longer resonant length due to the low frequency. Uniform amplitude across the horn yields weld integrity and provides consistent results. The 15 kHz press creates less attenuation in a thermoplastic material, allowing the welding of softer plastics like polyethylene and polypropylene. Optional sound enclosures are available.

Model 1595

- Bench mounted – features a cast aluminum base and integral mounting hub
- Dual non tie-down, anti-repeat palm button circuitry – allows safe control of the system by the operator
- Standard 4" stroke - optional 6" stroke available
- Motorized lift mechanism - raises and lowers the press head during set up

Model 1595 Stand

Model 1596

- Slimline actuator
- Designed for automated systems – ideal where space is at a premium, conserving the work environment from bulky machinery
- Mounts on a bridge or any other structural member – allowing more flexibility
- Standard 4" stroke - optional 6" stroke available

Model 1596 Slimline

(Left) Five 15 kHz machines mounted together to weld an automobile carpet with a servo driven table to facilitate the process.

(Right) Sonics' 15 kHz welders are ideal for assembling tailights and other plastic assemblies

EO/M Power Supply

- Microprocessor controlled - welds in either energy or time
- Calibration pulse prior to every weld
- Stores and sequences up to nine jobs
- Output to a CRT/monitor
- 2500 or 4000 watts output

ET Power Supply

- Automatic frequency control
- Overload Protection Circuitry
- Digital Timer Controls
- LED front panel display
- 2500 or 4000 watts output

Sound Enclosure

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20 kHz Ultrasonic Welder

Model 1098

Sonics offers to the plastics industry its core product, the 20 kHz system. This frequency has become the industry standard because it creates the necessary power and amplitude to enable the melting of most thermoplastic components.

An ultrasonic system is composed of a press (actuator) and a power supply. All of our 20 kHz presses have dual speed controls, linear ball bushings, 4" stroke air cylinder, and positive stop adjustment. Standard gain ratios are available for process optimization.

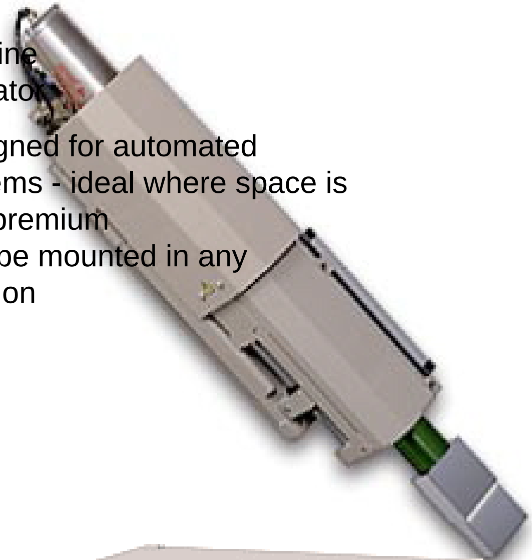
- Bench Top Model - features a cast aluminum base and removable mounting hub
- Dual Non-Tie Down Anti-Repeat Palm Buttons -allows safe control of the system by the operator. Optional non-contact cycle start buttons available.
- Front Mounted Emergency Stop
- Easy Set-Up - Front panel has controls for the pressure gauge, regulator, and head down switch (1098 only)
- Counter Balance Spring
- Round 3 1/2" diameter steel column - for radial alignment.
- Snap in Converter - rotates 360 degrees
- Optional Upper and Lower Limit Switches
- Optional Sound Enclosures Available

- Similar to the 1098 model - a slimline actuator mounted onto a column and base. This model does not have front panel controls
- In-line Mounted Air Cylinder

Model 1096

- Optional Precision Regulator - allows the head to travel with more precision to the plastic part

Model 1099



- Slimline Actuator
- Designed for automated systems - ideal where space is at a premium
- Can be mounted in any position

Sonics' F Series Power Supplies Include:

- FM - Welds to time or energy
- FO/ML - Welds to time, energy, or distance
- FD - Welds to time
- FDL - Welds to time or distance
- FC - Continuous duty
- Outputs of 1000, 1500 and 2000 watts

[Click here to learn more about Sonics' power supplies.]

FD Power Supply

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40 kHz Ultrasonic Welder

High frequency yields gentle action

Sonics' 40 kHz welder enables welding of delicate and small, close-tolerance assemblies where applied force, pressure, and vibrations need to be minimized. Due to the low amplitude, there is less stress to the welded part. The 40 kHz press is small, fast, precise, and virtually inaudible. Typical applications include printed circuit boards, microelectronic components, and medical devices.

Model 4095

Model 4095

- Bench mounted – features a cast aluminum base and removable mounting hub for ease of adapting into special systems
- Dual non-tie down anti-repeat palm buttons – allows safe control of the system by the operator. Optional non-contact cycle start buttons available
- Front mounted emergency stop – rapidly aborts the weld cycle
- Positive stop adjustment
- Dual speed controls
- Optional upper and lower limit switches
- Optional Linear Encoder

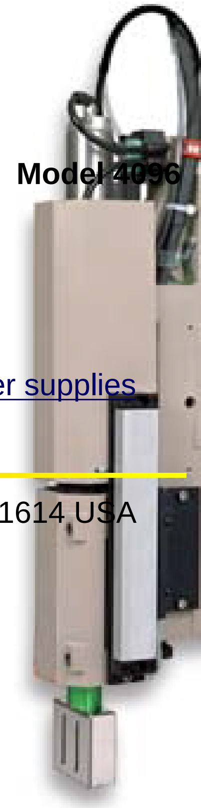
Model 4096

- Slimline actuator
- Designed for automated systems – ideal where space is at a premium, conserving the work environment from bulky machinery
- Mounts onto a bridge or any other structural member – allowing more flexibility

Sonics' F Series Power Supplies Include:

FM Power Supply

- FM - Welds to time or energy
- FO/ML - Welds to time, energy, or distance
- FD - Welds to time
- FDL - Welds to time or distance
- FC - Continuous duty
- Output of 700 watts



Model 4096

Click here to learn more about Sonics' power supplies

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Ultrasonic ElectroPress™

Model 20 EP

Model 40 EP

Remarkable Control made possible

Sonics' ElectroPress™ features a stepper motor drive that controls the advancing speed and final position of the ultrasonic horn. The system is designed for high precision, close tolerance applications as well as applications that require special materials or delicate components. Combined with Sonics' FM Power Supply *(Below)* and linear feedback encoder, the press is capable of controlling the final weld position to a tolerance of 0.0003" (0.008 mm) through a broad range of velocities. This yields repeatable welds with exact final dimensions of the bonded components.

Features & Benefits

- **Rigid Mount Booster** - minimizes horn deflection through the elimination of springs, o-rings, and other flexible components
- **Software Interface Package** - for programming trigger force, weld velocity, and weld distance parameters
- ***Monitor/Log Menu Selection*** - captures weld and distance data and presents a one-line status after each weld
- ***Power vs. Time Graph*** - monitors an application during the set-up and qualification period illustrating the effect of changing the distance and velocity control settings

Rigid Mount Booster

Supplied with Sonics' FM power supply

- ***Calibration Pulse Prior to Every Weld***
- ***Line Voltage Regulation Circuitry*** - provides constant RF voltage to the converter regardless of incoming voltage fluctuations, resulting in constant amplitude
- ***Load Regulation*** - maintains constant amplitude at the horn face.
- ***Starts Under Heavy Loads***
- ***Microsonic***™ ***Processor*** - permits data collection for SPC analysis and performs process monitoring

EP Controller with FM Power Supply

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Ultrasonic Hand Held Welder

Ideal For Manual Operations

Sonics manufactures two 500-watt hand held ultrasonic welders for plastics assembly in frequencies of 20 kHz and 40 kHz. They are designed specifically for welding, staking, inserting, and spot welding applications. These lightweight hand guns are ideally suited for manual operations with low volume production requirements or for assembling parts with difficult to reach weld areas.

The units consist of an ultrasonic power supply and a 1.5 lbs. (.68 kg) hand gun with a 10' RF cable. The 20 kHz hand guns are supplied with integral ½" (12.7 mm) diameter titanium front drivers with replaceable flat face tips. Additional standard and custom tips are available. The 40 kHz hand gun is supplied with a removable horn.

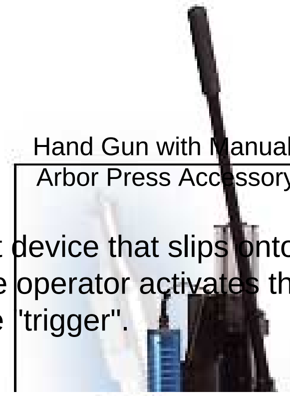
Model H520/CV52

Features & Benefits

- Power supply - features autotune circuitry, line voltage regulation, load regulation, and constant amplitude throughout the weld process
- Microprocessor based programmable timer - for weld times from 0.1 to 9.9 seconds
- Digital amplitude control
- Standard DB9 Input/Output connector - interfaces with automated machines
- Overload protection circuitry - for the power supply and converter

Accessories

The Manual Arbor Press *(right)* is designed specifically for low volume production or prototype work. This press is available with foot switch actuation or cam actuation.



Hand Gun with Manual Arbor Press Accessory

Pistol Grip Hand Held Welder

The Pistol Grip *(left)* is a lightweight device that slips onto the standard model hand gun. The operator activates the ultrasonics by simply pulling on the "trigger".

The Stapler attachment *(right)* is ideally suited for sealing low production rate clamshell packages.

Hand Held Welder with Stapler Attachment

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Vibration Welder

Features & Benefits

- Touch screen display
- Windows™ NT operating system
- Welds in time, distance, or energy
- Process data collection capabilities
- Modem for remote diagnostics and software upgrades
- Auto-tune circuitry
- Powerful drive mechanism
- Smallest footprint in the industry
- Largest lift table in the industry
- Safety light curtains

Sonics' Vibration Welder is generally used to weld larger plastic components together, has the ability to bond a wider variety of plastics, and affords maximum flexibility in accommodating unusual shapes and sizes up to 48" x 22" x 20" (1220mm x 560mm x 508mm).

In this technology, vibrations are generated when magnets on either side of the welding head are rapidly turned on and off at low frequencies of 200 Hz to 250 Hz. A non-vibrating part is hydraulically lifted from below to meet a horizontally vibrating part. The vibrations cause friction and heat, melting the plastic, and an impenetrable bond is effectuated between the plastic parts

Applications that have been successful using the Vibration Welder include door panels, carpeting, glove boxes, air spoilers, resonators, and automotive lenses.

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Spin Welder

Model 1010

Perfect for Cylindrical Parts

Spin Welding is the technology of choice when assembling round or cylindrically shaped parts and in particular, parts molded in semi-crystalline materials. During the spin welding process, one plastic component is spun against a mating plastic component that is held stationary in a nest. The friction created by the spinning of one part against its mating part, under applied pressure, generates heat to melt and fuse the two plastic parts together.

The spin welder has been successful in welding a variety of filters, pump housings, tanks and pressure vessels, insulated containers, hose fittings, rigid tubing, piping and pails.

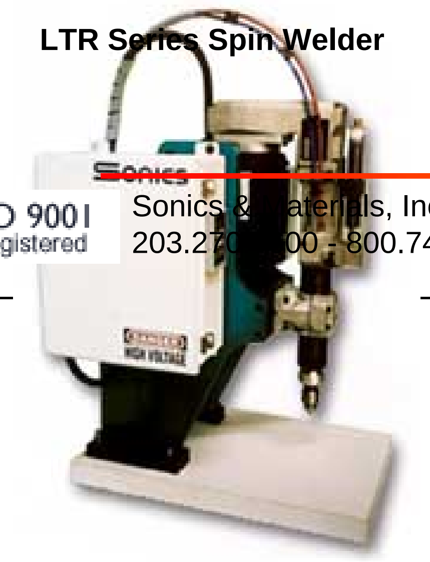
Power Supply

In addition to our standard equipment, we offer customized spin welding machines and systems. Some examples include radially orienting spin welders, horizontal designed welders to handle long extrusions, and machines that are designed and built for automated in-line assembly systems

Features & Benefits

- Ability to melt a significant amount of material at the joint interface
- Hermetically seals various applications
- Bonds materials with fillers such as glass
- Accommodates virtually any diameter part with proper torque and rpm
- Handles virtually any length extrusion

LTR Series Spin Welder



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SONICS
Newtown, CT USA

F Series Power Supplies

For 20 kHz and 40 kHz Systems

Standard Features

- Automatic Tuning - matches the frequency of the power supply to the converter/booster/horn
- Line Voltage Regulation Circuitry - provides constant RF voltage to the converter regardless of incoming voltage fluctuations, resulting in constant amplitude
- Load Regulation - maintains constant amplitude at the horn face
- Start Under Heavy Loads

- Overload Protection Circuitry - prevents damage to the internal components if the system is operated under adverse conditions
- Input/Output Ports - Controls or monitors the functions of the power supply via a PC or PLC
- Modular - Plug in boards for easy service
- Nominal Output - 20 kHz: 1000, 1500, 2000 watts / 40 kHz: 700 watts

FM Power Supply

- Microprocessor controlled - welds in energy or time
- Calibration pulse prior to every weld - samples the system's power requirements prior to every weld to ensure accurate and consistent performance
- Force triggering capability - provides accurate and repeatable starting trigger pressure
- Easy to use keypad operator interface
- Stores and sequences up to nine jobs
- Reset/Reject Alarm or Signal
- Auto-On Capability


FM Power Supply

FO/ML Power Supply

- All of the features of the FM power supply with a Linear Encoder for distance welding - depths assured to +/-0.001" (0.025 mm), allowing greater control of precision welding operations in either absolute or incremental modes.

FD Power Supply

- Digital Timer Controlled - welds in time only, Delay, weld hold, and repulse time adjustable from 0.00-9.99 seconds
- Back Lit Two-Line LCD Display - easy to read alphanumeric panel in either English or metric
- Stores up to Ten Jobs
- "Power On" Recall of Last Stored Job
- Reset/Reject Alarm or Signal
- Easy to Use Keypad Operator Interface

FD Power Supply

FDL Power Supply

- All of the features of the FD power supply *(above)* with a Linear Encoder for distance welding-depths assured to +/-0.001" (0.025 mm), allowing greater control of precision welding operations in either absolute or incremental modes

FC Power Supply

- Continuous Duty - designed for applications requiring continuous sealing or controlling of sonics by an automated system
- I/O to PLC or PC
- Available in Modular Form - mounted on an aluminum plate for direct mounting within a machine frame

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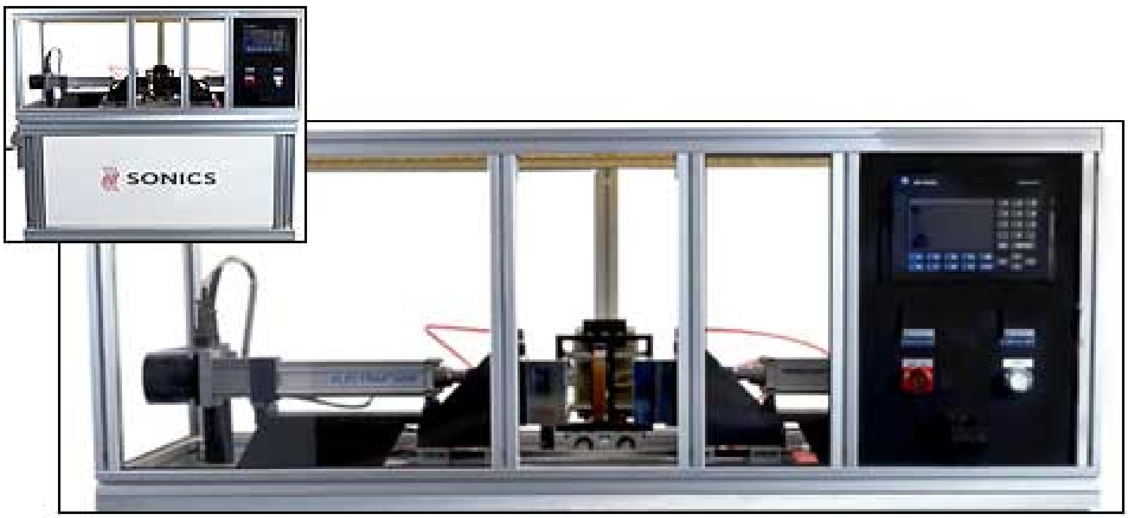
Additional Solutions

Hot Plate Welding - allows the flexibility to weld both semi-crystalline and amorphous thermoplastic materials by either radiant or direct contact heat. Since there is no relative motion between the joints of the parts, complex shapes can be easily welded.



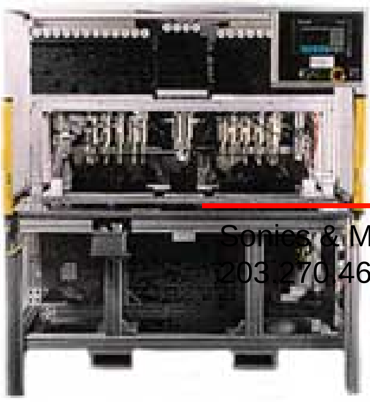
Servo-Controlled Hot Plate Welder

Hot plate Welders are available with pneumatic, hydraulic, or servo-controlled actuation and feature programmable temperature and cycle controls.

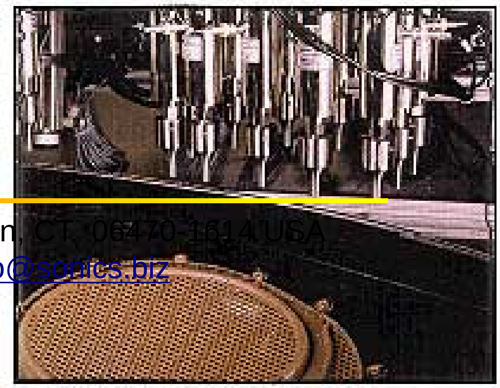
Heat Staking & Inserting - these presses, both manual and pneumatic, are available for single or multiple staking points or threaded insert applications. Unlike ultrasonic horns, heat staking and insertion tools can be designed in multiples over a large surface with different planes. The process is very cost effective due to its ability to stake or insert multiple points simultaneously.

Hot Air/Cold Staking - recommended for similar, but more difficult to stake, applications as heat staking equipment. However, by using the hot air/cold staking process, tighter staking results can be achieved.

Special Systems - can be designed with multiple heads or rotary index tables to meet customer's high production demands or unique production



requirements.



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SONICS

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15 kHz
Ultrasonic Plastics Welding Systems

Models **1595** **1596**

Available with 2500 Watts and 4000 Watts

Model 1595 Bench Press

General Description

The 15 kHz welder extends the range of our capabilities for assembling large parts. With 15 kHz, most thermoplastics can be welded faster and, in most cases, with less material degradation than with 20 kHz. Parts marginally welded at 20 kHz, especially those fabricated from the high performance engineering resins, can be effectively welded at 15 kHz.

At lower frequencies, horns have a longer resonant length and can be made larger in all dimensions.

Horns with a greater area and higher amplitude facilitate the welding of larger assemblies. Uniform amplitude across the horn increases the integrity of the weld, greatly improving results.

Another important advantage of using 15 kHz is that there is significantly less attenuation through a thermoplastic material, permitting the welding of many softer plastics, and at greater far field distance than had previously been possible.

Standard features include:

- Automatic calibration pulse prior to every weld (microprocessor models only)
- Electronically adjustable output control enables precise amplitude selection. (Not available on 4000W units)
- Piezoelectric force transducer ensures accurate and repeatable starting trigger pressure (microprocessor models only)
- 360° snap-in converter simplifies mounting and adjustment
- Clamp Force at 100 psig/1256 lb. (5587 N)
- Pre-trigger capability standard
- Independent speed control for head ascent and descent (except 1596 Slimline)
- Thomson liner ball bushings and 1" diameter heavy duty guide rods for optimum rigidity
- RS232 serial port interface (microprocessor models only)
- Pneumatic requirements – clean, dry air at 100 psig
- Motorized press welding height adjustment (except 1596 Slimline)
- External output port for quality control limits and rotary table control (microprocessor models only)
- Enhanced memory capability – stores up to 9 separate jobs and sequences 9 jobs

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ULTRASONIC

For more information: **1.800.745.1105 • www.sonics.biz**

WELDING PRESS DESCRIPTION

Model 1595 Bench Press

The Model 1595 is a bench model press with a rigid cast aluminum base, dual non tie-down, anti-repeat palm buttons and emergency stop. The welding press has a motorized lift mechanism to raise and lower the actuator during setups and adjustment. Front panel controls include individual up and down pressure regulators and gauges, head down switch, and head up and down speed controls. The Model 1595 can be supplied with either the microprocessor or timer controlled power supply.

Model 1596 Slimline Actuator

The Model 1596 is designed specifically for use in automated systems, particularly where space is at a premium. The Slimline head can be mounted in any position on a bridge or other rigid structural member. For maximum reliability and unparalleled smoothness, the welding head is guided on precision ground shafts with low friction Thomson linear ball bushings. The Model 1596 can be supplied with either the microprocessor or timer controlled power supply. A four wire cable is provided for easy activation of the system.

WELDING PRESS SPECIFICATIONS

Model 1595 Bench Mounted Press

- Column Diameter: 3.75" (9.5 cm)
- Down Stroke: 4" (10.2 cm) standard and 6" (15.2 cm) optional
- Air cylinder: 4" (10.2 cm) diameter
- Dimensions:
  Height: 56" (140 cm) Width: (without base) – 10.25" (26 cm)
  Base Dimensions: 16" W x 3.75" H x 25" D (40.6 x 9.5 x 63.5 cm)
  Center line of horn to center of column: 13.5" (34.3 cm)
  Maximum height of horn above work surface: 15" (37.1 cm)
- Weight: 270 lbs. (122.5 kg)

Model 1596 Slimline

- Down Stroke: 4" (10.2 cm) standard and optional 6" (15.2 cm)
- Air cylinder:
  4" (10.2 cm) diameter
- Dimensions:
  Height: 29.5" (74.9 cm), Width: 9.375" (23.8 cm)
  Mounting Holes: (8 places) 0.515" diameter thru
  Center to Center width distance: 8.375" (21.3 cm)
  Center to Center height distance: 6.625" (16.8 cm)
  Center of Horn to Back plate: 5.687" (14.4 cm)
- Weight: 85 lbs. (38.6 kg)

POWER SUPPLY DESCRIPTION

Model EO/M

The microprocessor-controlled power supply, capable of welding in time or constant energy mode, assures repeatable, consistent results. A calibration pulse prior to every cycle separates machine losses from the energy imparted into each component. The system’s keypad, located on the front panel of the power supply, allows assembly parameters such as weld time, hold time, energy desired and quality control limits to be easily entered. The microprocessor controller can store up to nine different jobs and can also be programmed to sequence these jobs. The power supply also features a power monitor, tuning control and overload protection circuitry to prevent damage to the components if the system is operated under adverse conditions. The EO/M power supplies have D type connectors to interface with a printer, monitor, or personal computer for magnetic storage of information or to perform statistical analysis.

Model ET

The ET series time-based power supply is solid state in design, features proven circuitry, and is modular in construction. The power supply incorporates automatic frequency control to eliminate the need for constant adjustment during the welding cycle. For maximum reliability, an overload protection circuit has been incorporated to automatically terminate the welding cycle when the system is operated under adverse conditions. A weld timer covering two ranges and a hold timer are provided on the ET Series power supply. LED front panel lights give a visual display of the timing cycle. Like the EO/M Series power supply, the ET Series features a power monitor and tuning control.

POWER SUPPLY SPECIFICATIONS

EO/M Series

- Frequency: 15 kHz ± 150 Hz
- Power Input: 220 VAC 50/60 Hz
- Power Output: 2500 watts, 4000 watts
- Dimensions: Height 6.375" (16.2 cm), Width 17.25" (43.8 cm)
- Depth: 22.375" (56.8 cm)
- Weight: 61 lbs (27.7 kg)

ET Series

- Frequency: 15 kHz ± 150 Hz
- Power Input: 220 VAC 50/60 Hz
- Power Output: 2500 watts, 4000 watts
- Dimensions: Height 6.375” (16.2 cm), Width 17.25” (43.8 cm)
  Depth: 22.375” (56.8 cm)
- Weight: 61 lbs (27.7 kg)
- Weld Timer: Two ranges .10 - 1 second and .10 - 5 seconds
  Optional 25 second maximum
- Hold Timer: .10 - 5 seconds

Options

- Linear Encoder - allows welding by distance in both incremental and absolute modes
- Automatic or manual sound enclosure

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A3787 UL REGISTERED FIRM ISO 9001

Sonics & Materials, Inc.

SONICS

Sonics & Materials, Inc.

20 kHz Ultrasonic Plastics Assembly Systems

Model 1098 Press with FD Power Supply

Providing over 30 years of plastics assembly solutions, including pioneering ultrasonic plastics assembly technology, Sonics manufactures the most comprehensive, state-of-the-art 20 kHz equipment in the industry.

Sonics' pneumatic equipment consists of a variety of interchangeable presses and power supplies to choose from...

Select a Power Supply

The FD/FDL Power Supply - This unit is our basic digitally timed control system that features an optional linear encoder.

The FM Power Supply - For more challenging applications, this microprocessor controlled power supply offers force triggering capability and allows you to weld in time or constant energy.

The FC Power Supply - Ideal for use in automated systems where the weld parameters are controlled from a PLC or PC, or for continuous sealing applications.

Select a Press

The Model 1098 Press - This press is considered a workhorse in the industry and is our "Best Seller".

The Model 1099 Press - Versatile! This model features an in-line air cylinder for compact design and increased rigidity. The press head or actuator is easily removed for future automation.

The Model 1096 Slimline - If your components require assembly from the side, upside-down or at an angle, the 1096 Slimline is ideal. This actuator can be mounted in virtually any position within an automated assembly line or system.

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Thermoplastic Assembly Solutions for Every Application

20 kHz "F" Series Power Supplies

Standard features:

Automatic Tuning - Automatically tunes to match the stack (converter/booster/horn) frequency
Line Voltage Regulation Circuitry - Provides constant RF voltage to the converter regardless of incoming voltage fluctuations, resulting in constant amplitude
Load Regulation - Maintains constant amplitude regardless of power draw
Output (Amplitude) Control - Fine tune adjustment of output amplitude at the horn face
Soft Start Overload Protection Circuitry - Starts under heavy loads. No mechanical relays. Overload protection occurs in nanoseconds.
Data Communication and Display - English or Metric
Input/Output Ports - To control and/or monitor the power supply functions via remote PLC or PC
Available Power Output (Watts) - 1000, 1500 and 2000 (3000 watt E-Series only)
Input Voltage - 220 VAC nominal (120 VAC optional on 1000 watt power supply)
Dimensions - 6.5" (165 mm) High x 17.0" (431.8 mm) Wide x 22.5" (571.5 mm) Deep
Weight - 25 lbs. (11.3 kg)

FD Power Supply

- Digital Timer Control - Assembly parameters are in time only
- Timer Functions - Delay, Weld, Hold and Repulse- 0.0 to 99.99 seconds
- Job Storage - Save up to 9 individual application settings
- Overload Reset Indicator

FDL Power Supply (not shown)

- All of the above features of the FD Power Supply with a Linear Encoder for weld depth accuracy of +/- 0.001" (0.025 mm) with reject alarm or output signal

FM Power Supply

- Microprocessor Controlled - Weld in time or constant energy mode
- Calibration Pulse Prior to Every Weld - Separates stack loses from actual energy delivered to the assembly ensuring that the same amount of energy is delivered to each part.
- Force Triggering - Programmable force prior to initiating the ultrasonic cycle
- Job Storage - Save up to 9 individual application settings
- Overload Reset Signal
- Reject Alarm and Output Signal
- RS232 Data and Graph Outputs

FO/ML Power Supply (not shown)

- All of the above features of the FM Power Supply with a Linear Encoder for weld depth accuracy of +/- 0.001" (0.025 mm) with reject alarm or output signal

FC Power Supply

- PLC/PC Interface Capability - External control of the ultrasonics on/off and amplitude functions.
- Continuous Duty - For continuous sealing applications·
- Monitors overload conditions.

Features For All 20 kHz presses

Model 1098 Press

- Snap-in Converters - Stack rotates 360 degrees to simplify radial horn alignment
- Hinged door for easy access
- Linear Ball Bushings - Adjustable low friction ball bushings provide maximum reliability and unparalleled smoothness
- 4" (101.6 mm) Stroke Pneumatic Cylinder
- Dual Pneumatic Speed Controls - Controls head advance and return speeds
- Positive Stop - Adjustable threaded stop that limits the downward travel of the horn
- Standard Ratio Aluminum and Titanium Boosters Available
- Optional Linear Encoder
- CNC Precision Machined Components

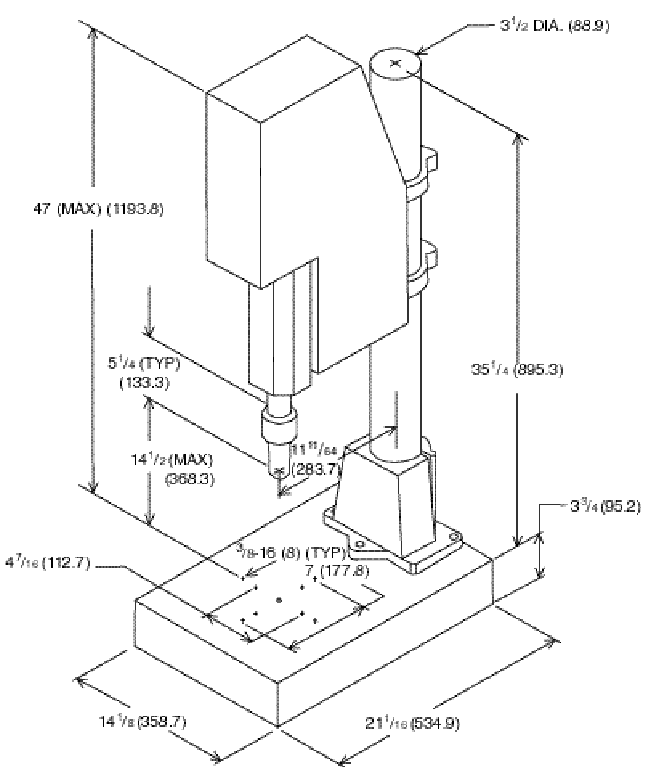
Model 1099 Press

Model 1096 Slimline

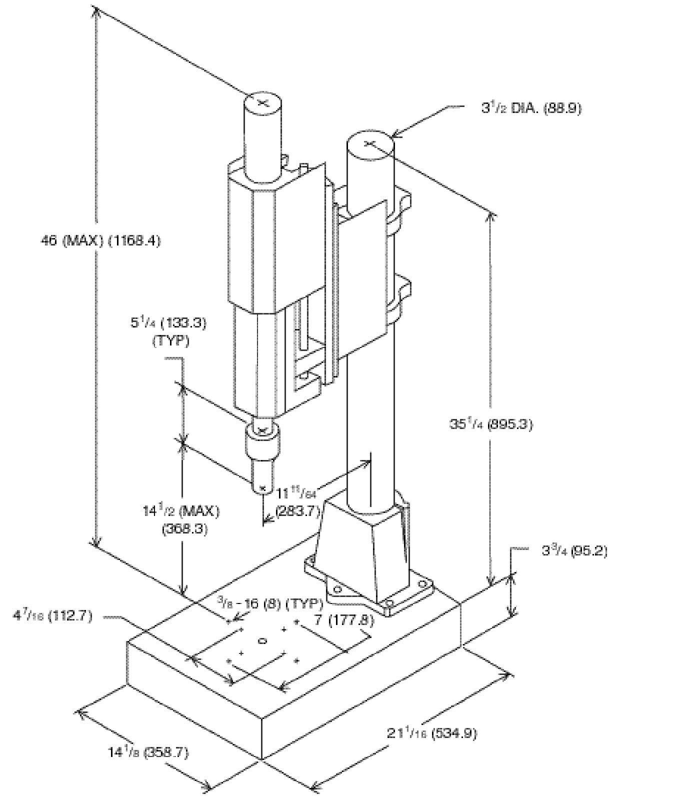
Specifications, Additional Features, and Options

	1098	1099	1096
Dual Cycle Start Buttons	Standard	Standard	N/A
Non-Contact Cycle Start Buttons	Optional	Optional	N/A
Front Emergency Stop	Standard	Standard	N/A
Shortened Pneumatic Stroke (1/4" to 2")	Optional	Optional	Optional
Front Panel Pneumatic Controls	Standard	N/A	N/A
Head Adjust Counter Balance Spring	Standard	Standard	N/A
Sound Enclosure	Optional	Optional	N/A
In-Line Pneumatic Cylinder	N/A	Standard	Standard
Precision Pneumatic Regulator	N/A	Optional	Optional
Linear Encoder	Optional	Optional	Optional
Automation Limit Switches	Optional	Optional	Optional
Rigid Mount Booster	Optional	Optional	Optional
Removable Base Assembly	Standard	Standard	N/A
Extended Length Column	Optional	Optional	N/A
Column Diameter	3.5"	3.5"	N/A
	(88.9 mm)	(88.9 mm)	N/A
Weight	158 lbs.	153 lbs.	30 lbs.
	(71.7 kg)	(69.4 kg)	(13.6 kg)
Clamping Force at 90 psig	441 lbs.	441 lbs.	441 lbs.
	(1961n)	(1961n)	(1961n)
Cylinder Bore Diameter	2.5"	2.5"	2.5"
	(63.5 mm)	(63.5 mm)	(63.5 mm)

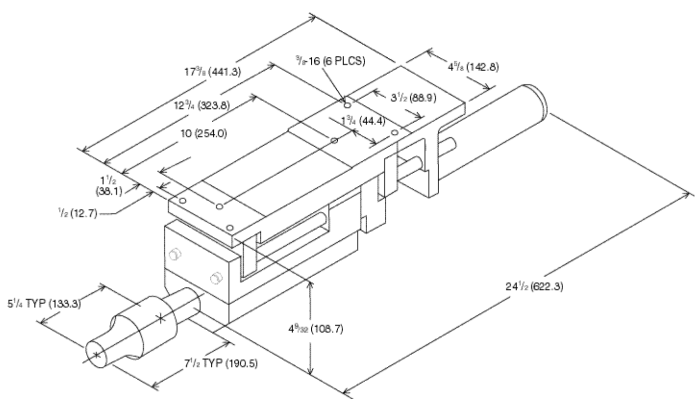
20 kHz Ultrasonic Plastics Assembly Systems: Dimensional Data



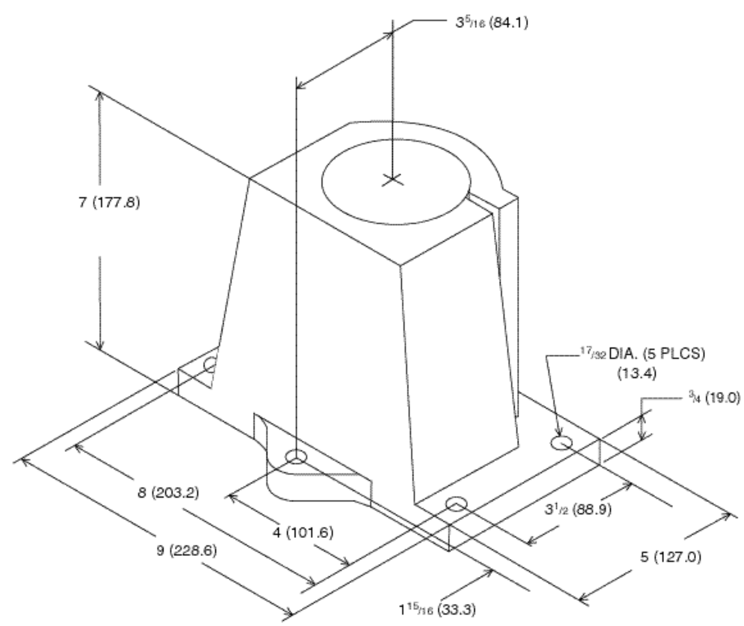
Model 1098 (Dwg SMI-1990-F)



Model 1099 (Dwg SMI-1990-G)



Model 1096 (Dwg SMI-1990-E)



Mounting Hub (Dwg SMI-1990-33)

Dimensions are shown in inches and millimeters, i.e., 1½ (38.1) signifies 1½″ (38.1 mm)

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SONICS

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40 kHz
Ultrasonic Plastics Welding Systems
Models 4095 4096

Model 4095 Welding Press

FM Power Supply

General Description

Ultrasonic welding at 40 kHz is particularly suited for smaller, precision plastic assembly applications that require gentler action. The tooling of 40 kHz welders is one-half the size of units operating at the more common 20 kHz frequency range. This results in a lower amplitude of horn vibration and consequently less stress on the parts being assembled.

The gentler action of 40 kHz ultrasonic welding is fast, precise and virtually inaudible. 40 kHz welders and components are smaller in size and are more readily accommodated where space is at a premium in automated assembly systems.

Typical assembly applications using 40 kHz ultrasonic welders include microelectronic components, printed circuit boards, high-precision assemblies such as intricate medical devices, and plastic parts in which class “A” surface marking is undesirable.

40 kHz is also well suited for ultrasonic staking or riveting, where the controlled flow of the molten plastic is used to capture or retain another component, usually of a dissimilar material.

Sonics offers 40 kHz ultrasonic plastics assembly systems with a power output of 700 watts. Power supplies offer digital control with an available linear encoder, or microprocessor-based systems featuring unique calibration pulse for the most demanding applications.

All of Sonics’ 40 kHz ultrasonic welding equipment can be configured to meet the particular requirements of a wide range of applications.

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ULTRASONIC

40 kHz Ultrasonic Plastics Welding Systems: Features and Specifications

Power Supplies

Sonics' 40 kHz, 700 watt ultrasonic welders offer a wide range of power supplies to meet particular performance and weld control requirements.

All 'F Series' Power Supplies feature auto tuning using phase lock loop (PLL) design which matches the frequency of the power supply to the converter/booster/horn assembly and adjusts to variable temperature and loading conditions. The power supplies are voltage-stabilized and can run at constant amplitude and power across a wide range of voltage inputs. Amplitude setpoint can be controlled by an external PLC or 0-10 V source. Since there are no mechanical relays, circuitry is protected from current overloads in nanoseconds, preventing failures from short circuits or cracked horns. 'F Series' Power Supplies are designed to start under extremely heavy loads.

FD Power Supply

The weld-by-time based FD power supply offers operational parameters that are easily entered by keypad and stored in English or metric units. Weld settings include delay time, weld time, hold time and repulse time. Job memory allows for storage of up to 9 applications and the system includes an overload reset indicator.

FM Power Supply

The microprocessor-controlled FM power supply allows for welding in either a time or constant energy mode and features a unique calibration pulse prior to every weld cycle. Additionally, a force trigger value can be entered to require a pressure load to the application prior to ultrasonic activation. With an overload reset indicator, reject alarm and RS-232 data and graph output, the FM power supply's operational parameters are easily entered via keypad and stored in English or metric units. Job memory allows for storage of up to 9 applications.

FC Power Supply

FC Power Supplies are designed to run continuously for applications requiring high-speed, continuous sealing. Ultrasonics can be on/off activated externally through a PLC when used in automated systems. For OEM's and RF sequencing requirements, power supplies are also available as plate-mounted board "kits" for direct mounting within a machine's control panel.

Welding Stands and Assembly System Configurations

Sonics' standard 40 kHz ultrasonic welders are configured as bench top units or slimline actuators for special automated machinery integration. Ultrasonic "stacks" (converter/booster/horn) are also available for special machinery integration and where multiple RF sequencing stations are required.

Model 4095 Welding Press

The 4095 Welding Press is a bench-top unit with a rigid cast aluminum base, dual, non tie down, anti-repeat palm buttons, and emergency stop. The press has adjustable pressure triggering and an adjustable positive stop. For greater operational flexibility, the power supply can be remotely positioned up to 35 ft. (10.6 m) from the welder.

Model 4096 Slimline Actuator

Designed for use in automated assembly systems, the Slimline head can be mounted in any position on a bridge or other structural member. The welding head is guided on precision linear roller bearing slides and can be matched with all of Sonics' power supplies including FD/FDL, FM and FC models.

Optional Linear Encoder

For more precise weld depth control, an optional linear encoder is available on either the model 4095 press or 4096 slimline actuator with depth of weld accuracy of +/-0.001" (0.025mm)

For extremely high precision, close tolerance depth of weld applications, Sonics' ElectroPress™ with stepper motor drive and FM power supply is recommended. To find out more about the Electropress™, call to request a brochure or visit our web site (specific link for the brochure is: http://www.sonics.biz/technical/ElectroPress.PDF).

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Printed in U.S.A.
5M/03/05

Registered by UL to ISO 9001

A3787 UL REGISTERED FIRM ISO 9001

Sonics & Materials, Inc.

SONICS

ElectroPress™ Ultrasonic Plastics Assembly System

Stepper Motor with Optical Encoder— The ElectroPress™ controls the advancing speed of the ultrasonic horn with a Stepper Motor Drive. Combined with a ball screw actuator, the Stepper System will control the final weld position to a tolerance of +/– 0.0003 in. (0.008 mm). The results are repeatable welds with exact final dimensions of the bonded components.

Other Features and Benefits of the ElectroPress™ include:

- Programmable digital force, velocity, and distance weld parameters
- Rigid mount booster technology
- In-line load cell for precise force trigger
- Linear ball screw actuator
- No air pressure required
- Round or optional square column
- Microsoft Windows 95 or Windows 98 software interface
- Available with 20 kHz or 40 kHz FM Series Power Supplies
- Two Weld Velocities and Distances Available

Sonics & Materials, Inc.

General Description

The ElectroPress™ Ultrasonic Plastics Assembly System is designed for high precision, close tolerance welding applications. Systematic incremental adjustments to velocity and distance, utilizing Sonics' software interface, can provide dimensional repeatability to within ± 0.0003 inch. Welding applications that use special materials or delicate components may also achieve improved results with the ElectroPress™. Some of the industries and types of applications that will benefit from this machine include: medical device applications, electronic industries, and companies that assemble items such as watches, electrical connectors, cellular phones, batteries, and camera components.

ElectroPress™ vs. Pneumatic Press

Ultrasonic plastics assembly differs significantly when using conventional pneumatic welding equipment versus the ElectroPress™. With a pneumatic welder, the applied force on a plastic part is adjusted by modifying the air pressure regulation to the cylinder. The air cylinder continues to travel even after the ultrasonics is turned off, creating the need for a positive stop to prevent the horn from over traveling.

The ElectroPress™ uses an electric stepper motor that converts rotary motion to linear motion, whereas a conventional press uses compressed air. Using compressed air, it is difficult to rapidly change pressure during a weld cycle, whereas with the ElectroPress™ these changes can be made almost instantaneously. The maximum travel distance of the horn is programmable, eliminating the need for a mechanical positive stop. The programmed weld velocity is used to control the applied force. Therefore, with the velocity and distance precisely controlled by the ElectroPress™, the actual weld cycle time will always be repeatable.

Precision control in an ElectroPress™ is enhanced through a rigid mount booster that prevents horn deflection. The booster is used to locate the stack assembly into the actuator head. The rigid mount booster has zero resilience and stack deflection. A typical pneumatic press contains a booster with o-rings. This may, under certain welding conditions, move and distort as the load is applied, resulting in horn deflection on the parts. The precision of the ElectroPress™ is further improved through the use of a rigid strain gauge load cell, yielding more accuracy than the flexible force trigger mechanism in a conventional press.

SONICS

Computer Interface and Requirements

Sonics provides a software interface package for programming the trigger force, weld velocity, and weld distance parameters of the ElectroPress™. Once the application is set up and running properly, the computer may be removed. The system will then run the ElectroPress™ setup program without further commands from the computer. Sonics can supply and set up a PC for the ElectroPress™ Utility Program for an additional charge or the customer may provide a base computer with the appropriate requirements. The recommended minimum computer requirements for the ElectroPress™ are as follows:

- Pentium 200 MHz.; 32 Meg Ram; 2 Gig Drive
- Minimum of two COM ports—COM 1, 2, 3 or 4
- Windows 95 or Windows 98 environment

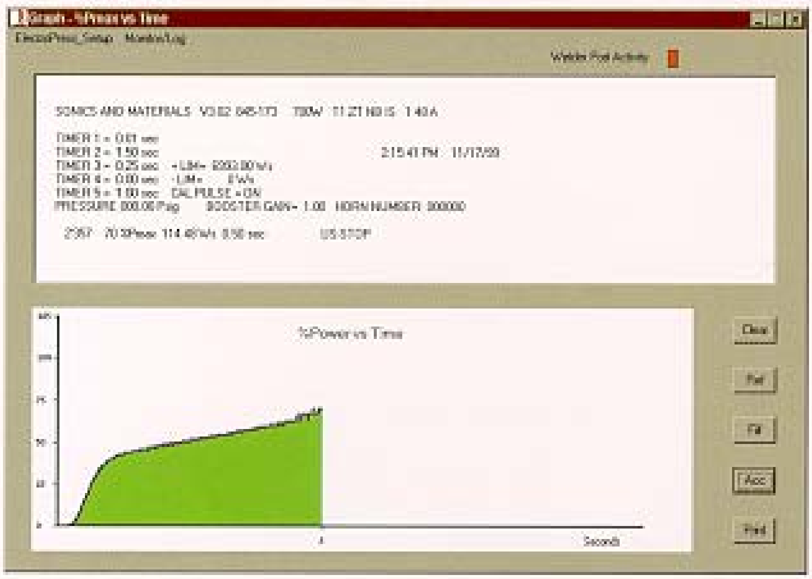
Various settings can be selected and programmed with the ElectroPress™ interface package. The system can be programmed to use either English or Metric **Units.** The welding distance can be set in either an **Absolute** or **Incremental** mode. With the **Absolute** mode, the system begins measuring the distance traveled from the "home" position and stops at the final weld depth. In the **Incremental** mode, the system begins measuring the travel distance once the horn contacts the part and force is applied and continues until the final weld depth is reached. The **Force Trigger**, or amount of force applied before ultrasonics is activated, can be set from 10 to 150 lbs. (50 to 650 newtons). The **Force Trigger** is measured with a rigid strain gauge load cell mounted in-line with the stack assembly (converter/booster/horn) and the ball screw actuator.

One **Travel Distance** and two **Weld Distances** along with two **Weld Velocities** can be set to achieve precise, repeatable assemblies. **Travel Distance** is defined as the distance between the horn's home position to the top of an unwelded part. **Weld Distance 1** is the first programmed weld distance and can be set in either

Absolute or **Incremental** modes. **Weld Velocity 1** sets the speed of travel during the first weld period once the force trigger has been reached.

For exceptional applications with unique welding joints or difficult materials to weld, the software interface comes with a second distance and velocity parameter group that can be programmed to change during the assembly process automatically. Once **Weld Distance 1** has completed its programmed travel at **Weld Velocity 1**, the controller then switches to **Weld Velocity 2** to the programmed **Weld Distance 2** setting.

If an assembly is misaligned or missing, the ElectroPress™ has the capability to abort the weld cycle based upon the predetermined tolerance window. The **Upper Part Tolerance** is provided to create a reference location above the assembly position that will allow the stepper motor controls to slow the head when it reaches this point and begin the search for the unwelded part. A **Lower Part Tolerance** provides a reference location below the assembly position, which will prevent the horn from contacting the fixture if the welder is cycled without parts.



ElectroPress™ Analysis Tools

Monitor/Log Display:

The software also provides a monitor/log menu selection. This selection will display a form intended to capture weld and distance data and present a one-line status after each weld. This data may be logged to a text data file and/or sent to the system print buffer. Some of the details listed within this display include: time/date stamp, peak power, weld energy, weld time, and weld distance.

Power Vs. Time Graph:

The software program has the capability to display a power vs. time graph to collect data for output and statistical analysis. This graph monitors an application during the set-up and qualification period illustrating the impact of distance and velocity controls on the weld. As a result, the graph displays a visual representation of ultrasonic power vs. time produced at the end of each weld. A trace accumulation mode is also available and can be used to gauge the repeatability of a weld profile.

FM Series Power Supply

A microprocessor controlled power supply is required to operate the ElectroPress.™ The benefit of this type of power source is repeatable, consistent results. The FM Series Power Supply features a unique calibration pulse, which dynamically samples the system's power requirements prior to every weld to ensure accurate and consistent performance. The supply regulates the line voltage and provides constant output amplitude throughout the weld process. The digital control and auto tuning matches the frequency of the power supply to the converter/booster/horn assembly and ultimately compensates for variations in temperature and loading conditions. The FM Series Power Supply can store up to nine different jobs and can be programmed to sequence these jobs. The power supply also features a power monitor, tuning control, and overload protection circuitry to prevent damage to the components if the system is operated in an adverse environment.

ElectroPress™ Specifications

Performance Specifications

• *20 EP and 40 EP (20 kHz and 40 kHz)*

Force Trigger: 10–150 lbs.; 1 lb. increments
50–650 newtons; 1 newton increments

Travel Velocity: 20 RPS (revolutions per second)
2.66 in./sec. (67.7 mm/sec.)

Weld Velocity 1 and 2: 0.01–10 RPS; 0.01 RPS increments
0.0266–1.33 in./sec. (0.675–33.782 mm/sec.)

Weld Distance:
Absolute: 0.0500–2.7500 in. (1.000–70.000 mm)
Incremental: 0.0010–0.5000 in. (0.010–12.700mm)
Position Accuracy: ±0.0003 in. (±0.008 mm)

Parts Search Zone:
Upper Tolerance: 0.0010–0.1000 in. (0.025–2.500 mm)
Lower Tolerance: 0.0010–0.1000 in. (0.025–2.500 mm)
Search Speed: 0.083 in./sec. (2.10 mm/sec.)

Mechanical Specifications

• *Model 20 EP Press (20 kHz) and 40 EP Press (40 kHz):*

Machine Size: to Top: 21.00 in. L x 14.00 in. W x 39.25 in. H
(533.4 mm L x 355.6 mm W x 996.9 mm H)

Weight: 20 kHz = 160 lbs. (72.6 kg)
40 kHz = 130 lbs. (59 kg)

Maximum Height of Horn above Work Surface: 20 kHz = approx. 14 in. (355.6 mm)
40 kHz = approx. 18 in. (457.2 mm)

Throat Depth: *(horn centerline to support column centerline)* approx. 11 in. (279.4 mm)

Throat Depth: *(horn centerline to edge of mounting hub)* approx. 8.5 in. (215.9 mm)

Maximum Deflection: 0.005 in. (0.127 mm) @150 lb. force (667 newtons)

Fixture Mounting Thread Size: 3/8–16, optional M10 x 1.25

Maximum Stroke: 2.75 in. (70 mm)

Palm Buttons: Standard dual mechanical switches or optional photo switches

Column: Standard 3.5 in. diameter round column or optional square column

Warranty

Sonics & Materials, Inc. warrants its products for a period of one year from the date of shipment against defect in material and workmanship under normal installation, use, and maintenance.

Electrical Specifications

• *ElectroPress™ Control Box Specifications*

AC Power: 120 VAC, 50/60 Hz @ 3 amp fuse rating
220 VAC, 50/60 Hz @ 1.6 amp fuse rating

Dimensions: 6.5 in. H x 17 in. W x 22.5 in. D
(165.1 mm H x 431.8 mm W x 571.5 mm D)

Weight: 20 lbs. (9.07 kg)

• *FM Series, Auto-Tuned, Regulated Output Power Supply Specifications*

Frequency/Power: 20 kHz: 1000, 1500, and 2000 watts
40 kHz: 700 watts

Input Voltage: 20 kHz, 1000 watts: 220 VAC–standard, 120 VAC–optional
40 kHz, 700 watts: 220 VAC–standard, 120 VAC–optional
20 kHz, 1500 and 2000 watts: 220 VAC

Dimensions: 6.5 in. H x 17 in. W x 22.5 in. D
(165.1 mm H x 431.8 mm W x 571.5 mm D)

Weight: 25 lbs. (11.338 kg)

SONICS

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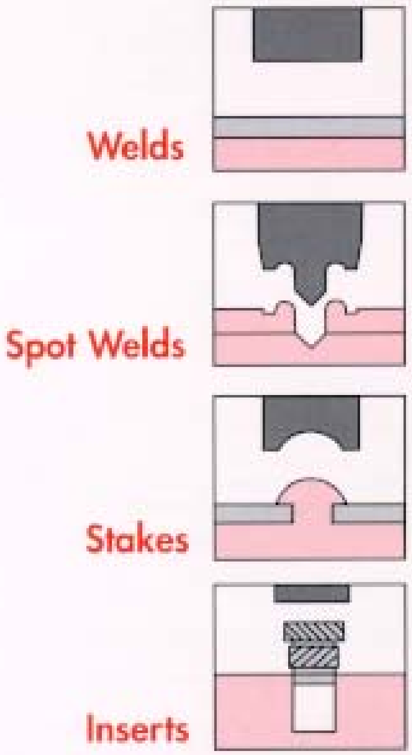
SONICS

Ultrasonic Hand Held Welders For Plastics Assembly



General Description

Sonics offers two 500 watt hand held ultrasonic welders for plastics assembly; a 20 kHz, Model H-520 and a 40 kHz, Model H-540. These compact and portable units are rugged, reliable, and easy to operate. They are designed specifically for welding, staking, inserting, and spot welding applications. The lightweight hand pieces are ideally suited for manual operations with low volume production requirements or for assembling parts with difficult to reach weld areas. The units consist of an ultrasonic power supply and a 1.5 lbs. (.68 kg) hand gun with a straight diameter cable. The 20 kHz hand guns are supplied with integral ½" (12.7 mm) diameter titanium front drivers with replaceable flat face tips. Other standard tips are available for various application requirements (see chart for tip information). In addition, custom tips can be designed for specific applications. The 40 kHz hand gun is supplied with a removable horn designed specifically for each customer's requirements.

Most manual applications can be performed with the 20 kHz model. However, the higher frequency and lower amplitude of the 40 kHz system makes it ideal for welding small assemblies that require gentler action. The hand gun systems are available to operate at a standard 120 volts or optional 220 volts nominal input voltage.

The power supply features autotune circuitry, which eliminates the need to retune the system each time it is turned on or when the horn/tip is changed. It also regulates the line voltage and provides constant amplitude throughout the weld process. The welders contain a microprocessor based programmable timer for weld times from 0.1 to 9.9 seconds. Another function of the microprocessor includes digital amplitude control. All of these beneficial features yield a more precise and repeatable cycle. Once set up, the user only needs to apply the tip of the hand gun to the parts being assembled and depress the switch on the gun's housing to operate the welder.

The H-520 and H-540 models have a standard DB9 I/O connector that can interface with automated machines via a PC or PLC. This connector allows the user to control amplitude and ultrasonics on/off times, as well as reset overload conditions. Users can, with the DB9 connector, monitor the output power (in watts) and hand gun run frequency.

The 500 watt welders both contain two overload protection circuits, one for the power supply and the other for the converter. The system's overload circuit protects the power supply from exceeding its maximum wattage. The advanced converter protection circuit is designed to protect against excessive voltage or current caused by the application. With a response time of less than 2 micro seconds, these circuits instantaneously prevent internal component damage to the power supply and converter.

Thermoplastic Assembly Solutions for Every Application

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Ultrasonic Hand Held Welding Applications

STAKING

STANDARD FLARED STAKE

The standard flared stake satisfies the requirements of most applications. This stake is recommended for bosses with an O.D. of 1/16 inch (1.6 mm) or larger, and is ideally suited for low density, nonabrasive amorphous plastics.

SPHERICAL STAKE

The spherical stake is preferred for bosses with an O.D. less than 1/16 inch (1.6 mm). It is also recommended for rigid crystalline plastics with sharp highly defined melting temperatures, for plastics with abrasive fillers, and for materials that degrade easily.

HOLLOW STAKE

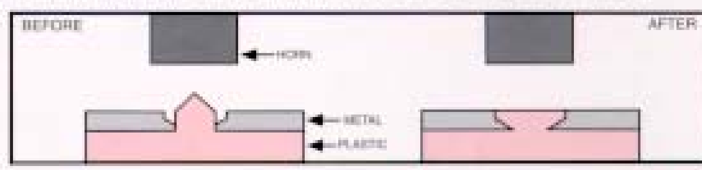
Bosses with an O.D. in excess of 5/32 inch (4 mm) should be made hollow. Staking a hollow boss produces a large, strong head without having to melt a large amount of material. Also, the hollow stake avoids sink marks on the opposite side of the component, and enables the parts to be reassembled with self-taping screws, should repair and disassembly be necessary.

KNURLED STAKE

The knurled stake is used in applications where appearance and strength are not critical. Since alignment is not an important consideration, the knurled stake is ideally suited for high volume production, and is often recommended for use with a hand held ultrasonic welder. Knurled tips are available in a wide variety of fine, medium and course configurations.

FLUSH STAKE

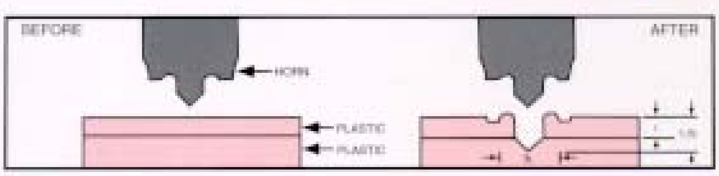
The flush stake is used for applications requiring a flush surface. The flush stake requires that the retained piece has sufficient thickness for a chamfer or counterbore.



Ultrasonic staking, also referred to as ultrasonic "heading" or "riveting", controls the flow of the molten plastic used to capture or retain another component in place. Ultrasonic staking provides an alternative to welding when the two parts consist of dissimilar materials that cannot be welded or when simple mechanical retention of one part relative to another is inadequate (i.e. as distinct from molecular bonding). A common application is the attachment of plastic to metal. Typically a metal part, with location holes, is placed over a plastic part with molded bosses. The horn tip is then pressed against the plastic boss and the vibratory motion creates friction and localized heating. As the boss melts, the light pressure from the horn forms a head to a shape determined by the horn tip configuration. When the vibrations stop, the plastic material solidifies, and the dissimilar materials are fastened together.

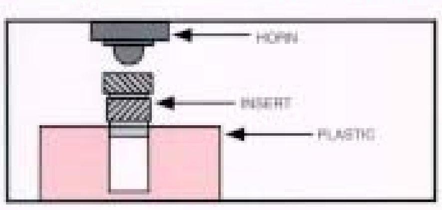
With staking, tight assemblies are possible because mating parts are clamped under pressure of the horn until the rivet head solidifies. There is no elastic recovery as is the case with heat staking or cold forming. A major advantage of ultrasonic staking over heat staking is that the ultrasonic staking tip remains relatively cool during the process, forming a clean head with no sticking or stringing during assembly.

SPOT WELDING



During spot welding, the horn tip penetrates through the top sheet and enters the bottom sheet to a depth of one half the top sheet thickness. The displaced molten plastic is shaped by a cavity in the tip to create an annular formation around the weld. Simultaneously, the molten plastic displaced from the second sheet flows into the preheated area and forms a permanent molecular bond. Large thermoplastic parts and applications with hard to reach joining surfaces can easily be welded together using an ultrasonic spot welder and standard replaceable tips.

ULTRASONIC INSERTION



Ultrasonic insertion involves a metal insert to be placed in a cored or drilled hole that is slightly smaller than the insert. This hole provides a certain degree of interference and also serves to guide the insert into place. The vibrating ultrasonic horn contacts the insert and the ultrasonic vibrations travel through the insert to the interface of the metal and plastic. Heat, generated by the insert vibrating against the plastic, causes the plastic to melt, and as the horn advances, the insert is embedded into the component. The molten plastic flows into the serrations, flutes, or undercuts of the inserts and, when the vibrations terminate, the plastic resolidifies and the insert is securely encapsulated in place. Inserts can be ultrasonically installed in most thermoplastics.

Ultrasonic insertion provides the high performance strength values of a molded-in insert while retaining all of the advantages of post-molded installation. Some of the advantages of ultrasonic insertion over other methods include rapid installation, minimal residual stresses in the component following insertion, elimination of potential mold damage, reduced mold fabrication costs and increased productivity as a result of reduced mold cycle times.

Optional Accessories Available for 20 kHz and 40 kHz Welders

Manual Press

A manual press is available for assembling parts where production volume does not justify more expensive pneumatic presses. The press provides a more controlled motion of the welder than is possible by just holding the hand gun, resulting in more consistent assemblies. This unit is available with foot switch or cam actuation. The trigger handle is removed from the hand gun housing when foot switch actuation is used.
Order No. - SD-M500 for 20 kHz and 40 kHz

Pneumatic Press

The pneumatic press is similar in style to the Manual Press, yet it contains dual anti-tie down palm buttons, a pressure regulator, and a pneumatic timer with all the required controls.
Order No. - SD-P500 for 20 KHz and 40 KHz

Stapler

A lightweight stapler attachment is optional for the Model CV52 and CV54 hand guns. It is ideally suited for sealing low production rate clamshell packages. The stapler is designed with a special pivoting mechanism that is attached to the standard hand held welders. The mechanism contains a steel anvil that applies pressure to a small area on the flanged outer edge of the clamshell package. The anvil is supplied with two sealing patterns. The standard is a medium diamond knurl on one end and a coarse diamond knurl on the other. To switch from one sealing pattern to the other, the anvil can be rotated 180 degrees.
Order No. - 20 kHz, CV00523; 40 kHz, CV00543

Pistol Grip

The Pistol Grip is designed to provide a more ergonomic handling of the handpiece for certain applications. It is a lightweight device that simply slips onto the hand guns. The operator activates the ultrasonics by pulling on the "trigger".
Order No. - 20 kHz, CV00524; 40 kHz, CV00544

Staking/Spot Welding Tips Specifications

Standard threaded tips available for staking, spot welding, and inserting are listed below. Special carbide faced wear resistant, flat, knurled, and custom faced tips are also available upon request.

STAKING

Plastic Boss Diameter		TIP CODE LETTER						
		Solid Boss Flare Head				Conical Boss Spherical Head		Hollow Boss
		High Profile		Low Profile		High Profile	Low Profile	
inches	mm	Tip Size	Stud Height*	Tip Size	Stud Height*			
1/32	0.793	A	.050	G	.019	AA	GG	–
1/16	1.587	B	.100	H	.0375	BB	HH	–
3/32	2.381	C	.150	I	.056	CC	II	–
1/8	3.175	D	.200	J	.075	DD	JJ	R
5/32	3.969	E	.250	K	.094	EE	KK	S
3/16	4.762	F	.300	L	.112	FF	LL	T

SPOT WELDING

Material Thickness		TIP CODE LETTER
inches	mm	
1/32	0.793	SA
3/64	1.190	SB
1/16	1.587	SC
5/64	1.984	SD
3/32	2.381	SE
7/64	2.778	SF

INSERTING

Insert Size	Inside Diameter of Insert	Pilot Diameter of Tip
SAE		
4-40	0.088	0.078
6-32	0.106	0.096
8-32	0.133	0.123
10-24	0.147	0.137
10-32	0.160	0.150
1/4-20	0.200	0.190
1/4-28	0.211	0.201
5/16-18	0.262	0.252
METRIC		
2.5 x 0.45	0.079	0.069
3 x 0.5	0.097	0.087
3.5 x 0.6	0.114	0.104
4 x 0.7	0.129	0.119
5 x 0.8	0.165	0.155
6 x 1	0.195	0.185
8 x 1.25	0.265	0.255

Ordering Information

Specify tip required using code letter.

Example:

Staking tip "A" indicates a tip used for staking - a 1/32" solid boss with a high profile flared head.

Spot weld tip "SA" indicates a tip used for spot welding - 1/32" thick material.

For more information on ultrasonic staking, spot welding, and inserting, request the following data sheets: "Ultrasonic Staking and Spot Welding of Thermoplastic Assemblies", and/or "Ultrasonic Installation of Inserts in Thermoplastic Components."

Ultrasonic Hand Held Welder Specifications

Power Supply

Model H520

Frequency/Power:	20 kHz: 500 watts
Input Voltage:	Standard 120 volts or optional 220 volts, 50/60 Hz Regulated between 95-135 volts or 190-265 volts
Weld Time:	0.1-9.9 seconds
Dimensions:	8.5 in. H x 13.5 in. W x 7.5 in. D (216 mm H x 340 mm W x 190 mm D)
Weight:	10 Lbs. (4.5 kg)

Model H540

Frequency/Power:	40 kHz: 500 watts
Input Voltage:	Standard 120 or optional 220 volts, 50/60 Hz Regulated between 95-135 volts or 190-265 volts
Weld Time:	0.1-9.9 seconds
Dimensions:	8.5 in. H x 13.5 in. W x 7.5 in. D (216 mm H x 340 mm W x 190 mm D)
Weight:	10 Lbs. (4.5 kg)

Hand Gun

Model CV52 (order no. CV00052)

Dimensions:	1.9 in. (48.3 mm) D, 7.6 in. (193 mm) L (with standard tip)
Weight:	1.5 Lbs. (0.68 kg)
Horn:	Integral with threaded end to accept replaceable tips
Material:	Titanium
Tip:	Standard - ½" (12.7 mm) diameter flat faced titanium tip (see chart for other tip configurations)
Cable Specifications:	Hardwired into hand gun. Optional detachable cable available
Lengths:	10 ft. standard, optional 15 ft. or 25 ft. available

Model CV54 (order no. CV00054)

Dimensions:	1.9 in. (48.3 mm) D, 6.3 in. (160 mm) L (without horn)
Weight:	1.5 Lbs. (0.68 kg)
Horn:	Supplied and priced separately
Material:	Titanium or aluminum
Cable Specifications:	Hardwired into hand gun. Optional detachable cable available
Lengths:	10 ft. standard, optional 15 ft. or 25 ft. available

Warranty

Sonics & Materials, Inc. warrants its products for a period of one year from the date of shipment against defects in material and workmanship under normal installation, use, and maintenance.

Sonics & Materials, Inc.

ISO 9001 REGISTERED • CE

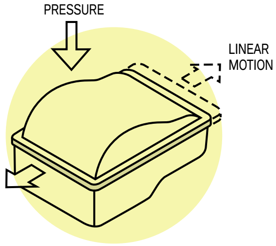
SONICS

MX Series
Linear Vibration Welder

Sonics & Materials, Inc.

MX10 Vibration Welder

Design Sonics' MX Series Linear Vibration Welders are designed for assembling large and/or complex shaped thermoplastic parts. The machines can also be tooled to assemble multiple smaller parts simultaneously. The MX Series can bond virtually all thermoplastic materials, whether injection molded, extruded, formed or thermoformed. Dissimilar materials (with compatible melting points), materials with fillers as well as composite materials and fabrics can also be bonded.



Process The fundamental process of vibration welding is straightforward. One part is held stationary in a lower tool. Under applied pressure, the mating part is vibrated against the stationary part in a linear direction. This combination of linear motion and pressure creates friction, which in turn, generates heat in the weld joint. The friction brings the two parts to their melt temperatures and bonding occurs.

Machine Each MX Series Vibration Welder features an industrial computer with a Windows™ based operating system and touch panel operator interface to program and monitor all parameters of the system, insuring quality, consistency and ease in setup and use.

Sonics' patented AUTO-TUNE feature allows the system to detect, set and lock the upper tool's optimum frequency in seconds. This facilitates maximum efficiency with minimal power to drive the tool at its pre-set amplitude.

Applications

- Carpet and Trim to Interior Automotive Panels
- Automotive Pillars
- Glove Boxes
- Head Lamp Assemblies
- Tail Lamp Assemblies
- Instrument Panels
- Air Intake Manifolds
- Medical Devices
- Fuel Tanks
- Filters

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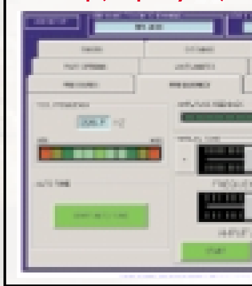
VIBRATION

SONICS

MX Series
Linear Vibration Welder

Job Setup (Frequency Tab)

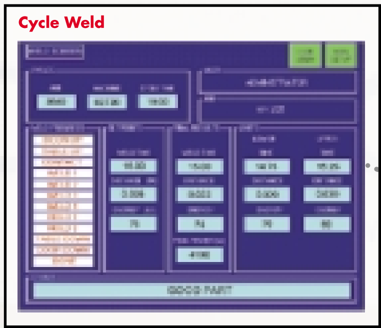


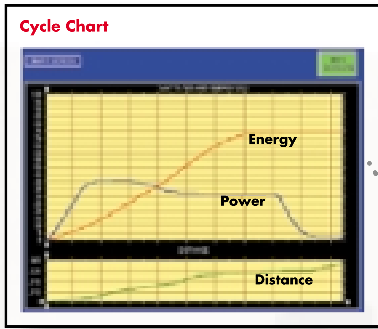
Power & Drive Features

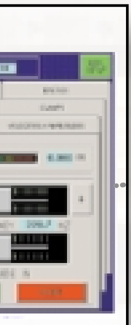
- **Digitally Controlled Electromagnetic Drive System**
- **Patented Automatic Tuning**
  Automatically detects, sets and locks the upper tool's optimum frequency in seconds
- **200 to 250 Hz Variable Output Frequency**
- **.040" (1 mm) to .070" (1.78 mm) Amplitude Setting**
- **± 0.003" (.07 mm) Amplitude Accuracy**
- **Return Alignment Accuracy of ± .002" (.05 mm)**
- **Standard Springs - Up to 90 lb. (41 kg) Upper Tool Weight**
- **Heavy Springs - Up to 120 lb. (54 kg) Upper Tool Weight**
- **"Shift-on-the-Fly" Welding**
  Increases or decreases amplitude and/or pressure during the weld cycle
- **Lower Tool Weight and Distance Detection**
  Automatically detects the lower tool's weight and, with parts loaded, detects exact table travel distance to the upper tool
- **Tooling Options**
  Mechanical Clamping, Vacuum Assist, Part-In-Place Sensors

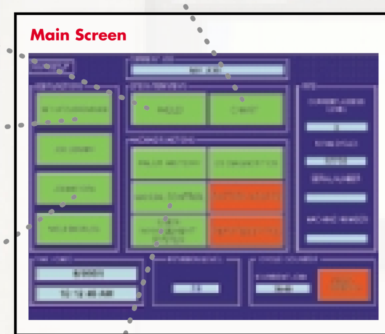
Operation Features

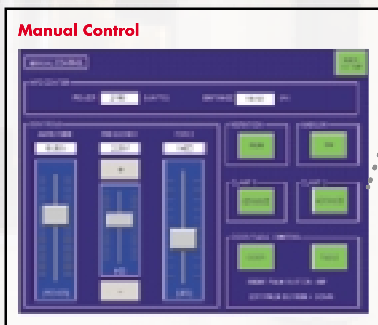
- **Industrial Computer / PLC Interfaced System**
- **Windows™ Based Software**
- **10.4" (264 mm) Color Touch Panel Operator Interface**
- **Allen-Bradley PLC**
- **PLC I/O Diagnostic Screen**
- **Three Welding Modes**
  Time, Distance and Patent Pending Energy Mode
- **Upper and Lower Limit Settings**
  In Time, Distance or Energy Mode, provides for upper and lower weld limit settings
- **Job Data Upload and Download Capability**
- **3.5" Floppy Drive**
- **Printer Port**
- **SPC Data Collecting**
- **Job Library**
  Stores up to 30 job settings with quick recall
- **Four User Access Levels**
  Limits access and program changes to authorized personnel only.
- **Single Button "Touch-and Go" Start**
  Left Hand or Right Hand Cycle Start











Mechanical Design Features

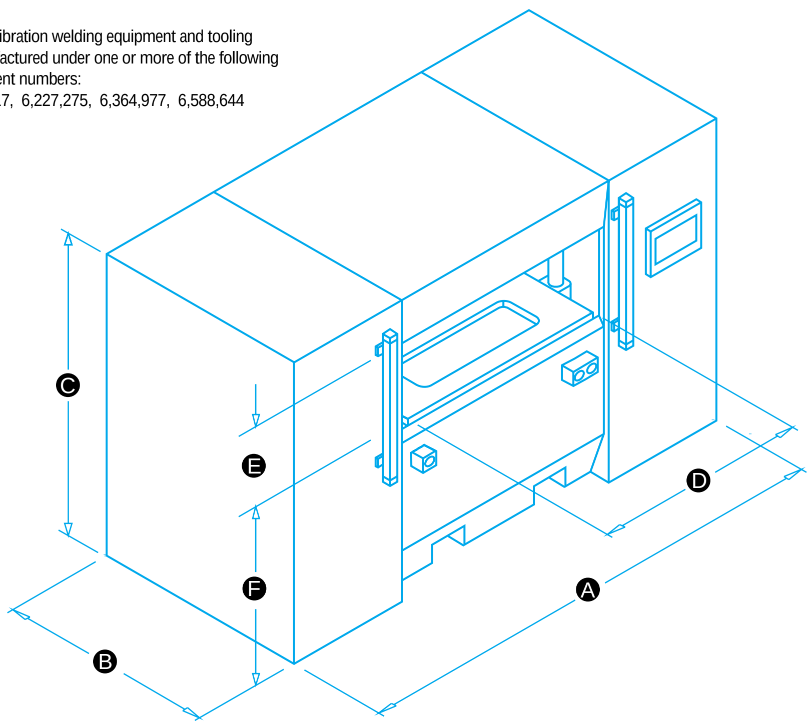
- **Tubular Steel Welded Main Frame Construction**
- **Four Spring Head Bridge**
  For large upper tool capacity
- **Multiple "Shock" Mounts**
  Minimizes vibration to the main structure
- **Closed Loop Hydraulic Pressure Control**
- **Variable Force Two-Speed Hydraulic Lift Table**
- **20" (508 mm) Table Stroke**
- **10" (254 mm) per second Lift Table Speed**
- **Fork Lift Provision**

Safety & Service Features

- **Safety Light Curtains**
- **Emergency Stop**
- **Heavy Duty Noise Insulation**
- **Integrated Pneumatic Door**
- **Hinged Rear Service Doors**
  For easy tool changeovers
- **Fully Accessible Electrical Service Panel**
- **Easy Access Hydraulic System**
- **Switched Interior Work Lights**
- **Factory Communications Modem**
  For remote factory upgrades, downloads, service and system diagnostics

	MX10	MX15	MX20	MX25
DIMENSIONAL DATA				
A - Machine Width	96" (2438 mm)	96" (2438 mm)	120" (3048 mm)	120" (3048 mm)
B - Machine Depth	38" (965 mm)	38" (965 mm)	38" (965 mm)	38" (965 mm)
C - Machine Height	75" (1905 mm)	85" (2159 mm)	75" (1905 mm)	85" (2159 mm)
D - Horizontal Opening	48" (1219 mm)	48" (1219 mm)	72" (1828 mm)	72" (1828 mm)
E - Vertical Opening	23" (584 mm)	28.5" (723 mm)	23" (584 mm)	28.5" (723 mm)
F - Floor to Lift Table Load Height	41" (1041 mm)	41" (1041 mm)	41" (1041 mm)	41" (1041 mm)
Lift Table Bed - Front to Back	22" (558 mm)	22" (558 mm)	22" (558 mm)	22" (558 mm)
Lift Table Stroke	20" (508 mm)	20" (508 mm)	20" (508 mm)	20" (508 mm)
Vibration Platen	37.75" x 14.75" (958 mm x 374 mm)	37.75" x 14.75" (958 mm x 374 mm)	37.75" x 14.75" (958 mm x 374 mm)	37.75" x 14.75" (958 mm x 374 mm)
POWER DATA				
Maximum Clamp Force (Less Lower Fixture Weight)	5,000 lbs. (22.2 kN)	5,000 lbs. (22.2 kN)	5,000 lbs. (22.2 kN)	5,000 lbs. (22.2 kN)
10 Horsepower (7.45 kW)	Standard	Standard	Standard	Standard
20 Horsepower (14.90 kW)	Optional	Optional	Optional	Optional
Output Frequency Range	200 to 250 Hz.	200 to 250 Hz.	200 to 250 Hz.	200 to 250 Hz.
Amplitude Range	.040" to .070" (1 mm to 1.78 mm)	.040" to .070" (1 mm to 1.78 mm)	.040" to .070" (1 mm to 1.78 mm)	.040" to .070" (1 mm to 1.78 mm)
WEIGHT DATA				
Approximate Gross Weight	7,500 lbs. (3401 kg)	8,000 lbs. (3628 kg)	8,500 lbs. (3854 kg)	9,000 lbs. (4081 kg)
Upper Tool Weight - Standard Springs	90 lbs. (41 kg) Max	90 lbs. (41 kg) Max	90 lbs. (41 kg) Max	90 lbs. (41 kg) Max
Upper Tool Weight - Heavy Springs	120 lbs. (54 kg) Max	120 lbs. (54 kg) Max	120 lbs. (54 kg) Max	120 lbs. (54 kg) Max
UTILITY REQUIREMENTS				
Electrical *(Other Electrical Voltages Available)*	480 VAC - 3 PH. 50/60 Hz 25 Amps 15 kVa	480 VAC - 3 PH. 50/60 Hz 25 Amps 15 kVa	480 VAC - 3 PH. 50/60 Hz 25 Amps 15 kVa	480 VAC - 3 PH. 50/60 Hz 25 Amps 15 kVa
Pneumatic/Air	80 PSI Min	80 PSI Min	80 PSI Min	80 PSI Min

Sonics vibration welding equipment and tooling is manufactured under one or more of the following U.S. patent numbers:
6,066,217, 6,227,275, 6,364,977, 6,588,644



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SONICS

Sonics & Materials, Inc.

Spin Welder

MODELS

1010 1020

Direct Drive Electric Motor System

Model 1010 Spin Welder

RLP Power Supply

General Description

Spin welding, also referred to as rotary friction welding, is the joining technology of choice when assembling spherically or cylindrically shaped thermoplastic parts.

In spin welding, one part, which has a circular cross section at the weld interface, is rapidly spun against its mating part which is held stationary in a nest fixture. The resulting heat that is generated by the combination of spinning action and friction brings the plastic material to its melt point and fuses the two parts together, producing a strong and impervious seal. Hermetic seals are also attainable depending upon the materials used and the weld joint configuration.

While spin welding works with all thermoplastics, and can accommodate virtually any diameter part, it is particularly suited for crystalline resins such as polyethylene and polypropylene.

Standard features include:

- 1/2" (12.7 mm) Steel Welded Framing
- Spin Power Head on Dual Columns
- 12" x 15" (304.8 mm x 381.0 mm) Fixture Tooling Platen
- DC Electric Drive Motor
- Automotive Drive/Spindle Bearing
- Dynamic Braking
- Cushioned Power Head Descent
- Dual, Anti Tie-Down, Palm-Start Buttons with Emergency Stop
- Two-Stage Vacuum Assist Capability
- 3.25" (82.55 mm) Bore Power Head Cylinder
- Brand Name Quality Components Throughout
- Full Safety Shielding on Power Head

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SPIN

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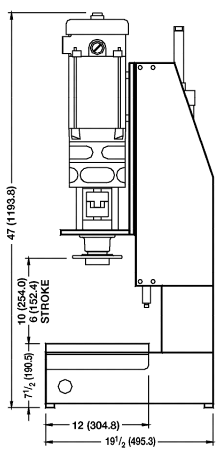
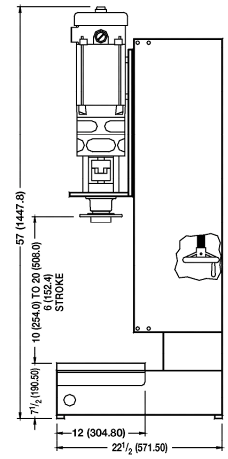


Model 1010

Sonics offers two standard Spin Welder stands or presses.

- *Model 1010 features a fixed, vertical opening that provides 10" (254 mm) of space between the drive head bearing and the nest fixture platen.*
- *Model 1020 offers an adjustable space opening from 10" - 20" (254 - 508 mm).*

Both models are designed to accommodate a wide range of application tooling and allow for easy part loading and unloading.



Model 1020

POWER SUPPLIES

Sonics' Spin Welders are available with either an RLP or PLC power supply. The RLP features relay logic type machine control that includes a scaled 20% to 100% RPM speed adjustment potentiometer. Three digital timers are used to set and adjust single, or two-stage cycle mode, spin time, and post-spin hold time. The PLC power supply offers like controls with PLC keypad for setting and adjusting weld time parameters. An LED RPM display is also included. Both power supplies can be remotely positioned for maximum operational flexibility.

TORQUE RANGES

Depending on the composition of the thermoplastic material and the diameter of the part to be spin welded, Sonics offers the following continuous duty electric drive motors as a standard feature on either the Model 1010 or Model 1020 stand:

SPIN WELDING TOOLING

Tooling is relatively simple to manufacture and can be designed to meet the specific needs and requirements of spin welding applications across a broad spectrum of industries. The Drive Head, the tool that holds the part to be spun, is attached to the drive bearing of the spin motor. Typically, Drive Heads are fabricated from aluminum and are either two-piece, compression spring loaded for single-stage spin welding or, are cast with a urethane core for vacuum-assisted, two-stage spin welding. The Nest Fixture is the tool that holds the stationary part in a fixed (non-rotating) position during the welding process. It is attached to the tooling platen directly beneath – and opposite – the drive head. Nest Fixtures are typically made of aluminum and occasionally require pneumatic or mechanical clamping to prevent the plastic part from "spinning out" during the weld cycle.

ITEM	LTR: Low Torque Range	MTR: Medium Torque Range	HTR: High Torque Range
HORSEPOWER	2.0	2.0	3.0
RPM	500 to 2500	350 to 1750	350 to 1750
IN/LBS OF TORQUE	50.0	72.0	108.0
TYPICAL DIAMETERS	Up to 2.0" (50.8 mm)	Up to 5.0" (127 mm)	Up to 8.0" (203.2 mm)

CUSTOM EQUIPMENT CONFIGURATIONS

Sonics' spin welding equipment can be designed to meet application-specific requirements. Typical customizing may include: horizontal units for long extrusions; added throat depth and/or increased horsepower for large diameter parts; reverse anvil models to accommodate turntables and conveyors; and customer-preferred system component specifications.

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A3787 UL REGISTERED FIRM ISO 9001

Sonics & Materials, Inc.

SONICS

Sonics & Materials, Inc.

Servo-Controlled Hot Plate Welder

Model HPS 152/152

General Description

Sonics offers to the plastics assembly industry a solution for welding single and multi-cavity parts produced by injection, extrusion, or blow molding. The hot plate welder, Model HPS 152/152, utilizes servo-motor actuation technology instead of traditional pneumatic or hydraulic actuation. Therefore, the system is capable of welding parts with wall thickness down to 1 mm.

The servo control system is compact, accurate, flexible, and reliable. In addition, it is sold at a price competitive with the pneumatic and hydraulic technologies. The Servo-Controlled Hot Plate Welder can be designed or modified to meet your application requirements.

There are many inherent features incorporated in the Servo-Controlled Hot Plate Welder that make it advantageous for these welding processes.

No Mechanical Stops Required - Through a keypad interface that contains password protection, all system actuation can be programmed. The welder can be rapidly set up due to its ability to store and retrieve programs through this keypad.

Quick & Easy Set-up - The tooling on the system is designed with a couple of bolts to eliminate the usual lengthy set-up procedure, making this unit very simple to operate and set up.

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Thermoplastic Assembly Solutions for Every Application

Servo-Controlled Hot Plate Welder: Features and Specifications

Additional Features

Dual Axis Positioning - Yields independent control of the part melt depth. It also ensures accuracy to +/- .001" for more precision over the weld cycle.

Variable Speed Control - To ensure even more accuracy, variable speed control can be programmed for a precise melt during heating and assembly cycles.

Contact Heating Mode - Direct contact bonding is suitable for most types of materials. This mode creates applied pressure and heat to seal plastic parts in seconds.

Radiant (Non-Contact) Heating Mode - This mode is ideal for abrasive materials or for materials that tend to stick or string. The system can be quickly and simply programmed in order to avoid contact of the parts with the platen during the heating phase.

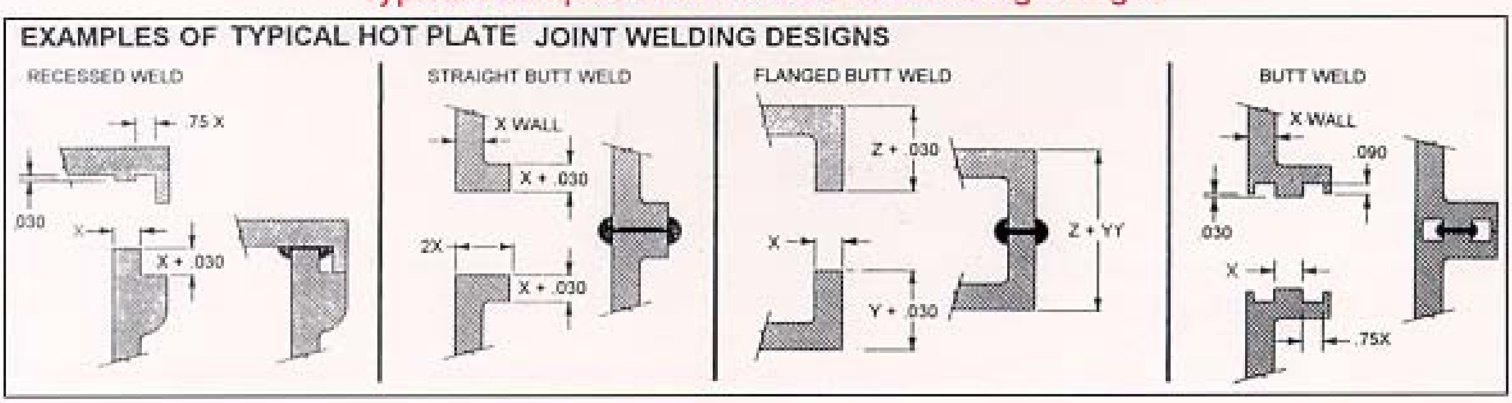
Independent Heating Zones - When welding parts of different materials, temperatures for separate heated platens can be digitally controlled and modified. A safety mechanism is in place to restrict the machine operation if temperatures fall below the target range. This is accomplished through feedback sensors.

Welder Specifications

Machine Dimensions		**Power Requirements:**	240/480 3 phase
Height:	66" (1677 mm)	**Platen Temperature Range:**	150°-550° F (66°C-288°C)
Width:	63" (1600 mm)	**Air Pressure Required:**	80 psig (5.4 bar)
Depth:	31" (788 mm)	**Heating Load:**	2 KW
Maximum Opening:	10" (254 mm)	**Melt Accuracy:**	+/- .001" (+/- .025 mm)
Hot Plate Area:	6" x 6" (152 mm x 152 mm)		

Optional:non-contact hot plate temperature range, up to 1000° F (538°C)

Typical Examples of Hot Plate Joint Welding Designs



Sonics can design or modify these systems as well as recommend the most appropriate joint welding design to meet a customer's specific application requirements.

Sonics & Materials, Inc.

SONICS

Sonics & Materials, Inc.

Ultrasonic Plastics Welding System

NEW! 20kHz

Model 2050 Press

Model FM Power Supply

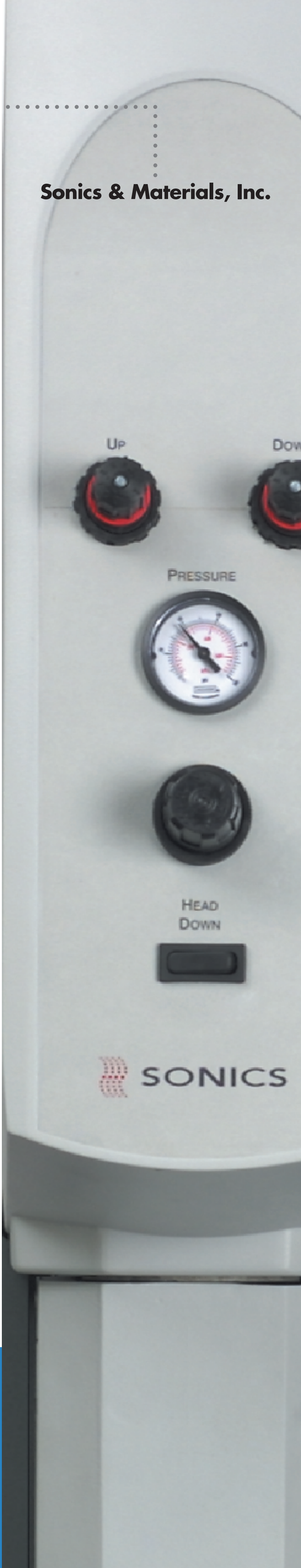
Innovators in the field of ultrasonic plastics welding equipment and technology since 1969, Sonics & Materials is proud to introduce its latest 20 kHz ultrasonic welding press. For more demanding applications, the MODEL 2050 PRESS features rigid design and engineering upgrades which, by decreasing the potential for press deflection by up to 30%, provides for larger part size and force requirements.

	Model FD	Model FM
Weld by Digital Time Only Mode	■	
Weld by Digital Time and/or Constant Energy Mode		■
Weld by Distance Mode (Optional)	■	■
Automatic Frequency Tuning	■	■
Multiple Job Storage and Memory	■	■
Calibration Pulse Prior to Every Weld		■
Back Lit LED Display	■	■
Force Triggering Capability		■
RS232 Data and Graph Output		■
Overload Protection Circuitry	■	■
English or Metric Display	■	■
Reject Alarm with Output Signal		■
Line Voltage and Load Regulation Circuitry *(Provides for Constant Amplitude during the Weld Cycle)*	■	■

Sonics' Model FD and FM Series Ultrasonic Power Supplies, with available power outputs of 1000, 1500 and 2000 watts, offer superior control and consistency for every application.

These notable features are highlighted by —

- **Single Piece Rigid Cast Aluminum Machine Base and Column Hub**
- **Increased Steel Column Diameter and Wall Thickness**
- **Single Rail Linear Slide**
- **Direct In-Line Air Cylinder**
- **Extended Center Base to Column Throat Depth Distance**
- **Additional 12" Center-to-Center Lower Fixture Mount Holes**
- **Front Panel Pneumatic Speed and Pressure Controls**



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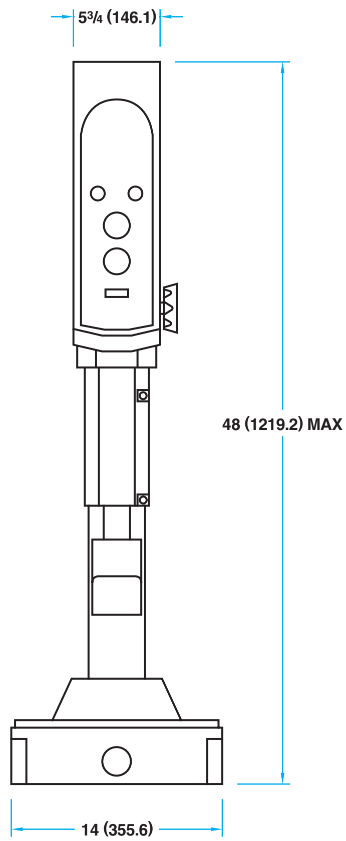
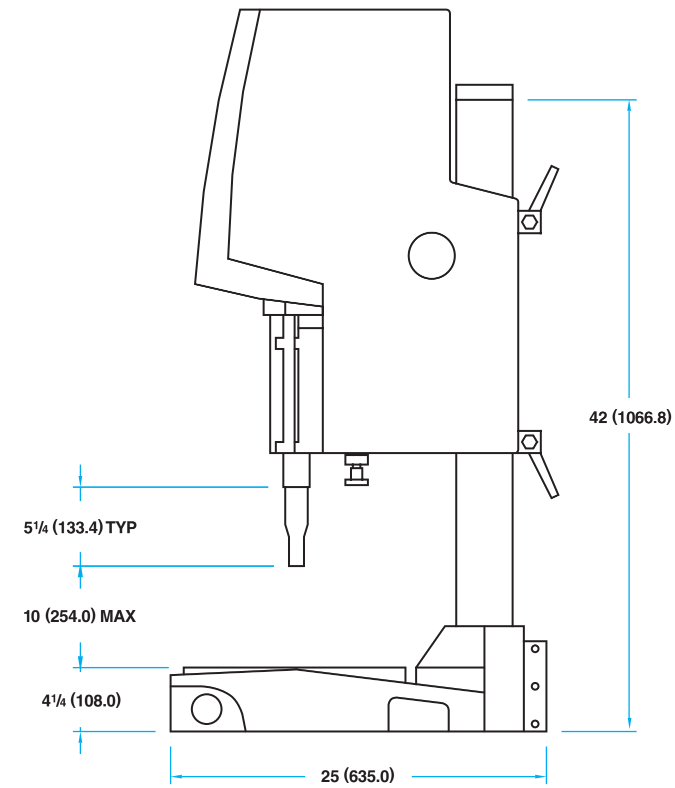
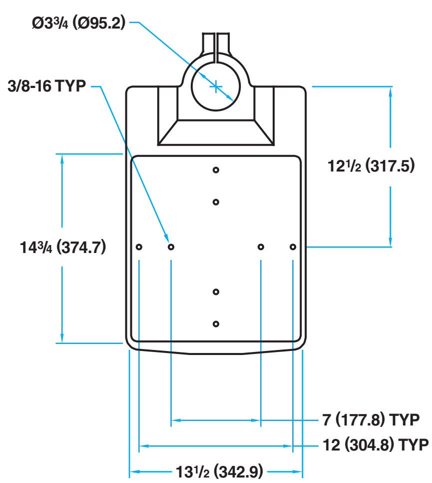
ULTRASONIC

20 kHz Model 2050 Ultrasonic Welding Press Dimensional Data

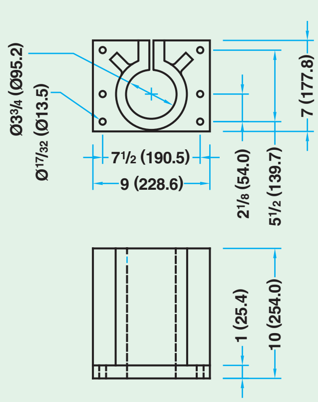
All Dimensions: Inches (mm)







Optional Stand-Alone Hub



Specifications, Additional Features, and Options

Dual Cycle Start Buttons	Standard
Non-Contact Cycle Start Buttons	Optional
Front Emergency Stop	Standard
Front Panel Pneumatic Controls	Standard
Head Adjust Counter Balance Spring	Standard
In-Line Pneumatic Cylinder	Standard
Adjustable Positive Stop	Standard
Automation Limit Switches	Optional
360° Snap-In Stack Assembly	Standard
Rigid Mount Booster	Optional
Stand Alone Column Hub	Optional
Extended Length Column	Optional
3.75" (95.3) Column Diameter	Standard
4" (101.6) Stroke Air Cylinder	Standard
6" (152.4) Stroke Air Cylinder	Optional
Air Cylinder Bore Diameter	2.5" (63.5)
Clamping Force at 90 PSIG	441 lbs. (1961n)
Input Voltage	220 VAC
Weight	180.5 lbs. / 81.9 kg

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SONICS

Sonics & Materials, Inc.

NEW! Model 2055

20kHz Ultrasonic Plastics Welding System

Model 2055 Press

Model FM Power Supply

Sonics & Materials, innovators in the field of ultrasonic plastics assembly equipment and technology since 1969, is proud to introduce its new 20 kHz ultrasonic welding press. The MODEL 2055 PRESS, created specifically for more demanding plastics assembly applications, features a super-rigid design that decreases the potential for press deflection by up to 30%. This innovative design provides for significantly larger part size and force requirements, and also includes engineering upgrades to further enhance performance and precision.

Ultrasonic Power Supplies

Sonics' Model FD and FM Series Ultrasonic Power Supplies, with available power outputs of 1000, 1500 and 2000 watts, offer superior control and consistency for every application.

	Model FD	Model FM
Weld by Digital Time Only Mode	■	
Weld by Digital Time or Constant Energy Mode		■
Weld by Distance Mode (Optional)	■	■
Automatic Frequency Tuning	■	■
Multiple Job Storage and Memory	■	■
Calibration Pulse Prior to Every Weld		■
Back Lit LED Display	■	■
Digital Force Triggering Capability		■
RS232 Data and Graph Output		■
Overload Protection Circuitry	■	■
English or Metric Display	■	■
Reject Alarm with Output Signal		■
Line Voltage and Load Regulation Circuitry *(Provides for Constant Amplitude during the Weld Cycle)*	■	■

Model 2055 Features

- **Single Piece Rigid Cast Aluminum Machine Base and Column Hub**
- **Increased Steel Column Diameter and Wall Thickness**
- **Single Rail Linear Slide**
- **Direct In-Line Air Cylinder**
- **Extended Center Base to Column Throat Depth Distance**
- **Additional 12" Center-to-Center Lower Fixture Mount Holes**
- **Linear Encoder for Distance Welding (optional)**

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ULTRASONIC

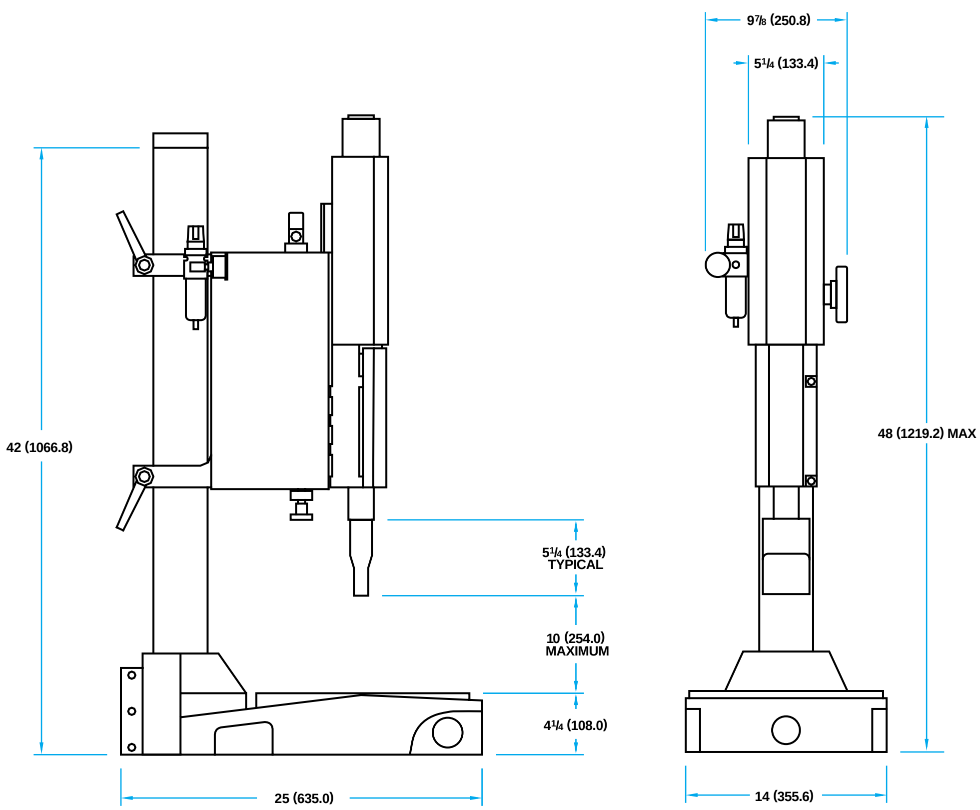
For more information: **1-800-745-1105 • www.sonics.biz**

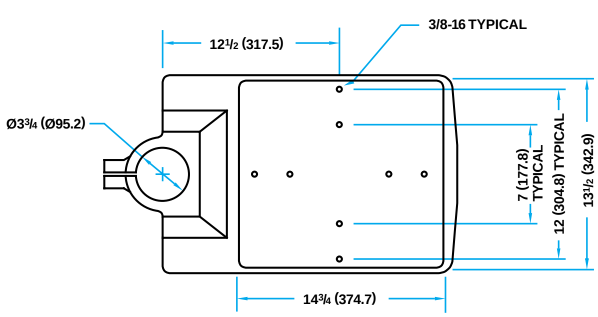
Model 2055 Ultrasonic Welding Press

Specifications, Additional Features, and Options

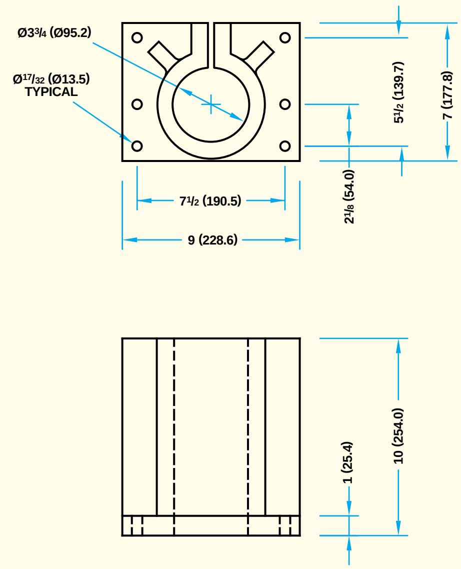
Dual Cycle Start Buttons	Standard
Non-Contact Cycle Start Buttons	Optional
Front Emergency Stop	Standard
Speed & Pressure Pneumatic Controls	Standard
Head Adjust Counter Balance Spring	Standard
In-Line Pneumatic Cylinder	Standard
Adjustable Positive Stop	Standard
Automation Limit Switches	Optional
360° Snap-In Stack Assembly	Standard
Rigid Mount Booster	Optional
Mechanical Force Trigger	Standard
Stand Alone Column Hub	Optional
Extended Length Column	Optional
Linear Encoder for Distance Welding	Optional
3.75" (95.3) Column Diameter	Standard
4" (101.6) Stroke Air Cylinder	Standard
6" (152.4) Stroke Air Cylinder	Optional
Air Cylinder Bore Diameter	2.5" (63.5)
Clamping Force at 90 PSIG	441 lbs. (1961n)
Input Voltage	220 VAC
Weight	165 lbs. / 74.8 kg

Dimensional Data All Dimensions: Inches (mm)





Optional Stand-Alone Hub



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Your Partner in Innovative Plastics Assembly Solutions

SONICS

Sonics & Materials, Inc.

Since our inception in 1969, our goal has been to provide you with innovative, reliable, and cost-efficient plastics assembly solutions, for the simplest to the most demanding applications. These processes have been successful through the use of our state-of-the-art equipment, which includes ultrasonic, vibration, spin, hot plate welding and heat staking systems. As a leader in the plastics welding industry, Sonics' philosophy has remained steadfast – to provide consistent support, technical innovations, unparalleled expertise, and the highest quality products for our customers.

PARTNERS & SOLUTIONS

Sonics recognizes that our customers are in an increasingly competitive global market place. That is why innovation has been the springboard of our growth – innovations in assembly stand construction, power supply design, controllers, as well as acoustic tooling and converters. The result is products that offer precision, economy, and control.

But even that is not enough, which is why we are equally committed to your total satisfaction before, during, and especially after the sale. As a valued business partner, we will not only provide you with superior technology, but also superior service and support. Our thermoplastic assembly processes are the right solution for you.

MORE THAN INNOVATIVE EQUIPMENT

Sonics is in the business of designing, implementing, and maintaining real world manufacturing solutions. Therefore, we will expend time and resources exploring a new application or application modification for both our potential and existing customers. Customization to meet your application requirements affords you more flexibility to meet your business needs.

Applications Lab

We maintain a fully equipped laboratory to test sample parts for their weldability and to determine the best process for assembly. Sonics' applications engineers will determine the optimal way to develop individual assembly stations and provide joint design recommendations, thus helping you to avoid costly trial and error experimentation. Our technical expertise and business knowledge enables comprehensive evaluations and suggestions that will yield the proper methodology and equipment necessary to make your application successful.

Technical Support

Our expert staff of plastics assembly engineers is always available for design consultation, equipment troubleshooting, application analysis, second opinions, or to answer any questions you may have. Their expertise is derived from continuous product improvements, enhancements, and technological breakthroughs. Why not ask advice from the people who are responsible for creating the technology you are using. Our goal is total customer satisfaction!

Technical Seminars

Comprehensive educational seminars on the various plastics assembly methods are given regularly at our corporate headquarters in Newtown, CT and in major cities around the world. These in-depth sessions are frequently updated to reflect the latest technological advances and can provide immediate as well as long-range benefits to participants and their companies. Alternatively, these seminars may be customized exclusively to your company's training needs.

PLASTICS ASSEMBLY SYSTEMS

Sonics product line includes ultrasonic, vibration, spin, hot plate bonding and heat staking equipment for the welding, joining and fastening of thermoplastic components, textiles, and other synthetic materials. Throughout our growth, our customer base has remained diverse, with our plastics assembly equipment being utilized in the automotive, medical, home entertainment, electronics, appliance, textile, packaging, toy and other industries. Some applications within these industries include automotive lenses, carpet welding, blower housings, carbon canisters, pumps and impellers, telephone hand sets, smoke detectors and waste containers.

ULTRASONIC

Ultrasonic welding joins plastics by rapidly transmitting ultrasonic energy through a shaped tool or "horn". This creates mechanical vibrations, friction, and heat to form a permanent seal between the parts. Sonics' ultrasonic bonding systems permit fast and clean assemblies. Since no adhesives or fasteners are used, ultrasonic welding minimizes risks to both the environment and employee safety by removing potentially hazardous materials from this stage of manufacturing. Thus, many industries have chosen ultrasonic welding as the preferred method of joining thermoplastic components.

Ultrasonic assembly processes are our forte. Let us help you select the optimal frequency/power configuration for your application. Three frequencies – 20, 40 and 15 kHz – make a broad range of applications possible. Generally, the size and configuration of the plastic parts to be welded will determine which device and frequency level are appropriate.

20 kHz is considered an industry standard because it can assemble common and intermediate sized parts, is above the normal range of human hearing (approximately 18 kHz) and creates the necessary power and amplitude to enable melting of most thermoplastics.

40 kHz systems are ideally suited for small plastics assembly applications that require gentle ultrasonic vibrations during the weld process. At 40 kHz, the ultrasonic horn is 50% smaller than a 20 kHz horn and has lower amplitude, which causes less stress on the parts being welded. Typical applications using 40 kHz ultrasonic welders include microelectronic components, printed circuit boards, and other high precision assemblies such as medical devices and critical, close tolerance plastic parts.

With **15 kHz**, most thermoplastics can be welded, especially those fabricated from high-performance engineering resins, which require high amplitude for successful assembly. This lower frequency also enables larger horns to be designed, thus facilitating the welding of larger assemblies. Uniform amplitude across the horn face increases weld integrity, ensuring superior results. There is also significantly less attenuation, allowing many softer plastics to be welded – and at greater far field distances than with other frequencies.

Optional sound enclosures are available for both our 15 kHz and 20 kHz equipment.

Slimline Actuators are also available. These remote actuators can be bridged or mounted into a machine structure at virtually any angle and are often used with automated systems where one or more actuators is required for simultaneous or sequential operation.

POWER & CONTROL

Built-in intelligence creates repeatable and consistent results. The ultrasonic power supply and controller are designed to program, monitor, and display various critical welding functions. The unit can be supplied for welding in energy, time, or distance or for continuous duty applications.

Sonics power supplies feature automatic tuning to match the frequency of the power supply to the converter/booster/horn. Line voltage regulation circuitry provides constant RF voltage to the converter regardless of incoming voltage fluctuations, resulting in constant amplitude. Load regulation maintains this constant amplitude at the horn interface, resulting in consistent welds regardless of power draw.

These units are designed to start under heavy loads to drive larger horns and include soft start circuitry to minimize the possibility of horn damage during the weld cycle. The power supplies contain overload protection circuitry to prevent damage to the internal components if the system is operated under adverse conditions. These supplies also contain adjustable output controls. I/O ports are available to control or monitor the functions of the power supplies using a PC or PLC. Available power ratings for the supplies are 700 watts at 40 kHz; 1000, 1500, 2000, and 3000 watts at 20 kHz; and 2500 and 4000 watts at 15 kHz.

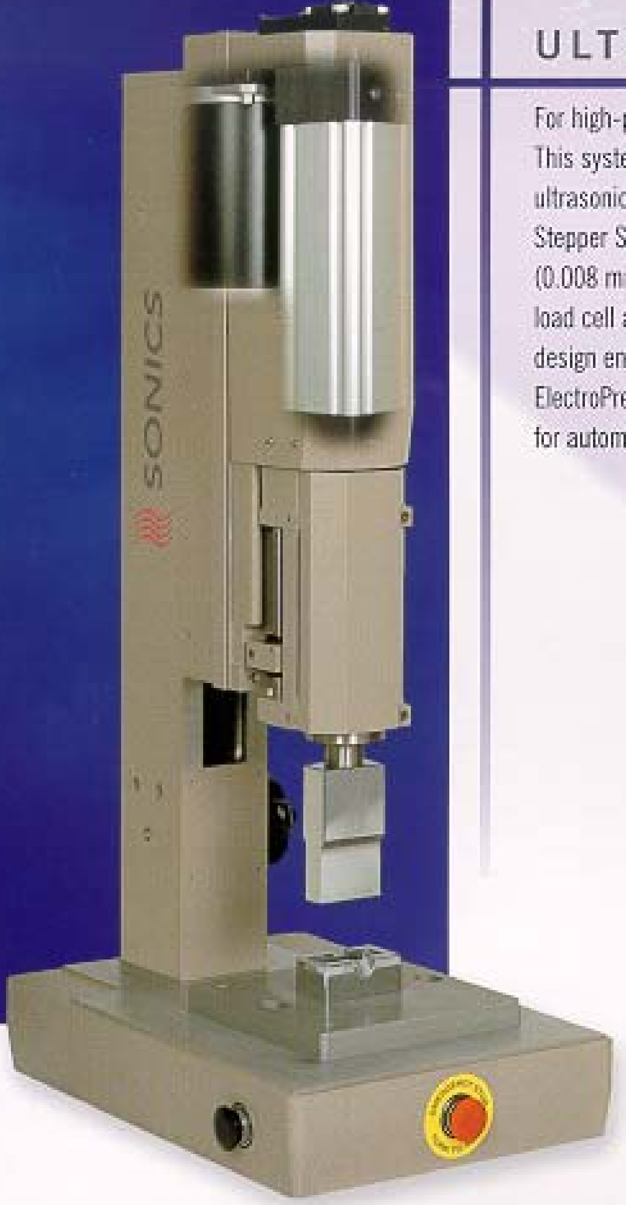
TOOLING

Sonics is a leader in the innovative design of tooling for ultrasonic, vibration, spin and hot plate welding. Using the customer's line drawings, CAD files or actual parts, our tooling is designed for optimum life and performance. From the initial design stage in which we use FEA (Finite Element Analysis) to the final manufactured tool, which is inspected for stable and even amplitude across the face, our ultrasonic horns set the industry standard.

Our capabilities range from simple tooling to complex designs and configurations. This includes contoured and adjustable segmented tooling for ultrasonic, vibration and hot plate welding applications. In addition, multi-element configurations can be designed for spot welding, staking, and insertion. Peripheral devices to properly clamp, hold, and align the parts with one another can also be incorporated into these systems.

Our tool fabrication materials include aluminum, titanium, hardened steel, stainless steel and cast polyurethanes. The tools are commonly finished with carbide facing or chrome plating for added strength and durability.

ULTRASONIC ELECTROPRESS™



For high-precision, close-tolerance assemblies, the ElectroPress™ is the ideal solution. This system contains a Stepper Motor Drive that controls the advancing speed of the ultrasonic horn, ensuring repeatable welds. Combined with a ball screw actuator, the Stepper System will control the final weld position to a tolerance of +/- 0.0003 in. (0.008 mm). Precision control is further enhanced through the use of a strain gauge load cell and a rigid mount booster that prevents horn deflection. This advanced design enables programmable force, velocity, and distance weld parameters. The ElectroPress™ can be mounted in any position on a bridge or other structural member for automated assemblies.

ULTRASONIC HAND HELD WELDER

For hand assembly operations such as welding, spot welding, staking and inserting, our compact, portable hand held unit is a smart solution. Inherent features include auto tuning, microprocessor based programmable timer, digital amplitude control, as well as converter and power supply protection circuits. The hand held welders are available with power outputs of 500 watts in frequencies of 20 kHz or 40 kHz. Optional accessories for the hand held welders include a light duty Manual Arbor Press, Stapler, and Pistol Grip.

SPIN WELDER

Spin welding is the technology of choice for assembling cylindrical thermoplastic parts. An advantage of using a spin welder is the ability to melt a significant amount of material at the joint interface. Parts that are made of semi-crystalline materials or parts that have high filler content, such as glass, can in most cases be hermetically sealed. With proper torque and rpm, the spin welder can accommodate virtually any diameter part and has been successful in welding filters, pump housings, tanks, insulated containers, hose fittings and tubing.

Sonics offers spin welding machines that have been developed for bench top production and automated in-line assembly systems. These systems feature fractional to multiple horsepower electric motor drive systems, digitally timed or PLC timer controlled power supplies, adjustable stroke and rpm control. A two-stage vacuum assisted drive bearing is provided to simplify the loading of parts.

In addition to our standard spin welders, we offer customized systems such as radial orienting spin welders.

VIBRATION WELDER

The vibration welder, specially suited for bonding larger plastic components together, has the ability to weld a wider variety of plastics and affords maximum flexibility in accommodating unusual shapes and sizes up to 48"x 22"x 20" (1220 mm x 560 mm x 508 mm). The vibration welder is computer-controlled, has a touch screen display and can weld in time, distance, or energy. Additional features include process data collection capabilities and a modem for remote diagnostics.

With its auto-tune feature, this is the most powerful drive mechanism in its class, with the smallest footprint and the largest lift table in the industry. Modular design allows for easy adaptation of multiple head configurations or automated assembly operations. Applications that have been successful using the vibration welder include glove boxes, door panels, lenses, air ducts, air spoilers, resonators, and intake manifolds.

ADDITIONAL SOLUTIONS

Sonics has the ability to provide solutions for the joining of parts with difficult configurations and materials.

Hot Plate Welding allows the flexibility to weld both semi-crystalline and amorphous thermoplastic materials by either radiant or direct contact heat. Since there is no relative motion between the joints of the parts, complex shapes can be easily welded. Hot plate welders are available with pneumatic, hydraulic, or servo-controlled actuation and feature programmable temperature and cycle controls.

Heat Staking & Inserting presses, both manual and pneumatic, are available for single or multiple head staking or inserting applications. Unlike ultrasonic horns, heat staking and insertion tools can be designed in multiples over a large surface with different planes. The process is very cost effective due to its ability to stake or insert multiple points simultaneously.

Hot Air/Cold Staking systems are recommended for similar applications as heat staking equipment. However, by using the hot air/cold staking process, repeatable and tight staking results can be achieved.

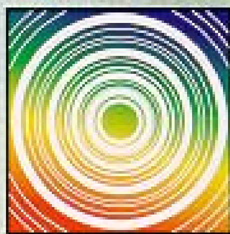
Special Systems can be designed with multiple heads or rotary index tables to meet customer's high production demands or unique production requirements.

SONICS

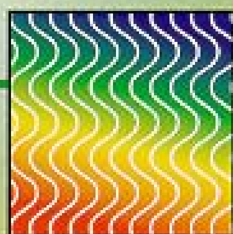
Sonics is dedicated to your total satisfaction throughout the application feasibility process to the final welded product, and even after that. Our staff is trained to assist you in every step of the way, from choosing the proper technique and equipment for your application to after-sales technical support and training. Becoming a business partner with Sonics allows you the opportunity to increase your production, while decreasing defects and production costs. We are here to provide the perfect solution to fit your plastics assembly needs to give you more control and consistency over your weld cycle. In addition, innovations, inherent features, and revolutionary power supplies enable Sonics to remain a leader within the competitive plastics assembly industry. When you think about a long-term relationship with state-of-the-art technology and service, think about SONICS…


VIBRATION


HEAT STAKING


SPIN


HOT PLATE


ULTRASONIC

Call today for your complimentary CD to further enhance your knowledge of Sonics' plastic welding capabilities and solutions or visit our website at **www.sonicsandmaterials.com**.

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Microprocessor

In operation, the MICROPROCESSOR continually monitors the dynamic conditions encountered during each process cycle, and automatically adjusts the energy or time requirements to ensure consistent performance.

Enhanced memory capability allows storage of up to 9 separate jobs and sequencing of 9 jobs.

The MICROPROCESSOR is programmed with a multi-function keypad consisting of ten numerical keys and fourteen function keys. Operating parameters such as time and energy are entered with the keypad and acknowledged on the liquid crystal display (LCD).

Each keystroke is acknowledged by an audible signal of short duration, while rejected assemblies and faults are indicated by an alarm signal of longer duration.

Four basic modes of operation are available, along with numerous auxiliary functions.

Modes of Operation

1. TIME BASED CYCLE WITH TIME DELAY TRIGGERING: The Weld and Hold timers are actuated after a predetermined delay period which is initiated when the horn contacts the component, which is similar to many conventional ultrasonic plastic assembly systems. The Delay, Weld and Hold Timers can be controlled to within .01 second.

2. Time Based Cycle With Piezoelectric Variable Force Triggering: The Weld and Hold Timers are actuated after a preselected coupling force is exerted on the components. A piezoelectric load cell senses the coupling force and the Trigger Force is adjustable from 1%-99% of the maximum available trigger force.

3. Constant Energy Based Cycle With Time Delay Triggering: The weld cycle starts after a predetermined delay period. The weld cycle continues until a preselected amount of energy in Watt Seconds (WS) has been delivered to the components being assembled, thus compensating for variations in voltage, coupling force, amplitude, etc. Because the energy delivered is constant, the duration of the weld cycle varies. The Hold Cycle follows the Constant Energy Weld Cycle as with conventional systems.

4. Constant Energy Based Cycle With Piezoelectric Variable Force Triggering. The Weld cycle is initiated after a preselected Trigger Force is reached, and its duration is dependent on the predetermined amount of energy delivered to the components.

LCD

Information appearing on the LCD includes:

1. Operating Parameters: Timer set values, energy set values, upper and lower limits (time or energy), trigger force, etc.

2. Dynamic Operating Conditions: Percentage of maximum power delivered and weld cycle duration or amount of energy delivered immediately following the completion of each cycle.

3. System Status Tests and Fault Indications: READY, SELF DIAGNOSTIC INPUT TEST, PRINTER TEST, EMERGENCY STOP, CHECK PRESS, FORCE MISSING, ETC.

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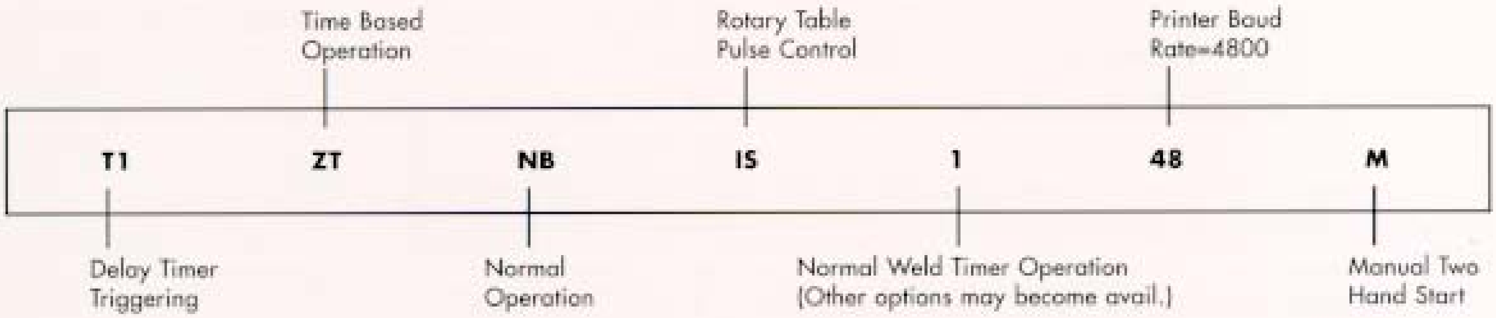
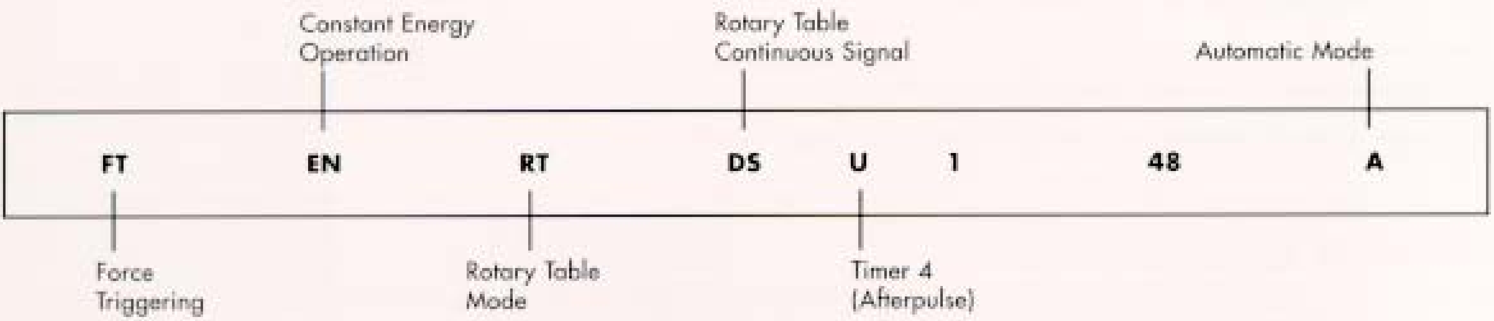
4. Mode Codes: Thirteen single or double character codes are used to identify the various functions used. Both function and numerical keys are used to select alternate functions.





Keypad

Numerical Keys: The numerical keys are used to input the various operating parameters and function values and, in some instances, to select functions and other values in code form, i.e., Mode Codes, Graph Time Axis Length, etc.

Function Keys: The function keys enable selection and display of the operating parameters, manual/automatic, normal/rotary table operation, program status, use of optional peripherals, various test and diagnostic procedures, etc.

ON/OFF Key: Controls line power to the power supply and the MICROPROCESSOR. A red LED provides a visual indication when the system is "ON".

CE Key: Cancels prior parameter value when a new value is to be entered. A red LED indicates CE Key is functional and displayed value may be cancelled.

ENTER Key: Enters and acknowledges new parameter values keyed in with numerical keys.

TEST Key: When depressed, the LCD Display indicates idle losses in air of converter/booster horn/horn as a percentage of the maximum power.

INFO Key: Displays number of operations, number of rejects, rated power of system, mode codes, duration of power curve time axis, job storage and recall, job sequencing, and activation/deactivation of calibration pulse.

MAN Key: Selects normal manual two hand operation and is used to jog rotary index table allowing one weld cycle if unit is incorporated in an automatic system. A green LED indicates when key is functional.

AUTO Key: Initiates automatic operation when unit is incorporated in an automated system. A green LED indicates when the system is operating in the Automatic Mode.

TIMER Key: Displays set values of the four timers and permits adjustment of the set values.

Timer 1: Delay timer for triggering or pretriggering with either time based or constant energy modes.
Timer 2: Weld timer used when time based mode of operation is selected.
Timer 3: Hold timer used with either time based or constant energy based modes.
Timer 4: Afterpulse timer used to release plastic assemblies which may adhere to the horn.
Timer 5: Abort cycle timer used for maximum weld time in the energy mode.

All standard timers are adjustable from 0.00 to 9.99 seconds in .01 second increments. Timers with longer weld times are available as an option.

REF Key: Displays constant energy set value (Ws) and permits adjustment of energy set value only when the constant energy mode of operation has been selected. Adjustable from 0.1 ro 9990.0 Ws for 1000 watt system, 0.1 to 14985.0 Ws for 1500 watt system, and 0.1 to 1998.0 Ws for 2000 watt system. A green LED indicates completion of an acceptable process cycle.

+LIM and -LIM Keys: Used to display and adjust upper and lower quality control tolerance limits. The limits are established in energy (ws) when the time based mode is selected, and time (sec) when the constant energy based cycle is selected. Each key incorporates a red LED which indicates when an assembly is rejected because either time or energy are above or below the set limits. An audible alarm also sounds when an assembly is rejected.

F TRIGGER Key: Displays and permits adjustment of the triggering force value as a percentage of trigger force available. Adjustable from 1% to 99%. When used in conjunction with the Head Advance pushbutton control on the front panel of the Model 1090, and 1098 pressed, the actual horn coupling force can be displayed as a percentage of available trigger force.

PRT Key: Permits display of parameters and dynamic process conditions when an optional CRT monitor or printer is used. A green LED indicates when data is being transmitted from the MICROPROCESSOR to the CRT monitor or printer.

O.L. RESET Key: Resets overload circuit when the power exceeds safe operating limits or when an off-frequency or fractured horn is in use. A red LED indicates when the overload circuit has tripped.

Communications Connections and Options

Three D type connectors are provided on every microprocessor controlled power supply.

- Printer/Monitor interface connector allowing the microprocessor to simultaneously communicate with both a printer and a monitor.
- Reject/Reset alarm input/output connector allowing the microprocessor to signal alarms and be reset remotely for subsequent cycles.
- Rotary Table input/output connector allowing the microprocessor to input and output to a rotary table.

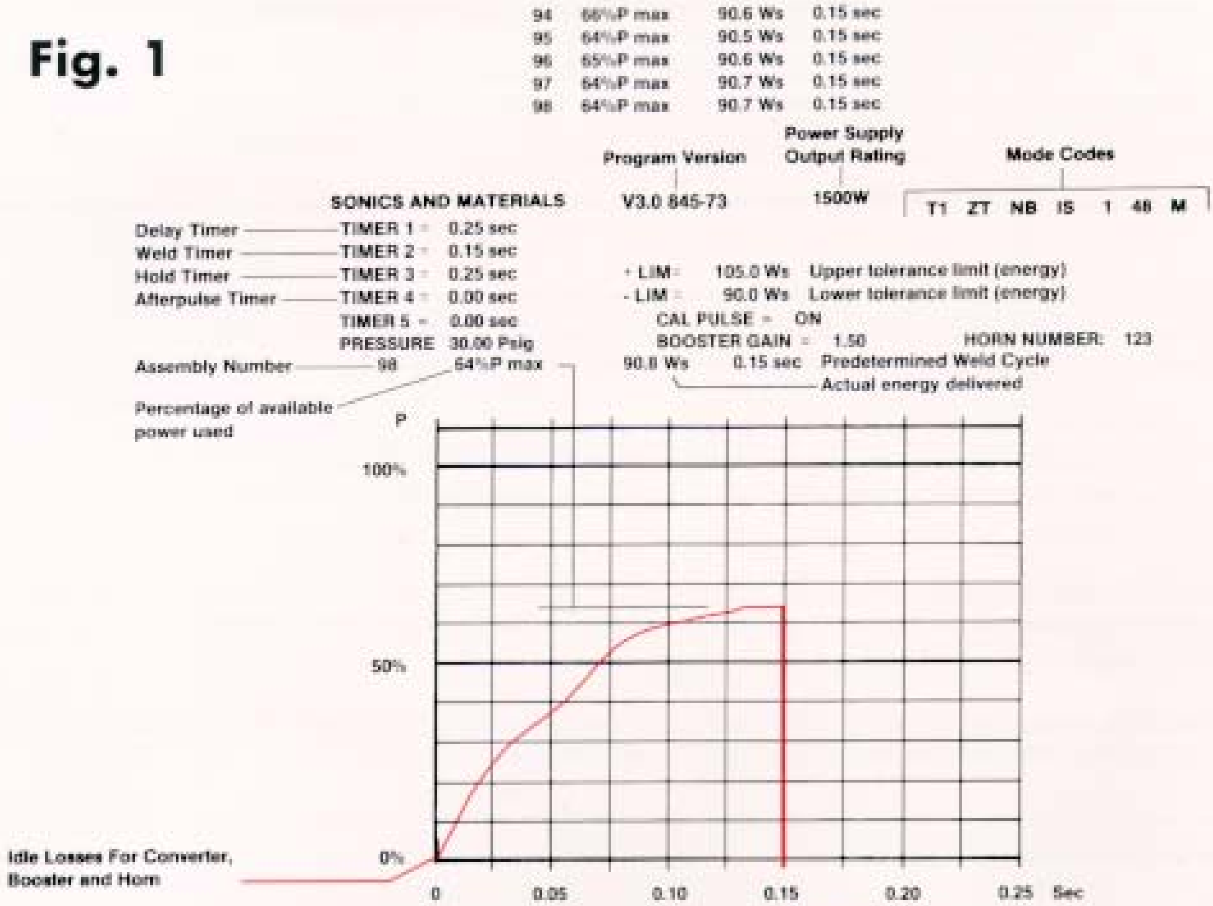
Set values of parameters and dynamic process conditions of each operation can be logged and displayed on the CRT monitor. A continuous hard copy printout of this information is provided by the printer and can be used for quality control documentation.

In addition, a graphic display of the actual power curve for the prior assembly operation can be printed out, thus making it possible to establish a reference profile which can be compared with subsequent operations.

Two printouts including set values of parameters, process conditions for a number of operations and a power curve are illustrated in Figure 1 and Figure 2.

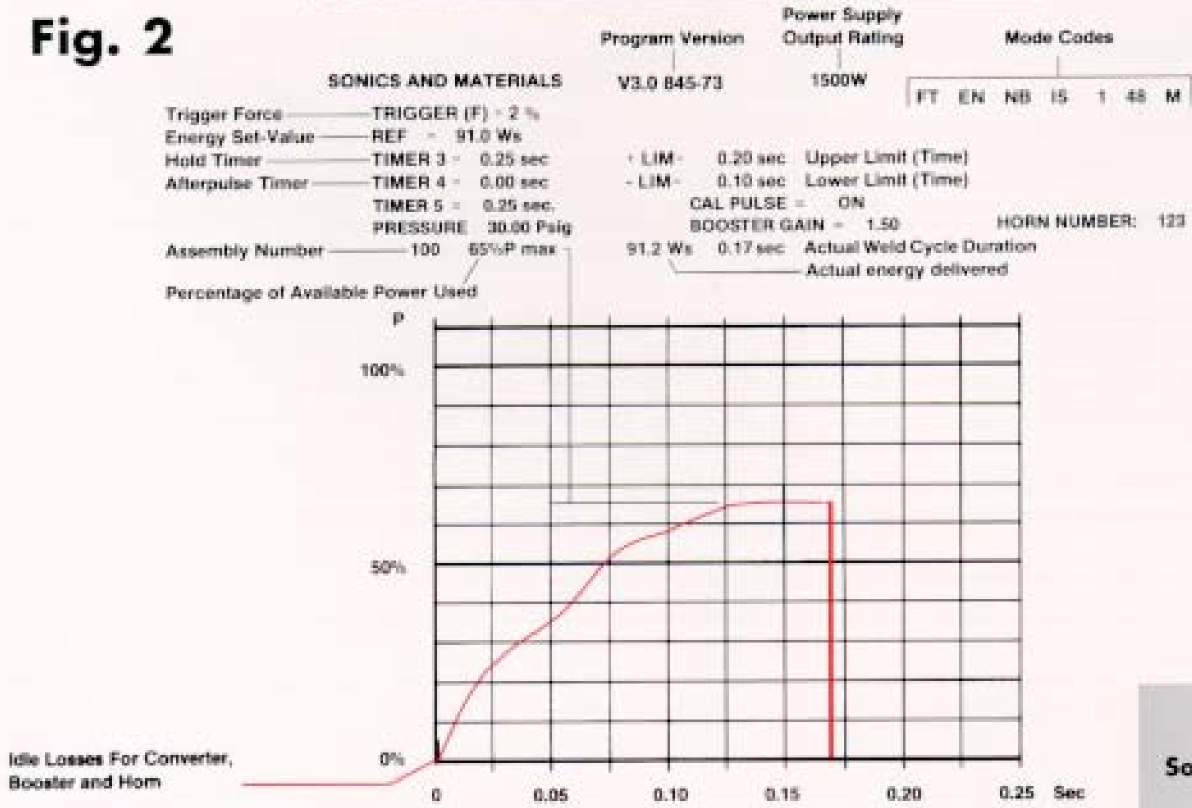
Figure 1 illustrates the values for components assembled in the time based mode with delay time triggering. Figure 2 details the same information for similar components assembled in the constant energy mode with force triggering.

Fig. 1



TIME BASED MODE WITH DELAY TIMER TRIGGERING

Fig. 2



CONSTANT ENERGY MODE WITH VARIABLE FORCE TRIGGERING

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Joint Designs for Ultrasonic Welding

Perhaps the most critical facet of ultrasonic welding is joint design (the configuration of two mating surfaces). It should be considered when the parts to be welded are still in the design stage, and incorporated into the molded parts. There are a variety of joint designs, each with specific features and advantages. Their selection is determined by such factors as type of plastic, part geometry, weld requirements, machining and molding capabilities, and cosmetic appearance.

Butt Joint with Energy Director

The butt joint with energy director is the most common joint design used in ultrasonic welding, and the easiest to mold into a part. The main feature of this joint is a small 90° or 60° triangular shaped ridge molded into one of the mating surfaces. This energy director limits initial contact to a very small area, and focuses the ultrasonic energy at the apex of the triangle. During the welding cycle, the concentrated ultrasonic energy causes the ridge to melt and the plastic to flow throughout the joint area, bonding the parts together.

For easy-to-weld resins (amorphous polymers such as ABS, SAN, acrylic and polystyrene) the size of the energy director is dependent on the area to be joined. Practical considerations suggest a minimum height between .008 and .025 inch (.2 and .6 mm).

Crystalline polymers, such as nylon, thermoplastic polyesters, acetal, polyethylene, polypropylene, and polyphenylene sulfide, as well as high melt temperature amorphous resins, such as polycarbonate and polysulfones are more difficult to weld. For these resins, energy directors with a minimum height between .015 and .020 inch (.4 and .5 mm) with a 60° included angle are generally recommended.

The 90° included angle energy director height should be at least 10% of the joint width, and the width of the energy director should be at least 20% of the joint width. Figure 1 shows a butt joint with a 90° included angle energy director. With thick-walled joints, two or more energy directors should be used, and the sum of their heights should equal 10% of the joint width.

To achieve hermetic seals when welding polycarbonate components, it is recommended that a 60° included angle energy director should be designed into the part. The energy director width should be 25% to 30% of the wall thickness. Figure 2 shows a butt joint with a 60° included angle energy director. Figure 3 shows how the parts should be dimensioned to allow for the flow of molten material from the energy director throughout the joint area.

With assemblies whose components are made of identical thermoplastics, the energy director can be designed into either half of the assembly. However, when designing energy directors into assemblies consisting of a part made of copolymers or terpolymers, such as ABS, and another part made of a homopolymer such as acrylic, the energy director should always be incorporated into the homopolymer half of the assembly.

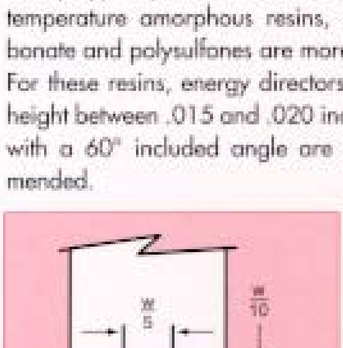

FIG. 1

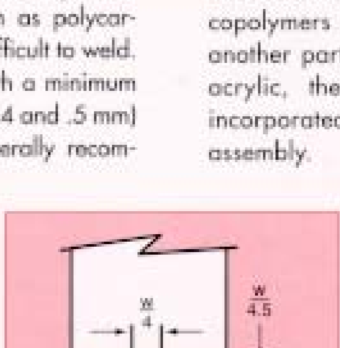

FIG. 2

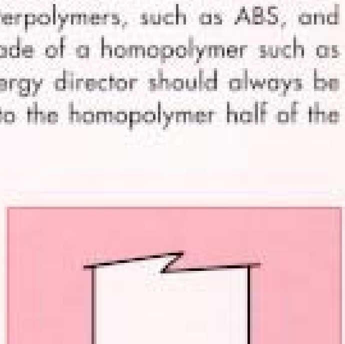

FIG. 3

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Thermoplastic Assembly Solutions for Every Application

Step Joint with Energy Director

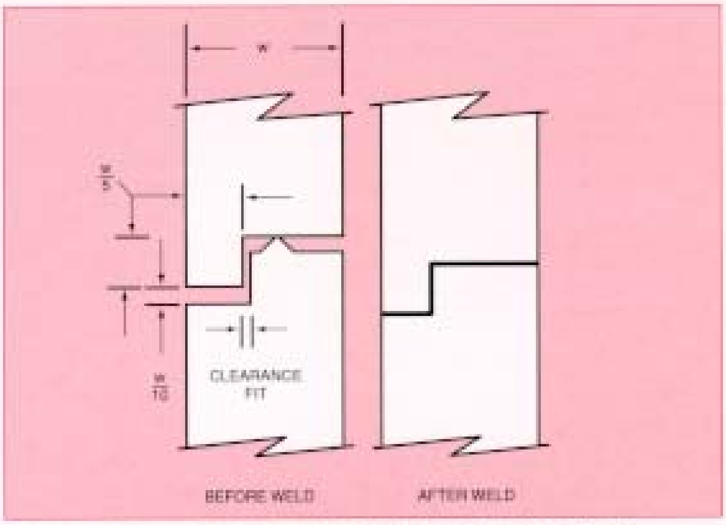

FIG. 4 STEP JOINT WITH 90° ENERGY DIRECTOR

The step joint with energy director is illustrated in Figure 4. This joint molds readily, and provides a strong, well aligned joint with a minimum of effort. This joint is usually stronger than a butt joint due to the fact that material flows into the vertical clearance. The step joint provides good strength in shear as well as tension, and is often recommended where good cosmetic appearance is required. When working with crystalline materials a 60° included angle energy director should be used instead of the 90° included angle energy director.

Tongue and Groove Joint with Energy Director

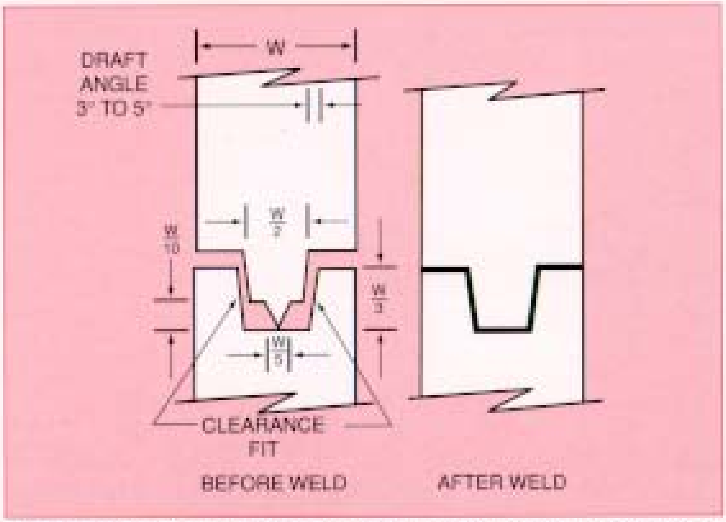

FIG. 6 TONGUE AND GROOVE JOINT WITH ENERGY DIRECTOR

Figure 5 shows variations of the basic step joint design.

The tongue and groove joint with energy director is illustrated in Figure 6. This joint is used primarily for scan welding, self location of parts, and prevention of flash both internally and externally. It provides the greatest bond strength of the three joints discussed so far.

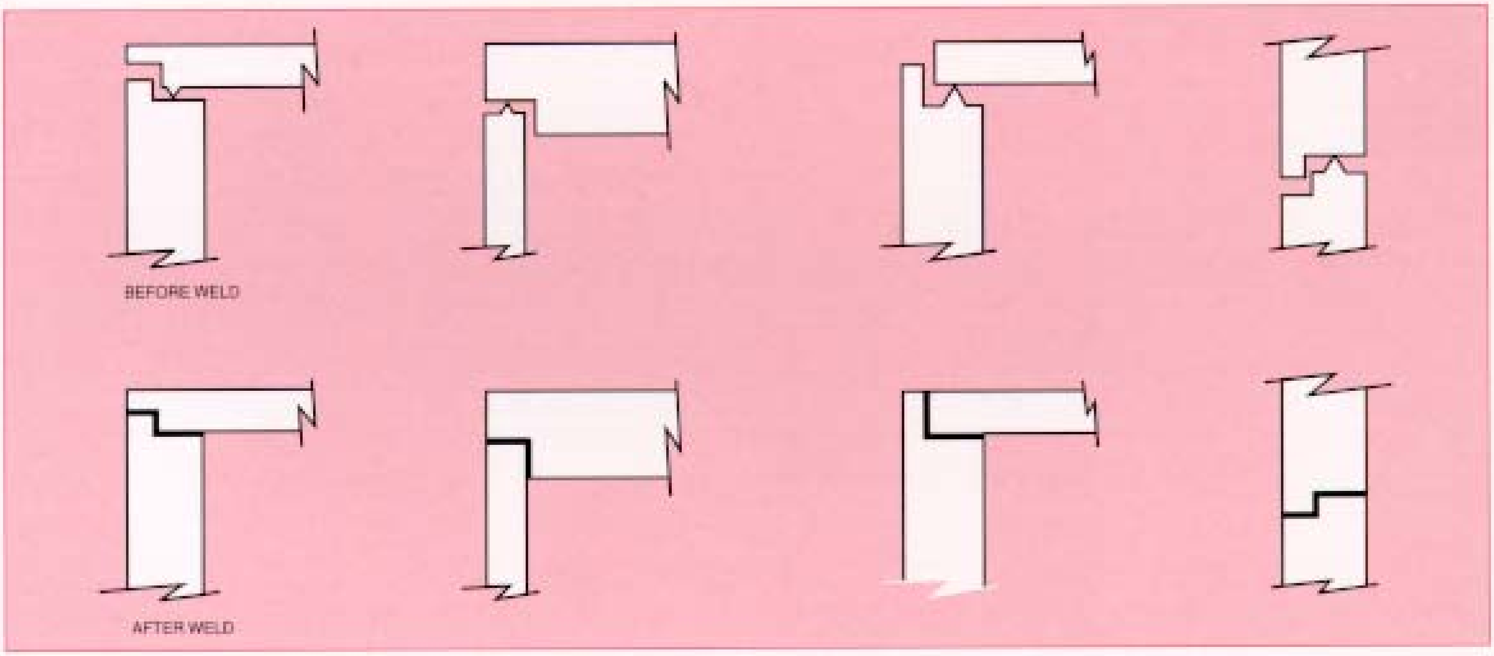

FIG. 5 STEP JOINT VARIATIONS

NOTE

Joints with energy directors are not recommended for use with crystalline materials when high strength or hermetic seals are required. When these criteria must be incorporated in crystalline assemblies, the shear joint described on the next page should be considered.

Shear Joint

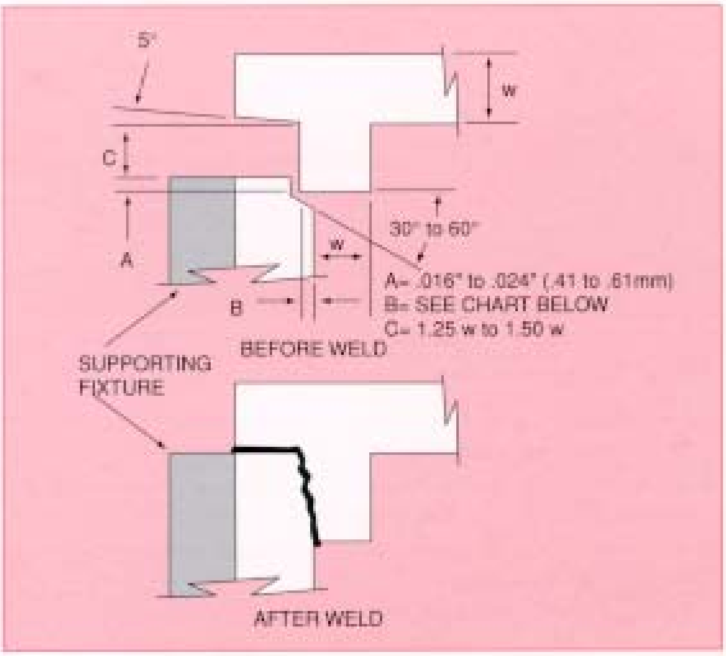

FIG. 7 SHEAR JOINT

The shear joint or interference joint shown in Figure 7 is generally recommended for high-strength hermetic seals on parts with square corners or rectangular designs, especially with crystalline resins.

Initial contact is limited to a small area which is usually a recess or step in either of the parts. The contacting surfaces melt first. As the parts telescope together, they continue to melt along the vertical walls. The smearing action of these two melt surfaces eliminates leaks and voids, making this the best joint for strong hermetic seals.

Several important aspects of the shear joint should be considered: 1) the top part should be as shallow as possible, 2) the outer walls should be well supported by a holding fixture, 3) the design should allow for a clearance fit, and 4) a lead-in (A) should be incorporated.

Maximum Part Dimension	Interference (B)
Less than 0.75" (19 mm)	0.008" to 0.012" (0.2 to 0.3 mm)
.075" to 1.50" (19 to 38 mm)	0.012" to 0.016" (0.3 to 0.4 mm)
Greater than 1.50" (38 mm)	0.016" to 0.020" (0.4 to 0.5 mm)

The shear joint requires weld times in the range of 3-4 times that of other joint designs because larger amounts of resin are being welded. In addition, a certain amount of flash will be visible on the surface after welding.

When flash cannot be tolerated for aesthetic or functional reasons, a well similar to the ones shown in Figure 8 should be incorporated.

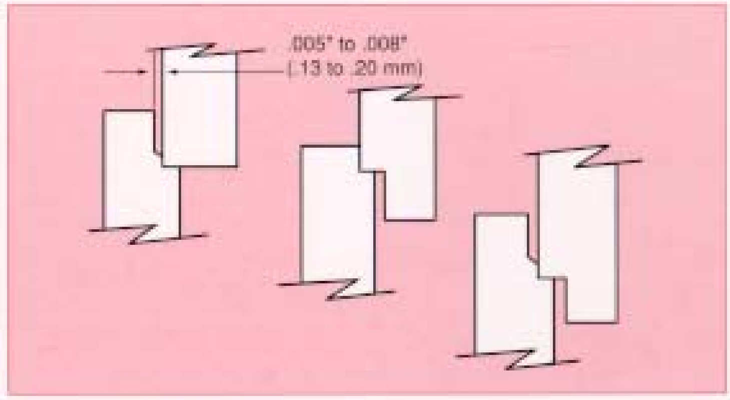

FIG. 8 SHEAR JOINTS WITH FLASH WELLS

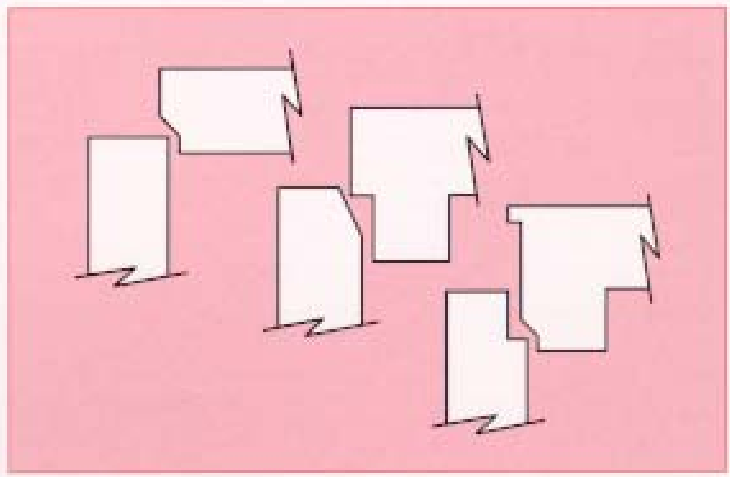

FIG. 9 SHEAR JOINT VARIATION

Modified joints, such as those shown in Figure 10, should be considered for large parts or for parts where the top piece is deep and flexible.

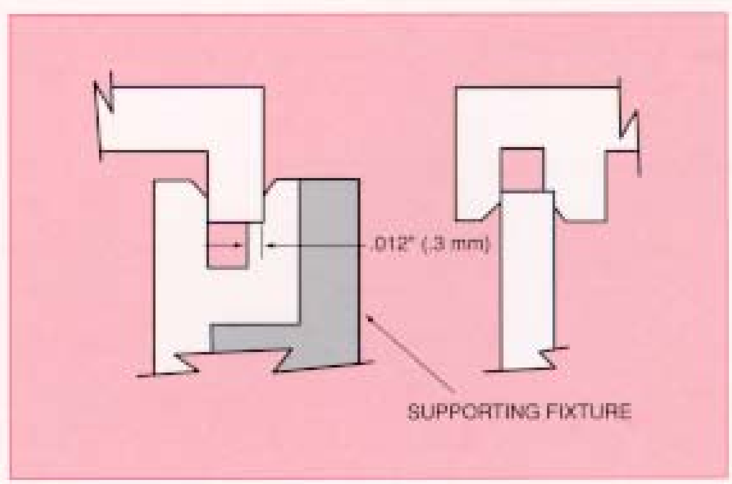

FIG. 10 SHEAR JOINT VARIATIONS FOR LARGE PARTS

Scarf Joint

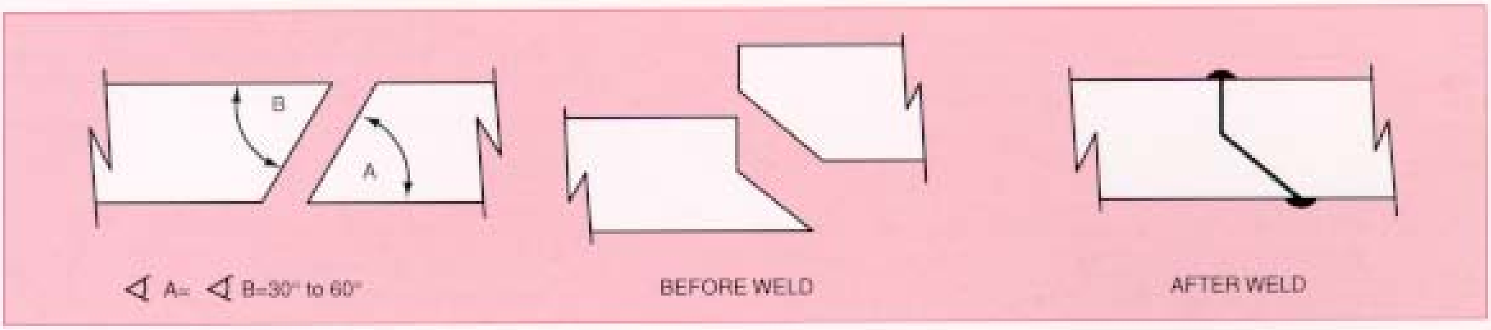

FIG. 11 SCARF JOINT

The scarf joint, illustrated in Figure 11, is generally recommended for high-strength hermetic seals on parts with circular or oval designs, especially with crystalline resins.

The scarf joint requires that the angles of the two parts be between 30° and 60° and be within one and one half degrees. If the wall thickness is .025" (0.63 mm) or less, an angle of 60° should be used. If the wall thickness is .060" (1.52 mm) or more, an angle of 30° should be used. Intermediate angles are recommended for wall thickness between .025" and .060" (.063 and 1.52 mm).

A minimum wall thickness of .030" (0.76 mm) at the outer edge of the scarf is recommended to prevent "blowout," or melting clear through the wall, during welding.

The scarf joint is not commonly used due to the difficulties encountered in maintaining component concentricity and dimensional tolerances. However, this joint is highly recommended when limited wall thicknesses preclude the use of a shear or modified shear joint.

A modified scarf joint is illustrated in Figure 12.

As shown in Figure 13, a flash well can be incorporated in the scarf joint to contain the excess molten material generated when the parts are welded. The length of the well should be at least equal to the cross sectional thickness of the part being welded.

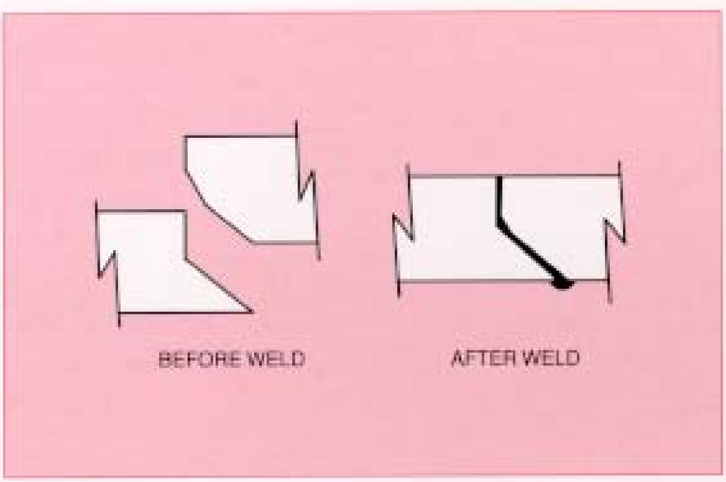

FIG. 12 MODIFIED SCARF JOINT

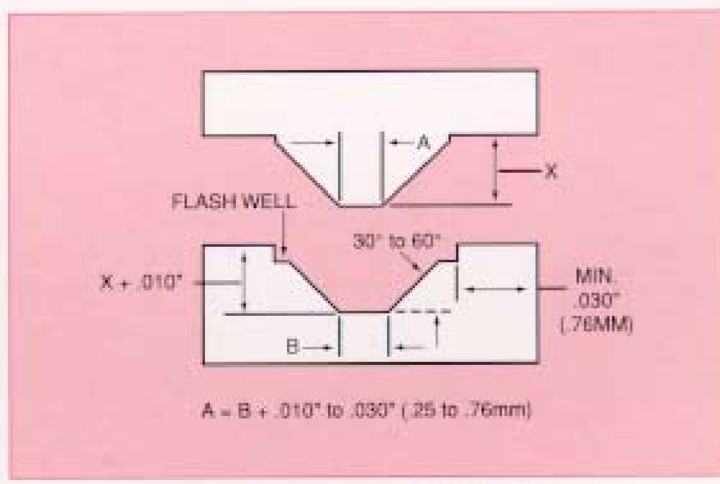

FIG. 13 SCARF JOINT WITH FLASH WELL

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Ultrasonic Staking and Spot Welding of Thermoplastic Assemblies

The basic principle of ultrasonic assembly involves conversion of high-frequency electrical energy to high-frequency mechanical energy in the form of reciprocating longitudinal motion which, when applied to a thermoplastic, generates frictional heat at the plastic/plastic or plastic/metal interface creating a localized melt.

In ultrasonic staking, also referred to as ultrasonic "heading" or "riveting", the controlled flow of the molten plastic is used to capture or retain another component, usually of a different material, in place.

Ultrasonic staking provides an alternative to welding when the two parts consist either of dissimilar materials which cannot be welded, or when simple mechanical retention of one part relative to another is adequate (i.e. as distinct from molecular bonding).

The most common application involves the attachment of metal to plastic. A hole in the metal part receives a pre-molded plastic boss. The horn tip, vibrating at high frequency contacts the boss, and through friction, creates localized heat. As the boss melts due to frictional heat, the light pressure from the horn forms a head to a shape determined by the horn tip configuration. When the vibrations stop, the plastic material solidifies, and the dissimilar materials are fastened together.

Unlike ultrasonic plastics welding, staking requires that out-of-phase vibrations be generated between the horn and the plastic surfaces. Light initial contact pressure is therefore a requirement for out-of-phase vibratory activity within the limited contact area. It is the progressive melting of the plastic boss under continuous, but light pressure, that forms the head. When staking, low pressure rather than high pressure is usually recommended.

With staking, tight assemblies are possible because mating parts are clamped under the pressure of the horn until the rivet head solidifies. There is no elastic recovery as is the case with heat staking or cold forming.

Ultrasonic staking should be considered when the parts to be assembled are still in the design stage. Several configurations for boss/cavity design are available, each with specific features and advantages. Their selection is determined by such factors as type of plastic, part geometry, assembly requirements, machining and molding capabilities, and cosmetic appearance. The principle of staking is the same for each: the area of initial contact between the horn and the boss is kept to a minimum, in order to concentrate the energy and produce a rapid melt.

The integrity of an ultrasonically staked assembly depends greatly upon the geometric relationship between the boss and the horn cavity. Proper design will produce optimum strength with minimum flash.

Whenever possible, the bosses should be designed with an undercut radius at the base to prevent fracturing or melting and should be tapered from the base to the top. Holes in the mating parts should be radiused or at least deburred. Long bosses should be avoided.

The boss should be properly located and rigidly supported from below to ensure that the energy will be dissipated at the horn/boss interface rather than exciting the entire plastic assembly and fixture.

Best staking results are obtained when the ultrasonic vibrations are started before the horn contacts the boss. This prevents "cold forming" and allows for the gradual reforming of the boss. The pretriggering of the ultrasonic vibrations is normally accomplished using a pretrigger switch.

To obtain repeatable results when staking, the distance that the horn travels should be consistent and limited by the positive stop adjustment.

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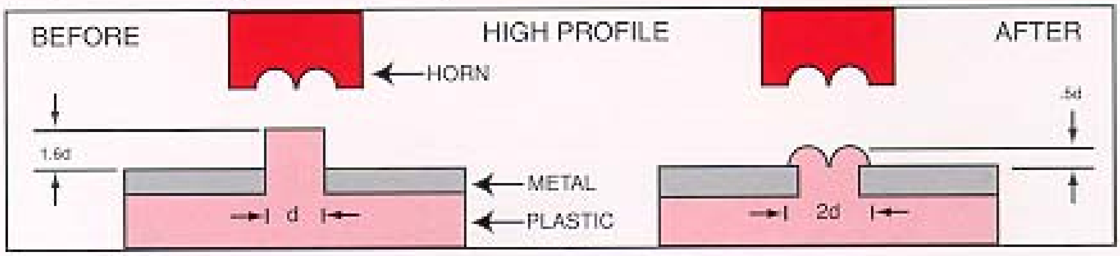
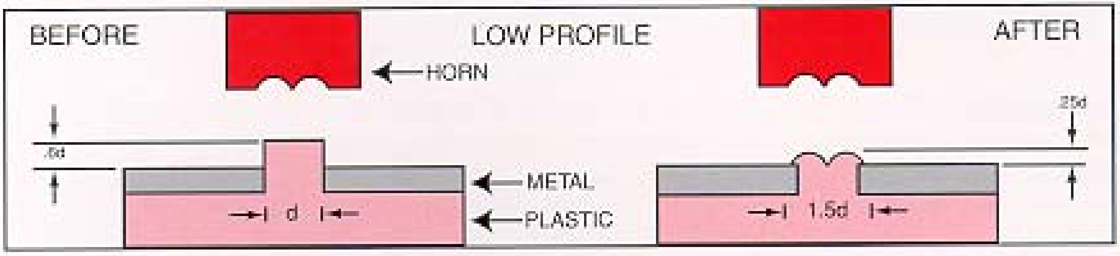
Staking

STANDARD FLARED STAKE

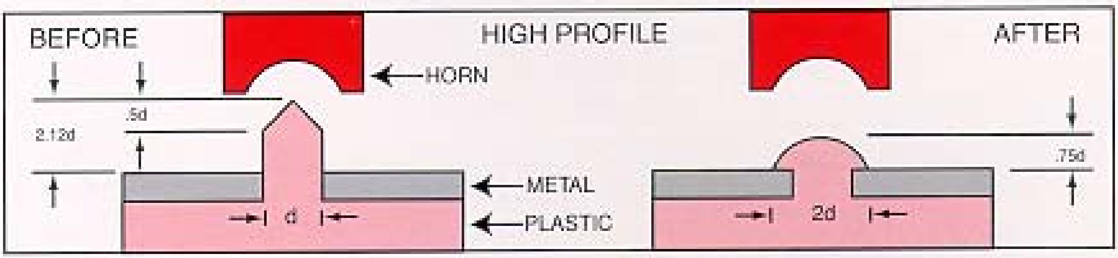
The standard flared stake satisfies the requirements of most applications. This stake is recommended for bosses with an O.D. of 1/16 inch (1.6 mm) or larger, and is ideally suited for low density, nonabrasive amorphous plastics.

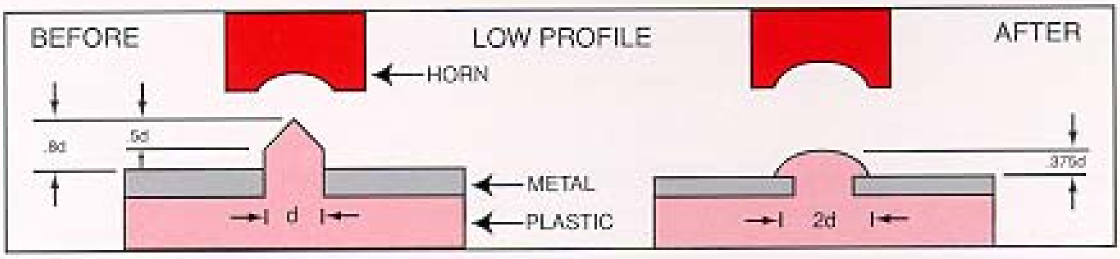




SPHERICAL STAKE

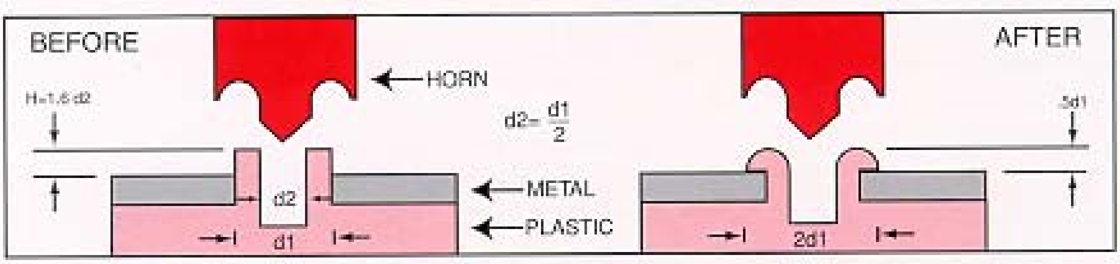
The spherical stake is preferred for bosses with an O.D. less than 1/16 inch (1.6mm) and is recommended for rigid crystalline plastics with sharp highly defined melting temperatures, for plastics with abrasive fillers, and for materials that degrade easily.





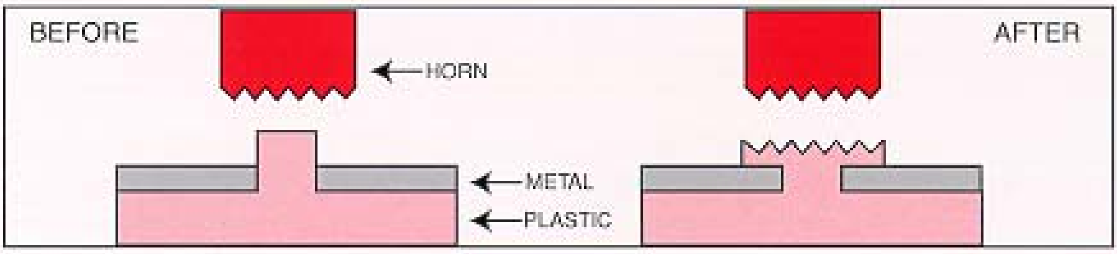
HOLLOW STAKE

Bosses with an O.D. in excess of 5/32 inch (4 mm) should be made hollow. Staking a hollow boss produces a large, strong head without having to melt a large amount of material. Also, the hollow stake avoids sink mark on the opposite side of the component, and enables the parts to be reassembled with self-tapping screws should repair and disassembly be necessary.



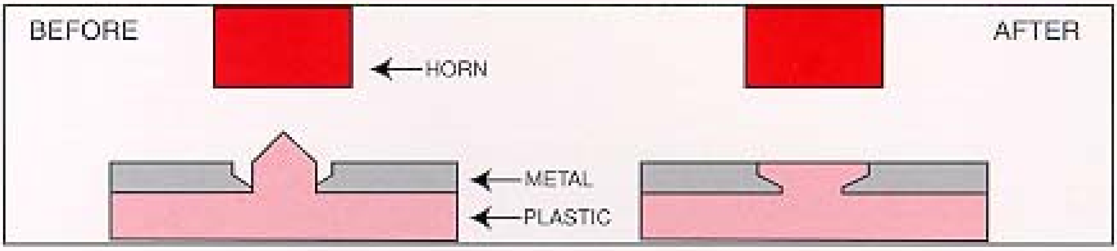
KNURLED STAKE

The knurled stake is used in applications where appearance and strength are not critical. Since alignment is not an important consideration, the knurled stake is ideally suited for high volume production, and is often recommended for use with a hand held ultrasonic spot welder. Knurled tips are available in a variety of fine, medium and coarse configurations.



FLUSH STAKE

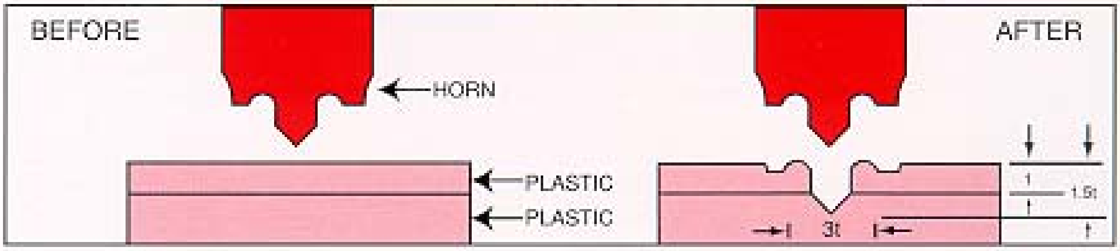
The flush stake is used for applications requiring a flush surface. The flush stake requires that the retained piece has sufficient thickness for a chamfer or counterbore.



Spot Welding

Using an ultrasonic spot welder and standard replaceable tips, large thermoplastic parts, and those with hard-to-reach joining surfaces can easily be welded together.

Vibrating ultrasonically, the pilot of the tip penetrates the top sheet and enters the bottom sheet to a depth of one-half the top sheet thickness. The displaced molten plastic is shaped by a radial cavity in the tip to form an annular formation around the weld. Simultaneously, the molten plastic displaced from the second sheet flows into the preheated area and forms a permanent molecular bond.



Staking/Welding Tips

Standard threaded tips available for staking and spot welding are listed on the back cover. Special carbide faced wear resistant tips are available for standard horns. Horns which cannot accept replaceable tips can readily be carbide coated. Most frequently bosses are ultrasonically staked one at a time using a standard horn and replaceable tip. It is possible, however, to stake several bosses simultaneously using a larger horn with multiple tips. Multi-element horns can be designed to satisfy applications where component geometry precludes the use of standard horns. Horns with up to six tips have been used successfully in multiple staking applications.

Staking

Plastic Boss Diameter		TIP CODE LETTER								HORN REQUIRED	
		Solid Boss Flare Head				Conical Boss Spherical Head		Hollow Boss	Horn Diameter	Horn Series "E"	
inches	mm	High Profile		Low Profile		High Profile	Low Profile			Thread Size	Part No.
		Tip Size	Stud Height*	Tip Size	Stud Height*						
1/32	0.793	A	.050	G	.019	AA	GG	-			
1/16	1.587	B	.100	H	.0375	BB	HH	-	1/2"	1/4-28	050000
3/32	2.381	C	.150	I	.056	CC	II	-	or		
1/8	3.175	D	.200	J	.075	DD	JJ	R	5/8"	1/4-28	062000
5/32	3.969	E	.250	K	.094	EE	KK	S			
3/16	4.762	F	.300	L	.112	FF	LL	T			
7/32	5.556	M	.350	O	.1312	MM	OO	U			
1/4	6.350	N	.400	P	.150	NN	PP	V	5/8"	5/16-24	062000

NOTE:
Flat tips are available with all of the above horns. Non-standard size tips are available upon request.
All material is titanium.
*Stud height above part to be staked.

Spot Welding

Material Thickness (t)		TIP CODE LETTER	HORN REQUIRED		
			Horn Diameter	Horn Series "E"	
inches	mm			Thread Size	Part No.
1/32	0.793	SA	1/2"	1/4-28	050000
3/64	1.190	SB	or		
1/16	1.587	SC	5/8"	1/4-28	062000
5/64	1.984	SD			
3/32	2.381	SE			
7/64	2.778	SF			
1/8	3.175	SG			
5/32	3.969	SH			
3/16	4.762	SI	3/4"	3/8-24	075000
7/32	5.556	SJ			
1/4	6.350	SK			
9/32	7.143	SL	1"	1/2-20	100000

Ordering Information

HORN
Specify horn required using code letter.

Example: Series "E" 050000, 1/4-28 indicates a 1/2" diameter tapped horn with 1/4-28 threads.

TIPS
Specify tip required using code letter.

Example: Staking Tip "A" indicates a tip used for staking a 1/32" solid boss with a high profile flared head. Spot Welding Tip "SA" indicates a tip used for spot welding 1/32" thick material.

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Ultrasonic Installation of Inserts in Thermoplastic Components

The basic principle of ultrasonic assembly involves conversion of high-frequency electrical energy to high-frequency mechanical energy in the form of reciprocating longitudinal motion which, when applied to a thermoplastic, generates frictional heat at the plastic/plastic or plastic/metal interface.

In ultrasonic insertion, a metal insert is placed in a cored or drilled hole which is slightly smaller than the insert. This hole provides a certain degree of interference and also serves to guide the insert into place. The vibrating ultrasonic horn contacts the insert and the ultrasonic vibrations travel through the insert to the interface of the metal and plastic. Heat, generated by the insert vibrating against the plastic, causes the plastic to melt, and as the horn advances, the insert is imbedded into the component. The molten plastic flows into the serrations, flutes, or undercuts of the insert and, when the vibrations terminate, the plastic resolidifies and the insert is securely encapsulated in place. In ultrasonic insertion, a slow horn approach, allowing the horn to develop a homogeneous melt phase, is preferable to "pressing" the insert.

Ultrasonic insertion provides the high performance strength values of a molded-in insert while retaining all of the advantages of post-molded installation. Inserts can be ultrasonically installed in most thermoplastics. Some of the advantages of ultrasonic inserting over other methods include rapid installation, minimal residual stresses in the component following insertion, elimination of potential mold damage, reduced mold fabrication costs and increased productivity as a result of reduced mold cycle times.

In some applications, multiple inserts can be imbedded simultaneously with special horns, increasing productivity and further reducing assembly and manufacturing costs.

Ultrasonic insertion is not restricted to standard-type threaded inserts. Inserts that can be installed ultrasonically include a variety of bushings, terminals, ferrules, hubs, pivots, retainers, feed-through fittings, fasteners, hinge plates, binding posts, handle-locating pins and decorative attachments.

Typically, the plastic component is fixtured and the insert is driven in place by the horn (Figure 1). However, in some cases, the part configuration might prohibit insert contact by the horn, and the horn is made to contact the plastic component instead of the insert (Figure 2).

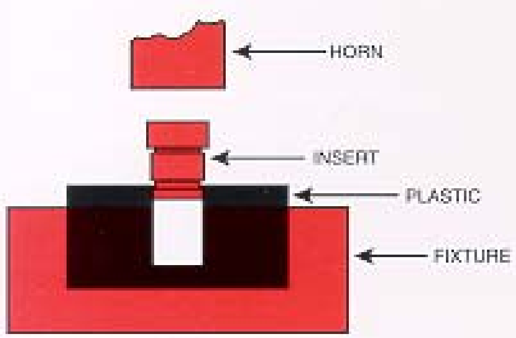

FIGURE 1

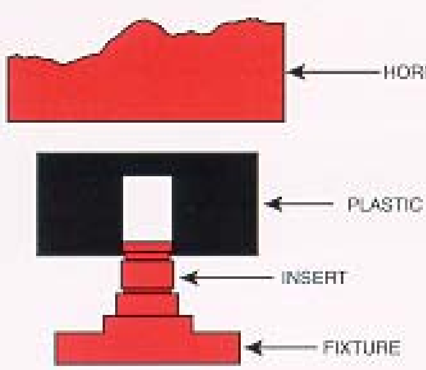

FIGURE 1

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Thermoplastic Assembly Solutions for Every Application

The functional characteristics or requirements of an application actually determine the insert and hole configuration. In all cases, a sufficient volume of plastic must be displaced to fill the under cuts, flutes, knurls, threads and/or contoured areas of the insert. Care should be exercised in selecting the proper inserts. Inserts are designed for maximum pull-out strengths, torque retention or some combination of both. Inserts with horizontal protrusions, grooves, or indents are usually recommended for high pull-out strength requirements. Inserts with vertical grooves, or knurls, are usually recommended for high torque retention. In regard to the hole configuration or insert selection, the recommendations provided by the insert manufacturer should always be observed.

Because the horn contacts the metallic insert, it is subjected to some wear. As a result, horns used for insertion are usually made of hardened steel or titanium. Carbide coating of titanium horns is also available.

For low volume applications, titanium horns with replaceable tips can be utilized.

Ideally, the diameter of the horn should be twice the diameter of the insert.

To prevent a "jack-out" condition, the top of the seated insert should be flush or slightly above the surface of the part.

Rigid fixturing should be placed directly under the insert.

In most instances, it is necessary to initiate ultrasonic vibrations prior to horn contact with the insert.

To maintain an accurate depth of insertion, the total distance the horn travels should be limited either mechanically by a positive stop, or electrically by a lower-limit linear encoder, or both.

CAUTION: When inserting, do not use weld time in excess of 1 1/2 seconds.

Ultrasonic Insertion Troubleshooting Guide

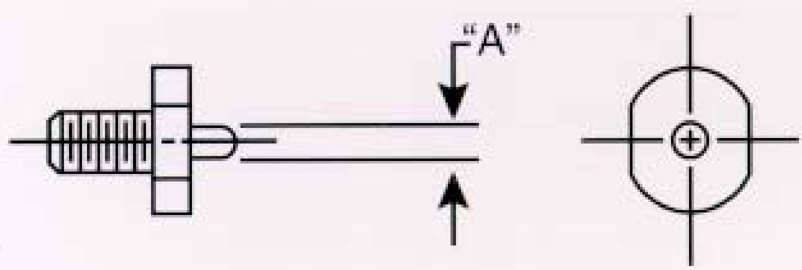
PROBLEM	SOLUTION
Insufficient pull-out or torque strength	Decrease pressure. Increase weld time. Increase amplitude (change booster). Decrease down speed. Increase insert interference Insert is too small or hole is too large. Increase hole depth. Decrease screw length.
Damage to insert	Decrease weld time or energy. Decrease amplitude (change booster). Increase pressure. Increase down speed.
Plastic cracks	Confirm that ultrasonics is on. Decrease pressure. Walls surrounding hole are too thin. Increase weld time or energy. Decrease amplitude (change booster). Decrease down speed. Enlarge hole diameter.
Partial insertion	Increase pressure. Decrease down speed. Decrease amplitude (change booster). Increase weld time or energy. Increase hole depth. Adjust positive stop. Check fixturing. Horn is at the end of its stroke.

Ultrasonic Insertion Troubleshooting Guide (Continued)

PROBLEM	SOLUTION
Inserting time is excessive	Decrease weld time or energy. Decrease hold time. Decrease amplitude (change booster). Increase pressure. Increase down speed. Insert is too large or hole is too small. Improper fixturing. Power required exceeds capability of power supply.
System overloads	Decrease pressure. Decrease down speed. Decrease amplitude (change booster). Tune power supply. Check for loose studs. Check coupling between horn and booster. Power required exceeds capability of power supply.
Insert does not remain inserted	Increase hold time.
Plastic fills the threaded bore of the insert	Increase hole depth. Insert is too large or hole is too small. Insert is too long.
Horn wears prematurely	Use hardened steel or carbide faced horn. Decrease amplitude (change booster). Insert is too large or hole is too small. Plastic is too abrasive.
Application is noisy	Start the ultrasonics just prior to the horn contacting the insert. Decrease amplitude (change booster). Increase pressure. Increase down speed. If possible contact plastic rather than insert. Use sound enclosure or hearing protectors.
Plastic flows over the top of the insert	Adjust positive stop to limit depth of insertion. Decrease weld time or energy. Insert is too large or hole is too small.
Horn heats up	Decrease amplitude (change booster). Air cool the horn. If possible contact plastic rather than insert. Check coupling between horn, booster and converter.

Inserting Tips

Insert Size	Inside Diameter Of Insert	Pilot Diameter Of Tip (Dim. A-inches)
SAE		
4-40	0.088	0.078
6-32	0.106	0.096
8-32	0.133	0.123
10-24	0.147	0.137
10-32	0.160	0.150
1/4-20	0.200	0.190
1/4-28	0.211	0.201
5/16-18	0.262	0.252
METRIC		
2.5 x 0.45	0.079	0.069
3 x 0.5	0.097	0.087
3.5 x 0.6	0.114	0.104
4 x 0.7	0.129	0.119
5 x 0.8	0.165	0.155
6 x 1	0.195	0.185
8 x 1.25	0.265	0.255



NOTE: Specify insert size (SAE or Metric) when ordering inserting tip.

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Characteristics of Thermoplastics for Ultrasonic Assembly Applications

The basic principle of ultrasonic assembly involves conversion of high-frequency electrical energy to high-frequency mechanical energy in the form of reciprocating vertical motion, which, when applied to a thermoplastic, can generate frictional heat at the plastic/plastic or plastic/metal interface. In ultrasonic welding, this frictional heat melts the plastic, allowing the two surfaces to fuse together; in ultrasonic staking, forming or insertion, the controlled flow of the molten plastic is used to capture or retain another component in place (staking/forming) or encapsulate a metal insert (insertion).

Thermoplastics can be ultrasonically assembled because they melt within a specific temperature range, whereas thermosetting materials, which degrade when heated are unsuitable for ultrasonic assembly.

Weldability of any thermoplastic depends on its stiffness or modulus of elasticity, density, coefficient of friction, thermal conductivity, specific heat and T_m or T_g.

Rigid plastics exhibit excellent welding properties because they readily transmit vibratory energy. Soft plastics, having a low modulus of elasticity, attenuate the ultrasonic vibrations, and as such are more difficult to weld. In staking, forming or spot welding, the opposite is true. Generally, the softer the plastic, the easier it is to stake, form or spot weld.

Resins are classified as amorphous or crystalline.

Ultrasonic energy is easily transmitted through amorphous resins and as such, these resins lend themselves readily to ultrasonic welding. Amorphous resins are characterized by random molecular arrangements, and a broad melting temperature range that allows the material to soften gradually before melting and flow without prematurely solidifying.

Because the molecular structure in the crystalline resins attenuate a great amount of energy, crystalline resins do not readily transmit ultrasonic energy, and they require higher energy levels than amorphous resins. These resins are characterized by a high, sharply defined melting point that causes melting and resolidification to occur rapidly. For these reasons, when welding crystalline resins, higher amplitude and energy levels should be used, and special consideration should be given to joint design.

Before discussing welding characteristics, the difference between near-field and far-field welding must be understood. Near-field welding refers to welding a joint located 1/4 inch (6mm) or less from the area of horn contact; while far-field welding refers to welding a joint located more than 1/4 inch (6mm) from the horn contact area. The greater the distance from the point of horn contact to the joint, the more difficult it will be for the vibration to trav-

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el through the material, and for the welding process to take place.

The differential, if any, in the melt temperature of the materials being welded should not exceed 30 degrees F (17 degrees C), and the materials' molecular structure should be compatible; ie: blends, alloys, copolymers and terpolymers. Moisture content, mold release agents, lubricants, plasticizers, fillers, reinforcing agents, regrinds, pigments, flame retardants, and resin grade are all variables that can influence weldability.

The moisture content of parts molded from resins that are hygroscopic (moisture absorbent) can be problematical. Nylon (and to a lesser degree polycarbonate and polysulfone) present most of the problem, and parts molded in these resins should be stored in sealed polyethylene bags with an appropriate dessicant immediately after molding. If moist parts are welded, the escaping vapors may cause voids and fissures in the molten material resulting in a weld of poor integrity.

Mold release agents such as zinc stearate, aluminum stearate, fluorocarbons and silicones are not compatible with ultrasonic welding. If it is necessary to use a mold release agent, the paintable/printable grades that permit painting and silk screening should be considered. Other release agents should be removed with either TF Freon for crystalline resins or a 50/50 solution of water and liquid detergent.

Lubricants, whether waxes, stearates or fatty esters, reduce intermolecular friction within the polymer and inhibit the ultrasonic assembly process. However, since they are generally dispersed internally, their effect is usually negligible.

Plasticizers, which usually impart flexibility and softness to a resin can interfere with a resin's ability to transmit vibratory energy. FDA-approved plasticizers do not present as much of a problem as metallic plasticizers, but experimentation is recommended.

Although fillers and reinforcing agents such as glass and talc can increase the ultrasonic weldability of soft thermoplastics considerably, they should be judiciously used. When additive content exceeds 10%, premature horn wear may result, and specially treated steel or carbide-faced titanium horns might be required. When filler content approaches 35%, there may be insufficient resin at the surface to obtain hermetic seals; and when filler content exceeds 40%, insufficient plastic is present at the interface to form a positive bond. Reinforcement composed of long glass fibers are always more problematical than reinforcement composed of short glass fibers.

Ultrasonic assembly is one of the few methods that permits regrinding of parts, since no foreign substance is introduced into the resin. Ultrasonically assembling parts which have been manufactured from regrind parts present no problem provided that the percentage of regrind is not excessive, and the plastic has not been degraded. Regrind limitations suggested by the resin suppliers should be observed.

Although most pigments do not interfere with the ultrasonic process, some oil-based colorants can adversely influence weldability. Non-oil based pigments should be used.

Flame retardants greatly affect the weldability of thermoplastics and the effects of these various additives should be investigated experimentally prior to resin selection. The grade of resin can have a significant influence on weldability. There is a great difference between injection/extrusion grades and cast grades. Their molecular weight, melt temperature and modulus of elasticity are quite different. Injection/extrusion grades should only be used with injection/extrusion grades, and cast grades should only be used with cast grades.

Chart I
Characteristics of Thermoplastics

MATERIAL	SPOT WELDING	STAKING SWAGING	INSERTING	FIELD OF WELDING NEAR	FAR
AMORPHOUS:					
ABS	E	E	E	E	G
ABS/POLYCARBONATE	G	G	G	G	F
ABS/PVC	G	G	F	G	F
ACRYLIC	G	F	G	G	F
ACRYLIC MULTI-POLYMER-XT POLYMER	G	G	G	G	F
ACRYLIC/PVC	G	G	F	G	F
ACRYLIC – IMPACT MODIFIED	F	F	P	F	P
BUTADIENE – STYRENE (BDS)	G	G	G	G	F
CELLULOSICS – CA, CAB, CAP	P	G	E	P	–
MODIFIED PHENYLENE OXIDE	E	E	E	E	G
POLYARYLATE	F	F	G	G	F
POLYCARBONATE	G	F	G	G	F
POLYETHERIMIDE	G	G	E	E	G
POLYSTYRENE, G.P.	F	F	G	E	E
POLYSTYRENE, IMPACT MODIFIED	F	F	G	G	P
PVC – RIGID	F	G	E	P	P
PVC – FLEXIBLE	P	–	–	P	–
SAN – NAS – ASA	F	F	G	E	E
STYRENE-MALEIC-ANHYDRIDE	E	E	E	E	G
SULFONE POLYMERS	F	F	G	G	F
CRYSTALLINE:					
ACETAL COPOLYMER	F	F	G	G	F
ACETAL HOMOPOLYMERS	F	F	G	G	F
FLUOROPOLYMERS	–	–	–	P	–
NYLON	F	F	G	G	F
PC-PET	G	G	E	E	G
POLYESTER – PBT	F	F	G	G	F
POLYESTER – PET	F	F	G	G	F
POLYETHERETHERKETONE	G	G	E	E	G
POLYETHYLENE (LDPE, HDPE)	G	F	G	P	P
POLYETHYLENE (UHMW)	–	–	–	–	–
POLYMETHYLPENTENE	G	F	E	F	P
POLYPHENYLENE SULFIDE	F	P	G	G	F
POLYPROPYLENE	E	E	G	F-P	P

E - Excellent G - Good F - Fair P - Poor – Not Suitable for Ultrasonic Assembly

Chart II
Compatability of Thermoplastics

	ABS	ACRYLIC MULTI POLYMER	ACETAL	ACRYLICS	CELLULOSICS	ABS/POLYCARBONATE	ABS/PVC	BDS	MPPO	NYLON	PC/PET	POLYARYLATE	POLYCARBONATE	POLYESTER-PBT	POLYESTER-PET	POLYETHERETHERKETONE	POLYETHERIMIDE	POLYETHYLENE	POLYPROPYLENE	POLYSTYRENE	PVC	SAN	ATYRENE-MALEIC-ANHYDRIDE	SULFONES
ABS	■	●		■		●	●	●														●	■	
ACRYLIC MULTI POLYMER	●	■		●		●	●															●		
ACETAL			■																					
ACRYLICS	■	●		■		●	●															●	■	
CELLULOSICS					■																			
ABS/POLYCARBONATE	●	●		●		■	●						●										●	
ABS/PVC	●	●		●		●	■														●		●	
BDS	●							■												●			●	
MPPO									■											●				
NYLON										■														
PC/PET											■		●		●									
POLYARYLATE												■												
POLYCARBONATE						●					●		■										●	
POLYESTER-PBT														■										
POLYESTER-PET											●				■									
POLYETHERETHERKETONE																■								
POLYETHERIMIDE																	■							
POLYETHYLENE																		■						
POLYPROPYLENE																			■					
POLYSTYRENE								●	●											■		●	●	
PVC							●														■			
SAN	●	●		●																●		■	●	
ATYRENE-MALEIC-ANHYDRIDE	■			■		●	●	●					●							●		●	■	
SULFONES																								■

■ Denotes compatability

● Denotes some compatability, but not all grades and compositions are compatible.

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Model FC Power Supply

INSTRUCTION MANUAL

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WARNING

WARNING

SAFETY PRECAUTIONS
READ BEFORE INSTALLING OR USING THE EQUIPMENT

This system has been designed to assure maximum operator safety. However, no design can completely protect against improper usage. For maximum safety and equipment protection, observe the following warnings at all times and read the instruction manual carefully before you attempt to operate the equipment.

– High voltage is present in the equipment. Disconnect plug before removing cover or servicing.

– Make sure equipment is properly grounded with a 3-prong plug. Before plugging in equipment, test outlet for proper earth grounding.

– Ultrasonic welders operate above normal audibility for most people. Ear protection is recommended. Consult the Appendix for a list of manufacturers of ear protectors

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TABLE OF CONTENTS

IMPORTANT SERVICE LITERATURE

***NOTE:** Please read carefully before operating the equipment, then forward to your service department.*

The system 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.

MANUAL CHANGE INFORMATION

We continually strive to be at the forefront of the latest electronic developments by adding circuit and component improvements to our equipment as soon as they are developed and tested.

Sometimes, due to printing and shipping requirements, we cannot incorporate these changes immediately into printed manuals. Hence, your manual may contain new change information. Change information, if any, is located in the Appendix.

We reserve the right to make any changes in the design or construction of our equipment at any time, without incurring any obligation to make any change whatsoever in units previously delivered.

The technical data and schematics in the manual are for informational purposes only and may not reflect the current configuration being shipped from our factory. Upon formal request, complete and up-to-date information can be provided from the factory free of charge.

UNPACKING AND INSPECTION

NOTE: We recommend keeping all carton(s) and packing material in case it might be necessary to move the equipment, or to ship it for repair.

Before unpacking the equipment, check the shipping carton for any visible damage. If you see any, be sure to follow the procedures described below under "Visible Loss or Damage." Otherwise, proceed to remove the equipment from the carton. Before storing any packing material, check it carefully for small parts. Then perform a visual inspection of the equipment to detect any evidence of damage which might have occurred during shipment. Check the following:

1. all components against the enclosed packing list,
2. all module plug-in units,
3. all wire plug-in connections.

The equipment was carefully packed and thoroughly inspected before leaving our factory. All units are tested and checked for problems prior to shipping. It is asked that when a problem does occur that all parts and components be inspected for damage (especially when the unit is not in working order when received). Responsibility for safe delivery was assumed by the carrier upon acceptance of the shipment. Claims for loss of damage sustained in transit must therefore be made upon the carrier, as follows:

VISIBLE LOSS OR DAMAGE

Any external evidence of loss or damage must be noted on the freight bill or express receipt, and signed by the carrier's agent. Failure to adequately describe such external evidence of loss or damage may result in the carrier's refusal to honor a damage claim. The form required to file such a claim will be supplied by the carrier.

CONCEALED LOSS OR DAMAGE

Concealed loss or damage means loss or damage which does not become apparent until the merchandise has been unpacked. The contents might have been damaged in transit due to rough handling even though the container may not show external damage. When the damage is discovered upon unpacking, make a written request for inspection by the carrier's agent within 48 hours of the delivery date. Then file a claim with the carrier since such damage is the carrier's responsibility. The form required to file such a claim will be supplied by the carrier. Do not destroy packing materials, or move material from one location to another before the carrier makes their inspection.

If the system or any unit is damaged, notify "Sonics." "Sonics" will arrange for repair or replacement of damaged equipment without waiting for the claim against the carrier to be settled, provided a new purchase order is issued to cover the repair or replacement costs. Should any damage, shortage or discrepancy exist, please notify us immediately.

INTRODUCTION

The FC model power supply is an auto-tuned ultrasonic generator that can be operated on a continuous basis, or pulsed via an outside control. This power supply can be used with a stand-alone converter, or with a pneumatic actuator. The FC does not offer time or energy-based control.

OVERVIEW OF ULTRASONIC PLASTICS ASSEMBLY

WHAT IS ULTRASONICS?

Ultrasonics refers to vibrational waves with a frequency above the human audible range which is usually above 18,000 cycles per second (Hz).

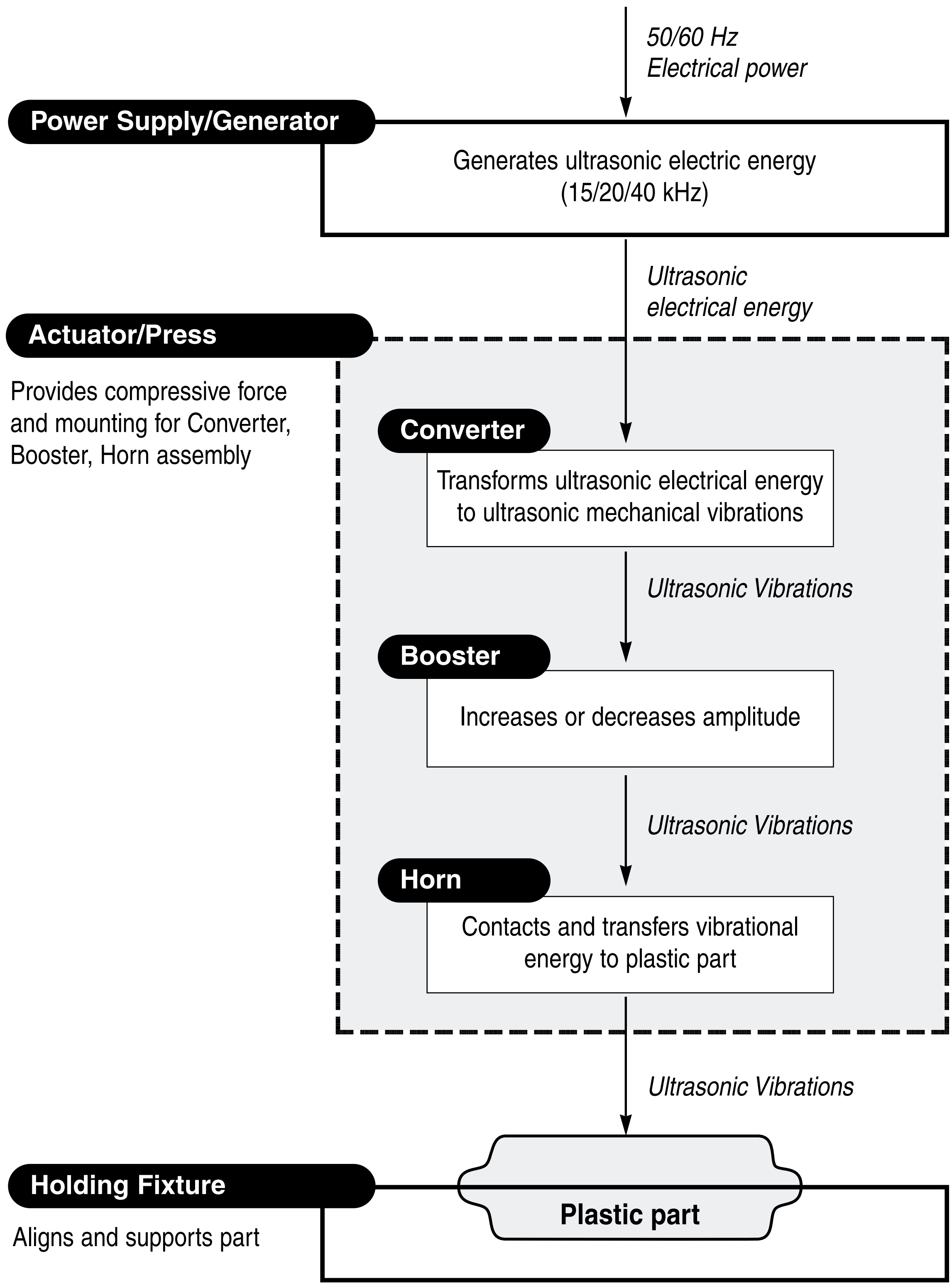
PRINCIPLE OF ULTRASONIC ASSEMBLY

The basic principle of ultrasonic assembly involves conversion of high frequency electrical energy to high frequency mechanical energy in the form of reciprocating vertical motion which, when applied to a thermoplastic, generates frictional heat at the plastic/plastic or plastic/metal interface. In ultrasonic welding, this frictional heat melts the plastic, allowing the two surfaces to fuse together; in ultrasonic staking or insertion, the controlled flow of molten plastic is used to capture or lock another material in place (staking) or encapsulate a metal insert (insertion).

ULTRASONIC ASSEMBLY SYSTEMS

"Sonics" ultrasonic assembly systems are generally composed of the following major elements: a power supply, converter, booster, horn, pneumatic press and holding fixture, as detailed in the diagram on the next page. A review of this diagram will help you understand the basic elements involved in the assembly process and their relation to each other.

"SONICS" ULTRASONIC ASSEMBLY SYSTEMS



GLOSSARY OF ULTRASONIC TERMS

POWER SUPPLY/GENERATOR – The solid state power supply converts standard 50/60 Hz electrical energy to 15,000 Hz, 20,000 Hz or 40,000 Hz (15/20/40 kHz) electrical energy.

ACTUATOR/PRESS – The pneumatic actuator provides compressive force and mounting for the converter, booster and horn assembly. The tabletop press consists of a base assembly, column and actuator (head).

CONVERTER – The converter changes the high frequency electrical energy supplied by the power supply to high frequency mechanical vibrations.

BOOSTER – Successful ultrasonic welding often depends on having the right amplitude at the horn face. Often it is not possible to design a horn which has both the necessary shape and required gain (ratios of input amplitude to output amplitude). In such cases, a booster is placed between the converter and the horn to either increase or decrease the amplitude of the horn. In addition to changing/maintaining the amplitude, the booster provides support and alignment in the welding system.

HORN – The horn is a tuned component of the system which comes in contact with the parts to be assembled. The horn 1) transfers the ultrasonic vibrations produced from the converter to the parts being welded, and 2) applies necessary force to the assembly while the material resolidifies.

HOLDING FIXTURE – The holding fixture or nest assures proper alignment and support of the parts being assembled.

NOTE: *For additional information on set-up and adjustment of the converter / booster / horn / holding fixture, refer to the Welding Press Instruction Manual.*

INSTALLATION

WARNING

The line cord of the controller/power supply is equipped with a 3-prong, grounding plug. Do not, under any circumstances, remove the ground prong. The plug must be plugged into a mating 3-prong, grounding type outlet.

ELECTRICAL POWER REQUIREMENTS

The power supply requires a fused, single-phase, standard 3-terminal grounding type receptacle capable of supplying the requisite voltage and current. Refer to the table below for power specification.

POWER SPECIFICATIONS

Model	Power Rating	115 vac	230 vac
FC740	700w	15 amps	10 amps
FC1020	1000w	15 amps	10 amps
FC1520	1500w	N/A	15 amps
FC2020	2000w	N/A	20 amps

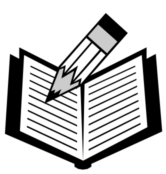
SETTING UP

The power supply is a free-standing assembly. It should be installed in a clear, uncluttered location that is free from excessive dirt, dust, corrosive fumes, and temperature and humidity extremes. The selected installation site should be near the electrical power source and away from equipment that generates abnormally high electrical transients. Observe the following additional instructions when installing the equipment:

a. Allow at least 6 inches (152.4mm) at the rear of the power supply for cable connections.

b. Position the power supply so that the front panel controls are visible and readily accessible.

c. The power supply is air cooled; allow sufficient space around the assembly to ensure adequate ventilation. If the power supply must be housed in a confined space, forced air cooling may be necessary to keep surrounding air within acceptable ambient temperature limits. Periodically check the ventilation grille and clean as necessary.



NOTE: *If power supply is to be run continuously, air cooling of the converter and horn is required. Use clean, dry compressed air filtered down to 5 microns (supplied to converter fitting – see page 11).*

NOTE: *Do not plug the power supply into an electrical outlet until all other connections have been made.*

ELECTRICAL CONNECTIONS

The standard cable supplied with a "Sonics" press is 10 feet. Optional extension cables are available up to 15 feet without modification.

When making the initial electrical connections, make sure the power is disconnected and follow these precautions.

1. Do not strain or kink the cables. When going around corners, allow as wide a bend as possible. Do not run the cables parallel to any power line within a distance of less than 1 foot (305mm).
2. To prevent the possibility of an electrical shock, ensure that the power supply line cord is properly grounded. Also make sure that the voltage rating of the electrical power source matches the power supply requirement (refer to the "Power Specifications" table on preceding page).
3. Check with your electrician if you have any wiring questions.

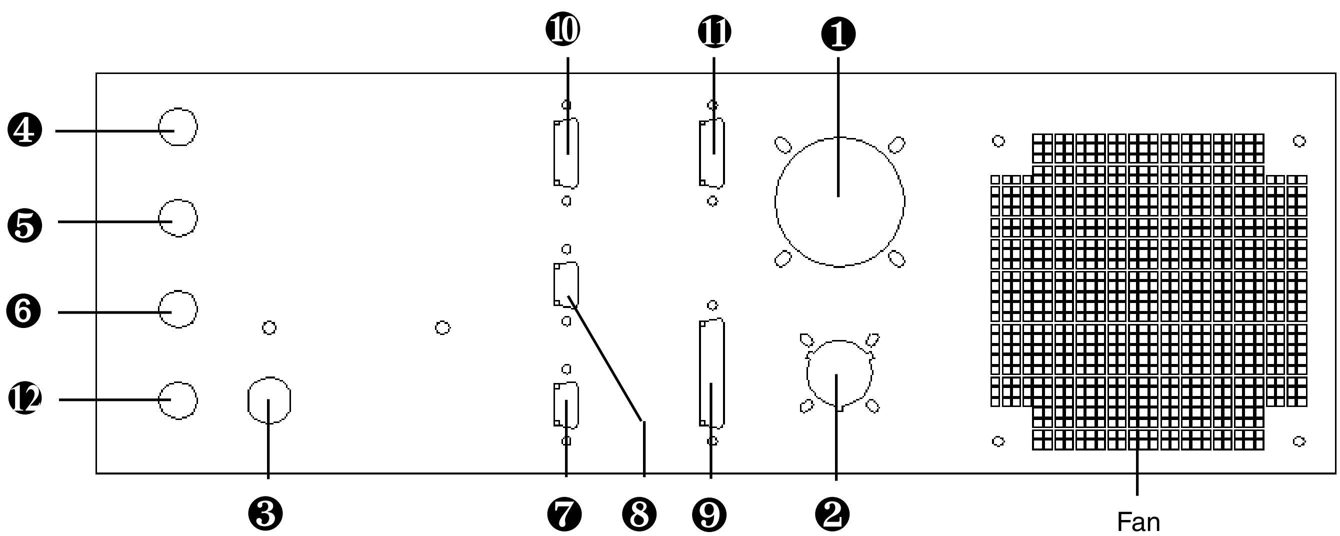
CABLE CONNECTIONS:

__NOTE:__ Detailed wiring diagrams are supplied in the Appendix at the back of this manual.

Located at the rear of the power supply are the cable connections as illustrated below. (The interconnecting cables will be supplied with your system.)

1. A round, 12-pin RF cable that connects the welding press or converter to the power supply.
2. An actuation cable that connects the power supply to a trigger source (refer to wiring diagrams in Appendix).
3. The power line cord that plugs into the appropriate electrical outlet.

Once these connections have been made, the power supply is ready for operation. If applicable, be sure to consult your welding press instruction manual to insure that all connections on the press side are correct, and that the press is ready for operation.



__NOTE:__ To see a list of converters that can be connected to the power supply, see the table on the following page.

Also located at the rear of the power supply are the following:

4. fuses (fixed 0.5 amp),
5. fuses (based on requirements listed in “Power Specifications” table, p. 8),
6. fuses (based on requirements listed in “Power Specifications” table, p. 8),
7. outputs J7 (see wiring diagrams in Appendix),
8. outputs J8 (see wiring diagrams in Appendix),

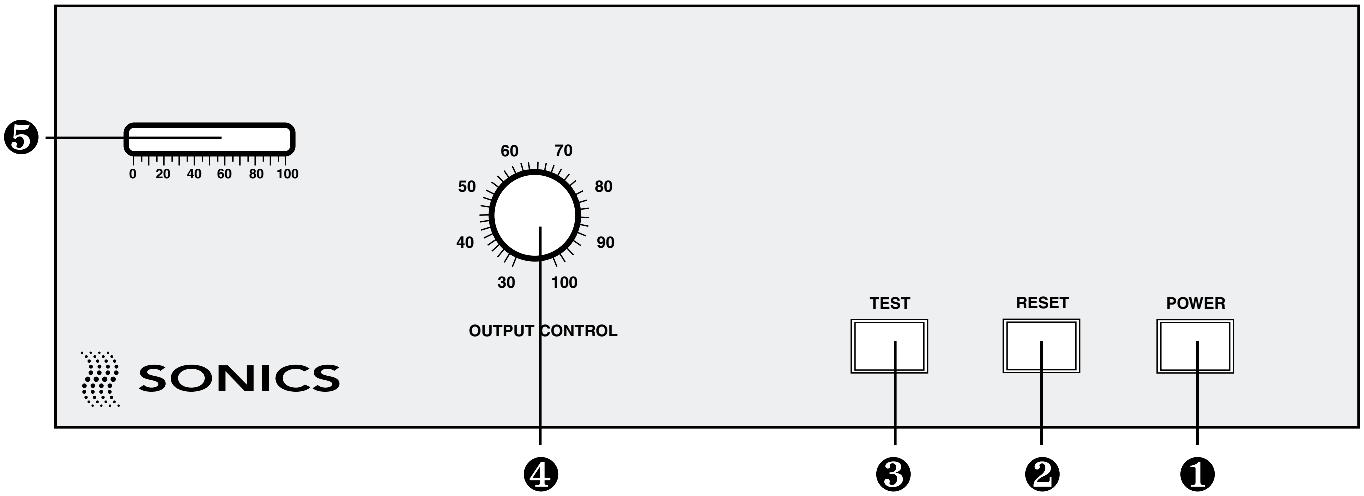
9-12. optional.

AVAILABLE CONVERTERS

Item No.	Description
CV00015	20 kHz with Button connector
CV00151	20 kHz with Lemo connector
CV00154	20 kHz with Lemo connector and fitting for air cooling
CV00157	20 kHz with Button connector and fitting for air cooling
CV00158	20 kHz Hand Gun with handles and cables
CV00331	20 kHz with Fischer connector
CV00334	20 kHz with Fischer connector and fitting for air cooling
CV00023	40 kHz with Button connector
CV00231	40 kHz with Lemo connector
CV00232	40 kHz with SHV connector side mounted
CV00234	40 kHz with Lemo connector and fitting for air cooling
CV00238	40 kHz Hand Gun with trigger switch and cable

FRONT PANEL CONTROLS

Located on the front panel of the power supply are the following controls:



WARNING

The RESET button is a built-in safety feature. When the power supply is connected to a press, be sure the press head actuation signals are not activated (or closed). If they are activated, the press head will descend immediately when the RESET button is depressed.

1. Red **POWER** button which turns the unit on and off.
2. Yellow **RESET** button which resets the power supply following an overload condition. If an overload condition exists, the button lights up. In addition, the **RESET** button must be depressed after the unit is first turned on before any operation can proceed.
3. Green **TEST** button which can be used to test ultrasonic operation (pressing it only manually activates the ultrasonics).
4. **OUTPUT CONTROL DIAL** which controls *fine* adjustment of the amplitude of the system's high-frequency vibrations over the full operating range. (*Major* adjustments of amplitude are made through the use of different boosters – consult your press manual for further information.)
5. **LED LOAD METER** which indicates the level of ultrasonics that is being transmitted to the welding press.

STARTING UP THE POWER SUPPLY

Press the red **POWER** button to turn the power supply on. The **POWER** button will light up. The yellow **RESET** button will also come on and will remain lit.

INITIAL OPERATION

After the power supply is turned on (as described above), follow these steps:

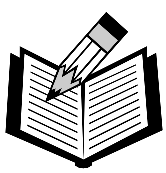
1. Make sure that all necessary preparations have been made with regard to the ultrasonic system and tooling, and that the items to be welded are in position.
2. Before pressing the **RESET** button, make sure the press head actuation (cycle start) signals are not activated (or closed). Then, press the **RESET** button to activate power supply operation.
3. Press the **TEST** button. While depressing the **TEST** button, check the LED Load Meter reading to make sure that it does not exceed 20%.

a) If the meter reading is above 20%, contact Sonics immediately for further instructions before proceeding.

b) If the meter reading is below 20%, you can proceed with operation.

During the testing process, keep in mind that the ultrasonics are only activated as long as the **TEST** button is depressed – once you release the **TEST** button, ultrasonics is terminated.

4. The power supply is now in ready mode.



NOTE: *The TEST and Load Meter check should always be done for all cold start-ups, and for any start-up after the system has been idle for 20 minutes or more.*

OVERLOAD PROTECTION

The overload protection circuit will terminate the welding cycle when the system is operated under adverse conditions, i.e., improper tuning, excessive power supply loading, loose or failed horn or booster, thereby protecting the power supply and other system components. When an overload condition exists, the **RESET** button will illuminate and remain lit until the condition has been corrected and the button is pressed. If the condition is not corrected, the **RESET** button will remain lit. If a repeated overload condition exists, resolve the problem before a failure of the power supply occurs.

If an overload condition exists, try the following:

— decrease horn force

— decrease amplitude (change booster or decrease output control)

— decrease downspeed

— check for loose or broken studs

— check the coupling surfaces between horn/booster and booster/converter

— check for cracked horn or booster

— check to see if the load meter exceeds 100% during weld process (if so, a higher powered unit is needed)

If you cannot remedy the situation, contact Sonics.

MAINTENANCE

GENERAL

1. Always make sure the power supply has adequate ventilation by keeping sufficient space around the assembly.
2. Periodically check the ventilation grilles and clean as necessary.

If problems are encountered, contact our Service Department at 1-800-745-1105.

REPAIRS / SERVICE

NOTE: *If packing unit for return shipment, DO NOT use styrofoam "peanuts."*

If problems are encountered, contact our Service Department at 1-800-745-1105.

It is suggested that a system in need of repair be sent back to the factory with a written description pertaining to the nature of the problem.

Always contact the factory for return authorization before shipping any instrument. Include date of purchase, model number, and serial number. For units not covered by the warranty, a purchase order should be forwarded to avoid unnecessary delay. Care should be exercised to provide adequate packing to insure against possible damage in shipment. The system should be sent with all transportation charges prepaid and return method of shipment indicated.

WARRANTY

Sonics & Materials, Inc., hereinafter referred to as “Sonics,” warrants its products for a period of one year from the date of shipment against defect in material and workmanship under normal installation, use, and maintenance as described in the operating instructions which accompany such equipment. During the warranty period, “Sonics” will, at its option, as the exclusive remedy, either repair or replace without charge for material and labor, the part(s) which prove upon our examination to be defective, provided the defective unit is returned to us properly packed with all transportation charges prepaid.

LIMITATION OF WARRANTY

This warranty is in lieu of any other warranties, either express, implied, or statutory. “Sonics” neither assumes nor authorizes any person to assume for it any other obligation or liability in connection with the sale of its products. “Sonics” hereby disclaims any warranty or 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 “Sonics” be liable to the purchaser or to any other person for any incidental or consequential damages or loss of profit or product resulting from any malfunction or failure of this “Sonics” product.

This warranty does not apply to equipment which has been subject to unauthorized repair, misuse, abuse, negligence or accident. Equipment which, in our judgment, 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.

No liability is assumed for expenses or damages resulting from interruptions in operation of the product or damages to material in process.

“Sonics” equipment is designed for maximum operator safety and incorporates built-in safety devices. Any modifications to these safety features will void the warranty. “Sonics” assumes no responsibilities for consequential damages incurred due to modifications to the said equipment.

“Sonics” reserves the right not to warrant horns of unusual or experimental design which in our judgment are more likely to fail in use.

Data supplied in the instruction manual has been verified and validated and is believed adequate for the intended use of the equipment. If the equipment or procedures are used for purposes other than those specified herein, confirmation of their validity and suitability should be obtained in writing from “Sonics.”

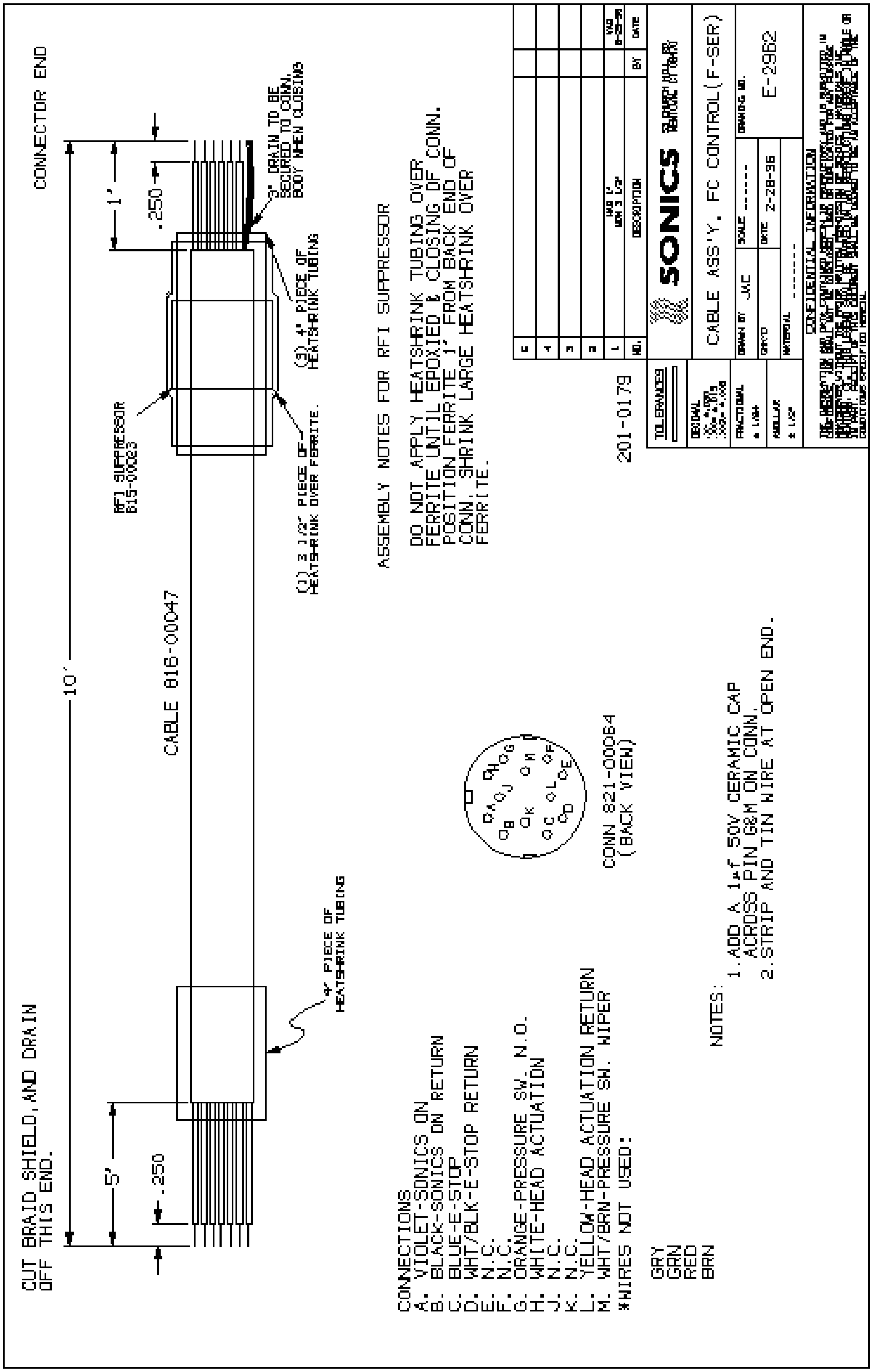
APPENDIX

EQUIPMENT WIRING DIAGRAMS AND ASSOCIATED I/O

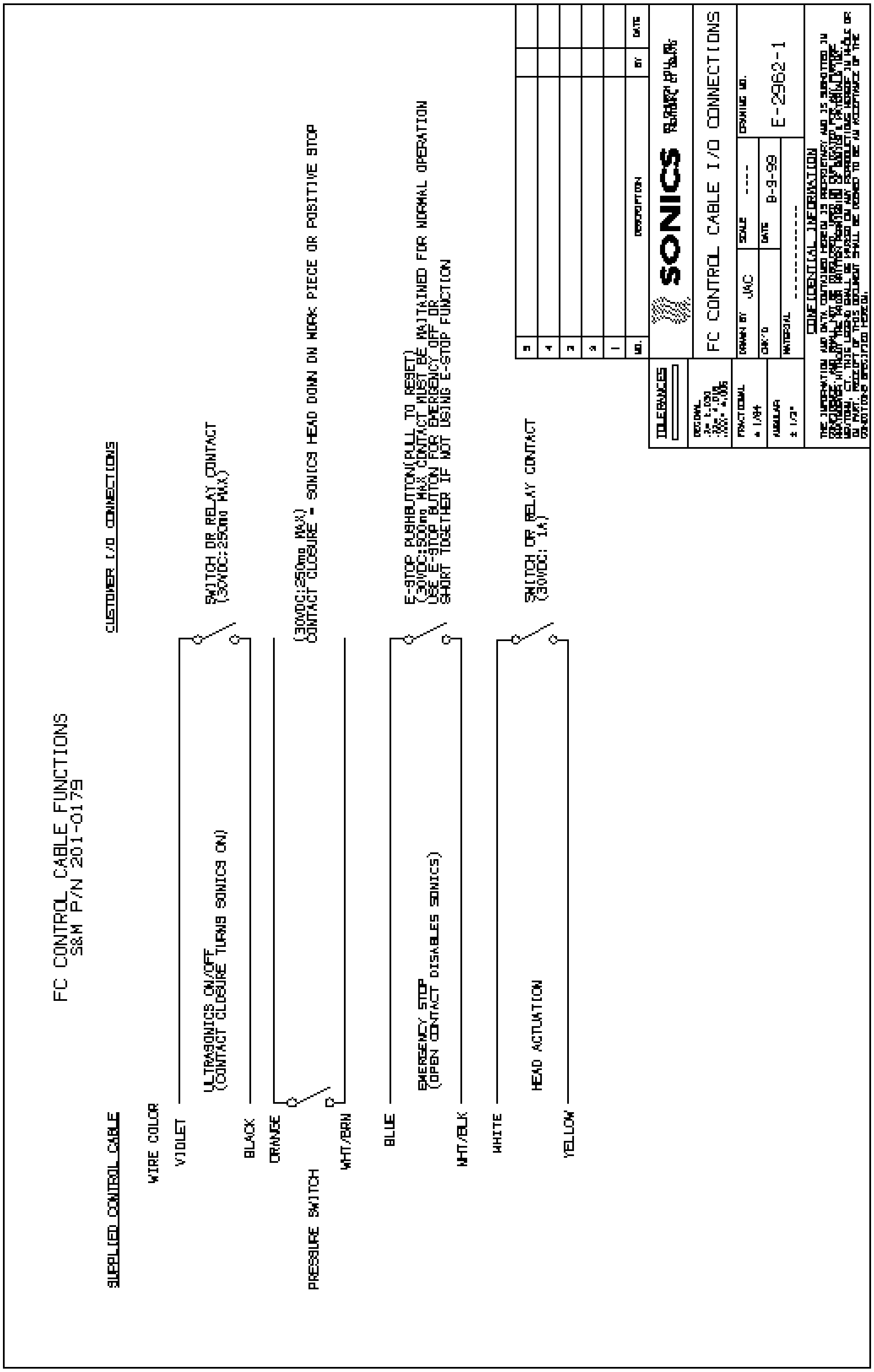
Model	Actuation J2	I/O J7	I/O J8
FC	E2962	E-3014	E-3013

Drawing	Part No.	Description
E-2962*/2962-1*	201-0179	FC continuous duty cable
E-3013*	201-0206	F-Series general I/O
E-3014*	201-0207	F-Series General I/O

*See drawing on following pages.


CUT BRAID SHIELD, AND DRAIN
OFF THIS END.
CONNECTOR END
10'
5'
1'
.250
.250
CABLE 816-00047
RFI SUPPRESSOR
815-00023
4" PIECE OF
HEATSHRINK TUBING
(1) 3 1/2" PIECE OF
HEATSHRINK OVER FERRITE.
(3) 4" PIECE OF
HEATSHRINK TUBING
3" DRAIN TO BE
SECURED TO CONN.
BODY WHEN CLOSING
ASSEMBLY NOTES FOR RFI SUPPRESSOR
DO NOT APPLY HEATSHRINK TUBING OVER
FERRITE UNTIL EPOXIED & CLOSING OF CONN.
POSITION FERRITE 1' FROM BACK END OF
CONN. SHRINK LARGE HEATSHRINK OVER
FERRITE.
CONNECTIONS
A. VIOLET-SONICS ON
B. BLACK-SONICS ON RETURN
C. BLUE-E-STOP
D. WHT/BLK-E-STOP RETURN
E. N.C.
F. N.C.
G. ORANGE-PRESSURE SW. N.O.
H. WHITE-HEAD ACTUATION
J. N.C.
K. N.C.
L. YELLOW-HEAD ACTUATION RETURN
M. WHT/BRN-PRESSURE SW. WIPER
*WIRES NOT USED:
GRY
GRN
RED
BRN
CONN 821-00064
(BACK VIEW)
NOTES:
1. ADD A 1µf 50V CERAMIC CAP
ACROSS PIN G&M ON CONN.
2. STRIP AND TIN WIRE AT OPEN END.
201-0179
DESCRIPTION
BY
DATE
TOLERANCES
DECIMAL
FRACTIONAL
± 1/64
ANGULAR
± 1/2°
SONICS
CABLE ASS'Y, FC CONTROL(F-SER)
DRAWN BY JAC
SCALE ------
DRAWING NO.
CHK'D
DATE 2-28-96
E-2962
MATERIAL -------
CONFIDENTIAL INFORMATION

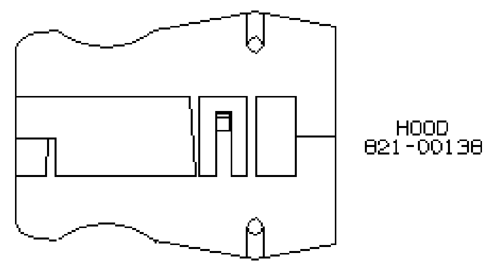
APPENDIX


FC CONTROL CABLE FUNCTIONS
S&M P/N 201-0179
SUPPLIED CONTROL CABLE
CUSTOMER I/O CONNECTIONS
WIRE COLOR
VIOLET
BLACK
ULTRASONICS ON/OFF
(CONTACT CLOSURE TURNS SONICS ON)
SWITCH OR RELAY CONTACT
(30VDC;250mA MAX)
ORANGE
PRESSURE SWITCH
WHT/BRN
(30VDC;250mA MAX)
CONTACT CLOSURE - SONICS HEAD DOWN ON WORK PIECE OR POSITIVE STOP
BLUE
WHT/BLK
EMERGENCY STOP
(OPEN CONTACT DISABLES SONICS)
E-STOP PUSHBUTTON(PULL TO RESET)
(30VDC;500mA MAX CONTACT MUST BE MAINTAINED FOR NORMAL OPERATION
USE E-STOP BUTTON FOR EMERGENCY OFF OR
SHORT TOGETHER IF NOT USING E-STOP FUNCTION
WHITE
YELLOW
HEAD ACTUATION
SWITCH OR RELAY CONTACT
(30VDC; 1A)
TOLERANCES
FRACTIONAL
± 1/64
ANGULAR
± 1/2°
NO.
DESCRIPTION
BY
DATE
SONICS
FC CONTROL CABLE I/O CONNECTIONS
DRAWN BY JAC
SCALE ----
DRAWING NO.
E-2962-1
CHK'D
DATE 8-9-99
MATERIAL
CONFIDENTIAL INFORMATION

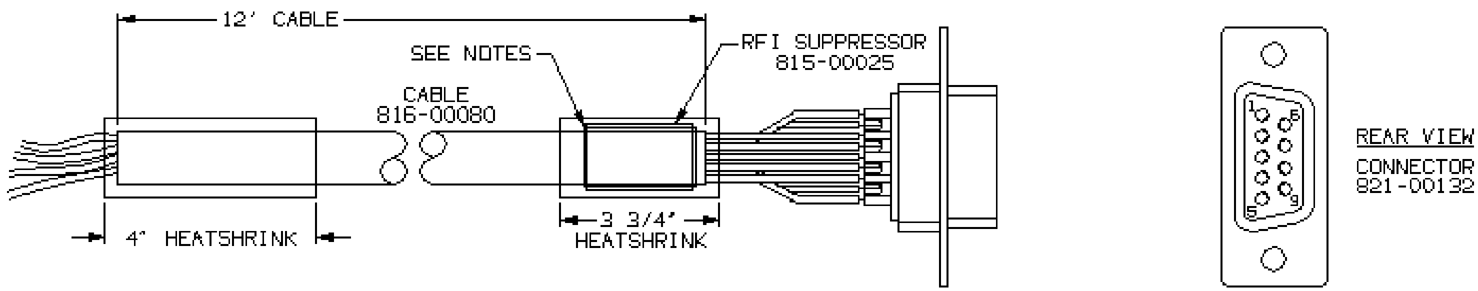
APPENDIX

NOTES:

1. ONE 1/4' DIA. X 3 3/4' LONG HEAT SHRINK TUBING AND ONE 3/8' DIA. X 3 3/4' LONG HEAT SHRINK TUBING UNDER FERRITE.
2. TWO 3/8' DIA. X 1' LONG HEAT SHRINK ON CABLE SIDE OF FERRITE.
3. CUT OFF WIRES NOT USED: (COLORS: BLUE, AND WHITE)



NOTE:
JUMP PIN 9
TO PIN 6



OUTPUT DEFINITIONS

PIN	COLOR-GA	FDL	FM	FO	FC
1	CABLE SHIELD	SHIELD GND	SHIELD GND	SHIELD GND	SHIELD GND
2	RED 24 GA	Hz/10	Hz/10	Hz/10	Hz/10
3	BLK 24 GA	TUNE LOCK IND.	TUNE LOCK IND.	TUNE LOCK IND.	TUNE LOCK IND.
4	BRN 24 GA	SMPS READY	SMPS READY	SMPS READY	SMPS READY
5	YEL 24 GA	O.L. RESET	O.L. RESET	O.L. RESET	O.L. RESET
6	ORG 24 GA	NC	NC	NC	NC
7	VIO 24 GA	O.L. IND.	O.L. IND.	O.L. IND.	O.L. IND.
8	GRY 24 GA	15VDC RETURN	15VDC RETURN	15VDC RETURN	15VDC RETURN
9	GRN 24 GA	COMMON EMITTER	COMMON EMITTER	COMMON EMITTER	COMMON EMITTER

201-0206

NO.	DESCRIPTION	BY	DATE
5			
4			
3			
2	ADDED OUTPUT CHART	JAC	10-22-98
1	ADDED NOTES		VAB 9-29-97

TOLERANCES (EXCEPT AS NOTED)
DECIMAL .X= ±.030 .XX= ±.015 .XXX= ±.005
FRACTIONAL ± 1/64
ANGULAR ± 1/2°

SONICS 53 CHURCH HILL RD. NEWTOWN, CT 06470

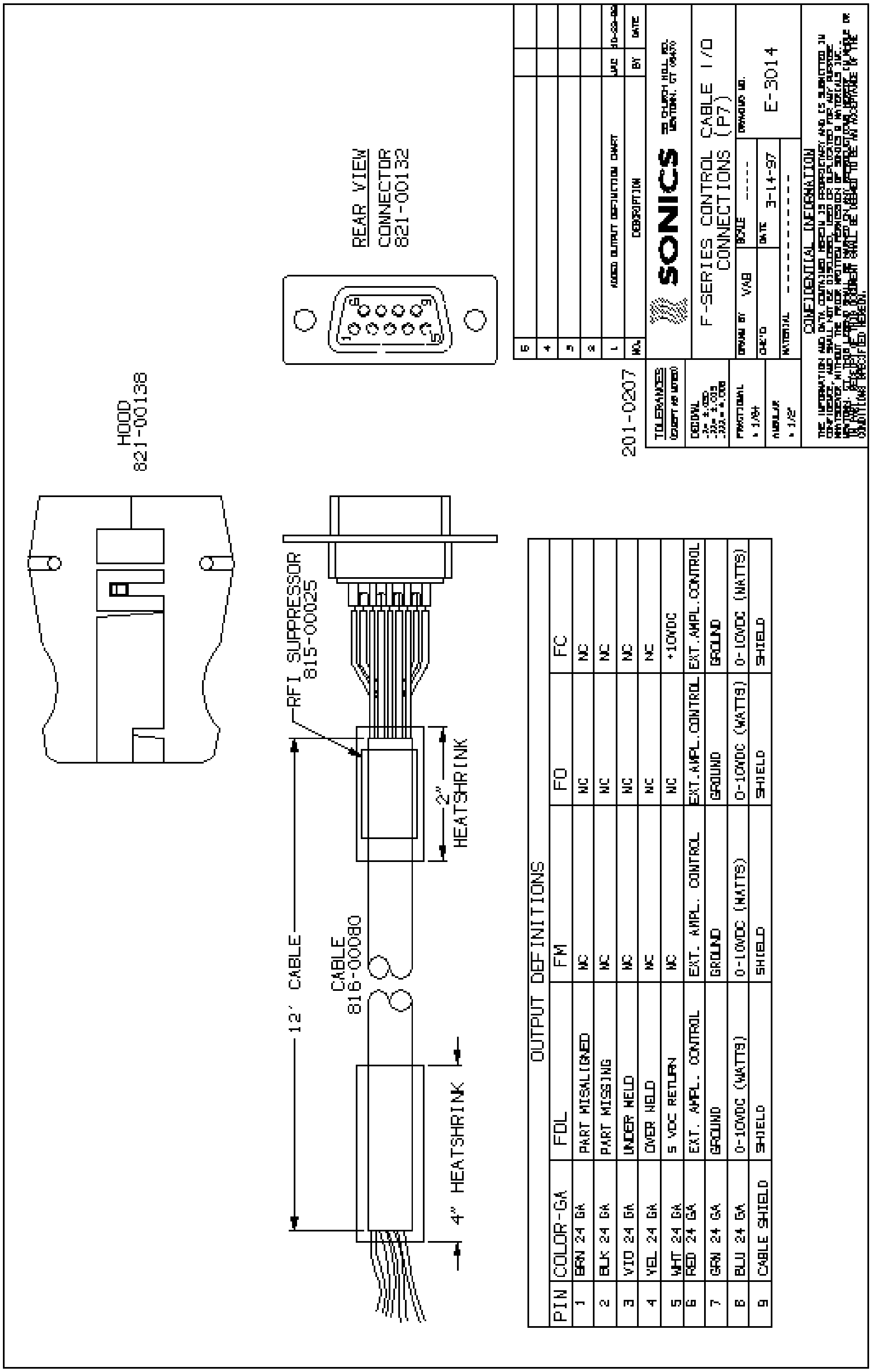
F-SERIES CONTROL CABLE I/O CONNECTIONS (P8)

DRAWN BY VAB	SCALE -----	DRAWING NO.
CHK'D	DATE 3-14-97	E-3013
MATERIAL ------------------------		

CONFIDENTIAL INFORMATION

THE INFORMATION AND DATA CONTAINED HEREIN IS PROPRIETARY AND IS SUBMITTED IN CONFIDENCE, AND SHALL NOT BE DISCLOSED, USED OR DUPLICATED FOR ANY PURPOSE WHATSOEVER WITHOUT THE PRIOR WRITTEN PERMISSION OF SONICS & MATERIALS INC., NEWTOWN, CT. THIS LEGEND SHALL BE MARKED ON ANY REPRODUCTIONS HEREOF IN WHOLE OR IN PART. RECEIPT OF THIS DOCUMENT SHALL BE DEEMED TO BE AN ACCEPTANCE OF THE CONDITIONS SPECIFIED HEREIN.

APPENDIX



OUTPUT DEFINITIONS					
PIN	COLOR-GA	FDL	FM	FO	FC
1	BRN 24 GA	PART MISALIGNED	NC	NC	NC
2	BLK 24 GA	PART MISSING	NC	NC	NC
3	VIO 24 GA	UNDER WELD	NC	NC	NC
4	YEL 24 GA	OVER WELD	NC	NC	NC
5	WHT 24 GA	5 VDC RETURN	NC	NC	+10VDC
6	RED 24 GA	EXT. AMPL. CONTROL	EXT. AMPL. CONTROL	EXT.AMPL.CONTROL	EXT.AMPL.CONTROL
7	GRN 24 GA	GROUND	GROUND	GROUND	GROUND
8	BLU 24 GA	0-10VDC (WATTS)	0-10VDC (WATTS)	0-10VDC (WATTS)	0-10VDC (WATTS)
9	CABLE SHIELD	SHIELD	SHIELD	SHIELD	SHIELD

SONICS

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europe@sonicsandmaterials.ch

Model FM Power Supply

INSTRUCTION MANUAL

SONICS

Sonics & Materials, Inc.

WARNING

SAFETY PRECAUTIONS
READ BEFORE INSTALLING OR USING THE EQUIPMENT

This system has been designed to assure maximum operator safety. However, no design can completely protect against improper usage. For maximum safety and equipment protection, observe the following warnings at all times and read the instruction manual carefully before you attempt to operate the equipment.

– High voltage is present in the equipment. Disconnect plug before removing cover or servicing.

– Make sure equipment is properly grounded with a 3-prong plug. Before plugging in equipment, test outlet for proper earth grounding.

– Ultrasonic welders operate above normal audibility for most people. Ear protection is recommended.

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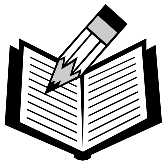
IMPORTANT SERVICE LITERATURE



***NOTE:** Please read carefully before operating the equipment, then forward to your service department.*

The system 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.

MANUAL CHANGE INFORMATION

We continually strive to be at the forefront of the latest electronic developments by adding circuit and component improvements to our equipment as soon as they are developed and tested.

Sometimes, due to printing and shipping requirements, we cannot incorporate these changes immediately into printed manuals. Hence, your manual may contain new change information. Change information, if any, is located in the Appendix.

We reserve the right to make any changes in the design or construction of our equipment at any time, without incurring any obligation to make any change whatsoever in units previously delivered.

The technical data and schematics in the manual are for informational purposes only and may not reflect the current configuration being shipped from our factory. Upon formal request, complete and up-to-date information can be provided from the factory free of charge.

UNPACKING AND INSPECTION

NOTE: We recommend keeping all carton(s) and packing material in case it might be necessary to move the equipment, or to ship it for repair.

Before unpacking the equipment, check the shipping carton for any visible damage. If you see any, be sure to follow the procedures described below under "Visible Loss or Damage." Otherwise, proceed to remove the equipment from the carton. Before storing any packing material, check it carefully for small parts. Then perform a visual inspection of the equipment to detect any evidence of damage which might have occurred during shipment. Check the following:

1. all components against the enclosed packing list,
2. all module plug-in units,
3. all wire plug-in connections.

The equipment was carefully packed and thoroughly inspected before leaving our factory. All units are tested and checked for problems prior to shipping. It is asked that when a problem does occur that all parts and components be inspected for damage (especially when the unit is not in working order when received). Responsibility for safe delivery was assumed by the carrier upon acceptance of the shipment. Claims for loss of damage sustained in transit must therefore be made upon the carrier, as follows:

VISIBLE LOSS OR DAMAGE

Any external evidence of loss or damage must be noted on the freight bill or express receipt, and signed by the carrier's agent. Failure to adequately describe such external evidence of loss or damage may result in the carrier's refusal to honor a damage claim. The form required to file such a claim will be supplied by the carrier.

CONCEALED LOSS OR DAMAGE

Concealed loss or damage means loss or damage which does not become apparent until the merchandise has been unpacked. The contents might have been damaged in transit due to rough handling even though the container may not show external damage. When the damage is discovered upon unpacking, make a written request for inspection by the carrier's agent within 48 hours of the delivery date. Then file a claim with the carrier since such damage is the carrier's responsibility. The form required to file such a claim will be supplied by the carrier. Do not destroy packing materials, or move material from one location to another before the carrier makes their inspection.

If the system or any unit is damaged, notify "Sonics." "Sonics" will arrange for repair or replacement of damaged equipment without waiting for the claim against the carrier to be settled, provided a new purchase order is issued to cover the repair or replacement costs. Should any damage, shortage or discrepancy exist, please notify us immediately.

INTRODUCTION

The FM model power supply is an auto-tuned ultrasonic generator with a built-in Microprocessor that allows time and energy-based control. The Microprocessor is programmed with a multi-function keypad and information is displayed on the back-lit liquid crystal display (LCD). This power supply can be used with a pneumatic actuator or with a stand-alone converter.

OVERVIEW OF ULTRASONIC PLASTICS ASSEMBLY

WHAT IS ULTRASONICS?

Ultrasonics refers to vibrational waves with a frequency above the human audible range which is usually above 18,000 cycles per second (Hz).

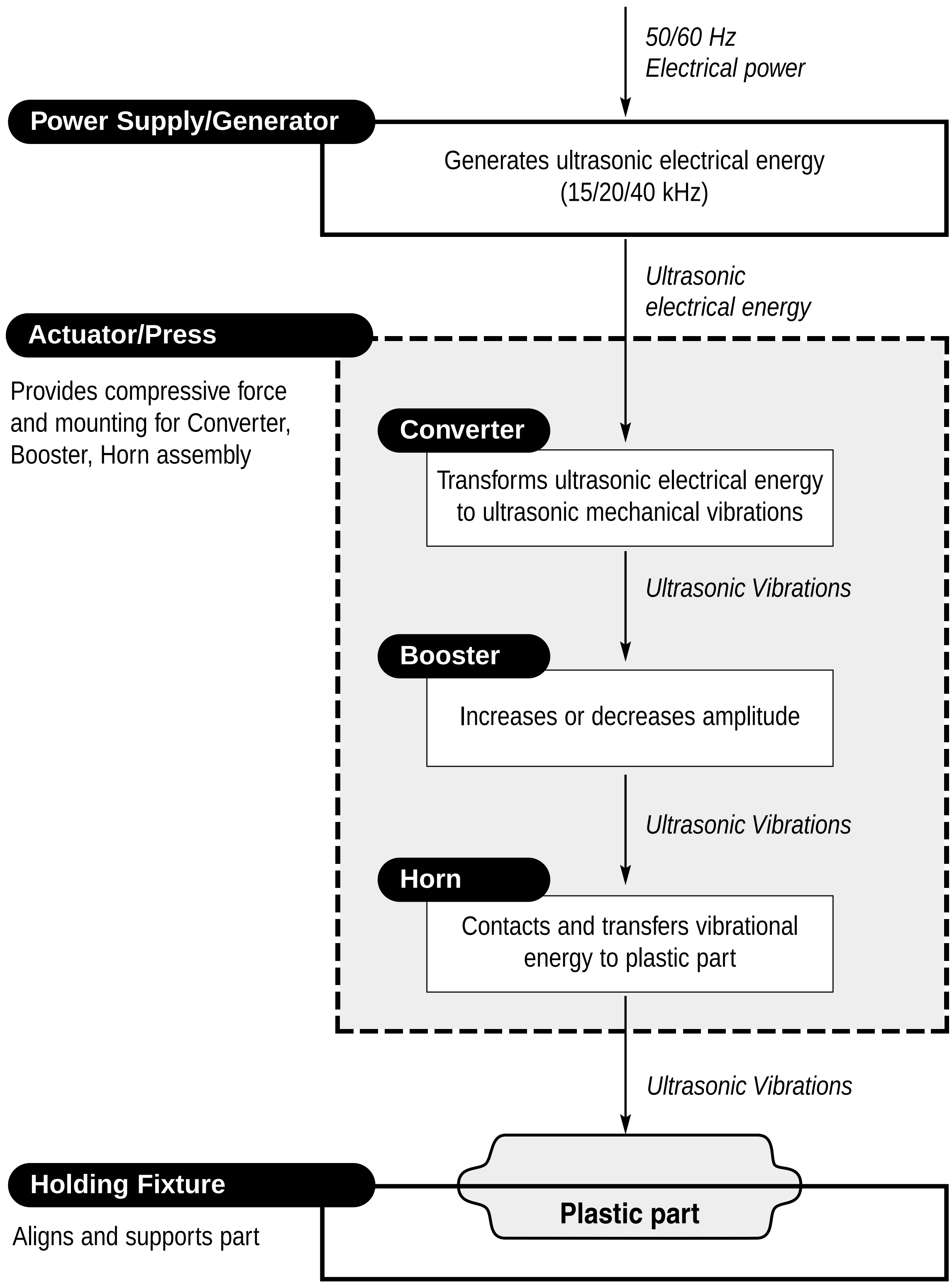
PRINCIPLE OF ULTRASONIC ASSEMBLY

The basic principle of ultrasonic assembly involves conversion of high frequency electrical energy to high frequency mechanical energy in the form of reciprocating vertical motion which, when applied to a thermoplastic, generates frictional heat at the plastic/plastic or plastic/metal interface. In ultrasonic welding, this frictional heat melts the plastic, allowing the two surfaces to fuse together; in ultrasonic staking or insertion, the controlled flow of molten plastic is used to capture or lock another material in place (staking) or encapsulate a metal insert (insertion).

ULTRASONIC ASSEMBLY SYSTEMS

"Sonics" ultrasonic assembly systems are generally composed of the following major elements: a power supply, converter, booster, horn, pneumatic press and holding fixture, as detailed in the diagram on the next page. A review of this diagram will help you understand the basic elements involved in the assembly process and their relation to each other.

"SONICS" ULTRASONIC ASSEMBLY SYSTEMS



GLOSSARY OF ULTRASONIC TERMS

POWER SUPPLY/GENERATOR – The solid state power supply converts standard 50/60 Hz electrical energy to 15,000 Hz, 20,000 Hz or 40,000 Hz (15/20/40 kHz) electrical energy.

ACTUATOR/WELDING PRESS – The pneumatic actuator provides compressive force and mounting for the converter, booster and horn assembly. The tabletop press consists of a base assembly, column and actuator (head).

CONVERTER – The converter changes the high frequency electrical energy supplied by the power supply to high frequency mechanical vibrations.

BOOSTER – Successful ultrasonic welding often depends on having the right amplitude at the horn face. Often it is not possible to design a horn which has both the necessary shape and required gain (ratios of input amplitude to output amplitude). In such cases, a booster is placed between the converter and the horn to either increase or decrease the amplitude of the horn. In addition to changing/maintaining the amplitude, the booster provides support and alignment in the welding system.

HORN – The horn is a tuned component of the system which comes in contact with the parts to be assembled. The horn 1) transfers the ultrasonic vibrations produced from the converter to the parts being welded, and 2) applies necessary force to the assembly while the material resolidifies.

HOLDING FIXTURE – The holding fixture or nest assures proper alignment and support of the parts being assembled.

WARNING

The line cord of the controller/power supply is equipped with a 3-prong, grounding plug. Do not, under any circumstances, remove the ground prong. The plug must be plugged into a mating 3-prong, grounding type outlet.

ELECTRICAL POWER REQUIREMENTS

The power supply requires a fused, single-phase, standard 3-terminal grounding type receptacle capable of supplying the requisite voltage and current. Refer to the table below for power specification.

POWER SPECIFICATIONS

Model	Power Rating	115 vac	230 vac
FM740	700w	15 amps	10 amps
FM1020	1000w	15 amps	10 amps
FM1520	1500w	N/A	15 amps
FM2020	2000w	N/A	20 amps

SETTING UP

The power supply is a free-standing assembly. It should be installed in a clear, uncluttered location that is free from excessive dirt, dust, corrosive fumes, and temperature and humidity extremes. The selected installation site should be near the electrical power source and away from equipment that generates abnormally high electrical transients. Observe the following additional instructions when installing the equipment:

a. Allow at least 6 inches (152.4mm) at the rear of the power supply for cable connections.

b. Position the power supply so that the front panel controls are visible and readily accessible.

c. The power supply is air cooled; allow sufficient space around the assembly to ensure adequate ventilation. If the power supply must be housed in a confined space, forced air cooling may be necessary to keep surrounding air within acceptable ambient temperature limits. Periodically check the ventilation grille and clean as necessary.

NOTE: *If power supply is to be run continuously, air cooling of the converter and horn is required. Use clean, dry compressed air filtered down to 5 microns (supplied to converter fitting – see page 12).*

NOTE: *Do not plug the power supply into an electrical outlet until all other connections have been made.*

ELECTRICAL CONNECTIONS

The standard cable supplied with a "Sonics" press is 10 feet. Optional extension cables are available up to 15 feet without modification.

When making the initial electrical connections, make sure the power is disconnected and follow these precautions.

1. Do not strain or kink the cables. When going around corners, allow as wide a bend as possible. Do not run the cables parallel to any power line within a distance of less than 1 foot (305mm).
2. To prevent the possibility of an electrical shock, ensure that the power supply line cord is properly grounded. Also make sure that the voltage rating of the electrical power source matches the power supply requirement (refer to the "Power Specifications" table on preceding page).
3. Check with your electrician if you have any wiring questions.

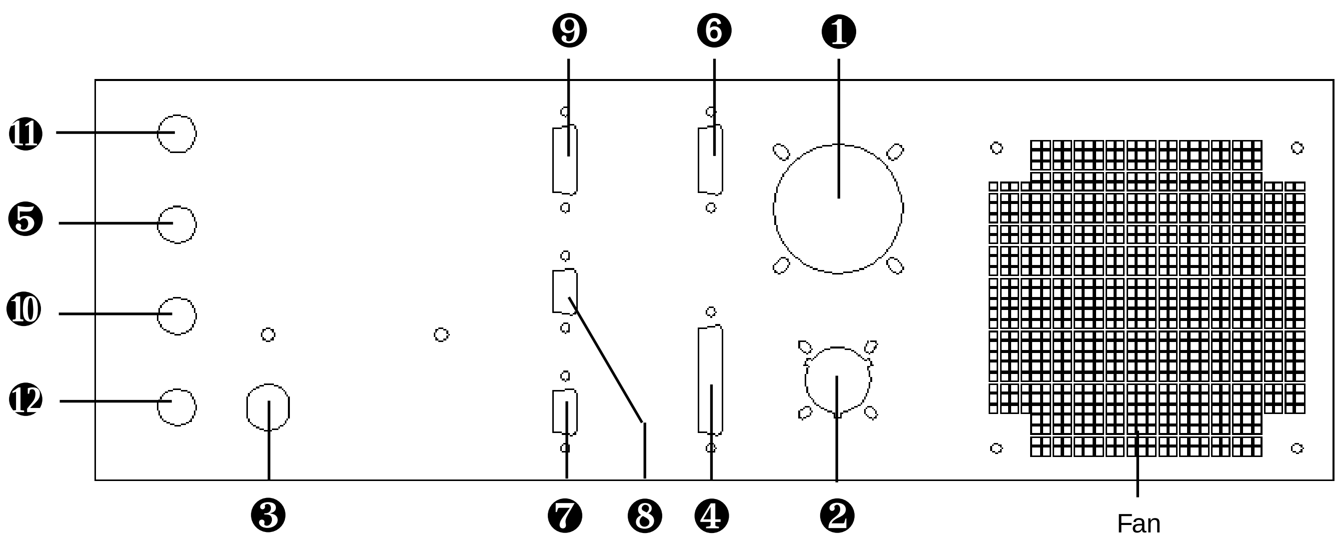
NOTE: Detailed wiring diagrams are supplied in the Appendix at the back of this manual.

CABLE CONNECTIONS:

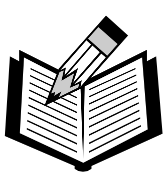
Located at the rear of the power supply are the cable connections as illustrated below. (The interconnecting cables will be supplied with your system.)

1. J1, a round, 12-pin RF cable that connects the welding press or converter to the power supply.
2. J2, an actuation cable that connects the power supply to a trigger source (refer to wiring diagrams in Appendix).
3. The power line cord that plugs into the appropriate electrical outlet.

Once these connections have been made, the power supply is ready for operation. If applicable, be sure to consult your welding press instruction manual to insure that all connections on the press side are correct, and that the press is ready for operation.



Also located at the rear of the power supply are the following:



NOTE: To see a list of converters that can be connected to the power supply, see the table on the following page.

4. J3 Printer Output
5. fuse (based on requirements listed in “Power Specifications” table, p. 9),
6. J6 Rotary Table Output (see wiring diagrams in Appendix),
7. J7 I/O (see wiring diagrams in Appendix),
8. J8 I/O(see wiring diagrams in Appendix),
9. J9 Reject Output
10. fuse (based on requirements listed in “Power Specifications” table, p. 9),
11. fuse (fixed 0.5 amp),
12. fuse, not optional (based on requirements listed in “Power Specifications” table, p. 9)

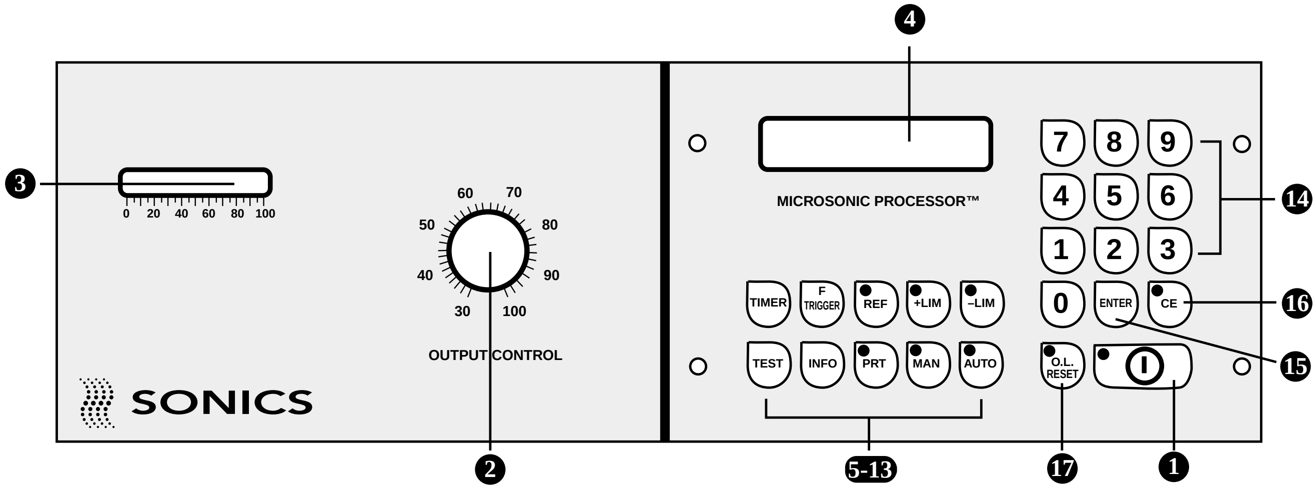
AVAILABLE CONVERTERS

Item No.	Description
CV00015	20 kHz with Button connector
CV00151	20 kHz with Lemo connector
CV00154	20 kHz with Lemo connector and fitting for air cooling
CV00157	20 kHz with Button connector and fitting for air cooling
CV00158	20 kHz Hand Gun with handles and cables
CV00331	20 kHz with Fischer connector
CV00334	20 kHz with Fischer connector and fitting for air cooling
CV00023	40 kHz with Button connector
CV00231	40 kHz with Lemo connector
CV00232	40 kHz with SHV connector side mounted
CV00234	40 kHz with Lemo connector and fitting for air cooling
CV00238	40 kHz Hand Gun with trigger switch and cable

OPERATING PROCEDURES

FRONT PANEL CONTROLS AND INDICATORS

Located on the front panel of the power supply are the following controls and indicators:



WARNING

The RESET button is a built-in safety feature. When the power supply is connected to a press, be sure the press head actuation signals are not activated (or closed). If they are activated, the press head will descend immediately when the RESET button is depressed.

1. ON/OFF key which turns the unit on and off. Red LED in upper left corner indicates unit is ON.
2. OUTPUT CONTROL DIAL which controls *fine* adjustment of the amplitude of the system's high-frequency vibrations over the full operating range. (*Major* adjustments of amplitude are made through the use of different boosters – consult your press manual for further information.)
3. LED LOAD METER which indicates the power level of ultrasonics that is being delivered to the welding press.
4. LCD SCREEN which displays various settings, parameters and prompts as detailed in the following pages.
5. TIMER key which selects and displays timer settings and permits adjustment of timer duration in .01 second increments (from 0.00 to 9.99 seconds) for five timers as follows:

   T1: *Delay Timer* (for normal delay triggering or pre-triggering).

   T2: *Weld Timer* (in time-based operation).

   T3: *Hold Timer* (in both time- and energy-based operation).

   T4: *Afterpulse Timer* (to release assemblies adhering to horn).

   T5: *Abort Cycle Timer* (limits maximum weld time permitted for an assembly).

6. F-TRIGGER key which displays and permits adjustment of triggering force as a percentage of maximum force. When used in conjunction with Head Advance Control (1098 Model only) actual horn coupling force can be displayed.

7. REF key which displays energy in Watt Seconds (Ws) when the constant energy mode has been selected, and permits adjustment of the set value in .1 Ws increments. Green LED in the upper left corner indicates completion of an acceptable process cycle.
8. +LIM / -LIM keys which display and establish upper and lower quality control tolerance limits in time (sec.) when energy mode is selected and in energy (Ws) when time mode is selected. Red LEDs in upper left corner indicate when rejects occur because either time or energy is above or below set limits.
9. TEST key which can be used to test ultrasonic operation and displays idle losses of converter/booster/horn as a percentage of maximum power when key is depressed.
10. INFO key which displays data (or parameters) on the LCD screen. Can be pressed up to eight times to display the following data (in the order shown):

    — *Number of cycles*

    — *Number of rejects*

    — *Rated output power of system*

    — *Mode Codes (functions selected)*

    — *Length of Graph Time Axis when printed out on optional printer*

    — *SAVE RECALL OTHER options*

    — *Job Sequencing*

    — *Calibration Pulse (activation or deactivation).*
11. PRT key which permits display of parameters and dynamic process conditions when optional CRT monitor or printer is used. Green LED in upper left corner indicates when data is being transmitted to a peripheral accessory.
12. MAN key which is only used with rotary table operation to select normal single cycle indexing (the default mode).
13. AUTO key which is only used with rotary table operation to select continuous cycling.
14. 0-9 Numeric key pad which allows input of numeric data or numeric selection options by pressing the keys.
15. ENTER key which enters data into the system as keyed in with numerical keys and displayed on the LCD screen.
16. CE key which cancels a prior parameter value when a new value is to be entered. Red LED in upper left corner indicates key is functional and will cancel a value displayed when depressed.
17. O.L. RESET key which resets the power supply following an overload condition. Red LED in upper left corner indicates an overload condition exists.

OPERATIONAL SIGNALS

Valid parameter entries and/or selections are verified by an audible signal of short duration. Invalid entries and/or selections (fault conditions) are signaled by an audible signal of longer duration.

OPERATIONAL FEATURES

– Adjustable Afterpulse Timer to separate parts from horn.

– Adjustable tolerance limits in energy (Ws) or time (sec) with visual and audible alarms.

– Information displays including: number of assemblies, number of rejects, power supply rated output, Mode Codes (functions selected) and length of time axis for optional power curve printout.

– Fault displays: CHECK PRESS, CHECK PRESSURE OR b8, FORCE MISSING, PRESS VALVE FAILURE.

– Keypad security to prevent unauthorized adjustment of parameters.

– Self diagnostic input test.

– Display of coupling force measurement (Model 1098 only).

– Storage capabilities of up to 9 programs.

– Job sequence of up to 9 programs.

– Deactivation of calibration pulse (i.e., when utilizing vacuum horns).

– Variable weld time in constant energy mode.

– Printer/CRT monitor interface permits connection to an optional CRT and/or printer or computer.

STARTING UP THE POWER SUPPLY

Press the ON/OFF key to turn the power supply on. The red LED will light up indicating the unit is on.

The LCD screen will briefly display “Sonics & Materials.” If a printer or CRT is not connected to the system, the following message will also be displayed briefly:

* * * NO PRINTER! * * *

Then the LCD screen will display “READY.”

INITIAL OPERATION

After the power supply is turned on (as described above), follow these steps:

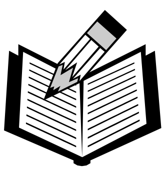
1. Make sure that all necessary preparations have been made with regard to the ultrasonic system and tooling, and that the items to be welded are in position.
2. Press and hold the TEST button. While depressing the TEST button, check the LCD reading. Make sure the reading on the LCD display (see example below) does not exceed 10%.

   US-TEST = 05%

   a) If the display is above 10%, contact Sonics immediately for further instructions before proceeding.

   b) If the display is below 10%, you can proceed with operation.

   During the testing process, keep in mind that the ultrasonics are only activated as long as the TEST button is depressed – once you release the TEST button, ultrasonics is terminated.
3. The power supply is now ready for operation.



NOTE: *The TEST and Load Meter check should always be done for all cold start-ups, and for any start-up after the system has been idle for 20 minutes or more.*

BASIC MODES OF OPERATION

The FM power supply's built-in microprocesor allows the use of either time-based or energy-based cycles in four basic modes, as follows:

1. Time-based cycle with time delay triggering or pre-triggering.
2. Time-based cycle with variable force triggering.
3. Constant energy-based cycle with time delay triggering or pre-triggering.
4. Constant energy-based cycle with variable force triggering.

TIME-BASED MODES

In a ***Time-Based Cycle with Time Delay Triggering,*** the Weld and Hold timers are actuated following the termination of a pre-determined delay period. This delay period is initiated when the horn contacts the part to be welded.

In a ***Time-Based Cycle with Variable Force Triggering,*** the Weld and Hold Timers are actuated after a pre-determined coupling force is exerted on the components.

For both of these time-based modes of operation, upper and lower tolerance limits in energy (Ws) can be adjusted.

ENERGY-BASED MODES

In a ***Constant Energy-Based Cycle with Time Delay Triggering,*** the weld cycle follows the termination of a pre-determined delay period. The weld cycle continues until a pre-selected amount of energy in Watt seconds (Ws) is delivered to the components. The duration of the weld cycle may vary, but the energy delivered is constant.

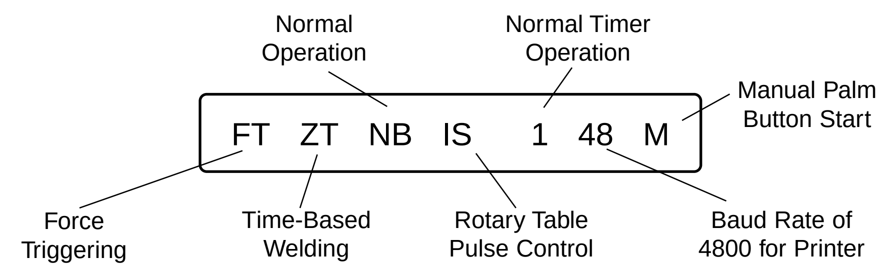
In a ***Constant Energy-Based Cycle with Variable Force Triggering,*** the Weld cycle is initiated after a pre-selected Trigger Force is reached. Once again, the duration of the weld cycle is dependent upon the pre-selected amount of energy delivered to the components.

In the case of energy-based modes of operation, the upper and lower tolerance limits are adjustable in time (seconds).

MODE CODES DISPLAY

The power supply is shipped with blank programs, so all data and parameters must be input by the customer. On initial start-up, the default mode selected is the Time-Based cycle. Press the INFO key four times and the following "Mode Codes" display will appear on the LCD screen:

DEFAULT SETTINGS



MODE CODES: FUNCTION ABBREVIATIONS

Following is a complete list of mode code abbreviations that will appear in eight positions on the LCD display and their corresponding meanings.

1st Position	T1	=	Ultrasonics are turned on following termination of delay time or pre-trigger
	or		
	FT	=	Ultrasonics actuated when trigger force has been reached
2nd Position	ZT	=	Time-based welding
	or		
	EN	=	Constant energy welding
3rd Position	NB	=	Normal operation (no rotary table)
	or		
	RT	=	Rotary table control and operation provided by microprocessor
4th Position	IS	=	Rotary table pulse control
	or		
	DS	=	Rotary table continuous signal control with acknowledgement
5th Position	U	=	Afterpulse Timer (T4) operational (Not a default)
	or		
	blank		
6th Position	1	=	Normal Timer operation
7th Position	48	=	Baud rate of 4800 for optional printer
8th Position	M	=	Manual, dual palm switch actuation
	or		
	A	=	Automatic impulse actuation

TIME-BASED MODES

NOTE: *When the Time-Based mode is in effect, the percentage of maximum power and energy (Ws) used are displayed on the LCD immediately following completion of the process cycle.*

SELECTING AND SETTING TIMERS IN A TIME-BASED CYCLE (with delay triggering)

As described on the previous pages, the default mode is the Time-Based cycle. Pressing the INFO key four times would display the following codes on the LCD Screen:

```
FT   ZT   NB   IS     1   48   A
```

The mode code “ZT” would be displayed in the second position, indicating time-based operation.

To change from Force Triggering (FT) to Time Delay Triggering (T1), press numerical key 1. The following display will appear:

```
T1   ZT   NB   IS     1   48   A
```

As mentioned previously, the five timers are:

Timer		Timer Number (NR)		Mode Code
Delay Timer	=	Timer 1	=	T1
Weld Timer	=	Timer 2	=	ZT
Hold Timer	=	Timer 3	=	T3
Afterpulse Timer	=	Timer 4	=	U
Abort Timer	=	Timer 5	=	

NOTE: *If you do not press the ENTER key to enter in new data within 30 seconds, the new data will be automatically entered in by the system.*

Press the TIMER key and the following display will appear:

```
TIMER NR = (1-5)
```

Press the appropriate numerical key to select a timer value to be displayed or set; i.e., press key 1 to display the set-value of the Delay Timer (T1); key 2, to display the set-value of the Weld Timer (T2); and so on.

Once a timer number has been selected, the red LED in the upper corner of the CE key will light up, indicating that the CE key is functional and must be depressed to enter a new time value, regardless of whether or not a previously established value is displayed. After depressing the CE key, which cancels the prior time value, key in a new value using the numeric keys and press the ENTER key to set the value, or wait thirty seconds and the value will be automatically accepted.

NOTE: *T1 should be selected and set at 0.00 seconds only when pre-triggering is required. Pre-triggering during normal welding operations can result in surface marking.*

Pre-triggering is accomplished by setting T1 to 0.00 sec, thus continuing the calibration pulse until T2 is actuated by the horn contacting the workpiece.

The Delay Timer (T1) can only be set or changed when Delay Timer Triggering (T1) has been selected. The Delay Timer is not operational when the Force Triggering function (FT) has been selected. Attempts to access T1 when the Force Trigger function has been selected will result in the following display:

TIMER 1 MODE IS OFF!

The Weld Timer (T2) can only be set or changed when Time-Based operation (ZT) has been selected. The Weld Timer is not operational when the Constant Energy function (EN) has been selected. Attempts to access T2 when the Constant Energy function has been selected will result in the following display:

US-TIME MODE IS OFF!

If no timer values are to be changed, press the ENTER key twice (providing that a time value is displayed) to return to system status READY.

SELECTING AND SETTING THE AFTERPULSE TIMER

In some applications involving staking, spot welding, or a vacuum horn, the completed assembly may remain attached to the horn. In such instances, the Afterpulse Timer (T4) can be used to actuate the ultrasonics briefly to release the assembly as the press retracts to rest position.

NOTE: *If the Afterpulse Timer is not in use, (which is the case if the Mode Code function "U" is not displayed), T4 should be cleared so that the displayed value is 0.00 sec. Although the Afterpulse Timer is not operational, any value set for T4 will extend the Hold Timer (T3) duration by that value.*

To use the Afterpulse Timer (T4), press the INFO key four times to display the current Mode Codes, for example, T1 ZT NB IS 1 48 M. Press the numerical key 5 and the letter "U" will appear in the fifth position of the LCD display between "IS" and "1," indicating that the Afterpulse Timer (T4) is operational. The new display will now appear as follows:

FT EN NB IS 1 48 A

Once the Afterpulse Timer is operational, parameters for it may be entered in the same manner as for all timers: press the Timer key and when prompted, press the corresponding numerical key (4); then use the CE and numerical keys to select the value desired.

To cancel operation of the Afterpulse Timer (T4), follow the same procedure described above to select the function. (The numerical key 5 acts as a toggle key to activate and cancel the Afterpulse function.) When the Afterpulse Timer is cancelled, the function letter “U” will no longer appear in the Mode Codes display.

SELECTING AND SETTING PROCESS CONTROL TOLERANCE LIMITS IN A TIME-BASED CYCLE

The process control tolerance limits are established in energy (Ws) when the Time-Based mode (ZT) is in effect.

If tolerance reject limits have not previously been set, or if all parameters have been cleared, the system will automatically display the default limits. For example, at 1500 watts, the display will show 0 Ws and 14,985.0 Ws for the lower and upper limits respectively.

Press the – LIM key to display the lower limit value on the LCD. The red LED on the CE key will light up indicating that the CE key is functional and must be depressed if a new lower limit value is to be entered.

Press the CE key to clear the displayed value, key in the new value with the numeric keys and set it by pressing the ENTER key. (If the ENTER key is not depressed, the value is accepted automatically after 30 seconds.)

Selection and adjustment of the upper tolerance limit is accomplished in the same manner once the + LIM key is pressed.

If entry of an improper limit value is attempted, i.e., a lower limit value that exceeds the upper limit value, the following display will appear on the LCD screen.

+ LIMIT<–LIMIT!

SELECTING AND ADJUSTING VARIABLE FORCE TRIGGER ACTUATION IN A TIME-BASED CYCLE

Press the INFO key four times to view the Mode Codes display. If FT is not displayed as the first setting, press the numerical key 1 to change the setting to Force Triggering.

Then, press the ENTER key to return to the READY display. Press the F TRIGGER key to display the existing Force Trigger value on the LCD. A red LED will indicate that the CE key is operational and must be depressed if a new Force Trigger value is to be entered.

Press the CE key to clear the display and key in the desired Force Trigger value. The force value can be established from 1% to 99% of the maximum press force (100% = 50 PSIG). A force of 0% cannot be entered.

Press the ENTER key or any other key to enter the new Force Trigger set value, or wait 30 seconds for automatic acceptance.

The Force Trigger (FT) value can only be set or changed when the Force Triggering (FT) mode is in effect. It is not operational when the Time Delay Triggering function (T1) has been selected. Attempts to access FT by depressing the F Trigger Key when the Time Delay Triggering (T1) function is in effect will result in this display:

```
FORCE-TRIG. MODE OFF
```

If the required coupling force is not reached because air pressure is not sufficient, the head will retract after five seconds and the following message will be displayed:

```
FORCE MISSING
```

An assembly cycle can be completed only when the fault has been corrected, either by increasing gauge pressure or decreasing the Force Trigger value.

The actual horn coupling force can be determined (Model 1098 only) by following the procedures explained on page 41.

CONSTANT ENERGY-BASED CYCLE WITH TIME DELAY TRIGGERING

When the CONSTANT ENERGY function (EN) has been selected, the weld cycle follows the termination of a predetermined delay period (T1) and continues until a pre-selected amount of energy (Ws) has been delivered to the components being assembled. When the Constant Energy function is in effect, the percentage of maximum power used and actual weld cycle duration are displayed on the LCD immediately following completion of the cycle.

To change from Time-based operation to the Constant Energy mode (EN), first press the INFO key four times to display the current Mode Codes. Press the numerical key 2 to change the Constant Time mode (ZT) to the alternate Constant Energy function (EN). To return to the READY display, press the ENTER key. Press the REF key to display any previously entered energy value on the LCD. A red LED will indicate that the CE key is functional and must be pressed in order to enter a new energy value.

Press the CE key to clear the current display values and use the numerical keys to set the new energy value. Press the ENTER key, or wait 30 seconds for automatic acceptance.

The REF value in (Ws) can only be set or changed when Constant Energy (EN) is in effect. It is not operational when the Time Based function (ZT) is in effect. Pressing the REF key when the Time Based function (ZT) is in use will result in the following display:

ENERGY MODE IS OFF

If the selected energy level is not reached within 10 seconds as a result of low coupling force or the absence of components in the part holding fixture, the cycle is terminated automatically and the following message will be displayed:

(X)%Pmax 0.00 sec

Quality Control Tolerance Limits

When the Constant Energy mode (EN) is in effect, the quality control tolerance limits are measured in time (sec).

If tolerance reject limits have not previously been set, or if all parameters have been cleared, the power supply will automatically display the default values of 0.00 sec and 9.99 sec for the lower and upper limits respectively.

CONSTANT ENERGY-BASED CYCLE WITH VARIABLE FORCE TRIGGERING (Refer to page 27 for keystroke sequence guide.)

This mode of operation utilizes both the Force Trigger (FT) and Constant Energy (EN) functions to assure consistent triggering and energy delivery.

To change from Time-based operation, press the INFO key four times to display the current Mode Codes, i.e., T1 ZT NB IS 1 48 A. Press the numerical keys 1 and 2 to select the alternate functions FT and EN. The new mode codes (in the first and second positions of the LSD display) will now appear as follows:

T1	ZT	NB	IS	U	1	48	A

The Delay Timer (T1) and Weld Timer (T2) are not active in this mode (because triggering is initiated by the piezoelectric load cell and weld cycle duration is determined by the pre-selected level of energy delivered to the components being assembled). The Hold Timer (T3) is active and can be set in the usual manner.

Force Trigger (FT) and the quality control tolerance limits (+LIM/-LIM) are also active in this mode and can be set in the usual manner.

TIMER 5

Timer #5 is an abort cycle timer that can override the hard coded value of 9.99 seconds as an absolute time out when in the Energy mode.

Timer 5 is set in the same manner as the other timers l through 4. If the abort cycle feature is not to be used, Timer 5 should be set to 9.99 sec. If Timer 5 were set to zero (0), then welding in the Energy mode could not occur because the counters start simultaneously. The weld cycle will be terminated by whichever applicable time limit is reached first. Again, timer 5 can only be used when welding in the Energy mode. Timer 2 and Timer 5 cannot be utilized simultaneously.

SELECTING AND SETTING THE MAXIMUM WELD TIME (in Constant Energy Mode)

In the Constant Energy Mode, the Abort timer (T5) overrides the actual weld cycle time and can therefore limit the maximum ultrasonic weld time permitted for an assembly. That is, if the value set for the Abort timer (T5) is reached before the programmed energy value is met, sonics will be terminated and the hold cycle will be initiated.

OVERVIEW OF OPERATIONS AND LCD DISPLAYS

MICROSONIC PROCESSOR™ OPERATING INSTRUCTIONS

	FUNCTION	DISPLAY BEFORE	KEY OPERATION SEQUENCE	DISPLAY AFTER
START-UP	Start power supply and Microsonic Processor™	—	● ⓘ	SONICS AND MATERIALS •••• NO PRINTER •••• READY
TEST	Test for idle losses in air	READY	TEST	US - TEST = 5%
TIMER	Select Timer Function	READY	TIMER	TIMER NR = (1-5)?
	Select Timer ex: Delay Trigger Timer	TIMER NR = (1-5)?	1	TIMER 1 = 0.00 sec
	Set Timer 1 ex: 0.25 sec.	TIMER 1 = 0.00 sec	CE 2 5	TIMER 1 = 0.25 sec
	Enter set value	TIMER 1 = 0.25 sec	ENTER	TIMER NR = (1-5)?
LIMIT	Select Upper Limit	READY	+ LIM	+ LIM = 14985.0 Ws
	Cancel Value	+ LIM = 14985.0 Ws	CE	+ LIM = 00000.0 Ws
	Set Upper Limit ex: 115.0 Ws	+ LIM = 00000.0 Ws	1 1 5 0	+ LIM = 115.0 Ws
	Enter set value	+ LIM = 115.0 Ws	ENTER	READY
WELDS	Display number of welds completed	READY	INFO	WELD CYCLES = 0
	Display number of rejects	READY	INFO INFO	REJECTS = 0
	DIsplay rated power	READY	INFO INFO INFO INFO	RATED POWER = 1500W
	Display Mode Codes	READY	INFO INFO INFO INFO	
DELAY TIMES	Select either Delay Timer Triggering or Force Triggering Functions			
	If Delay Triggering (T1):	T1 ZT NB IS 1 48 M	1	FT ZT NB IS 1 48 M
	If Force Triggering (FT):	FT ZT NB IS 1 48 M		T1 ZT NB IS 1 48 M
ENERGY	Select either Time Based function or Constant Energy Function			
	If Time Based (ZT):	T1 ZT NB IS 1 48 M	2	T1 EN NB IS 1 48 M
	If Constant Energy (EN):	T1 EN NB IS 1 48 M		T1 ZT NB IS 1 48 M

	FUNCTION	DISPLAY BEFORE	KEY OPERATION SEQUENCE	DISPLAY AFTER
AFTERPULSE	Select Afterpulse Timer (T4) or cancel Afterpulse Timer (T4).	T1 ZT NB IS 1 48 M	5	FT ZT NB IS 1 48 M
TRIGGER FORCE	Select Trigger Force	READY	F TRIGGER	TRIGGER (F) = 1%
	Set Trigger Force ex: 25%	TRIGGER (F) = 1%	CE 2 5	TRIGGER (F) = 25%
	Enter set value	TRIGGER (F) = 25%	ENTER	READY
REF	Select and clear energy (REF) set value	READY	REF CE	REF = 00000.0 Ws
	Set REF value ex: 100.0 Ws	REF = 00000.0 Ws	1 0 0 0	REF = 100.0 Ws
	Enter REF Value	REF = 100.0 Ws	ENTER	READY
SECURITY	Secure keypad to prevent unauthorized adjustment of parameters. Release keypad security	T1 ZT NB IS 1 48 M	0 7	READY
PRINT	Continuous sequential display or printout of dynamic operating conditions on optional CRT or printer	READY	PRT	READY
	Printout of weld curve by optional printer	READY	ENTER Depress and hold for two seconds	* DATA TO PRINTER * READY

OVERVIEW OF SET-UP PROCEDURES AND DISPLAYS

CONSTANT ENERGY WITH VARIABLE FORCE TRIGGERING

	FUNCTION	DISPLAY BEFORE	KEY OPERATION SEQUENCE	DISPLAY AFTER
START-UP	Start power supply	—	⏻	SONICS AND MATERIALS •••• NO PRINTER •••• READY
TEST	Test for idle losses in air	READY	TEST	US - TEST = 5%
FORCE TRIGGER	Determine whether Force Trigger function has been selected	READY	INFO INFO INFO INFO	FT EN NB IS 1 48 M
	If not:	T1 EN NB IS 1 48 M	1	FT EN NB IS 1 48 M
CONSTANT ENERGY	Determine whether Constant Energy function has been selected	READY	INFO INFO INFO INFO	FT EN NB IS 1 48 M
	If not:	FT ZT NB IS 1 48 M	2	FT EN NB IS 1 48 M
TRIGGER FORCE	Select Trigger Force	READY	F TRIGGER	TRIGGER (F) = 00%
	Set Trigger Force ex: 25%	TRIGGER (F) = 00%	CE 2 5	TRIGGER (F) = 25%
	Enter set-value	TRIGGER (F) = 25%	ENTER	READY
REF	Select and clear energy set value	READY	REF CE	REF = 00000.0 W
	Set REF value ex: 100.0 Ws	REF = 00000.0 WS	1 0 0 0	REF = 1000 W
	Enter REF value	REF = 1000 WS	ENTER	READY
TIMERS	Select Timer Function	READY	TIMER	TIMER NR = (1-5)?
	Select Hold Timer (T3)	TIMER NR = (1-5)?	3	TIMER 3 = 0.00 sec
	Set Hold Timer ex: 25 sec.	TIMER 3 = 0.00 sec	CE 2 5	TIMER 3 = 0.25 sec
	Enter set-value (T3)	TIMER 3 = 0.25 sec	ENTER	TIMER NR = (1-5)?
AFTERPULSE	Cancel Afterpulse Timer (T4)	TIMER NR = (1-5)?	4 CE ENTER	TIMER NR = (1-5)?

	FUNCTION	DISPLAY BEFORE	KEY OPERATION SEQUENCE	DISPLAY AFTER
UPPER LIMIT	Select Upper Limit function	READY	+ LIM CE	+ LIM = 0.00 sec
	Set Upper Limit ex: 0.90 sec.	+ LIM = 0.00 sec	9 0	+ LIM = 0.90 sec
	Enter set-value	+ LIM = 0.90 sec	ENTER	READY
LOWER LIMIT	Select Lower Limit function	READY	– LIM CE	– LIM = 0.00 sec
	Set Lower Limit ex: 0.60 sec.	– LIM = 0.00 sec	6 0	– LIM = 0.60 sec
	Enter set-value	– LIM = 0.60 sec	ENTER	READY
OFF	Turn off power supply and Microsonic Processor™	READY (Or any other display when power supply is ON.)		* * * OFF * * * —

PROGRAM VERSION DESIGNATION

To review the program version number, press and hold the TEST and REF keys simultaneously when “SONICS & MATERIALS” appears on the LCD DISPLAY at start-up. The display will then show the program version number i.e., V2.6 845-19 1500W. To return to system status READY, simply release the TEST and REF keys.

CLEAR WELD COUNTER

As described earlier, the number of welds or process cycles can be displayed by pressing the INFO key once when the system status READY is displayed. To clear the displayed value at the end of a shift or when otherwise required, press the CE key once. The LCD screen display will change to “DELETE = CE?” Press the CE key once to clear the number of welds display and change to the number of rejects display, i.e., “REJECTS = 5.”

CLEAR REJECT COUNTER

Also as described earlier, the number of rejects can be displayed by pressing the INFO key twice, when the system status READY is displayed, (or by using the procedure described directly above to Clear the Weld Counter.

To clear the displayed value of rejects when required, press the CE key twice. The LCD screen display will change to “DELETE = CE?” Press the CE key once to cancel the number of rejects display and return to the system status READY display.

JOB STORAGE

Up to 9 different jobs may be stored and recalled or changed upon demand. Typical information stored includes timers (T1-T5), Force Trigger, Energy Reference, +/-Limits, Booster Gain, Horn Number, Air Pressure (reference only), and Cal Pulse ON/OFF.

Save

To use the job storage feature, press the INFO key six times. The LCD screen display will show the following message:

SAVE RECALL OTHER

From this display, jobs can be saved or recalled. To save a job, press numerical key 1(as “SAVE” is in the first display position). A new display will appear:

```
JOB NUMBER: __
```

Saved jobs will be numbered 1 through 9. Use the numerical keys to enter in the desired job number (1 - 9). Once the job number is keyed in, press the ENTER key. The following message will be displayed on the LCD screen:

```
SAVE O.K.! __
```

All the parameters for that job will be saved under the number keyed in. To return to system status READY, press the ENTER key.

Recall

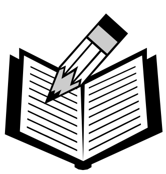
To recall a job that has been saved, first access the “SAVE RECALL OTHER” display (by pressing the INFO key 6 times). Then, press numerical key 2 (since recall is in the second display position). The following message will appear on the LCD screen display:

```
JOB NUMBER: __
```

Use the numerical keys to enter in the number (1 through 9) of the job to be recalled. Once the number is keyed in, press the ENTER key. The LCD screen will display:

```
RECALL O.K.! __
```

The system will not respond if there is no job saved under a number corresponding to the numerical key pressed.



NOTE: *Pressure is reference only, this does not change the actual air pressure.*

Other

The “OTHER” option in the “SAVE RECALL OTHER” display allows the storage of Pressure, Booster Gain and Horn Number parameters. To record these values, press the numerical key 3 on the keypad. The display will change to:

```
PRESSURE 000.00 Psig
```

To record a pressure, first press the CE key. This will clear out the current entry.

PRESSURE 0.00 Psig

Use the numerical keys to enter in the new pressure value. When the desired pressure is displayed on the LCD screen, press the ENTER key. The LCD screen display will show the following:

BOOSTER GAIN = 0.00 __

To set a new Booster Gain ratio, use the CE and numerical keys in the same manner described above for recording the Pressure value. Upon completion, press the ENTER key and the LCD display will change to:

HORN NUMBER: 000000 __

To record a new Horn Number, follow the same procedures as for recording Pressure and Booster Gain.

JOB SEQUENCE

Once jobs have been stored, they can be sequenced in accordance with application requirements. Saved jobs can be sequenced in any order and may be repeated in the sequence up to a maximum of 9 steps. Each job in the sequence is considered one step, with a maximum of 9 steps in a sequence before the sequence is repeated. The weld line report to the printer/CRT will include the step number in the sequence. The LCD screen display will indicate the step in the sequence that will be performed in the next weld operation.

To use the job sequence feature, press the INFO key 7 times (from the READY 1 mode). The LCD display will show the following:

SEQUENCE OFF

To sequence, first press the CE key. The LCD display will change to:

SEQUENCE

Use the numerical keypad to enter in the numbers corresponding to the sequence of stored jobs to be utilized. For example, a display of “SEQUENCE 1324182” will sequence Job l, then Job 3, Job 2, and so on. If the system does not respond to (and display) an entry, it is because there is no job saved under that number.

The following is an example where four jobs are to be sequenced and one set of parameters (Job 1) is to occur twice in the sequence. The sequence is as follows:

SEQUENCE 1 2 1 5

The LCD screen will show the following displays as the jobs are sequenced:

Display for	first cycle	READY 1	STEP #1
	second cycle	READY 2	STEP #2
	third cycle	READY 1	STEP #3
	fourth cycle	READY 5	STEP #4

NOTE: Sequence repeats, going back to first cycle.

CAL PULSE

The microprocessor controlled welder calibrates itself prior to each weld cycle. The use of the calibrator (cal) pulse enables the machine to automatically monitor the idle losses in the converter/ booster/horn assembly just as the head begins its descent to the part. The system adds the energy necessary to vibrate the horn in air, to the total energy programmed to weld a part. The cal pulse is utilized only in the Constant Energy mode, although it is activated during all modes of operation. Occasionally, it is necessary to turn the cal pulse off. For example, in order to place a part into the horn prior to welding (i.e.; vacuum horns), the cal pulse can be turned on and off from the front panel.

Press the INFO key 8 times from the READY 1 mode. The display will read either "CAL PULSE IS ON" or CAL PULSE IS OFF." Press the CE key, (which will act as a toggle) and the cal pulse will be either turned on or turned off. The system will acknowledge by showing the new (on or off) setting on the LCD display.

KEYPAD SECURITY

The keypad can be “locked” so that all operating parameters that are selected and set with the keypad are locked in, preventing unauthorized cancellation or adjustment.

To activate the security feature, first press the INFO key 4 times to display the current Mode Codes (i.e., T1 ZT NB IS 1 48 M, or other variation). Then, press the numerical keys 0 and 7 in sequence within one second to lock the keypad. When the keypad is secured in this manner, all parameter values can still be displayed, but the CE key is not functional (the red LED will not light up and parameters cannot be cancelled or changed). Any attempt to change or enter parameters with the CE key will result in the following message being displayed on the LCD screen:

KEYBOARD IS LOCKED

To return to normal operation and unlock the keypad, repeat the lock procedure - press the numerical keys 0 and 7 (within one second) while the Mode Codes are displayed. The red LED in the upper corner of the CE key will be illuminated again to prompt and permit cancellation.

PRINTER INTERFACE AND OPERATION

NOTE: *Use of a printer causes the cycle to be extended by approximately 200 ms.*

PRINTER OPERATION

If a printer is to be used for documentation of the dynamic process conditions, it must have an RS232 serial port interface, a buffer of 2K bytes and be capable of accepting a transmission rate of 4800 Baud. Following completion of an assembly cycle, the assembly number, percentage of maximum power used, energy level, weld cycle duration and reject status can be printed.

When the number of welds or number of rejects is displayed on the LCD, as a result of pressing the INFO key the requisite number of times, that same information can be printed.

The green LED in the upper corner of the PRT key must be illuminated for a printout of process conditions to occur. Press the PRT key to obtain a printout. Refer to the printer displays shown on the next pages for examples.

PRINTOUT OF THE WELD ENERGY CURVE

A graphic display of the actual weld curve can also be printed out if a printer with a serial port interface and a buffer of 2K bytes, such as an Epson Model LX-810 or comparable, unit is used.

The printout of the weld curve plots the actual pattern of instantaneous loading as a function of time. The vertical line at the beginning of the printout indicates the idle losses of the converter, booster and horn in air; and the area under the curve corresponds to the energy delivered throughout the cycle. (Refer to the sample printer displays on the next page for examples.)

The printout of the weld curve is initiated by pressing the ENTER key for approximately 1 second until an audible alarm sounds and the following message appears on the LCD screen:

* DATA TO PRINTER *

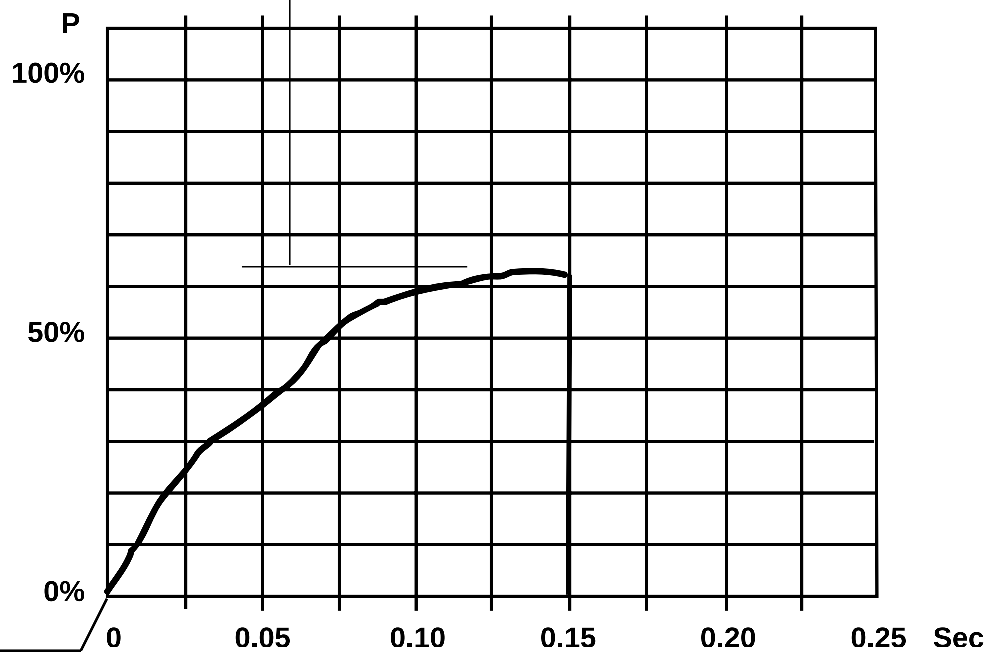
The printout requires approximately 70 seconds to complete, with a Baud rate of 4800.

PRINTER DISPLAYS

Time Based mode with delay timer triggering

		Program Version	**Power Supply Output Rating**	**Mode Codes**
SONICS AND MATERIALS		**V3.0 845-73**	**1500W**	**T1 ZT NB IS 1 48 M**
Delay Timer	Timer 1 = 0.25 sec			
Weld Timer	Timer 2 = 0.15 sec	+ LIM = 105.0 Ws	Upper tolerance limit (energy)	
Hold Timer	Timer 3 = 0.25 sec	– LIM = 90.0 Ws	Lower tolerance limit (energy)	
Afterpulse Timer	Timer 4 = 0.00 sec	CAL PULSE = ON		
	Timer 5 = 0.00 sec	BOOSTER GAIN = 1.50		HORN NUMBER: 123
	Pressure 30.00 Psig	0.15 sec	Predetermined Weld Cycle	
Assembly Number	98	90.8 Ws	Actual energy delivered	

Percentage of available power used — 64%P max



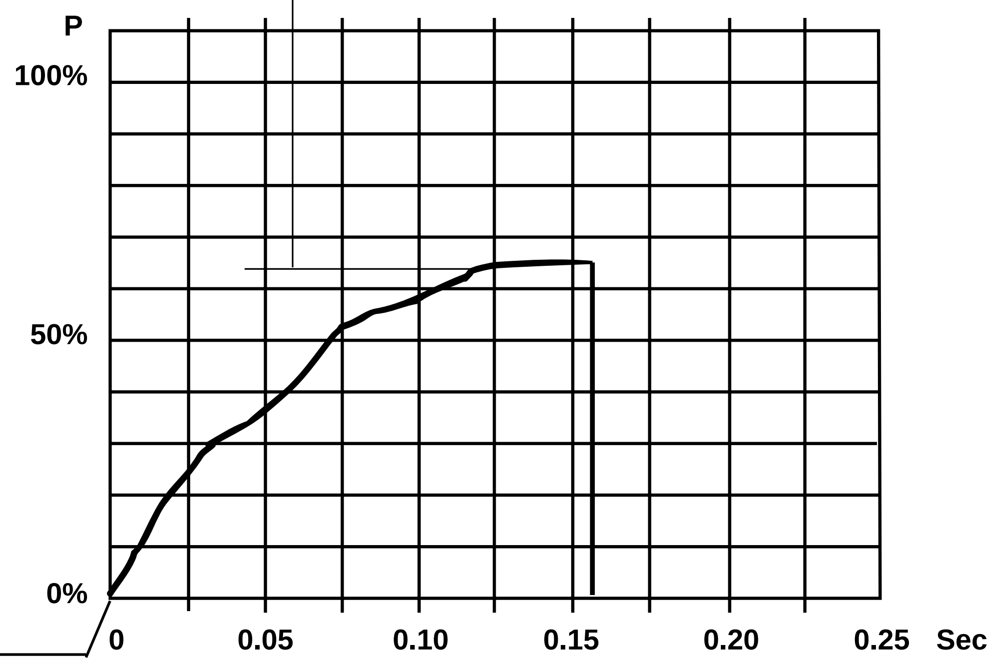
Idle Losses For Converter, Booster and Horn

Constant energy mode with variable force triggering

	Program Version	Power Supply Output Rating		Mode Codes
SONICS AND MATERIALS	**V3.0 845-73**	**1500W**		**FT EN NB IS 1 48 M**

Trigger Force — Trigger (F) = 2%
Energy Set-Value — REF = 91.0 Ws   + LIM = 0.20 sec   Upper Limit (Time)
Hold Timer — Timer 3 = 0.25 sec   – LIM = 0.10 sec   Lower Limit (Time)
Afterpulse Timer — Timer 4 = 0.00 sec   CAL PULSE = ON
Timer 5 = 0.25 sec   BOOSTER GAIN = 1.50   HORN NUMBER: 123
Pressure 30.00 Psig   0.17 sec   Actual Weld Cycle Duration
Assembly Number — 100   91.2 Ws   Actual energy delivered

Percentage of available power used — 65%P max



Idle Losses For Converter, Booster and Horn

The keypad is not functional during the time a printout is being made until a short audible tone is heard and the LCD returns to system status "READY." Printing can be stopped at any time by pressing any key. The printer will continue printing, however, until the data stored in the buffer has been printed.

Time axis plot lengths of 250 ms, 500 ms, 1 second, 5 seconds and 10 seconds are available for printout. The time axis desired must be specified prior to the assembly cycle, as follows.

Press the INFO key five times until the following display appears on the LCD screen:

GRAPH TIME AXIS

The red LED in the corner or the CE key indicates that it is functional and therefore, the displayed value can be cancelled and changed.

Press the CE key and then key in the appropriate numerical code (see below) for the Time Axis Plot Length desired. Acknowledge the entry by pressing the ENTER key or wait 30 seconds for automatic acceptance.

CODE	TIME AXIS LENGTH
02	250ms
05	500ms
10	1 sec
50	5 sec
99	10 sec

GRAPH HEADER

In addition to cycle parameters, the printout will also include readings for Air Pressure, Cal Pulse, Booster Gain and Horn Number. These values may be entered through the keypad. The printout readings are reference values only; i.e., if the gauge pressure setting reads 45 psig and the printout reads "PRESSURE 20 PSIG", the parts will be welded with 45 psig. The same applies for "Booster Gain" and "Horn Number."

REJECT PRINTOUTS

The reason for a reject, such as ± LIM or T5, will be printed out for each weld. If the Timer 5 limit is exceeded, then the printout will read as follows:

25 76/o   176.6 ws   0.40 sec. **** Reject T5

For the example above, the printout indicates that this cycle was rejected because the Timer 5 setting (0.40 sec.) was exceeded. In this case, the red LED’s in the corners of both the +LIM and -Lim keys will be illuminated.

SYSTEM STATUS TESTS AND FUNCTIONS

POWER SUPPLY TEST AND DISPLAY

The ultrasonic power supply can be actuated briefly and tested by pressing and holding the TEST key. The value displayed on the LCD screen should not exceed 10% or 20% on the LED bar graph.

OPERATION SEQUENCE DISPLAY

The operation sequence, which includes the trigger, time and energy functions in use during a process cycle, can be displayed on the LCD screen during subsequent cycles. To display the sequence, press the numerical key 4 when the Mode Codes are displayed.

Each function abbreviation is displayed as it is actuated, and all function abbreviations are retained in display until the cycle is completed, i.e., T1 T2 T3, T1 T2 T3 T4, T1 T2 T3 T4+ US, FT T2 T3, FT EN T3 and other variations.

The power supply can be returned to the system status READY display during the process cycle by repeating the procedure used above to select the operation sequence display (press the numerical key 4 when the Mode Codes are displayed).

SYSTEM STATUS TESTS AND MISCELLANEOUS FUNCTIONS

NOTE: *Refer to page 42 for an overview of system status tests displays.*

In addition to the basic modes and functions described in the preceding sections, the power supply provides additional testing and operating functions, as listed below.

Input Test

To display the status of the various system inputs, press the TEST and AUTO keys simultaneously when "SONICS & MATERIALS" appears on the LCD screen at start-up. The display will change to "INPUT TEST." When the TEST and AUTO keys are released, the status of the various inputs will be displayed in an alphabetical code. From left to right, the inputs are as follows (see next page):

Input No.	Function	Alphabetical Status Codes	
1.	Emergency stop/converter door interlock	A = ON	a = OFF
2.	Not used at present time	B = ON	b = OFF
3.	Stop timer 2	C = OFF	c = ON
4.	Not used at present time	D = OFF	d = ON
5.	Stop timer 3	E = OFF	e = ON
6.	Stop timer 4	F = OFF	f = ON
7.	Rotary table valve monitoring	G = Missing	g = OK
8.	Press valve monitoring	H = Missing	h = OK
9.	Head advance control	I = OFF	i = ON
10.	External Start	J = OFF	j = ON
11.	L H Palm Switch	K = OFF	k = ON
12.	R H Palm Switch	L = OFF	l = ON
13.	Rotary table acknowledgement 1	M = OFF	m = ON
14.	Rotary table acknowledgement 2	N = OFF	n = ON
15.	Press upper limit switch	O = OPEN	o = CLOSED
16.	Horn contact acknowledgement	P = OFF	p = ON

To terminate the test and clear the display, press the ON/OFF key.

PRINTER TEST (only with Optional Peripherals)

To access the Printer Test feature, first ensure that the optional printer is “ON.” Then, press the TEST and PRINT keys simultaneously when “SONICS AND MATERIALS” appears on the LCD screen at start-up. The display will change to “PRINTER TEST” and a test sample will be printed on the printer.

To terminate the test, press the ON/OFF key.

WARNING

The F TRIGGER key must be depressed before the horn makes contact or an invalid force measurement, or the value "0%," will be displayed.

COUPLING FORCE MEASUREMENT (Model 1098 only)

To measure the actual horn coupling force, turn the head down key switch clockwise. Then, as the head is descending, press the F TRIGGER key and keep it depressed until the horn contacts the parts.

The coupling force will be displayed on the LCD screen as a percentage of the maximum available force. (100% = 50 Psig = 245 Ibs. =1,090 Newtons)

Release the head advance control(s) to terminate measurement.

Because of the characteristics of the piezoelectric load cell, the display will be accurate only if the temperature remains constant and the period of measurement does not exceed 30 seconds. If a 30 second duration is exceeded, release the head advance control and repeat the procedure above.

CLEAR PARAMETERS

To cancel all variable parameters and release keypad security, press the INFO and F TRIGGER keys simultaneously when "SONICS & MATERIALS" appears on the LCD screen at start-up. The power supply will return to normal Force Trigger Operation with Delay Triggering mode.

All keypad LED's will light up and stay illuminated until the INFO and F TRIGGER keys are released and the unit is turned Off.

SYSTEM STATUS TESTS

SYSTEM STATUS TESTS AND MISCELLANEOUS FUNCTIONS

FUNCTION	DISPLAY BEFORE	KEY OPERATION SEQUENCE	DISPLAY AFTER
Input Test	SONICS AND MATERIALS	TEST + AUTO	INPUT TEST ABCDEFGhIJKLMNoP
CRT Monitor/Printer Test	SONICS AND MATERIALS	INFO + PRT	* * PRINTER TEST * *
Cancel Parameters	SONICS AND MATERIALS	INFO + F TRIGGER	* * * * OFF * * * *
Program Version Designation	SONICS AND MATERIALS	TEST + REF	V2.6 845-19 1500W Typical Display
Cancel Number of Welds	READY WELD CYCLES = 100 DELETE = CE?	INFO CE CE	WELD CYCLES = 100 DELETE = CE? REJECTS = 5
Cancel Number of Rejects	READY REJECTS = 5 DELETE = CE?	INFO INFO CE CE	REJECTS = 5 DELETE = CE? READY
Select Time Axis Length (power curve)	READY	INFO INFO INFO INFO INFO	GRAPH-TIME-AXIS: 02
Set Plot Length ex: 500 ms.	GRAPH-TIME-AXIS: 02	CE 5	GRAPH-TIME-AXIS: 05
Enter Plot Length	GRAPH-TIME-AXIS: 05	ENTER	READY
Advance Head For Set-Up	READY	Depress Head Advance Control	* * * ADJUST * * *
Force Measurement	* * * ADJUST * * *	F TRIGGER	TRIGGER TEST = 15%

OVERLOAD PROTECTION

The overload protection circuit will terminate sonics when the system is operated under adverse conditions, i.e., improper tuning, excessive power supply loading, loose or failed horn or booster, thereby protecting the power supply and other system components. When an overload condition exists, the RESET button will illuminate and remain lit until the button is pressed (regardless of whether the condition is corrected or not). If a repeated overload condition exists, resolve the problem before a failure of the power supply occurs.

NOTE: *System will still cycle even though the power supply is in overload condition, but sonics will not be delivered.*

If an overload condition exists, try the following:

— decrease horn force

— decrease amplitude (change booster or decrease output control)

— decrease downspeed

— check for loose or broken studs

— check the coupling surfaces between horn/booster and booster/converter

— check for cracked horn or booster

— check to see if the load meter exceeds 100% during weld process (if so, a higher powered unit is needed)

If you cannot remedy the situation, contact Sonics' Service Department at 1-800-745-1105.

MAINTENANCE

GENERAL

1. Always make sure the power supply has adequate ventilation by keeping sufficient space around the assembly.
2. Periodically check the ventilation grilles and clean as necessary.

REPAIRS / SERVICE

If problems are encountered, contact our Service Department at 1-800-745-1105.

It is suggested that a system in need of repair be sent back to the factory with a written description pertaining to the nature of the problem.

NOTE: *If packing unit for return shipment, DO NOT use styrofoam "peanuts."*

Always contact the factory for return authorization before shipping any instrument. Include date of purchase, model number, and serial number. For units not covered by the warranty, a purchase order should be forwarded to avoid unnecessary delay. Care should be exercised to provide adequate packing to insure against possible damage in shipment. The system should be sent with all transportation charges prepaid and return method of shipment indicated.

WARRANTY

Sonics & Materials, Inc., hereinafter referred to as “Sonics,” warrants its products for a period of one year from the date of shipment against defect in material and workmanship under normal installation, use, and maintenance as described in the operating instructions which accompany such equipment. During the warranty period, “Sonics” will, at its option, as the exclusive remedy, either repair or replace without charge for material and labor, the part(s) which prove upon our examination to be defective, provided the defective unit is returned to us properly packed with all transportation charges prepaid.

LIMITATION OF WARRANTY

This warranty is in lieu of any other warranties, either express, implied, or statutory. “Sonics” neither assumes nor authorizes any person to assume for it any other obligation or liability in connection with the sale of its products. “Sonics” hereby disclaims any warranty or 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 “Sonics” be liable to the purchaser or to any other person for any incidental or consequential damages or loss of profit or product resulting from any malfunction or failure of this “Sonics” product.

This warranty does not apply to equipment which has been subject to unauthorized repair, misuse, abuse, negligence or accident. Equipment which, in our judgment, 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.

No liability is assumed for expenses or damages resulting from interruptions in operation of the product or damages to material in process.

“Sonics” equipment is designed for maximum operator safety and incorporates built-in safety devices. Any modifications to these safety features will void the warranty. “Sonics” assumes no responsibilities for consequential damages incurred due to modifications to the said equipment.

“Sonics” reserves the right not to warrant horns of unusual or experimental design which in our judgment are more likely to fail in use.

Data supplied in the instruction manual has been verified and validated and is believed adequate for the intended use of the equipment. If the equipment or procedures are used for purposes other than those specified herein, confirmation of their validity and suitability should be obtained in writing from “Sonics.”

DIP SWITCH DEFAULT SETTINGS

SWITCH	POS. OFF	POS. ON	DEFAULT
DIP-1	Force Trigger Mode (FT)	T1 (ZT) Model	OFF
DIP-2	Weld by Timer 2 (T2)	Weld by Energy (EN)	OFF
DIP-3	Normal mode without Rotary table	Rotary table mode to DIP-4	OFF
DIP-4	Rotary table mode with pulse control	Rotary table mode with continuous control and ackn.	OFF
DIP-5	Timer 4 adds to hold time	Timer 4 as shake off pulse during press return	OFF
DIP-6	N/A	N/A	OFF
DIP-7	Printer output 1,200 Baud	Printer output 4,800 Baud	ON
DIP-8	Alternate start method	Two-hand start only	ON

Refer to p. 18 for function abbreviations.

APPENDIX

EQUIPMENT WIRING DIAGRAMS AND ASSOCIATED I/O

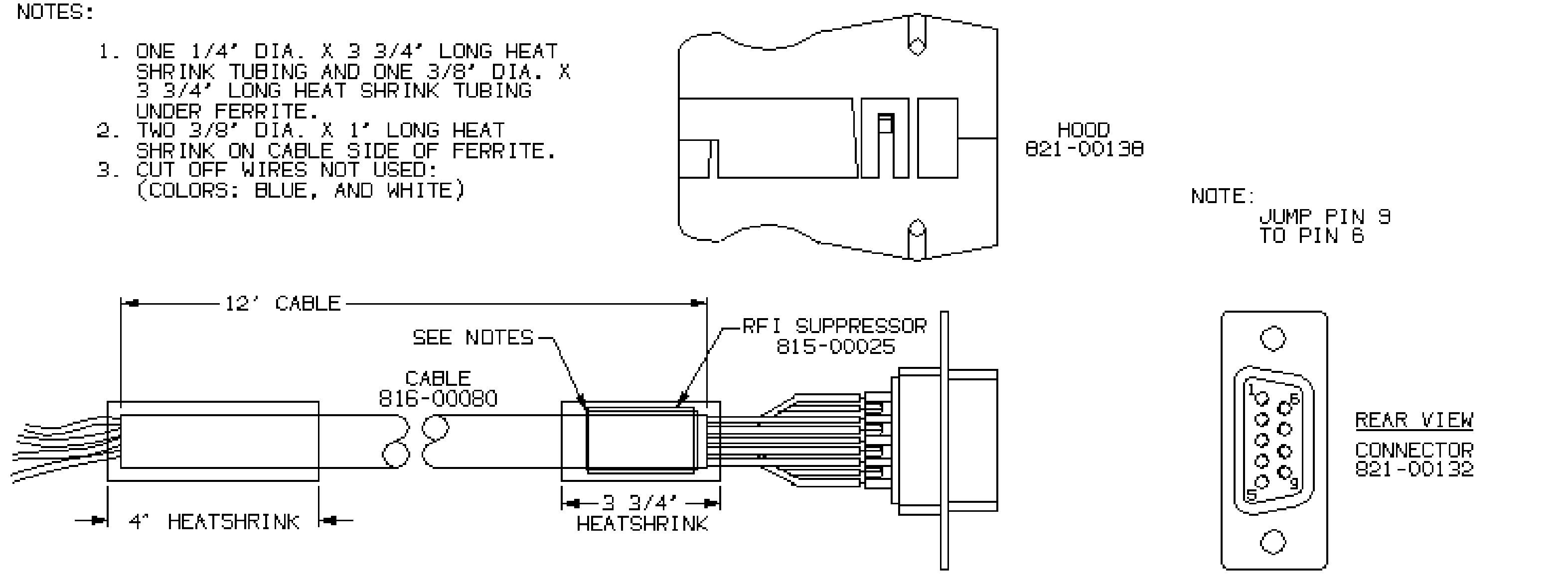
Model	Wiring Diagram	Actuation J2	I/O J3	I/O J6	I/O J7	I/O J8	I/O J9
FM	E-2952	E-2703	E-2480	E-2483	E-3014	E-3013	E-2902

Drawing	Description
E-2480	Printer Cable
E-2483	Rotary Table Cable
E-2703	Impulse Actuation Cable
E-2902	Good Part/Bad Part and Abort Cable. Special*
E-2952	FM Wiring Diagram
E-3013	F-Series General I/O
E-3014	F-Series General I/O

*Pin 3 has 24 vdc for the reject output and pin 2 has a switched return on standard machines. Good part/Bad part and Abort is a special modification.

NOTES:

1. ONE 1/4' DIA. X 3 3/4' LONG HEAT SHRINK TUBING AND ONE 3/8' DIA. X 3 3/4' LONG HEAT SHRINK TUBING UNDER FERRITE.
2. TWO 3/8' DIA. X 1' LONG HEAT SHRINK ON CABLE SIDE OF FERRITE.
3. CUT OFF WIRES NOT USED: (COLORS: BLUE, AND WHITE)



OUTPUT DEFINITIONS

PIN	COLOR-GA	FDL	FM	FO	FC
1	CABLE SHIELD	SHIELD GND	SHIELD GND	SHIELD GND	SHIELD GND
2	RED 24 GA	Hz/10	Hz/10	Hz/10	Hz/10
3	BLK 24 GA	TUNE LOCK IND.	TUNE LOCK IND.	TUNE LOCK IND.	TUNE LOCK IND.
4	BRN 24 GA	SMPS READY	SMPS READY	SMPS READY	SMPS READY
5	YEL 24 GA	D.L. RESET	D.L. RESET	D.L. RESET	D.L. RESET
6	ORG 24 GA	NC	NC	NC	NC
7	VIO 24 GA	D.L. IND.	D.L. IND.	D.L. IND.	D.L. IND.
8	GRY 24 GA	15VDC RETURN	15VDC RETURN	15VDC RETURN	15VDC RETURN
9	GRN 24 GA	COMMON EMITTER	COMMON EMITTER	COMMON EMITTER	COMMON EMITTER

201-0206

NO.	DESCRIPTION	BY	DATE
5			
4			
3			
2	ADDED OUTPUT CHART	VAC	10-29-98
1	ADDED NOTES	VAB	6-25-97

TOLERANCES (EXCEPT AS NOTED)
DECIMAL .X= ±.030 .XX= ±.015 .XXX= ±.005
FRACTIONAL ± 1/64
ANGULAR ± 1/2°

SONICS 53 CHURCH HILL RD. NEWTOWN, CT 06470

F-SERIES CONTROL CABLE I/O CONNECTIONS (P8)

DRAWN BY VAB
SCALE -----
DRAWING NO. E-3013
CHK'D
DATE 3-14-97
MATERIAL ----------------------

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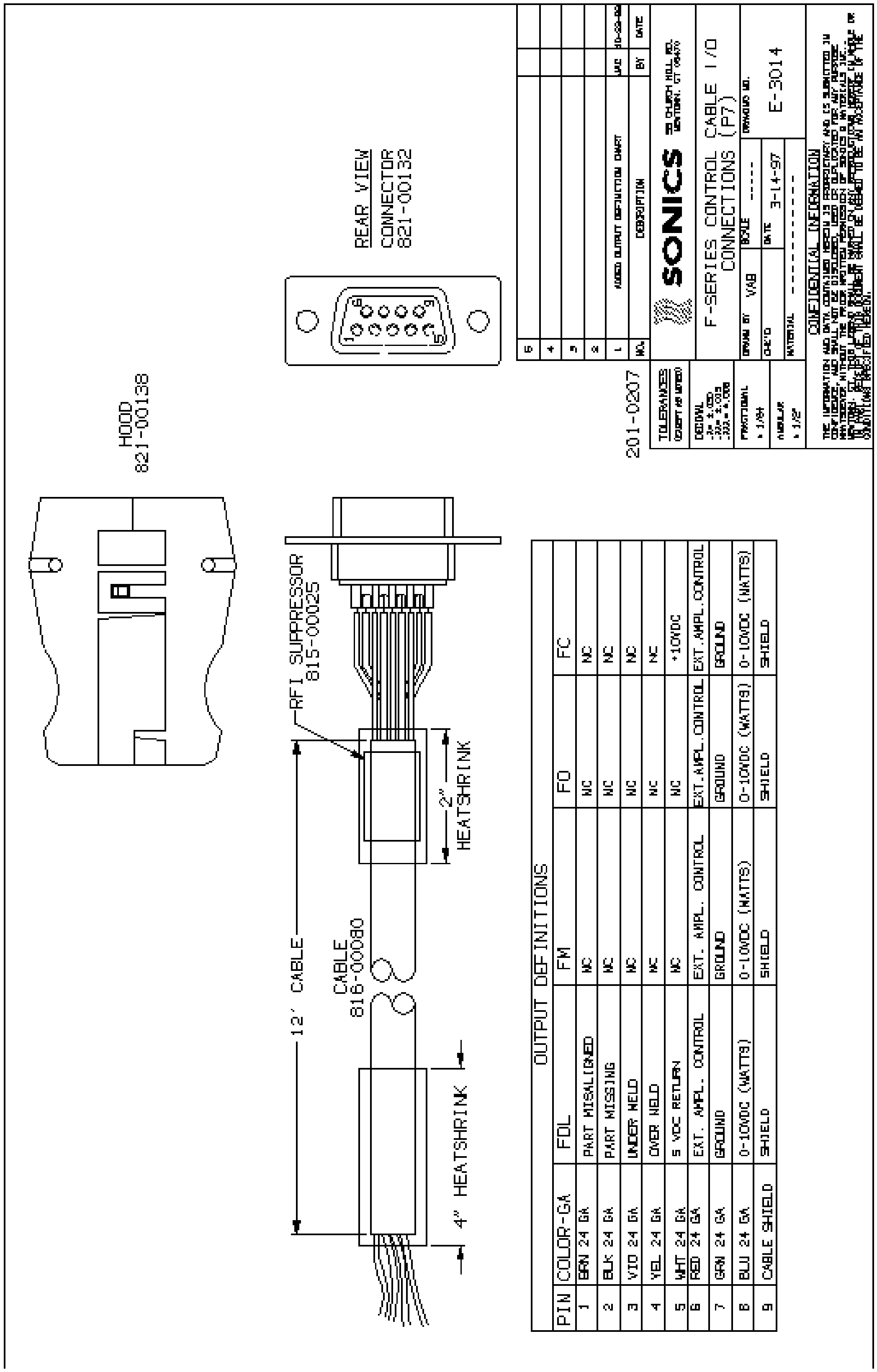
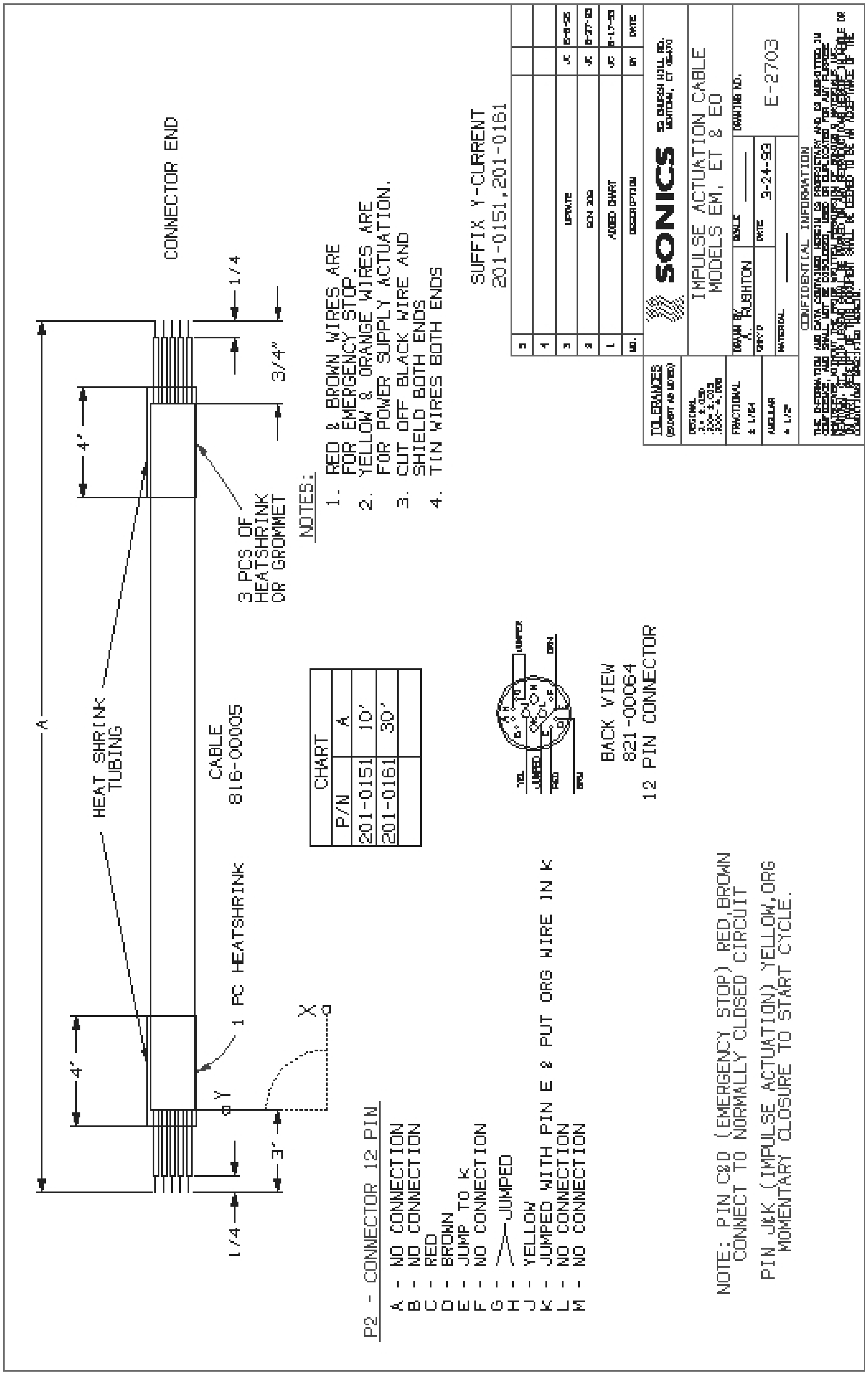
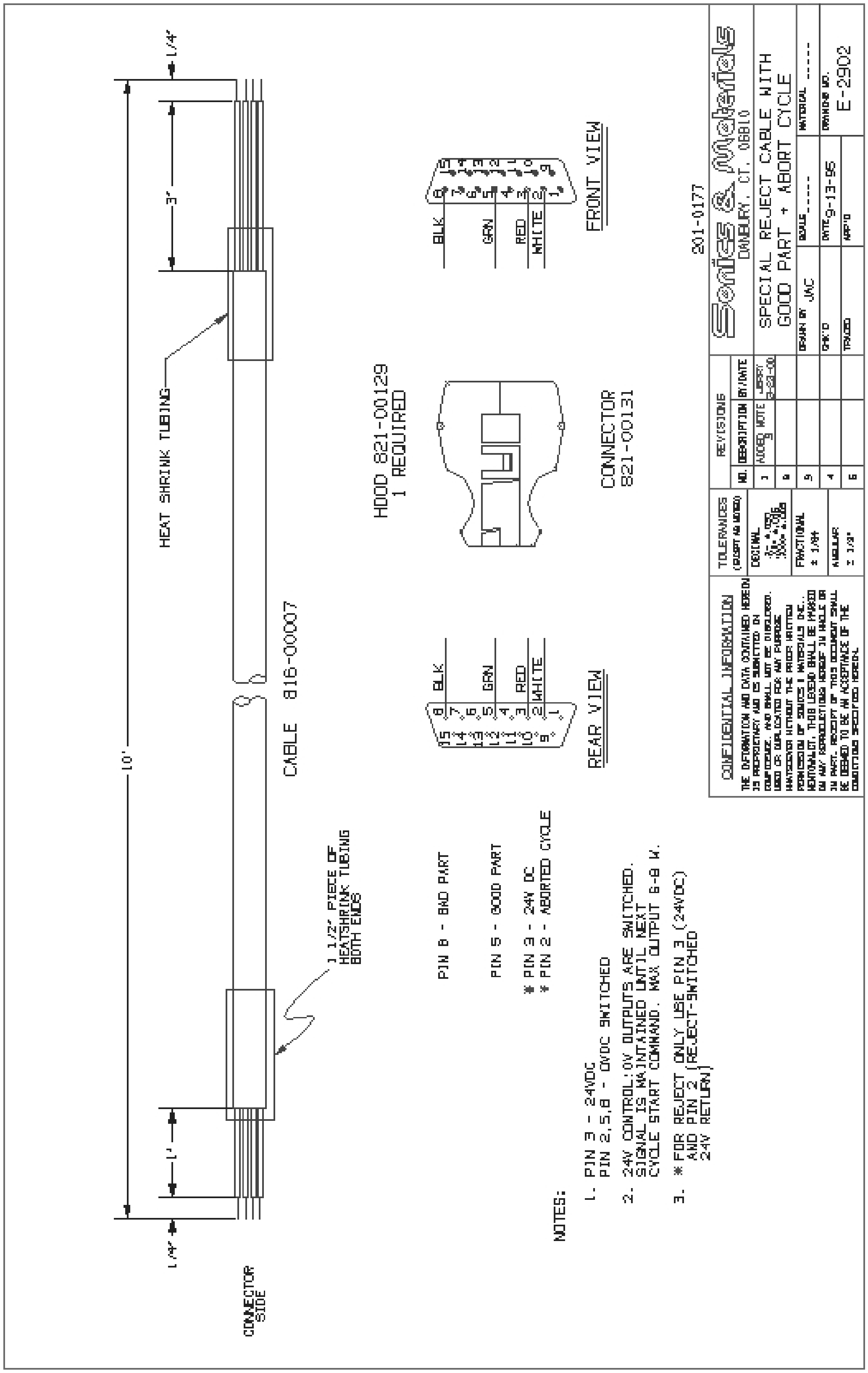


OUTPUT DEFINITIONS

PIN	COLOR-GA	FDL	FM	FO	FC
1	BRN 24 GA	PART MISALIGNED	NC	NC	NC
2	BLK 24 GA	PART MISSING	NC	NC	NC
3	VIO 24 GA	UNDER WELD	NC	NC	NC
4	YEL 24 GA	OVER WELD	NC	NC	NC
5	WHT 24 GA	5 VDC RETURN	NC	NC	+10VDC
6	RED 24 GA	EXT. AMPL. CONTROL	EXT. AMPL. CONTROL	EXT.AMPL.CONTROL	EXT.AMPL.CONTROL
7	GRN 24 GA	GROUND	GROUND	GROUND	GROUND
8	BLU 24 GA	0-10VDC (WATTS)	0-10VDC (WATTS)	0-10VDC (WATTS)	0-10VDC (WATTS)
9	CABLE SHIELD	SHIELD	SHIELD	SHIELD	SHIELD


CONNECTOR END
1/4
3/4"
4'
3 PCS OF HEATSHRINK OR GROMMET
NOTES:
1. RED & BROWN WIRES ARE FOR EMERGENCY STOP.
2. YELLOW & ORANGE WIRES ARE FOR POWER SUPPLY ACTUATION.
3. CUT OFF BLACK WIRE AND SHIELD BOTH ENDS
4. TIN WIRES BOTH ENDS
SUFFIX Y-CURRENT
201-0151,201-0161
SONICS
IMPULSE ACTUATION CABLE
MODELS EM, ET & EO
DRAWN BY K. RUSHTON
DATE 3-24-93
DRAWING NO. E-2703
CONFIDENTIAL INFORMATION
A
HEAT SHRINK TUBING
CABLE
816-00005
CHART
P/N A
201-0151 10'
201-0161 30'
BACK VIEW
821-00064
12 PIN CONNECTOR
1 PC HEATSHRINK
X
Y
3'
4'
1/4
P2 - CONNECTOR 12 PIN
A - NO CONNECTION
B - NO CONNECTION
C - RED
D - BROWN
E - JUMP TO K
F - NO CONNECTION
G - JUMPED
H - JUMPED
J - YELLOW
K - JUMPED WITH PIN E & PUT ORG WIRE IN K
L - NO CONNECTION
M - NO CONNECTION
NOTE: PIN C&D (EMERGENCY STOP) RED,BROWN CONNECT TO NORMALLY CLOSED CIRCUIT
PIN J&K (IMPULSE ACTUATION) YELLOW,ORG MOMENTARY CLOSURE TO START CYCLE.


10'
1/4"
1'
3"
1/4"
HEAT SHRINK TUBING
CONNECTOR SIDE
CABLE 816-00007
1 1/2" PIECE OF HEATSHRINK TUBING BOTH ENDS
HOOD 821-00129
1 REQUIRED
PIN 8 - BAD PART
PIN 5 - GOOD PART
* PIN 3 - 24V DC
* PIN 2 - ABORTED CYCLE
BLK
GRN
RED
WHITE
REAR VIEW
CONNECTOR
821-00131
FRONT VIEW
NOTES:
1. PIN 3 - 24VDC
PIN 2,5,8 - 0VDC SWITCHED
2. 24V CONTROL:0V OUTPUTS ARE SWITCHED. SIGNAL IS MAINTAINED UNTIL NEXT CYCLE START COMMAND. MAX OUTPUT 6-8 W.
3. * FOR REJECT ONLY USE PIN 3 (24VDC) AND PIN 2 (REJECT-SWITCHED 24V RETURN)
201-0177
CONFIDENTIAL INFORMATION
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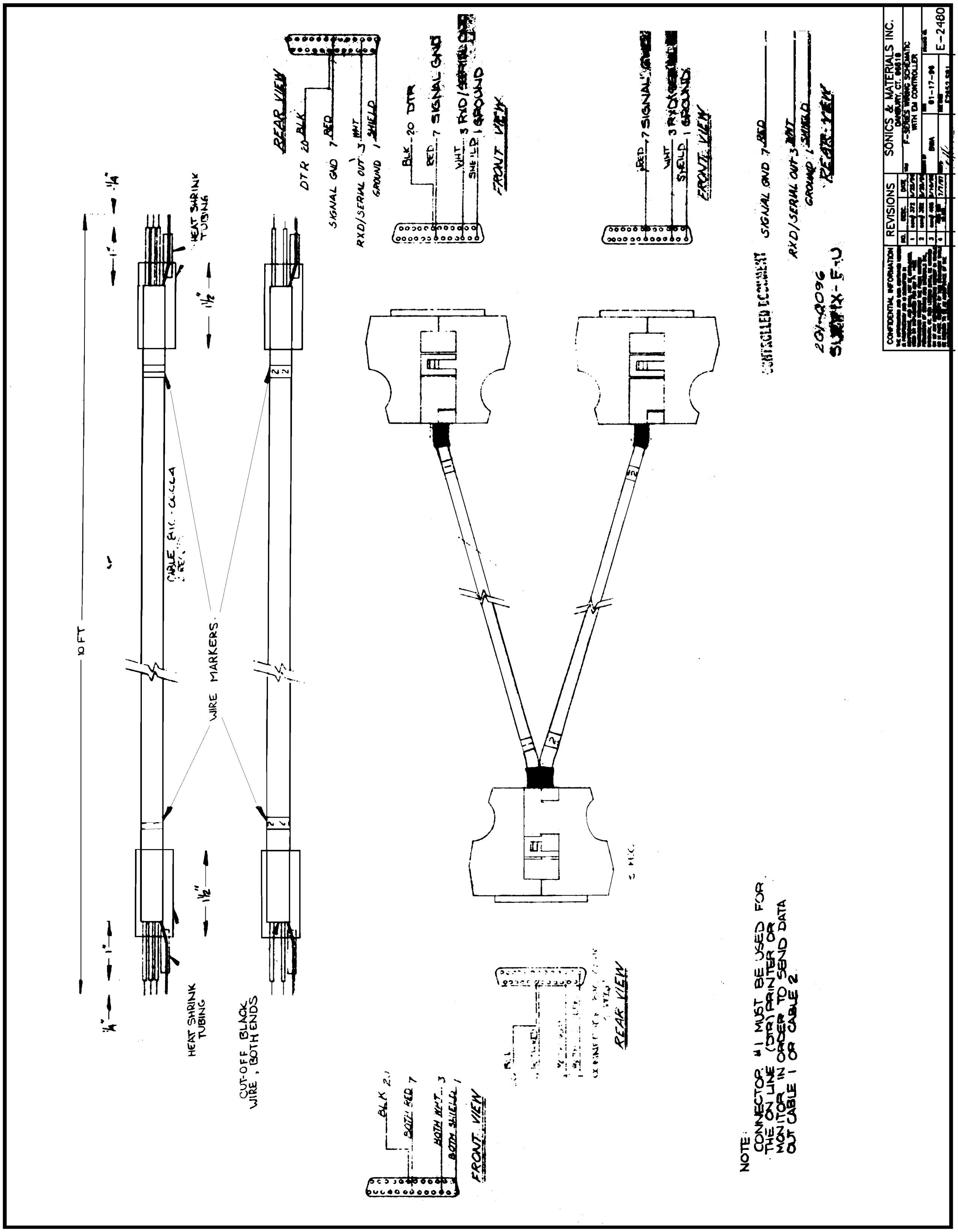
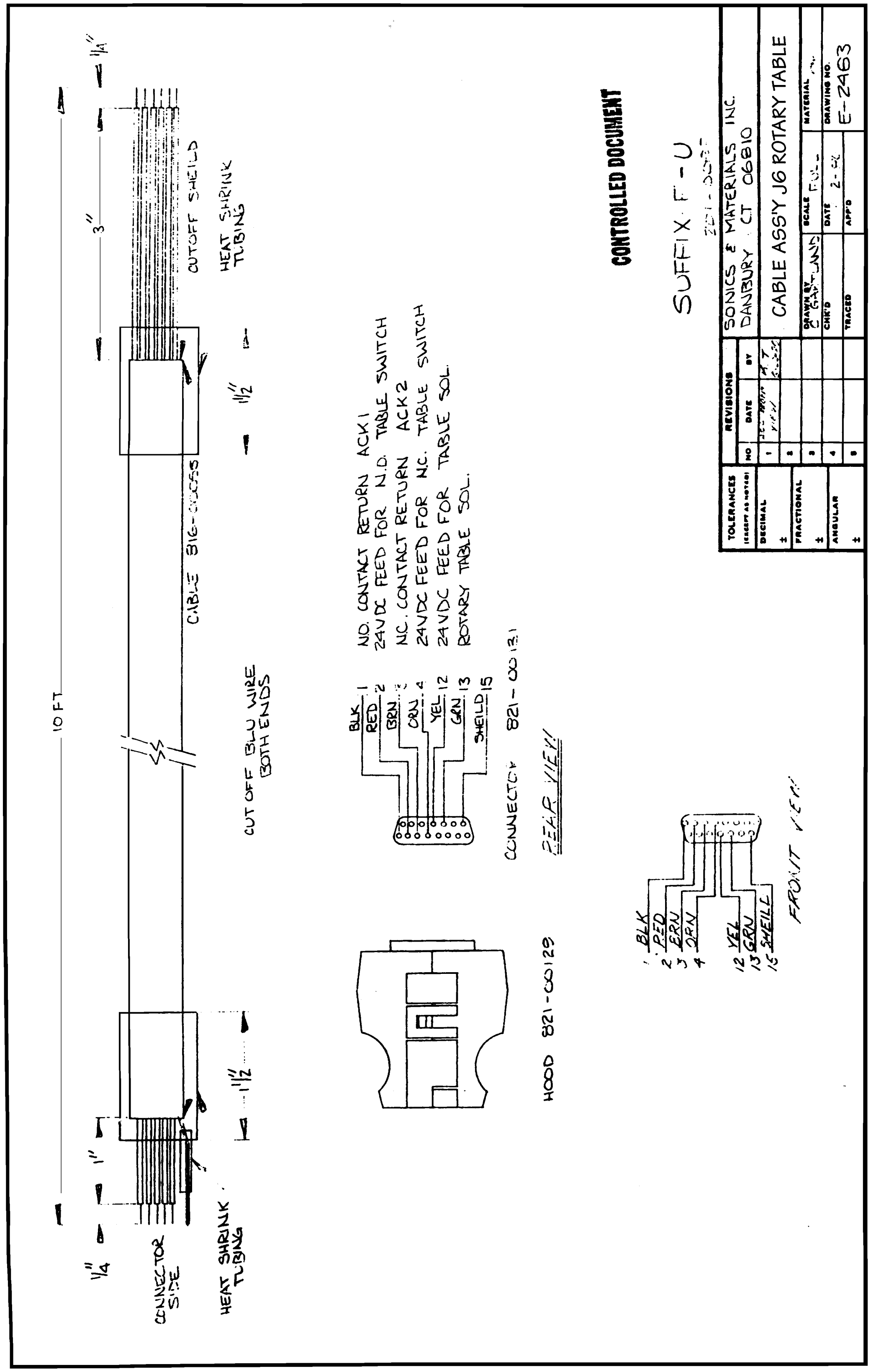
TOLERANCES
DECIMAL
FRACTIONAL ± 1/64
ANGULAR ± 1/2°
REVISIONS
NO. DESCRIPTION BY/DATE
1 ADDED NOTE 3
2
3
4
5
Sonics & Materials
DANBURY, CT. 06810
SPECIAL REJECT CABLE WITH GOOD PART + ABORT CYCLE
DRAWN BY JAC
SCALE -----
MATERIAL -----
CHK'D
DATE 9-13-95
DRAWING NO.
E-2902
TRACED
APP'D


REAR VIEW
DTR 20 BLK
SIGNAL GND 7 RED
RXD/SERIAL OUT 3 WHT
GROUND 1 SHIELD
FRONT VIEW
HEAT SHRINK TUBING
WIRE MARKERS
10 FT
CUT-OFF BLACK WIRE, BOTH ENDS
NOTE: CONNECTOR #1 MUST BE USED FOR THE ON LINE (DTR) PRINTER OR MONITOR IN ORDER TO SEND DATA OUT CABLE 1 OR CABLE 2
SONICS & MATERIALS INC.
E-2480

SONICS


10 FT
3"
1/4"
1"
1 1/2"
CUTOFF SHEILD
HEAT SHRINK TUBING
CONNECTOR SIDE
CUT OFF BLU WIRE BOTH ENDS
BLK 1
RED 2
BRN 3
ORN 4
YEL 12
GRN 13
SHEILD 15
N.O. CONTACT RETURN ACK1
24VDC FEED FOR N.O. TABLE SWITCH
N.C. CONTACT RETURN ACK2
24VDC FEED FOR N.C. TABLE SWITCH
24VDC FEED FOR TABLE SOL.
ROTARY TABLE SOL.
CONNECTOR 821-00131
REAR VIEW
HOOD 821-00129
FRONT VIEW
CONTROLLED DOCUMENT
SUFFIX F-U
TOLERANCES
DECIMAL
FRACTIONAL
ANGULAR
REVISIONS
NO
DATE
BY
SONICS & MATERIALS INC.
DANBURY, CT 06810
CABLE ASS'Y J6 ROTARY TABLE
DRAWN BY
CHK'D
TRACED
SCALE
DATE
APP'D
MATERIAL
DRAWING NO.
E-2463

SONICS

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europe@sonicsandmaterials.ch

Model FD/FDL Power Supply

INSTRUCTION MANUAL

SONICS

Sonics & Materials, Inc.

WARRANTY

Sonics & Materials, Inc., hereinafter referred to as "S&M", warrants its products for a period of one year from the date of shipment against defects in material and workmanship under normal installation, use, and maintenance as described in the operating instructions which accompany such equipment. During the • warranty period, S&M will, at its option, as the exclusive remedy, either repair or replace without charge for material and labor, the part(s) which prove upon our examination to be defective, provided the defective unit is returned to us properly packed with all transportation charges prepaid.

Limitation Of Warranty

This warranty is in lieu of any other warranties, either express, implied, or statutory. S&M neither assumes nor authorizes any person to assume for it any other obligation or liability in connection with the sale of its products. S&M hereby disclaims any warranty of 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 S&M be liable to the purchaser or to any other person for any incidental or consequential damages or loss of profit or product resulting from any malfunction or failure of this S&M product.

This warranty does not apply to equipment which has been subject to unauthorized repair, misuse, abuse, negligence, or accident. Equipment which, in our judgement, 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.

No liability is assumed for expenses or damages resulting from interruptions in operation of the product or damages to material in process.

S&M equipment is designed for maximum operator safety and incorporates built-in safety devices. Any modifications to these safety features will void the warranty. S&M assumes no responsibilities for consequential damages incurred due to modifications to the said equipment.

This warranty does not cover equipment used for applications requiring metal-to-metal contact with weld time in excess of 1 second.

Data supplied in the instruction manual has been verified and validated and is believed adequate for the intended use of the equipment. If the equipment or procedures are used for purposes other than those specified herein, confirmation of their validity and suitability should be obtained in writing from S&M.

Warning

Safety Precautions
Read Before Installing Or Using Equipment

This system has been designed to assure maximum operator safety. However, no design can completely protect against improper usage. For maximum safety and equipment protection, observe the following warnings at all times and read the instruction manual carefully before you attempt to operate the equipment.

- High voltage is present in the equipment. Disconnect the line cord plug before removing the cover or servicing.
- Make sure the equipment is properly grounded with a 3-prong plug. Before plugging in the equipment, test the electrical outlet for proper earth grounding.
- Ultrasonic welders operate above normal audibility for most people. Ear protection is recommended. Consult the Appendix for a list of manufacturers of ear protectors.

Important Service Literature

Please read carefully before operating the equipment, then forward to your service department.

The equipment 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.

Manual Change Information

We continually strive to keep up with the latest electronic developments by adding circuit and component improvements to our equipment as soon as they are developed and tested.

Sometimes, due to printing and shipping requirements, we cannot incorporate these changes immediately into printed manuals. Hence, your manual may contain new change information. Change information, if any, is located in the Appendix.

We reserve the right to make any changes in the design or construction of our equipment at any time, without incurring any obligation to make any change whatsoever in units previously delivered.

The technical data and schematics in the manual are for informational purposes only and may not reflect the current configuration being shipped from our factory. Upon formal request, complete and up to date information can be provided from the factory free of charge.

Table Of Contents

List Of Illustrations / Tables

Section I

DESCRIPTION

I-I. Introduction.

I-2. This instruction manual provides descriptive information and installation and programming instructions for the Model FD Controller/Power Supply (Figure I-I). This unit is a component of a Sonics & Materials ultrasonic assembly system. The Model FD consists of a number of versions with different output power capabilities. Unless otherwise stated, the information provided in this instruction manual applies to all versions.

I-3. Principles Of Ultrasonic Plastic Assembly.

I-4. In ultrasonic plastic assembly, high frequency (15,000 to 40,000 Hz) electrical energy is converted into high-frequency mechanical energy in the form of reciprocating vertical motion. When applied to a thermoplastic, the reciprocating vertical motion generates frictional heat at the plastic/plastic or plastic/metal interface. In ultrasonic welding, the plastic melts and flows throughout the joint area because of applied pressure; when the ultrasonic vertical motion stops, the molten plastic solidifies and a high-strength bond results In ultrasonic staking or Insertion, the controlled flow of molten plastic is used to capture or lock another material in place (staking) or encapsulate a metal insert (insertion).

Figure I-I
Model FD
Controller/ Power

Description

1-5. Ultrasonic Assembly System.

1-6. Sonics & Materials ultrasonic assembly systems typically consist of a controller/power supply, converter, booster, horn, pneumatic press, and holding fixture **(Figure 1-2)**.

a. **Controller / Power Supply.**
The controller/power supply, the subject of this instruction manual, is a solid-state assembly which converts standard 50-60 Hz electrical power into ultrasonic electrical power. It also functions as the main control point for programming and monitoring the operating parameters of the system. Internal timers automatically time assembly functions in accordance with operator-programmed data.

b. **Converter.**
The converter changes the ultrasonic electrical power supplied by the controller/power supply to high-frequency mechanical vibrations.

c. **Booster.**
Successful ultrasonic assembly often depends on having the proper amplitude of mechanical vibrations at the horn tip. Designing a horn with the necessary shape and gain (ratio of output amplitude to input amplitude) is often impossible. In such cases, a booster is installed between the converter and the horn to increase or decrease the output amplitude as required for the particular application.

d. **Horn.**
The horn is the system component that contacts the parts to be assembled. It transfers the ultrasonic vibrations developed by the converter to the parts being assembled and applies the necessary pressure to the parts while the molten thermoplastic material resolidifies.

e. **Pneumatic Press.**
The pneumatic press, sometimes referred to as the stand, provides compression force and mounting for the converter, booster, and horn assembly. It consists of a base assembly, column, and head.

f. **Holding Fixture.**
The holding fixture or nest assures proper alignment and support of the parts being assembled.

Description

1-7. Major Differences Between Controller / Power Supply Models.

1-8. The Model FD controller/power supply is available with output power ranging from 700 to 2,000 watts. An optional linear encoder is available, and will require the installation of a optical linear bar on the press. •

1-9. Specifications.

1-10. Pertinent specifications for the various models of the controller/power supply are listed in **Table 1-1**.

Table 1-1. Specifications

Output Power Rating	Input Power Requirement	Output Frequency	Dimensions
* 700 W	220 VAC, 10A	40k Hz	6.5" H x 17" W x 22.5" D (16.5 cm x 43.2 cm x 57.2 cm)
*1000 W	220 VAC, 10A	20k Hz	
1500 W	220 VAC, 15A	20k Hz	
2000 W	220 VAC, 15A	20k Hz	

*110 VAC optional.

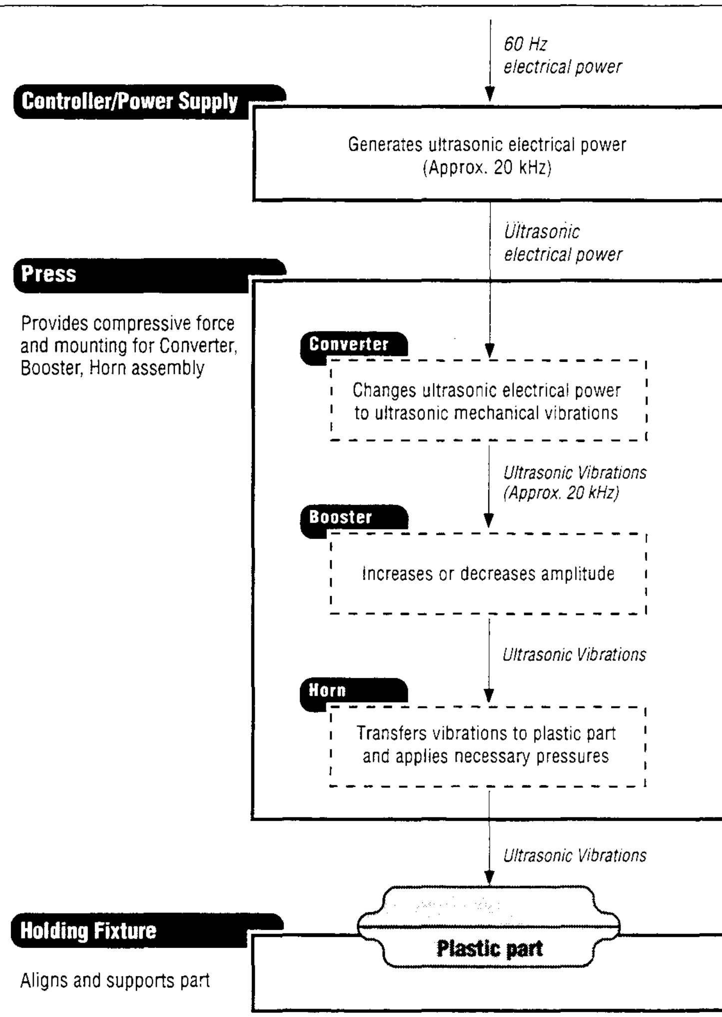


Figure 1-2. Ultrasonic Assembly System Block Diagram

Section II

INSTALLATION

2-1. Inspection.

2-2. After unpacking the controller/power supply, perform a thorough visual inspection for any evidence of damage that may have occurred during shipment. Check the packing material carefully for small items before disposing of the material.

2-3. Claims For Loss Or Damage.

2-4. The controller/power supply was thoroughly inspected and carefully packed before leaving the factory. Responsibility for its safe delivery was assumed by the carrier upon acceptance of the shipment. Claims for loss or damage in transit must be made to the carrier, as follows:

a. **Concealed Loss Or Damage.**
Concealed loss or damage is loss or damage that does not become apparent until the equipment has been unpacked. The contents might have been damaged in transit due to rough handling even though the shipping container may not show any external damage. When damage is discovered upon unpacking, make a written request for inspection by the carrier's agent within 48 hours of the delivery date. Then, file a claim with the carrier since the damage is the responsibility of the carrier. The form required to file such a claim will be supplied by the carrier. Do not destroy packing materials or move material from one location to another before the carrier makes his inspection.

b. **Visible Loss Or Damage.**
Any external evidence of loss or damage must be noted on the freight bill or express receipt and signed by the carrier's agent. Failure to adequately describe such external evidence of loss or damage may result in the carrier's refusal to honor a damage claim. The form required to file a claim will be supplied by the carrier.

2-5. If the controller/power supply is damaged, notify Sonics & Materials, Inc. We will arrange for repair or replacement of damaged equipment without waiting for the claim against the carrier to be settled, provided that a new purchase order is received to cover the repair or replacement costs. Should any damage, shortage, or discrepancy exist, please notify us immediately.

2-6. Electrical Power Requirements.

2-7. The controller/power supply requires a fused, single-phase, standard 3-terminal grounding type receptacle. Input voltage and current capability requirements for the various models are listed in **Table 1-1**.

Warning

The line cord of the controller/power supply is equipped with a 3-prong, grounding plug. Do not, under any circumstances, remove the ground prong. The plug must be plugged into a mating 3-prong, grounding type outlet.

2-8. Installation Site Requirements.

2-9. The controller / power supply is a free-standing assembly. It should be installed in a clear, uncluttered location that is free from excessive dirt, dust, corrosive fumes, and temperature and humidity extremes. Space requirements are listed in **Table 1-1**. The selected installation site should be near the electrical power source and away from equipment that generates abnormally high electrical transients. Observe the following additional instructions when installing the equipment:

a. Allow at least 6 inches (15 cm) at the rear of the controller/power supply for cable connections.

b. Position the controller/power supply so that the front panel controls are visible and readily accessible.

c. The controller/power supply is air cooled; allow sufficient space around the assembly to ensure adequate ventilation. If the controller/power supply must be housed in a confined space, forced air cooling may be necessary to keep surrounding air within acceptable ambient temperature limits.

d. Locate the controller/power supply within 30 feet (9 cm) of the pneumatic press.

2-10. Making Electrical Connections.

2-11. Make system electrical connections to the controller/power supply as follows:

Caution

When making electrical connections, be careful not to strain or kink the cables. When going around corners, make as wide a bend as possible. Do not run cables parallel to any power line that is within 1 foot (30 cm) of the cables. The interconnecting cables are supplied with the system. **(See Figures 2-1 through 2-4.)**

a. Connect the RF and base or actuating cables between the mating connectors at the rear of the controller/power supply and the pneumatic press.

b. If the remote overload reset capability is to be used, connect the remote overload cable between the mating connector at the rear of the controller/power supply and the remote overload reset station.

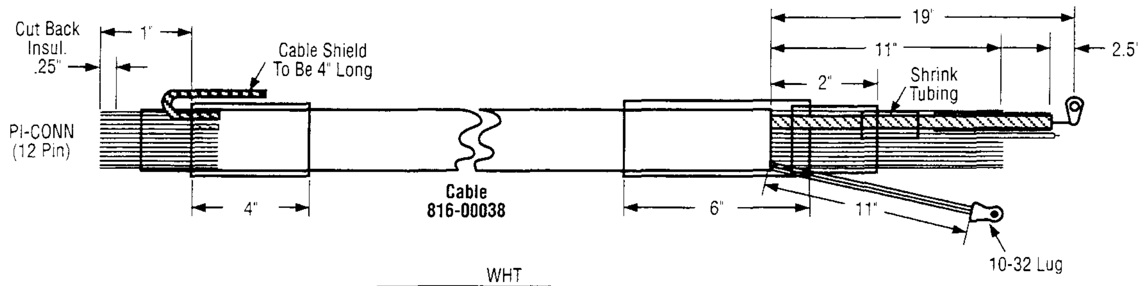
c. On units with a linear encoder installed, connect the linear encoder cable **(Figure 2-3)** between linear encoder connector J9 at the rear of the controller/power supply and the system linear encoder.

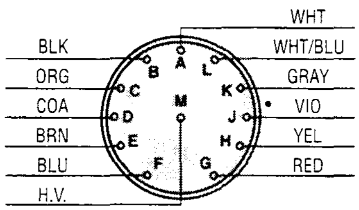
d. If the controller/power supply is equipped with the encoder window outputs option, connect the encoder window outputs cable **(Figure 2-4)** between J7 the mating connector at the rear of the controller/power supply and the external monitoring equipment.

e. If a controller such as a PLC device is used, connect a control cable **(Figure 2-5)** between J8 the mating connector at the rear of the controller/power supply and the external controller.

f. Ensure that the voltage rating of the electrical power source matches that of the controller/power supply. Plug the line cord of the controller/power supply into the electrical outlet. To prevent the possibility of electrical shock, ensure that the line cord is properly grounded.

Installation





Rear View

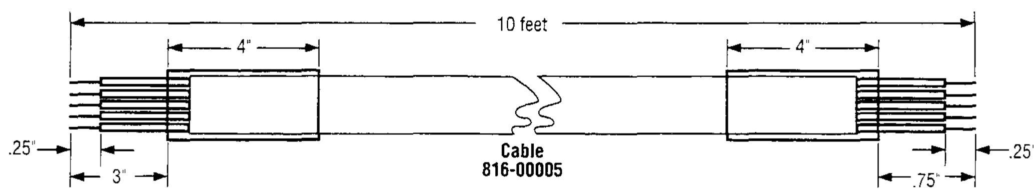
12 Pin Connection
MS-3106-E28-18P
821-00104

Pin	Wire	Description
A	White	24 V To Solenoid
B	Black	24 V Return
C	Orange	Pressure Switch (Normally Open)
D	Coax Shield	Converter (RF) Return
E	Brown	Sonic Stop Input
F	Blue	Pressure Switch (Common)
G	Red	Pressure Switch (Normally Closed)
H	Yellow	Head Down
J	Violet	Not Used In Model FD
K	Gray	Head Down
L	White / Blue	Not Used In Model FD
M	(HV) White	RF To Converter

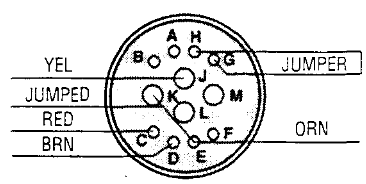
Figure 2-1.

RF Interconnecting Cable

Impulse Actuation Cable



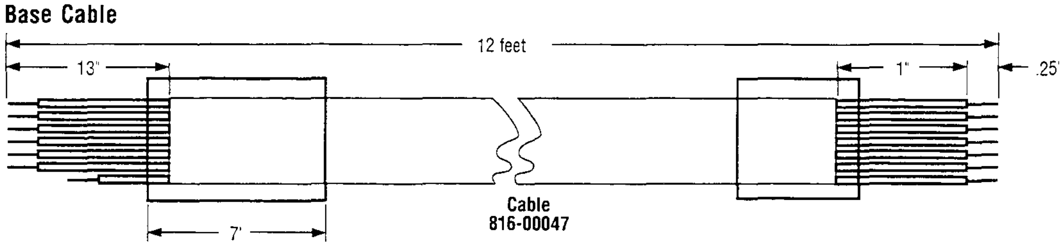
Pin	Wire	Description
A	No Connection	
B	No Connection	
C	Red	E-Stop
D	Brown	E-Stop
E	Orange	Impulse (Start)
F	No Connection	
G	Jump To H	
H	Jump To G	
J	Yellow	Impulse (Start)
K	Jump w/ Pin E, ORG	
L	No Connection	
M	No Connection	



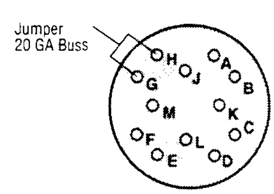
Rear View

Connector 821-00064
12 PIN Connector

Base Cable



Pin	Wire	Description
A	Black	Palm Button (Normally Open)
B	Greeen	Palm Button (Normally Closed)
C	Red	E-Stop
D	Brown	E-Stop
E	Yellow	24 V Return
F	Blue	24 V Return
G	Jump To H	
H	Jump To G	
J	No Connection	
K	White	Not Used In Model FD
L	No Connection	
M	Gray	Not Used In Model FD



Rear View

Connector 821-00064

Figure 2-2.

Actuating and Base Cables

Installation

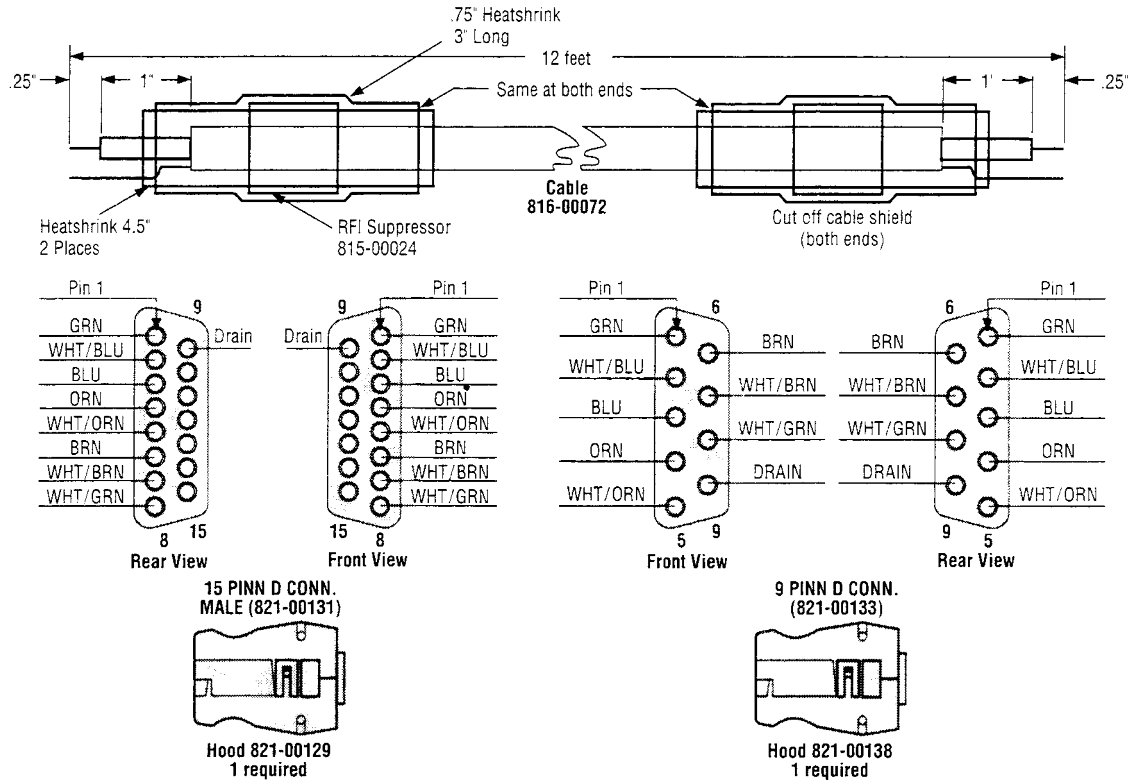


Figure 2-3.

Linear Encoder Cable

Assembly Notes For RFI Suppressor:

1. Do not apply heatshrink tubing over ferrite until epoxied and closing of connector.
2. Position ferrite 1" from back end of connector. Shrink large heatshrink over ferrite, be sure smaller heatshrink is not longer than larger heatshrink. If occurs, remove excess with razor blade.

Control Cable Functions

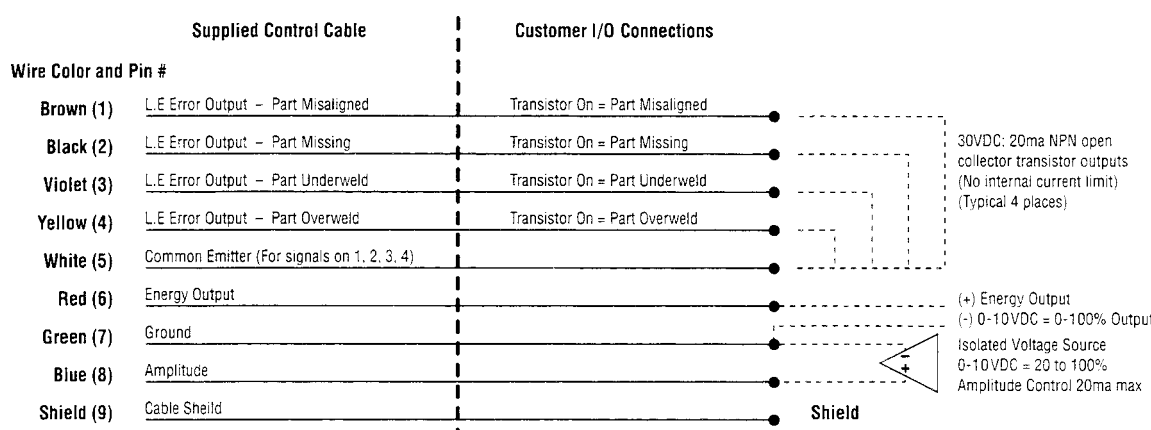


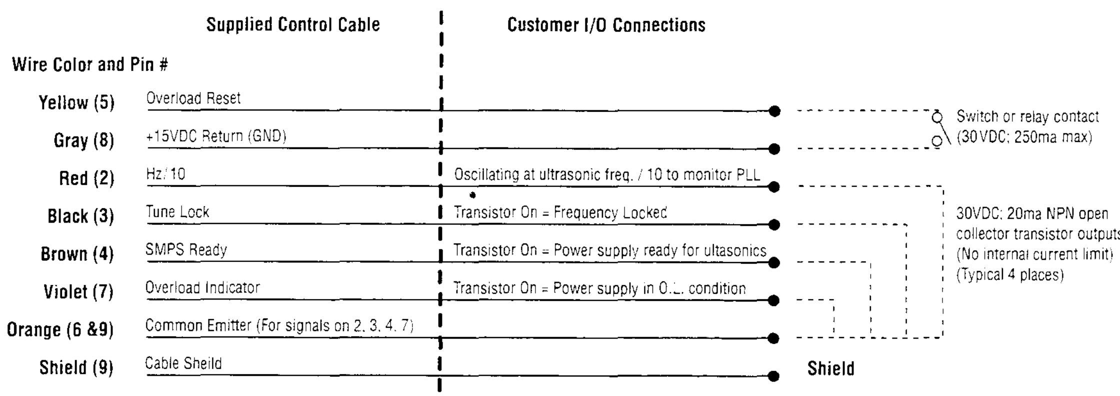
Figure 2-4.

Encoder Window Outputs Cable

Notes:

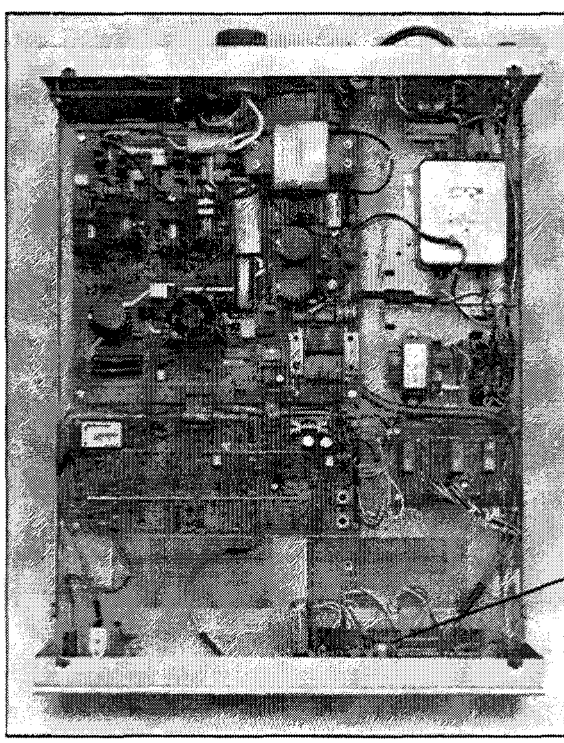
1. Models FM & FC use pin 6 and Models FD & FO use pin 9 for common emitter. These pins are jumpered together and use the orange wire.
2. Dotted line denotes customer connections.
3. Used with Model FD having linear encoder option.

Control Cable Functions



Notes:
1. Models FM & FC use pin 6 and Models FD & FO use pin 9 for common emitter. These pins are jumpered together and use the orange wire.
2. Dotted line denotes customer connections.

Figure 2-5.
I/O Control Cable



Linear Encoder Enable Switch S1

	On	Off
S1-4	Not used	
S1-3	LE Off	LE On
S1-2	Enter to Start	Auto On
S1-1	English	Metric

Figure 2-6.
DIP Switch Identification

2-12. Internal Switch Settings.

2-13. The controller/power supply contains four internal DIP switches **(Figure 2-6)**, which are set in accordance with ordering information prior to shipment. The switch functions are as follows:

Switch No.	On	Off
1	Metric	English
2	Non-enter	Enter
3	Linear Encoder Installed	No Linear Encoder Installed
4	Not used	

2-14. On model FD with an installed linear encoder only, DIP switch 1 allows for selection of either metric or English measurement units. If it is desired to change from the current measurement mode (metric or English) to the alternate mode, proceed as follows:

a. Using the ON/OFF switch, turn off the controller/power supply and disconnect the line cord from the electrical power source.

b. Remove the controller/power supply cover.

c. Set DIP switch 1 to the ON position for metric, or to the OFF position for English measurement units.

Caution

Changing measurement units will cause all previously stored values to be cleared. Reprogramming of the controller/power supply will be required.

f. Install the controller/power supply cover and plug the line cord into the electrical power outlet.

2-15. The model FD can operate with or without a linear encoder bar. When a linear encoder is not in use, the setup procedure is as follows:

Caution

Do not use a Model FD controller/ power supply with a non-encoder stand unless DIP switch 3 is properly set in accordance with the following instructions.

a. Using the ON/OFF switch, turn off the controller/power supply and disconnect the line cord from the electrical power source.

b. Remove the controller/power supply cover.

c. Set DIP switch 3 to the ON position if the controller/power supply is to be used with a non-encoder stand. Ensure that this switch is set to the OFF position if the controller/power supply is to be used with a stand equipped with a digital encoder.

d. Install the controller/power supply cover and plug the line cord into the electrical power outlet.

Section III Programming & Setup

3-1. Introduction.

3-2. This section contains instructions for setting the system parameters for the assembly operations to be performed. No special programming expertise is required.

3-3. Functions Of Controls, Indicators, And Connectors.

3-4. The controls, indicators, and connectors of the controller/power supply are shown in **Figures 3-1, and 3-2**. The functions of these items are as follows:

a. **LOADING Meter.**
This meter **(1, Figure 3-1)** is a bar type meter that is used to observe the controller/power supply operation.

b. **OUTPUT Control.**
OUTPUT control **(2, Figure 3-1)** allows the operator to make fine adjustment of the amplitude of the system high-frequency vibrations. (Major amplitude adjustments are made by selecting the proper system booster.)

c. **Numerical Keyboard.**
Numerical keyboard **(3, Figure 3-1)** allows the operator to enter numerical values for selected setup parameters. The keyboard may be locked out electronically (refer to paragraph 3-10) to prevent tampering or inadvertent changes in operating parameter values.

d. **LCD Display.**
LCD display **(4, Figure 3-1)** provides a visual alphanumeric display of selected functions and numerical values during system parameter setup or review.

e. **EXIT Key.**
EXIT key **(5, Figure 3-1)** allows the operator to exit from a selected function.

f. **TIMERS Key.**
TIMERS key **(6, Figure 3-1)** selects the timers function for parameter setup. The timer function utilizes three separate screens on LCD display **(4)**; cycling through the screens is accomplished by repeat pressing of the TIMERS key.

Note:

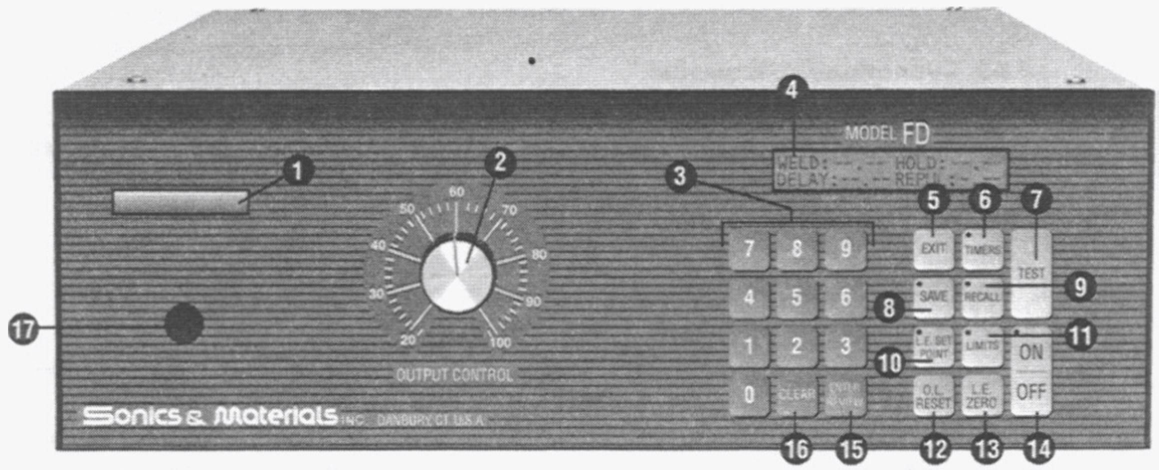
The TIMERS key and other function keys contain an LED. The LED lights when the corresponding function is active.

g. **TEST Key.**
TEST key **(7, Figure 3-1)**, when pressed, turns on the ultrasonics to allow matching of the controller/power supply.

h. **SAVE Key.**
SAVE key **(8, Figure 3-1)** enables the operator to store a complete setup for later recall, thereby eliminating the need for reprogramming. Up to nine complete setups can be stored.

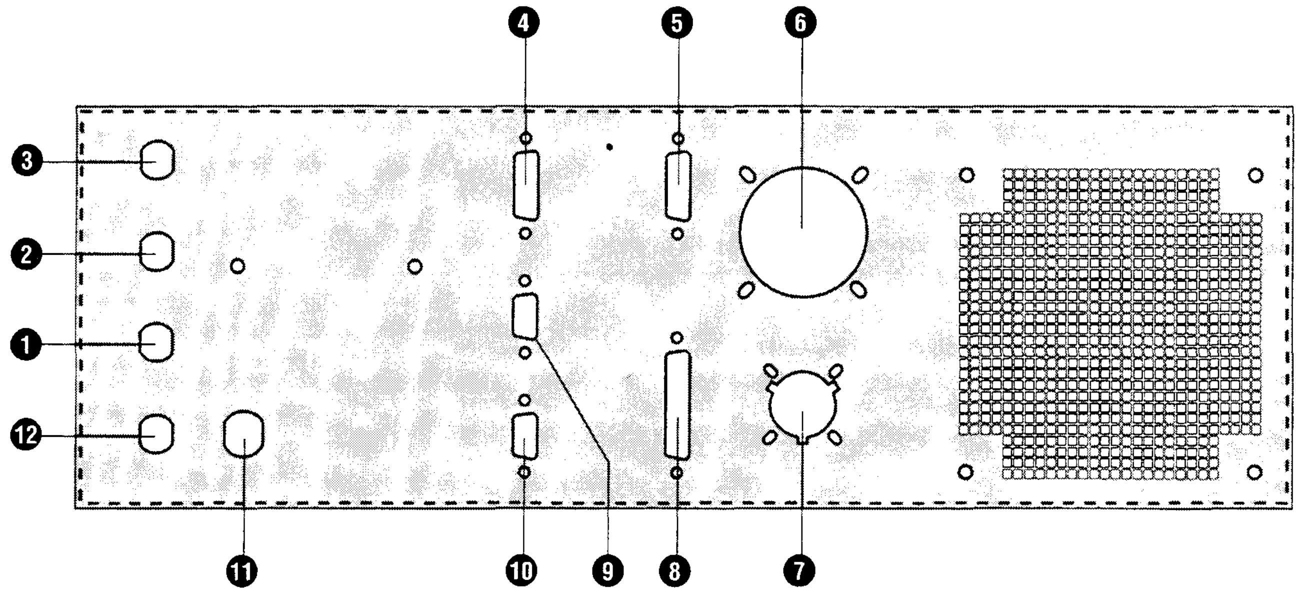
i. **RECALL Key.**
RECALL key **(9, Figure 3-1)** is used to recall stored system setups.

Programming and Setup



1. Load Meter
2. Output Control
3. Numerical Keys
4. LCD Display
5. Menu Exit Key
6. Timer Functions
7. Test (Activates Sonics)
8. Save (Job Storage)
9. Recall (Job Storage)
10. Increments or Absolute Set Points
11. Error Limits
12. Overload Reset
13. Linear Encoder Counter Reset
14. Power Switch
15. Enter / Review
16. Clear
17. Stack Match Control

Figure 3-l.
Model
Controller/Power
Supply, Front View



1. Fuse F2
2. Fuse F3
3. Fuse F4
4. Linear Encoder J9
5. *Not Used*
6. RF Interconnect J1
7. Base Cable or Impulse Actuation J2
8. *Not Used*
9. PLC Input/Output J8
10. Encoder Window Output J7
11. Power Input
12. *Not Used*

Figure 3-2. Controller/ Power Supply, Rear View

j. **L.E. SET POINT Key.**
L.E. SET POINT key **(10, Figure 3-1)**, with linear encoder bar option only, allows the operator to select the linear encoder set point function for entry of the desired absolute or incremental numerical value of weld depth.

k. **LIMITS Key.**
LIMITS key **(11, Figure 3-1)**, with linear encoder bar option only, allows the operator to select the limits function for entry of desired pre-weld and absolute or incremental post-weld limit values. Absolute pre-weld, absolute post-weld, and incremental post-weld display screens are accessed by repeated key actuation.

l. **O.L. RESET Key.**
O.L. RESET key **(12, Figure 3-1)**, when pressed, restores controller/power supply operation after an overload. Overload is indicated by blinking of the LED in the ON/OFF key and an "OVERLOAD!" indication on LCD display **(4)**.

m. **L.E. ZERO Key.**
L.E. ZERO key **(13, Figure 3-1)** is used with linear encoder bar option only. When pressed, it resets the linear encoder distance to zero with the head in the up position.

n. **ON/OFF Switch.**
ON/OFF switch **(14, Figure 3-1)** is an alternate action switch that turns the controller/power supply on and off. An LED in the switch lights when the controller/power supply is on.

o. **ENTER / REVIEW Key.**
ENTER/REVIEW key **(15, Figure 3-1)** is a dual function key. When any programming function is active, pressing this key accepts the numerical value indicated by a cursor on the LCD display **(4)** screen as the active value for that function, and advances the cursor to the next numerical entry parameter. When no programming function is active, this key is used to access informational screens on the LCD display to review active programmed values.

p. **CLEAR Key.**
CLEAR key **(16, Figure 3-1)** enables the operator to clear numerical values from the LCD display screens during data entry. It can also be used at power up to enable clearing of numerical values for all functions simultaneously.

q. **STACK MATCH control.**
The model FD is an automatic controller/power supply. The stack match control **(17, Figure 3-1)** enables the matching of the horn to the model FD. Remove the front panel plug and rotate the screw adjustment (while depressing TEST button 17) until the lowest value is obtained on the LOADING meter.

r. **Fuses.**
Fuses **(1, 2 & 3, Figure 3-2)** protect against electrical overloads in the controller/power supply circuits. Fuse ratings differ with the various models, as follows:

Output Power	Fuse Ratings		
	F2	F3	F4
700W, 1000W - 220 VAC	10A	10A	1/2A
700W - 120 VAC	15A	15A	1/2A
1000W - 120 VAC	20A	20A	1/2A
1500W, 2000W - 220 VAC	15A	15A	1/2A

s. **Linear Encoder Connector.**
Linear encoder connector **(4, Figure 3-2)**, is used only when linear bar encoder option is installed, is used to connect the controller/power supply to the system linear encoder.

t. **RF Connector.**
RF connector **(6, Figure 3-2)** is used to connect the ultrasonic electrical output of the controller/power supply to the welding system converter.

u. **Actuation Connector.**
Actuation connector **(7, Figure 3-2)** is used to connect the controller/power supply to the control switch in the pneumatic press or to a remote start device.

v. **PLC Connector.**
PLC connector **(9, Figure 3-2)** is used to connect the controller/power supply to an external PLC device.

w. **Error Output Connector.**
Error output connector **(10, Figure 3-2)** is used only when linear bar encoder option is installed. It is used to supply an output signal to an external monitoring device when the system head detects missing or misaligned parts during the assembly process, or when parts are poorly welded (over weld/ under weld).

x. **Line Cord.**
Line cord **(11, Figure 3-2)** connects the controller/power supply to the electrical power source.

3-5. Controller/Power Supply Turn On And Shutdown

3-6. To turn on the controller/power supply, press ON/OFF switch **(14, Figure 3-1)**. The LED in the switch will light and the message "Sonics & Materials Timer" will be displayed on LCD display **(4)**; when the linear bar option is enabled, the message "Sonics & Materials Digital Timer - English" or "Sonics & Materials Digital Timer - Metric", depending on the selected measurement mode, will be displayed. This message will be followed by the message "press ENTER to start welder". When ENTER/REVIEW key **(15)** is pressed, the LCD display will revert to the last informational screen that had been selected prior to the previous shutdown.

3-7. To shut down the controller/power supply, press the ON/OFF switch again. The LED in the switch will go off and LCD display **(4)** will go blank.

Note:

If the meter should deflect to full scale when the TEST key is pressed, release the TEST key. Nominal setups require less than 20% deflection of the meter when tested in air. Check for faults if full scale in air is observed. If an overload condition occurs, press O.L. RESET key **(13)** *to clear the overload condition.*

3-8. Review Of Active Setup Parameter Values.

3-9. A series of informational display screens (also reffered to as the ready screens) may be accessed for review of active setup parameter values. The display screens are informational only; no numerical values may be entered during the review process. The setup parameter review sequence is arranged in the form of a loop, and differs for models containing the linear encoder option. **(See Figure 3-3.)** The first LCD display that will appear in the sequence is the last informational screen viewed prior to the last shutdown or programming function selection. The selected screen is also displayed during the weld cycle to allow the operator to view specific data during a weld. The weld cycle can be started only from a ready screen, not from any editing screen. To review the active setup parameter values, proceed as follows:

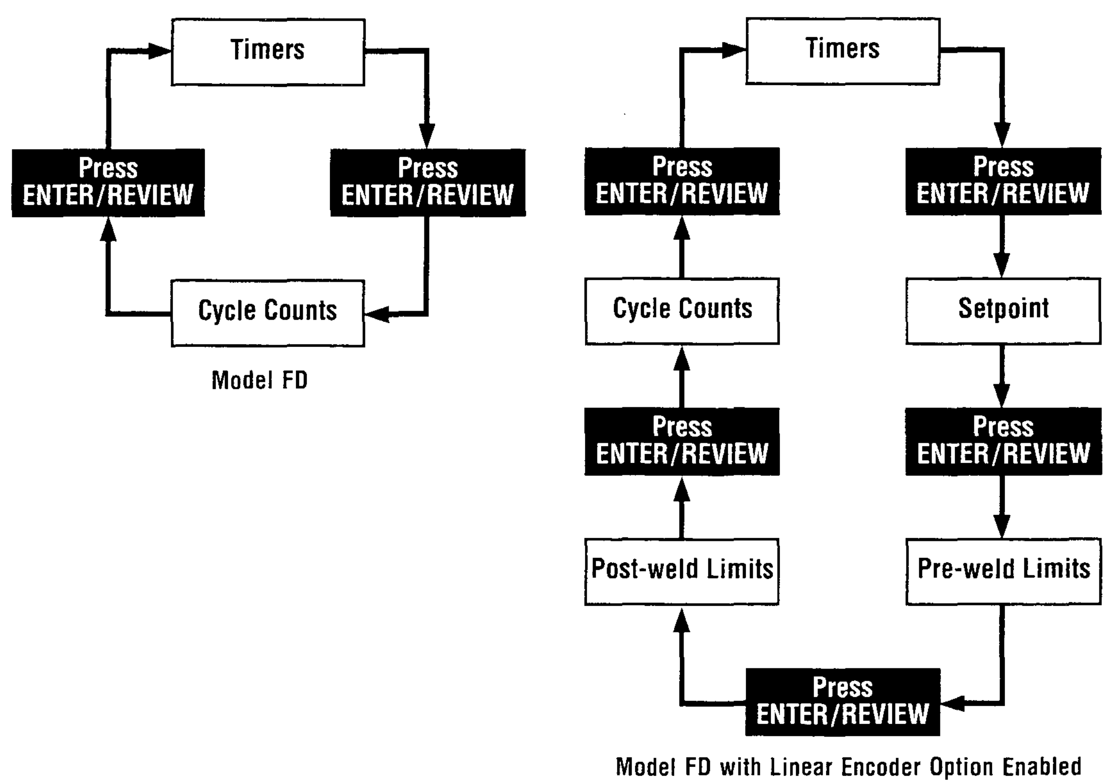


Figure 3-3. Informational Display Sequence Diagram

Note:

For purposes of the following discussion, it is assumed that the TIMERS function display appears on the LCD display initially.

a. Review the active weld time, hold time, delay time, and repulse time parameter values shown on the LCD display. To advance to the next informational screen on the model FD, proceed to step **e**; model FD with linear option enabled, perform all of the following steps in the given sequence.

b. On the model FD with linear option enabled, press ENTER/REVIEW key **(15)**. The LCD display screen will show the currently active absolute or incremental setpoint and distance values, depending on which mode (absolute or incremental) has been programmed.

c. On the model FD with linear option enabled, press ENTER/REVIEW key **(15)**. The LCD display screen will show the current pre-weld minimum, maximum, and distance values.

d. On the model FD with linear option enabled, press ENTER/REVIEW key **(15)**. The LCD display screen will show the current post-weld minimum, post-weld maximum, and maximum distance values.

e. Press ENTER/REVIEW key **(15)**. The LCD display screen will show the number of completed operating cycles performed since the current program count was initiated, and will cue the operator on how to reset the cycle counter to zero.

f. Press ENTER/REVIEW key **(15)**. The LCD display will return to the TIMERS display screen.

3-10. Keyboard Lock / Unlock.

3-11. The numerical keyboard of the controller/power supply can be locked electronically to prevent tampering or inadvertent disturbance of parameter settings. It must be unlocked for entry of new settings. To lock or unlock the numerical keyboard, proceed as follows:

a. Turn off the controller/power supply.

b. While pressing the 7 key on numerical keyboard **(3, Figure 3-1)**, turn the controller/power supply back on. LCD display **(4)** will show the current numerical keyboard status (i.e., "KEYBOARD: LOCKED" or "KEYBOARD: UNLOCKED").

c. To change the numerical keyboard status from locked to unlocked, or vice versa, key in 007 on numerical keyboard **(3)** and press ENTER/REVIEW key **(15)**. This must be done in less than 1 second. The LCD display will toggle from the current status to the opposite status.

3-12. Entering Parameter Values.

3-13. General Instructions. Unless otherwise directed via the LCD display, use the following general instructions to select system operating functions and enter desired numerical values:

a. Ensure that the numerical keyboard is unlocked.

b. Select the function to be programmed by pressing the corresponding function key. The LED in the key will light while the selected function is active.

c. The LCD display screen will show the current active value(s) for the selected function. If the screen shows two parameter values, a cursor will be positioned opposite the value that can be programmed.

d. If the displayed value marked by the cursor is not the desired value, the displayed value can either be erased or written over at the operator's discretion. Erasing the incorrect value may reduce confusion; overwriting may be faster. To erase an incorrect entry, press CLEAR key **(16, Figure 3-1)**. To enter the new value, use the numerical keyboard. If an error is made during data entry, press the CLEAR key and repeat the entry process. When the desired value is displayed, press ENTER/REVIEW key **(15)**. The cursor will move to the next parameter value on the LCD display screen. Use the same procedure to enter the desired value for the indicated parameter.

e. Some functions (i.e., TIMERS) employ a number of LCD display screens. In such cases, advancing to the next screen is accomplished by pressing the applicable function key again after all values on the currently displayed screen have been entered.

f. To exit from any function, press EXIT key **(5)**. The LCD display will revert to the last informational display (ready) screen shown before the programming function was selected.

Note:

The values to be entered during programming vary from application to application. If the application has been processed in our laboratory, consult our report for recommended parameter values. Otherwise, optimum parameter values must be determined by actual trial. Each variable should be studied independently by welding several groups of parts at a number of settings, while the other variables are held constant. The results of each weld operation should be observed, and the optimum setting for that variable recorded. Only one variable should be changed at a time. When optimum values for all variables have been determined, the settings may be stored in the controller/power supply memory for subsequent recall, or recorded for future use in identical applications.

To simplify the programming procedures in the following paragraphs, incorrect values will be erased, rather than overwritten. Keep in mind, however, that overwriting can be done, if preferred.

3-14. TIMERS Function.

a. General Information.
The TIMERS function is used to select time durations for specific assembly operations and to select the applicable horn pre-trigger state. A typical welding operation consists of four principal steps. First, the horn is lowered to contact the parts to be assembled and pressure is applied to the parts. **Delay time** is the time allotted for pressure to build up after the parts have been contacted and before the application of ultrasonic vibrations to the horn. After this delay period, ultrasonic vibrations are applied to the parts for the time period designated as the **weld time**. After the weld time period, pressure is maintained to ensure proper bonding of the parts; **hold time** is the length of time allotted for this step. The final step is an application of ultrasonic vibrations to the horn to ensure that the parts being assembled do not adhere to the horn; the time period for this step is the **repulse time**. When welding large pieces, it is sometimes necessary to pre-trigger the horn; the **pre-trigger** can be turned on and off using the TIMERS function.

b. TIMERS Programming Procedure.

(1) Select the TIMERS function by pressing TIMERS key **(6, Figure 3-1)**. The LED in the key will light, and LCD display **(4)** will show one of three windows.

(2) If the displayed screen is not the weld/hold time screen, press the TIMERS key as needed until this screen is displayed. The cursor on the screen will point to the weld time function.

(3) Note the displayed weld time. If the displayed time is the desired value, press ENTER/REVIEW key **(15)**. If it is not the desired weld time, press CLEAR key **(16)**; then, enter the desired weld time via numerical keyboard **(3)** and press the ENTER/REVIEW key. The cursor will move down to the next parameter on the screen when the ENTER/REVIEW key is pressed.

(4) Select the desired hold time using the same procedure as in preceding step **(2)**.

(5) Press TIMERS key **(6)** to advance to the next screen. The cursor will point to the first parameter on the screen, the delay time.

(6) Select the desired delay time using the same procedure as in step **(2)** above. The cursor will move down to the repulse time parameter.

(7) Select the desired repulse time using the same procedure as in step **(2)** above.

(8) Press TIMERS key **(6)** again to advance to the pre-trigger screen. This screen will show whether the pre-trigger is on or off. If it necessary to change the pre-trigger state, press ENTER/REVIEW key **(15)** so that the desired pre-trigger state is shown on the screen. (Pressing the ENTER/REVIEW key repeatedly toggles the pre-trigger state on and off.)

(9) Press EXIT key **(5)** to exit from the TIMERS function. The LED in TIMERS key **(6)** will go off.

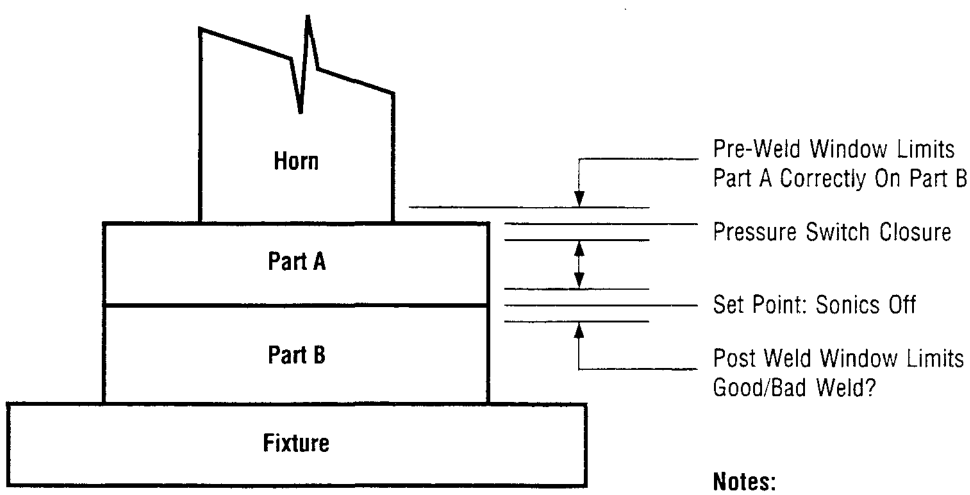
3-15. L.E. SET POINT Function. The L.E. SET POINT function, available when the linear encoder feature is enabled and a linear encoder bar is installed, is used to enter the desired digital encoder mode, absolute or incremental setpoint (one or the other, not both). In the incremental mode, the setpoint is the distance from the point where the system horn contacts the parts being assembled to the final travel limit of the horn. In the absolute mode, the setpoint value is the total travel distance of the horn. To enter the desired setpoint, proceed as follows:

a. Press L.E. SET POINT key **(10, Figure 3-1)**. The LED in this function key will light, and the LCD display screen will show absolute and incremental setpoint parameters, with the cursor opposite the absolute setpoint.

b. If the absolute mode is the desired operating mode and the displayed setpoint value is correct, press ENTER/ REVIEW key **(15)**. If the absolute mode is the desired operating mode and the displayed setpoint value is not the desired value, press CLEAR key **(16)**, enter the desired value via numerical keyboard **(3)**, and press the ENTER/ REVIEW key. If the absolute mode is not the desired operating mode, press the CLEAR key to clear the indicated absolute setpoint value and press the ENTER/REVIEW key. The cursor on the LCD display screen will move down to the incremental setpoint parameter when the ENTER/REVIEW key is pressed.

c. Use a procedure similar to that in preceding step b to select the incremental setpoint value.

d. Press EXIT key **(5)** to exit from the L.E. SET POINT function. The LCD display will revert to the last informational (ready) screen (ready) viewed prior to the L.E. SET POINT function selection.



Notes:
1. In absolute mode, all options are available but are not required for welding
2. In incremental mode, pre-weld window limits are not available due to the nature of the function. Pressure switch zeros linear encoder.

Figure 3-4.
Linear Encoder Limits

3-16. LIMITS Function. The LIMITS function, available only on units with the linear encoder function installed, is used for entry of pre-weld and post-weld minimum and maximum limits. **(See Figure 3-4).** To set these limits, proceed as follows:

a. Press LIMITS key **(11, Figure 3-1)**. The LED in the key will light and the LCD display screen will show the current absolute pre-weld minimum and maximum values, with the cursor opposite the minimum value.

b. If the displayed minimum value is not the desired minimum, press CLEAR key **(16)**. Then, enter the desired absolute pre-weld minimum value via numerical keyboard **(3)** and press ENTER/REVIEW key **(15)**. The cursor will move to the pre-weld maximum parameter.

c. Use a procedure similar to that in preceding **step b** to set the desired pre-weld maximum limit.

d. Press LIMITS key **(11)** again. The LED display will advance to the next screen, showing absolute post-weld minimum and maximum parameters.

e. If the absolute mode is to be used for the assembly process, set the absolute post-weld minimum and maximum values using procedures similar to those in steps **b** and **c** above. If the absolute mode is not to be used, clear any displayed minimum and maximum values using CLEAR **(16)** and ENTER/REVIEW **(15)** keys.

f. Press LIMITS key **(11)** again. The LED display will advance to the next screen, showing incremental post-weld minimum and maximum limits, with the cursor at the minimum parameter.

g. If the incremental mode is to be used for the assembly process, set the incremental post-weld minimum and maximum limits to the desired values using procedures similar to those in steps **b** and **c** above. If the incremental mode is not the desired operating mode, clear the displayed minimum and maximum values using the CLEAR and ENTER/REVIEW keys.

h. Press EXIT key **(5)** to exit from the LIMITS function.

3-17. L.E. ZERO Function. The L.E. ZERO function, available only on units with the linear encoder function installed, is used to reset the linear encoder. When L.E. ZERO key **(13, Figure 3-1)** is pressed, the linear encoder is zeroed if the system head is up, and the LED display screen shows the absolute setpoint value and a distance of 000.00mm or 0.000 in.; if the head is not in the up position, the LCD display will show the peak distance traveled since the linear encoder was zeroed.

3-18. Saving Controller / Power Supply Setups.

3-19. Once the correct operating values for all variables have been entered, the complete setup can be stored in the controller/power supply memory. This eliminates the need for complete reprogramming for the same assembly process at some later date. Up to 9 complete setups can be stored. The procedure is as follows:

a. Ensure that correct values have been entered for all variables.

b. Press SAVE key **(8, Figure 3-1)**. The LED in the key will light, and the LCD display screen will show the following:

FREE JOBS: 1 2 3 4 5 6 7 8 9
SAVE JOB #

The free jobs numbers indicate the available storage addresses; if a storage location is already in use, the number of that location will not appear in the free jobs display.

c. Select one of the free jobs numbers from the LCD display and enter that number via numerical keyboard **(3)**. The selected number will appear in the SAVE JOB # entry. Press ENTER/REVIEW key **(15)** to store the current setup in the selected location. The LCD display will revert to the last informational display (ready) screen viewed prior to the SAVE function selection.

Note:

Record the selected job number for the stored setup. It will be necessary to use that number when the stored setup is to be recalled.

3-20. Recalling Stored Setups.

3-21. To recall a complete setup from storage for use in a current assembly application, proceed as follows:

a. Determine the job number under which the desired setup has been stored.

b. Press RECALL key **(9, Figure 3-1)**. The LED in the key will light and the LCD display screen will show the following:

STORED JOBS: _ _ _ _ _ _ _ _ _
LOAD JOB #

The STORED JOBS entry will show all available stored jobs as numbers. If one of the stored jobs is to be recalled for use, proceed to step c; if it is to be deleted from storage, proceed to step d.

c. Select the desired job number and key in that number as the LOAD JOB # entry via numerical keyboard **(3)**. Then, press ENTER/REVIEW key **(15)**. The LCD display will revert to the last informational (ready) screen viewed prior to the RECALL function selection.

d. To delete a job from storage, select the desired job number and key in that number as the LOAD JOB # entry via numerical keyboard **(3)**. Then press the CLEAR key. The LCD display screen will show the message PRESS ENTER to delete job # _ _ _ _ _ _. If the displayed job number is the one to be deleted, press ENTER/REVIEW key **(15)**. The LCD display will revert to the last informational (ready) screen viewed prior to the RECALL function selection.

3-22. Clearing All Numerical Entries.

3-23. To eliminate time consuming individual clearing of numerical entries during programming, a simultaneous numerical value clearing feature is available. This feature can be used only with the numerical keyboard unlocked. To clear all numerical entries simultaneously, proceed as follows:

a. Using ON/OFF key **(14, Figure 3-1)**, turn off the controller/power supply.

b. Hold down CLEAR key **(16)** and turn the controller/power supply back on. The LED display will cue the operator to press the ENTER/REVIEW key to delete all settings.

c. Press ENTER/REVIEW key **(15)**.
All current numerical entries will be cleared.

3-24. Overload Reset.

3-25. The overload protection circuits of the controller/power supply will terminate the welding cycle when the system is operated under adverse conditions (i.e., incorrect tuning, excessive controller/power supply loading, loose or failed system components), thereby protecting the controller/power supply and other system components against damage. When an overload condition occurs, the LED in the ON/OFF key flashes and an "OVERLOAD!" message is displayed on the LCD display. To clear an overload condition, press O.L. RESET key **(12, Figure 3-1)**. Note, however, that the overload condition will recur until the problem has been corrected.

APPENDIX

Manufacturers Of Hearing Protectors

David Clark Company
P.O. Box 155
Worcester, MA 01613-0155

Direct Safety Company
Dept. 5
7815 S. 546th Street
Phoenix, AZ 85044

Flents Products Company, Inc.
14 Orchard Street
Norwalk, CT 06850

Industrial Safety and Security Company
1386 Newbrech Street
Lima, OH 45801

Jackson Products
5801 Safety Dr. N.E.
Belmont, MI 49306

Regis Industrial Supply Company
727 Eric Street at Ontario
Grafton, OH 44044

Safety Services, Inc.
5288 Wynn Rd.
Kalamazoo, MI 49005

Manufacturers Of Sound Absorbing Material

AirTex Industries, Inc.
3558 Second Street North & 36 Ave.
Minneapolis, MN 55412

American Acoustical Products
Division of Ward Process
9-T Cochituate Street
Natick, MA 01760

Cabot Corporation
E.A.R. Division
7911 Zionsville Road
Indianapolis, IN 46268

Delaware Valley Corporation
502 Broadway
Lawrence, MA 01841

Ferro Corporation
Composites Division
34 Smith Street
Norwalk, CT 06856

Hendrick Manufacturing Company
7th Avenue & Elidco Drive
Carbondale, PA 18407

Illbruck, Inc.
3810 Washington Avenue North
Minneapolis, MN 55412

Scott
Foam Division
1500 East Second Street
Chester, PA 19013

Specialty Composites Corporation
Delaware Industrial Park
650 Dawson Drive
Newark, DE 19713

The Soundcoat Company, Inc.
3002-T Croddy Way
Santa Ana, CA 92704

Please Note:
The information given on this page is supplied with the understanding that no product discrimination is intended and that no endorsement of a product by Sonics & Materials INC. is implied.

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Models 1595 Press / 1596 Actuator

INSTRUCTION MANUAL

SONICS

Sonics & Materials, Inc.

WARNING

WARNING

SAFETY PRECAUTIONS
READ BEFORE INSTALLING OR USING THE EQUIPMENT

This system has been designed to assure maximum operator safety. However, no design can completely protect against improper usage. For maximum safety and equipment protection, observe the following warnings at all times and read the instruction manual carefully before you attempt to operate the equipment.

– The equipment has safety devices that require both hands to be on the palm buttons until the horn contacts the work piece. Do not defeat or modify these safety devices.

– Do not use with foot switch unless alternate means of pinch-point protection is provided.

– High voltage is present in the equipment. Disconnect plug before removing cover or servicing.

– Make sure equipment is properly grounded with a 3-prong plug. Before plugging in equipment, test outlet for proper earth grounding.

– High voltage potential may be present in the converter as a result of temperature changes. Do not touch the converter contact unless you first short both pins or the button to the converter case with an insulated tool.

– Never squeeze or grab a vibrating horn.

– Do not modify horn configurations.

– Ultrasonic welders operate above normal audibility for most people. Ear protection is recommended. Consult the Appendix for a list of manufacturers of ear protectors.

– Do not affix any device to any portion of the horn.

Sonics & Materials, Inc.

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TABLE OF CONTENTS

IMPORTANT SERVICE LITERATURE

***NOTE:** Please read carefully before operating the equipment, then forward to your service department.*

The system 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.

MANUAL CHANGE INFORMATION

We continually strive to be at the forefront of the latest electronic developments by adding circuit and component improvements to our equipment as soon as they are developed and tested.

Sometimes, due to printing and shipping requirements, we cannot incorporate these changes immediately into printed manuals. Hence, your manual may contain new change information. Change information, if any, is located in the Appendix.

We reserve the right to make any changes in the design or construction of our equipment at any time, without incurring any obligation to make any change whatsoever in units previously delivered.

The technical data and schematics in the manual are for informational purposes only and may not reflect the current configuration being shipped from our factory. Upon formal request, complete and up-to-date information can be provided from the factory free of charge.

UNPACKING AND INSPECTION

NOTE: *We recommend keeping all carton(s) and packing material in case it might be necessary to move the equipment, or to ship it for repair.*

Before unpacking the equipment, check the shipping carton for any visible damage. If you see any, be sure to follow the procedures described below under “Visible Loss or Damage.” Otherwise, proceed to remove the equipment from the carton. Before disposing of any packing material, check it carefully for small parts. Then perform a visual inspection of the equipment to detect any evidence of damage which might have occurred during shipment. Check the following:

1. all components against the enclosed packing list,
2. all module plug-in units,
3. all wire plug-in connections.

The equipment was carefully packed and thoroughly inspected before leaving our factory. All units are tested and checked for problems prior to shipping. It is asked that when a problem does occur that all parts and components be inspected for damage (especially when the unit is not in working order when received). Responsibility for safe delivery was assumed by the carrier upon acceptance of the shipment. Claims for loss of damage sustained in transit must therefore be made upon the carrier, as follows:

VISIBLE LOSS OR DAMAGE

Any external evidence of loss or damage must be noted on the freight bill or express receipt, and signed by the carrier’s agent. Failure to adequately describe such external evidence of loss or damage may result in the carrier’s refusal to honor a damage claim. The form required to file such a claim will be supplied by the carrier.

CONCEALED LOSS OR DAMAGE

Concealed loss or damage means loss or damage which does not become apparent until the merchandise has been unpacked. The contents might have been damaged in transit due to rough handling even though the container may not show external damage. When the damage is discovered upon unpacking, make a written request for inspection by the carrier’s agent within 48 hours of the delivery date. Then file a claim with the carrier since such damage is the carrier’s responsibility. The form required to file such a claim will be supplied by the carrier. Do not destroy packing materials, or move material from one location to another before the carrier makes their inspection.

If the system or any unit is damaged, notify “Sonics.” “Sonics” will arrange for repair or replacement of damaged equipment without waiting for the claim against the carrier to be settled, provided a new purchase order is issued to cover the repair or replacement costs. Should any damage, shortage or discrepancy exist, please notify us immediately.

INTRODUCTION

The models 1595 and 1596 are 15 kHz pneumatic actuators used for ultrasonic plastics assembly. The 1595 is a tabletop version, whereas the 1596 can be mounted on a bridge or rigid structural member for use with automated systems. Both models are available in two power levers – 2500 & 4000 watts – and both can be used with the following power supplies:

- ET . . . . .Timer
- EO/M . . . . .Microprocessor
- EO/ML . . . . .Microprocessor/Linear Encoder

OVERVIEW OF ULTRASONIC PLASTICS ASSEMBLY

WHAT IS ULTRASONICS?

Ultrasonics refers to vibrational waves with a frequency above the human audible range which is usually above 18,000 cycles per second (Hz).

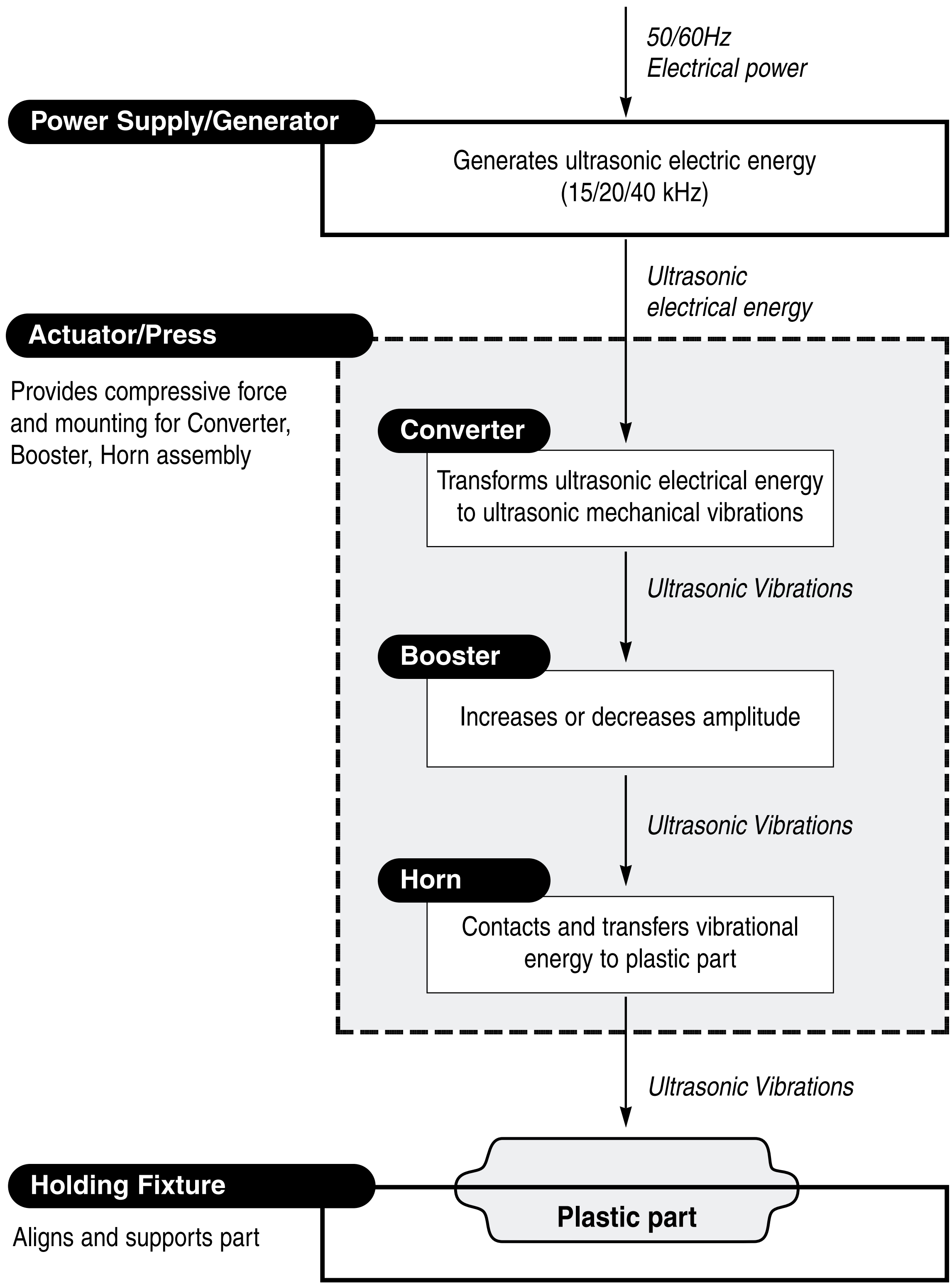
PRINCIPLE OF ULTRASONIC ASSEMBLY

The basic principle of ultrasonic assembly involves conversion of high frequency electrical energy to high frequency mechanical energy in the form of reciprocating vertical motion which, when applied to a thermoplastic, generates frictional heat at the plastic/plastic or plastic/metal interface. In ultrasonic welding, this frictional heat melts the plastic, allowing the two surfaces to fuse together; in ultrasonic staking or insertion, the controlled flow of molten plastic is used to capture or lock another material in place (staking) or encapsulate a metal insert (insertion).

ULTRASONIC ASSEMBLY SYSTEMS

“Sonics” ultrasonic assembly systems are generally composed of the following major elements: a power supply, converter, booster, horn, pneumatic press and holding fixture, as detailed in the diagram on the next page. A review of this diagram will help you understand the basic elements involved in the assembly process and their relation to each other.

"SONICS" ULTRASONIC ASSEMBLY SYSTEMS



GLOSSARY OF ULTRASONIC TERMS

POWER SUPPLY/GENERATOR – The solid state power supply converts standard 50/60 Hz electrical power to 15,000 Hz, 20,000 Hz, and 40,000 Hz (15/20/40 kHz) electrical energy.

ACTUATOR/PRESS – The pneumatic actuator provides compressive force and mounting for the converter, booster, and horn assembly. The tabletop press consists of a base assembly, column and actuator (head).

CONVERTER – The converter changes the high frequency electrical energy supplied by the power supply to high frequency mechanical vibrations.

BOOSTER – Successful ultrasonic welding often depends on having the right amplitude at the horn face. Often it is not possible to design a horn which has both the necessary shape and required gain (ratios of input amplitude to output amplitude). In such cases, a booster is placed between the converter and the horn to either increase or decrease the amplitude of the horn. In addition to changing/maintaining the amplitude, the booster provides support and alignment in the welding system. (See page 18 for booster selection.)

HORN – The horn is a tuned component of the system which comes in contact with the parts to be assembled. The horn 1) transfers the ultrasonic vibrations produced from the converter to the parts being welded, and 2) applies necessary force to the assembly while the material resolidifies.

HOLDING FIXTURE – The holding fixture or nest assures proper alignment and support of the parts being assembled.

1595

1596

INSTALLATION

ELECTRICAL POWER

The press is powered by the power supply. Consult your power supply instruction manual to determine power specifications.

AIR SUPPLY

The press requires a source of dry, filtered (5 micron), oil-free, compressed air capable of supplying a constant line pressure of 100 psig. (690 kPa / 7 bar) at a minimum capacity of 4 CFM (.1 cubic meters).

WARNING

Do not connect the press to an air source supplied by a compressor lubricated with synthetic oils or oils containing phosphate esters or chlorinated hydrocarbons. This type of lubricant may cause the air filter to malfunction, and the plastic bowl to rupture.

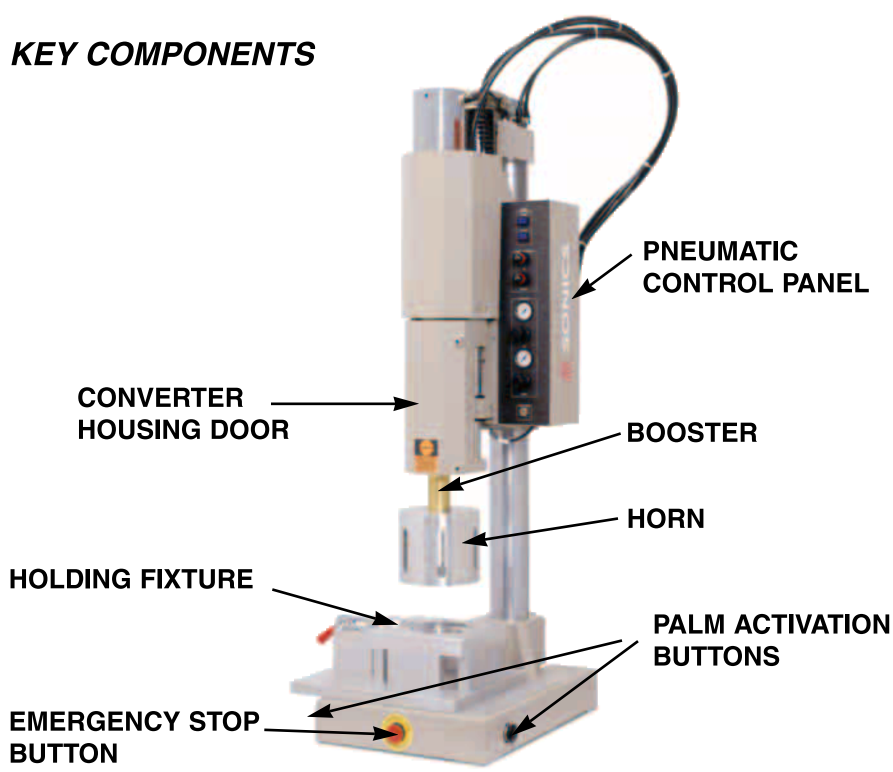
SETTING UP

The press should be installed in a clear, uncluttered location that is free from excessive dirt, dust, corrosive fumes, and temperature and humidity extremes. The selected installation site should be near the electrical power and air supply sources and away from any equipment that generates abnormally high electrical transients. Observe the following additional instructions when installing the press:

a. The press should be placed on a sturdy, level table or bench capable of supporting a minimum of 500 pounds (227 kg).

b. Allow at least 6 inches (152.4mm) at the rear of the press for cable connections.

KEY COMPONENTS



NOTE: *If the power supply is to be run continuously, air cooling of the converter and horn is required. Use clean, dry compressed air filtered down to 5 microns (supplied to converter fitting).*

NOTE: *Do not strain or kink the cables. When going around corners, allow as wide a bend as possible. Do not run the cables parallel to any power line within a distance of less than 1 foot (304.8mm).*

CONNECTIONS

When making the initial connections, make sure all power is disconnected.

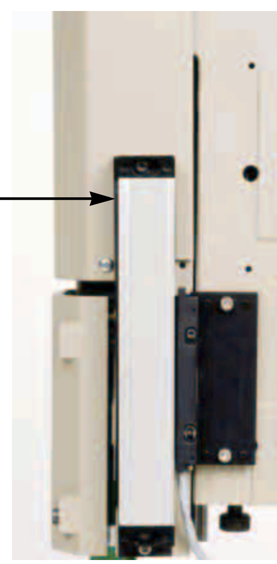
1. Connect the air supply source to the press air filter located at the bottom rear of the control panel, using a hose having a minimum inside diameter of 1/4 inch (6.4 mm).
2. Connect the RF and base (actuating) cables of the (table top only) press to the power supply. (Consult your power supply instruction manual for details.)
3. Check with your electrician if you have any wiring questions.

OPTIONS

A Linear Encoder is available as an option for the 1595 and 1596 models. The Linear Encoder allows distance-controlled welding in both incremental and absolute modes.

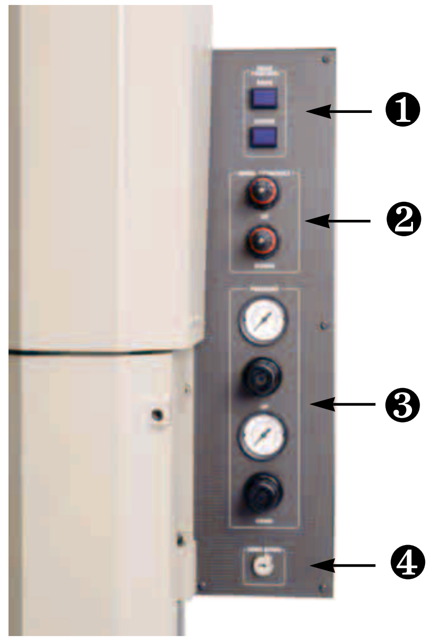
The Linear Encoder is supplied with a 9-pin male connector that connects to a matching 9-pin female connector on the power supply (factory installed).

LINEAR ENCODER



CONTROL PANEL

Located to the right of the converter housing is a control panel with the following features:



1. Blue **HEAD POSITION** buttons (labeled "RAISE" and "LOWER") which move the head up or down on the column when depressed.
2. Black and red **SPEED CONTROL** knobs which allow regulation of the speed at which the horn descends and returns (stroke speed).

   These controls are factory adjusted for average operating conditions. When minor adjustments are necessary, be sure to adjust in small degrees.

   The upper knob, labeled "UP," controls the return speed – turn it clockwise to slow the speed, counterclockwise to increase speed.

   The lower knob, labeled "DOWN," controls the extend speed – turn it clockwise to slow the speed, counterclockwise to increase the speed.
3. Black **PRESSURE REGULATORS** with corresponding gauges that allow regulation of the pressure with which the horn contacts the part and returns to the home position. Pull the knobs to make adjustments, and then push in to lock settings when desired pressure is displayed. Once pulled, turning the knobs clockwise increases pressure, and turning them counterclockwise decreases pressure.
4. The **HORN DOWN** key switch which when turned clockwise moves the converter housing to the extended position (this action does not cause ultrasonics to be activated).

INITIAL EQUIPMENT SETUP

WARNING

Never tighten the horn to the booster using the housing door as the upper wrench as this may cause damage to the booster and/or converter.

ASSEMBLING AND MOUNTING CONVERTER, BOOSTER, AND HORN

If the converter, booster, and horn are not already assembled, follow these instructions:

1. Clean the mating surfaces of the converter and booster, as well as the threaded stud and hole. Check that the stud is tight (see recommended torque requirements on page 13).
2. Hand assemble the converter and booster together. Using spanner wrenches as shown below, tighten to 50-55 inch-lbs. (5.7-6.2 newton-meters). **Do not force or overtighten.**

CONVERTER/BOOSTER

3. Clean the mating surfaces of the booster and horn, as well as the threaded stud and hole. Check that the stud is tight. (See recommended torque requirements on next page.)
4. Hand assemble the horn to the booster. Using spanner wrenches as shown below, tighten to 50-55 inch-lbs. (5.7-6.2 newton-meters). **Do not overtighten.**

CONVERTER/BOOSTER/HORN

5. Using the 3/16” (4.7 mm) T-handle wrench provided, loosen (turn counterclockwise) the two cap screws screws on the hinged converter housing and open the door.
6. Place the converter / booster / horn assembly in the housing with the horn facing down. Fit the male brass button connector on the top of converter into the brass grooved ridge connector in the bottom of the interior housing, and gently push the assembly up and in so that the booster mounting ring rests on the lower support ridge.

__NOTE:__ When performing any of the operations described on this page and pages 14 and 15, DO NOT turn on the power supply.

CONVERTER / BOOSTER / HORN ASSEMBLY

WARNING

Never tighten the horn to the booster using the housing door as the upper wrench as this may cause damage to the booster and/or converter.

7. Close the converter housing door and tighten (turn clockwise) the two socket head cap screws just until they are snug. Do not tighten the horn to the booster using the door as the upper wrench. Hand-forcing the horn on and off in this manner can twist the converter wires and cause a failure. If the horn is not in the correct position to make contact with your material, loosen the cap screws re-open the converter housing door, and re-position the converter / booster / horn assembly.

__NOTE:__ If you do not close the housing door once the assembly is in place, the assembly can fall out.

RECOMMENDED TORQUE REQUIREMENTS

Component	Inch-Lbs.	Newton-Meters
Converter / Booster	50 - 55	5.7 - 6.2
Booster / Horn	50 - 55	5.7 - 6.2
Stud	55	6.2

HORN AND FIXTURE ALIGNMENT

For maximum productivity, the clearance between the horn and the part should be at a minimum. However, adequate clearance should be provided to enable easy loading and unloading of the part from the holding fixture. The maximum stroke distance is 4" (optional 6" stroke available). Ensure that the head is not too close to the limit of its down travel distance. Otherwise, the horn may not have sufficient distance to travel downwards to achieve a full depth of weld. Set welding height as described below:

1. Position the holding fixture loosely on the base plate using 3/8-16 screws.
2. Place the part to be welded in the fixture.
3. Set the air pressure to zero by turning the UP PRESSURE regulator knob fully counterclockwise.
4. To get the head into the position desired, use one or both of the methods described below to make adjustments as needed:
   a. Loosen the two column clamps (counterclockwise) and use the HEAD POSITION buttons to move the head up or down.The head can also be manually rotated slightly (from side to side).Once the head is in the desired position, tighten the column clamps.
   b. With the column clamps locked (tightened) in place, the HORN DOWN Key switch (which activates the air cylinder) can be used to advance the horn.
5. Loosen the cap screws on the converter housing door and gently rotate the converter/booster/horn assembly as required to ensure proper horn-to-part alignment.

WARNING

When the air pressure is decreased, the converter housing can drop down to its limit, so be sure to either support it or remove anything in its path.

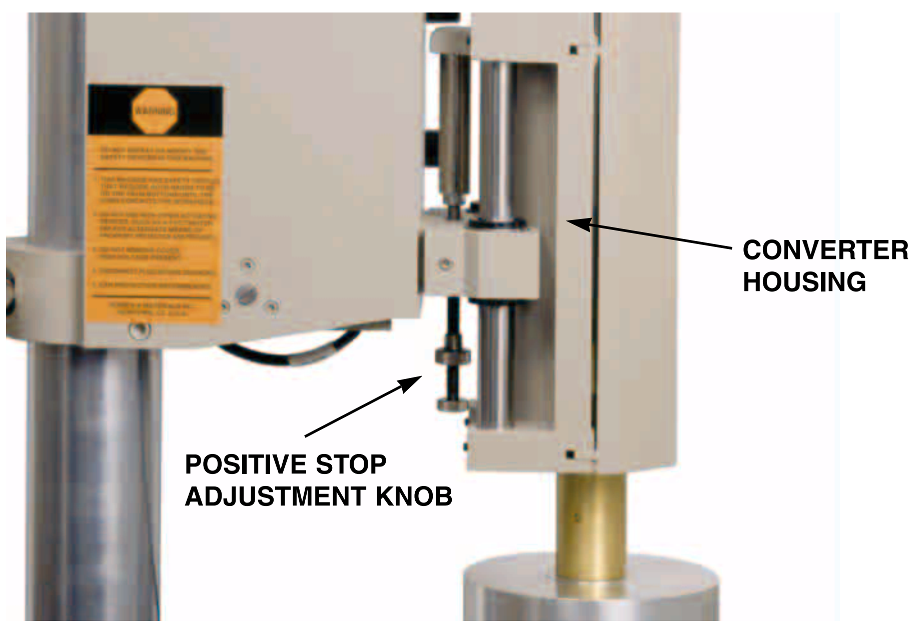
6. Tighten the converter housing door screws, and then tighten the fixture on the base plate.
7. Check for proper mating of fixture, parts, and horn. If the horn and parts are not in parallel contact, shim the fixture or adjust leveling screws as required. Adjust the positive stop knob for proper weld depth (see below).
8. Set the UP PRESSURE regulator to a reading of 20 psig (140 kPa/1.4 bar) on the pressure gauge. (Turn the PRESSURE knob clockwise.) This 20 psig reading is the initial pressure and may later change according to application requirements.

   The UP PRESSURE, used to raise the horn, should be regulated according to the size of the horn you are using. The larger the horn, the more UP PRESSURE required.

NOTE: *For maximum safety and productivity, adjust the clearance between the horn and the part to a minimum that will still allow ease of loading and unloading.*

POSITIVE STOP ADJUSTMENT

The positive stop is set to limit the downward travel of the horn to approximately 75%. Readjustments may be required. Coarse adjustment of the clearance between the face of the horn and part should be made using the elevation control. Fine adjustment should be made using the positive stop. The positive stop can adjust vertical positioning with a 4" stroke (or optional 6" stroke).



The positive stop adjustment knob is located behind the converter housing. Turning the knob clockwise will decrease downward travel distance. Turning the knob counterclockwise will increase the downward travel distance. When making any adjustments be aware of the necessary clearances required.

WARNING

The equipment has safety devices that require both hands to be on the palm buttons until the horn contacts the workpiece. ***Do not defeat or modify these safety devices.***

ACTUATION

The 1595 press is equipped with two maintained anti-repeat (non-tie-down) palm buttons, one located on the left and one on the right side of the base of the press. Both palm buttons must be pressed simultaneously to activate the press to cycle the welder. To operate the press, follow these simple steps:

1. Make sure the column clamps are locked.
2. Depress both black palm buttons simultaneously.
3. Once the horn comes in contact with the part and the ultrasonics are activated, release the palm buttons. If you release the buttons before contact is made, the head will immediately return to its “home” position.

The operation of the 1596 actuator is controlled by the automated system. A four-wire actuation cable is provided which ties into the output side of a PLC, or other system controlling device. Momentary two wire closure from a dry source will initiate the welder’s cycle. For more information, refer to the power supply manual and the included wiring diagrams.

NOTE: *Power supply cannot be shut off once the weld cycle has started. Termination of cycle can only be achieved by using the EMERGENCY STOP button.*

EMERGENCY STOP

To abort the 1595 press during welding, simply press the red EMERGENCY STOP button located at the front center of the press base.

Once the EMERGENCY STOP button has been depressed, the head will retract and return to its “home” position, remaining there until the button is released. Simply rotate the EMERGENCY STOP button to the right 1/4 turn to release the press for further operation.

For the 1596 actuator, a four-wire actuation cable contains two normally closed wires which control the emergency stop function. For more information, refer to the power supply manual and the included wiring diagrams.

WARNING

Do not use with a footswitch unless alternate means of pinch-point protection is provided.

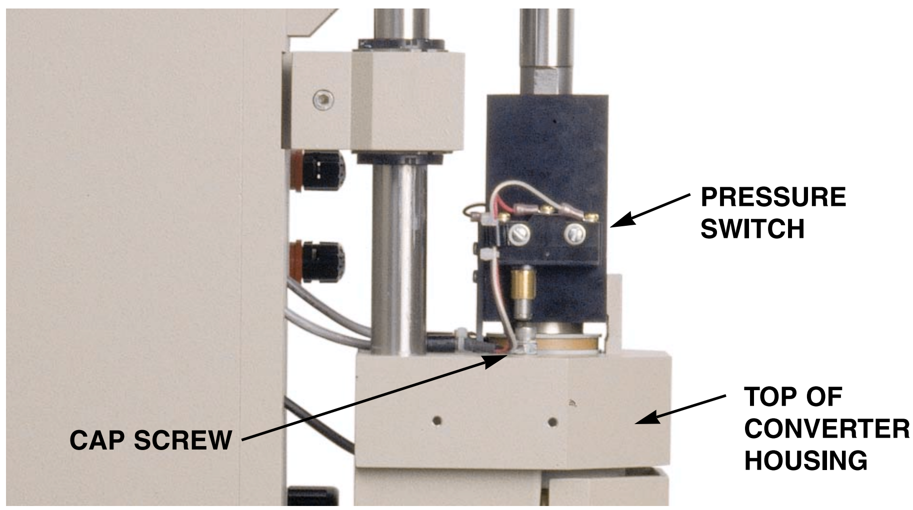
FINE ADJUSTMENTS

PRESSURE SWITCH ADJUSTMENT

For systems mounted in the normal vertical position with downward travel, no adjustment should be necessary. The minimum trigger pressure is factory set to approximately 10-12 psig (69 kPa/.7 bar - 83 kPa/.8 bar).

However, if the minimum trigger pressure requires recalibration or re-adjustment, observe the following procedure:

1. Maintain air pressure and unplug the power supply from the electrical source.
2. Remove the four screws holding the five-sided cover.
3. Loosen the jam nut holding the 8-32 cap screw in place.
4. Rotate the cap screw counter-clockwise (up) until the Pressure Switch closes.



5. Next rotate the cap screw clockwise (down) until the Pressure Switch opens.
6. Rotate cap screw clockwise (down) 1/4 turn past the Pressure Switch open position.
7. Tighten the jam nut to lock cap screw in position.
8. Replace the cover and four screws.
9. Plug the power supply into the electrical source.
10. Cycle the welder.

A press actuating in an upward direction should be set to trigger at a minimum of 14-16 psig (a value which is nominally factory set only if “Sonics” is notified prior to purchase that the press will be used for vertical welding). Lower values may affect trigger performance where false triggering may be observed.

UPPER LIMIT SWITCH

The optional Upper Limit Switch may be used as a safety interlock in automation to prevent the movement of material handling equipment (indexing) when the horn is down. It also may be used to initiate the movement of material handling equipment when the horn is up. The Upper Limit Switch is located opposite the Pressure Switch.

The Upper Limit Switch is factory set and should be suitable for all applications.

BOOSTER SELECTION

NOTE: *Consult the Applications Manual or call our Applications Lab for proper booster selection.*

The first step in optimizing welding conditions is to select a booster which will provide the necessary amplitude. For parts 2" (50.8mm) in diameter or greater, start with a moderate amplitude booster such as a green. Determine optimum amplitude by welding a few parts, and repeat the procedure with boosters giving higher or lower amplitude. If there appears to be little or no difference, use the booster giving the highest amplitude.

Six standard boosters, color coded or engraved for ease of identification, are available either to increase or decrease the amplitude.

WARNING

High gain boosters, such as silver and black in combination with high gain horns can result in the horn cracking or failing. See note above.

BOOSTERS

Color	Part No.	Gain	Amplitude Effect
Black	BHN16TBK	2.50	Increase
Silver	BHN16TSI	2.00	Increase
Gold	BHN16GD	1.50	Increase
Brown	BHN16BR	1.25	Increase
Green	BHN16GR	0	No Change
Purple	BHN23PU	0.75	Decrease

PRESSURE

During the welding process, sufficient pressure should be applied to the part so that the mating surfaces contact each other. If the pressure is too low, the process will run inefficiently causing unnecessarily long weld time cycles, marking of the parts or poor welding. If the pressure is too high, the horn may stop vibrating, the part(s) might fracture, or the power supply might overload.

Refer to the Applications manual for additional information on pressure settings. In general, a starting setting of between 25-30 psig (172 kPa/1.7 - 207 kPa/2 bar) can be used as a guideline, but you will need to adjust the air pressure to a desired setting based upon the application results.

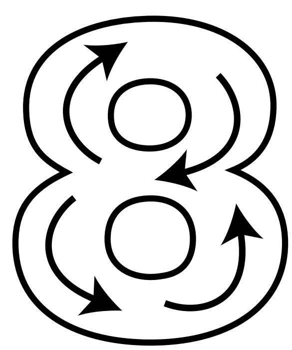
RE-ESTABLISHING PROPER BOOSTER / HORN INTERFACES

NOTE: *Contact between the booster and horn should be parallel. When encountering symptoms such as loud noises or tuning difficulties, examine the booster / horn interfaces for parallelism, corrosion, galling or foreign deposits. Also check the tightness of the stud.*

To re-establish proper interfaces, follow these instructions:

1. Using open-ended wrenches, separate the booster from the horn. Clean each item and then examine interfaces for irregularities (scoring).
2. If irregularities are present, remove the stud.
3. Tape a sheet of 400 grit emery cloth to a smooth, flat surface. (Do not use coarser than 400 grit.)
4. Grasp the lower portion of the booster or horn and move it across the emery cloth. To ensure proper lapping, a) hold the part straight, b) apply light downward pressure, and c) move in one direction only in a figure 8 pattern.

   Repeat the figure 8 pattern once more.



WARNING

DO NOT use anything coarser than 400 grit emery cloth.

NOTE: *Machining of booster / horn may alter the ability to tune the component to the system. System inoperation may occur.*

5. Then, rotate the booster or horn 1/3 of a turn in a clockwise direction and then repeat step 4.
6. Repeat step 5.
7. Using wire brush, clean stud, then replace securely. Tighten new stud to the recommended torque specifications on page 13.

MAINTENANCE

***NOTE:** If packing unit for return shipment, DO NOT use styrofoam "peanuts."*

REPAIRS / SERVICE

If problems are encountered, contact our Service Department as follows:

Phone: 1-800-745-1105 • 1-203-270-4600

Fax: 1-203-270-4610

E-Mail: service@sonicsandmaterials.com

It is suggested that a system in need of repair be sent back to the factory, with a written description pertaining to the nature of the problem.

Always contact the factory for return authorization before shipping any instrument. Include date of purchase, model number, and serial number. For units not covered by the warranty, a purchase order should be forwarded to avoid unnecessary delay. Care should be exercised to provide adequate packing to insure against possible damage in shipment. The system should be sent with all transportation charges prepaid and return method of shipment indicated.

WARRANTY

Sonics & Materials, Inc., hereinafter referred to as "Sonics," warrants its products for a period of one year from the date of shipment against defect in material and workmanship under normal installation, use, and maintenance as described in the operating instructions which accompany such equipment. During the warranty period, "Sonics" will, at its option, as the exclusive remedy, either repair or replace without charge for material and labor, the part(s) which prove upon our examination to be defective, provided the defective unit is returned to us properly packed with all transportation charges prepaid.

Ultrasonic welding horns constructed of titanium or aluminum are guaranteed against defects for a period of one year from date of shipment. "Sonics" will repair or replace a cracked or defective horn once without charge, if failure occurs within the warranty period.

Ultrasonic welding horns constructed of steel are guaranteed against defects for a period of ninety days from date of shipment. "Sonics" will repair or replace a cracked or defective steel horn once at a charge of 50% of the original purchase price, if failure occurs within the warranty period.

LIMITATION OF WARRANTY

This warranty is in lieu of any other warranties, either express, implied, or statutory. "Sonics" neither assumes nor authorizes any person to assume for it any other obligation or liability in connection with the sale of its products. "Sonics" hereby disclaims any warranty or 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 "Sonics" be liable to the purchaser or to any other person for any incidental or consequential damages or loss of profit or product resulting from any malfunction or failure of this "Sonics" product.

This warranty does not apply to equipment which has been subject to unauthorized repair, misuse, abuse, negligence or accident. Equipment which, in our judgment, 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.

No liability is assumed for expenses or damages resulting from interruptions in operation of the product or damages to material in process.

"Sonics" equipment is designed for maximum operator safety and incorporates built-in safety devices. Any modifications to these safety features will void the warranty. "Sonics" assumes no responsibilities for consequential damages incurred due to modifications to the said equipment.

"Sonics" reserves the right not to warrant horns of unusual or experimental design which in our judgment are more likely to fail in use.

This warranty does not cover equipment used for applications requiring metal-to-metal contact with weld time in excess of 1 second.

Data supplied in the instruction manual has been verified and validated and is believed adequate for the intended use of the equipment. If the equipment or procedures are used for purposes other than those specified herein, confirmation of their validity and suitability should be obtained in writing from "Sonics."

SONICS

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Models 4095 Press / 4096 Actuator

INSTRUCTION MANUAL

SONICS

Sonics & Materials, Inc.

WARNING

WARNING

SAFETY PRECAUTIONS
READ BEFORE INSTALLING OR USING THE EQUIPMENT

Our systems have been designed to assure maximum operator safety. However, no design can completely protect against improper usage. For maximum safety and equipment protection, observe the following warnings at all times and read all applicable instruction manuals carefully before you attempt to operate any equipment.

– The equipment has safety devices that require both hands to be on the palm buttons until the horn contacts the work piece. Do not defeat or modify these safety devices.

– Do not use with foot switch unless alternate means of pinch-point protection is provided.

– High voltage is present in the equipment. Disconnect plug before removing cover or servicing.

– Make sure equipment is properly grounded with a 3-prong plug. Before plugging in equipment, test outlet for proper earth grounding.

– High voltage potential may be present in the converter as a result of temperature changes. Do not touch the converter contact unless you first short both pins or the button to the converter case with an insulated tool.

– Never squeeze or grab a vibrating horn.

– Do not modify horn configurations.

– Ultrasonic welders operate above normal audibility for most people. Ear protection is recommended. Consult the Appendix for a list of manufacturers of ear protectors.

– Do not affix any device to any portion of the horn.

Sonics & Materials, Inc.

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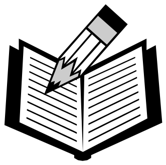
TABLE OF CONTENTS

IMPORTANT SERVICE LITERATURE



***NOTE:** Please read carefully before operating the equipment, then forward to your service department.*

The system 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.

MANUAL CHANGE INFORMATION

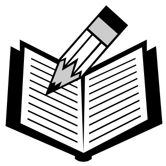
We continually strive to be at the forefront of the latest electronic developments by adding circuit and component improvements to our equipment as soon as they are developed and tested.

Sometimes, due to printing and shipping requirements, we cannot incorporate these changes immediately into printed manuals. Hence, your manual may contain new change information. Change information, if any, is located in the Appendix.

We reserve the right to make any changes in the design or construction of our equipment at any time, without incurring any obligation to make any change whatsoever in units previously delivered.

The technical data and schematics in the manual are for informational purposes only and may not reflect the current configuration being shipped from our factory. Upon formal request, complete and up-to-date information can be provided from the factory free of charge.

UNPACKING AND INSPECTION



NOTE: *We recommend keeping all carton(s) and packing material in case it might be necessary to move the equipment, or to ship it for repair.*

Before unpacking the equipment, check the shipping carton for any visible damage. If you see any, be sure to follow the procedures described below under “Visible Loss or Damage.” Otherwise, proceed to remove the equipment from the carton. Before disposing of any packing material, check it carefully for small parts. Then perform a visual inspection of the equipment to detect any evidence of damage which might have occurred during shipment. Check the following:

1. all components against the enclosed packing list,
2. all module plug-in units,
3. all wire plug-in connections.

The equipment was carefully packed and thoroughly inspected before leaving our factory. All units are tested and checked for problems prior to shipping. It is asked that when a problem does occur that all parts and components be inspected for damage (especially when the unit is not in working order when received). Responsibility for safe delivery was assumed by the carrier upon acceptance of the shipment. Claims for loss of damage sustained in transit must therefore be made upon the carrier, as follows:

VISIBLE LOSS OR DAMAGE

Any external evidence of loss or damage must be noted on the freight bill or express receipt, and signed by the carrier’s agent. Failure to adequately describe such external evidence of loss or damage may result in the carrier’s refusal to honor a damage claim. The form required to file such a claim will be supplied by the carrier.

CONCEALED LOSS OR DAMAGE

Concealed loss or damage means loss or damage which does not become apparent until the merchandise has been unpacked. The contents might have been damaged in transit due to rough handling even though the container may not show external damage. When the damage is discovered upon unpacking, make a written request for inspection by the carrier’s agent within 48 hours of the delivery date. Then file a claim with the carrier since such damage is the carrier’s responsibility. The form required to file such a claim will be supplied by the carrier. Do not destroy packing materials, or move material from one location to another before the carrier makes their inspection.

If the system or any unit is damaged, notify “Sonics.” “Sonics” will arrange for repair or replacement of damaged equipment without waiting for the claim against the carrier to be settled, provided a new purchase order is issued to cover the repair or replacement costs. Should any damage, shortage or discrepancy exist, please notify us immediately.

INTRODUCTION

The models 4095 and 4096 are 40 kHz precision pneumatic actuators used for ultrasonic plastics assembly. The 4095 is a tabletop version, whereas the 4096 can be mounted on a bridge or rigid structural member for use with automated systems. Either can be supplied with the following power supplies:

- FC 740 . . . . .Continuous duty
- FD 740 . . . . .Digital timer
- FM 740 . . . . .Microprocessor
- FO 740ML . . . . .Microprocessor/Linear Encoder

OVERVIEW OF ULTRASONIC PLASTICS ASSEMBLY

WHAT IS ULTRASONICS?

Ultrasonics refers to vibrational waves with a frequency above the human audible range which is usually above 18,000 cycles per second (Hz).

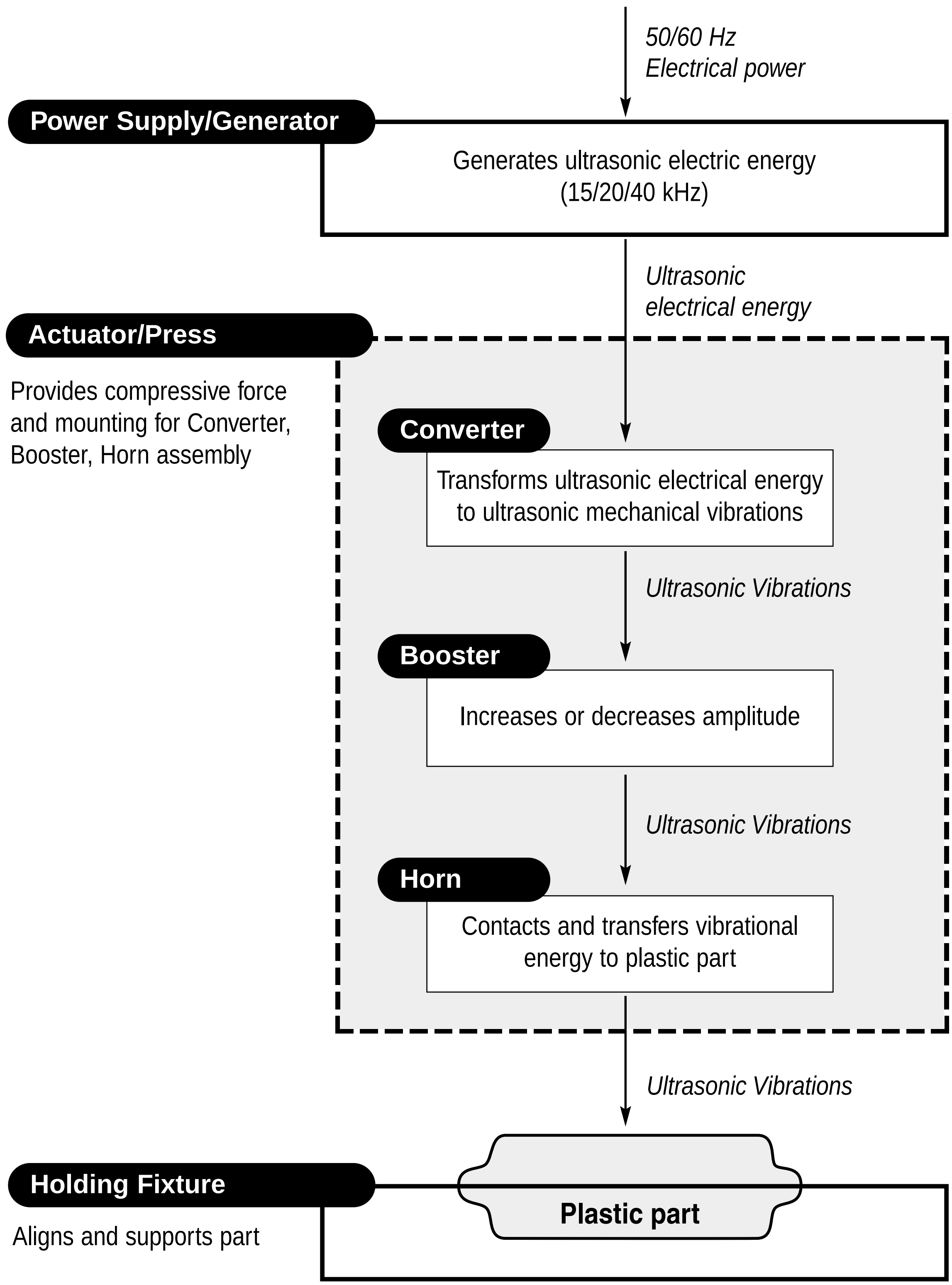
PRINCIPLE OF ULTRASONIC ASSEMBLY

The basic principle of ultrasonic assembly involves conversion of high frequency electrical energy to high frequency mechanical energy in the form of reciprocating vertical motion which, when applied to a thermoplastic, generates frictional heat at the plastic/plastic or plastic/metal interface. In ultrasonic welding, this frictional heat melts the plastic, allowing the two surfaces to fuse together; in ultrasonic staking or insertion, the controlled flow of molten plastic is used to capture or lock another material in place (staking) or encapsulate a metal insert (insertion).

ULTRASONIC ASSEMBLY SYSTEMS

“Sonics” ultrasonic assembly systems are generally composed of the following major elements: a power supply, converter, booster, horn, pneumatic press and holding fixture, as detailed in the diagram on the next page. A review of this diagram will help you understand the basic elements involved in the assembly process and their relation to each other.

"SONICS" ULTRASONIC ASSEMBLY SYSTEMS



GLOSSARY OF ULTRASONIC TERMS

POWER SUPPLY/GENERATOR – The solid state power supply converts standard 50/60 Hz electrical power to 15,000 Hz, 20,000 Hz, or 40,000 Hz (15/20/40 kHz) electrical energy.

ACTUATOR/PRESS – The pneumatic actuator provides compressive force and mounting for the converter, booster, and horn assembly. The tabletop press consists of a base assembly, column and actuator (head).

CONVERTER – The converter changes the high frequency electrical energy supplied by the power supply to high frequency mechanical vibrations.

BOOSTER – Successful ultrasonic welding often depends on having the right amplitude at the horn face. Often it is not possible to design a horn which has both the necessary shape and required gain (ratios of input amplitude to output amplitude). In such cases, a booster is placed between the converter and the horn to either increase or decrease the amplitude of the horn. In addition to changing/maintaining the amplitude, the booster provides support and alignment in the welding system. (See page 17 for booster selection.)

HORN – The horn is a tuned component of the system which comes in contact with the parts to be assembled. The horn 1) transfers the ultrasonic vibrations produced from the converter to the parts being welded, and 2) applies necessary force to the assembly while the material resolidifies.

HOLDING FIXTURE – The holding fixture or nest assures proper alignment and support of the parts being assembled.

MODEL 4096

MODEL 4095

INSTALLATION

ELECTRICAL POWER

The press is powered by the power supply. Consult your power supply instruction manual to determine power specifications.

AIR SUPPLY

The press requires a source of dry, filtered (5 micron), oil-free, compressed air capable of supplying a constant line pressure of 85 psig. (586 kPa / 6 bar) at a minimum capacity of 2 CFM.

WARNING

Do not connect the press to an air source supplied by a compressor lubricated with synthetic oils or oils containing phosphate esters or chlorinated hydrocarbons. This type of lubricant may cause the air filter to malfunction, and the plastic bowl to rupture.

SETTING UP

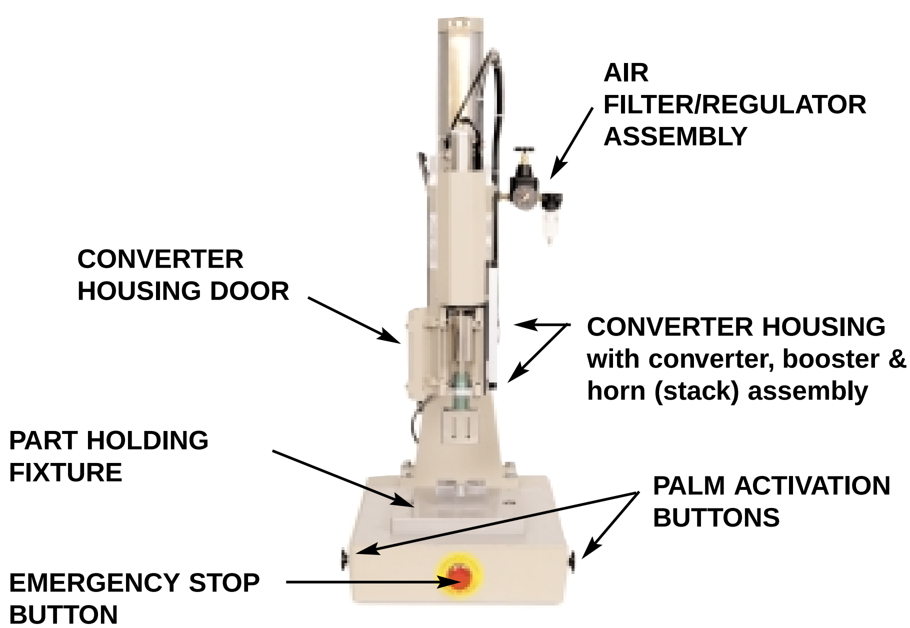
The press should be installed in a clear, uncluttered location that is free from excessive dirt, dust, corrosive fumes, and temperature and humidity extremes. The selected installation site should be near the electrical power and air supply sources and away from any equipment that generates abnormally high electrical transients. Observe the following additional instructions when installing the press:

a. The press should be placed on a sturdy, level table or bench capable of supporting a minimum of 500 pounds (227 kg).

b. Allow at least 6 inches (152.4mm) at the rear of the press for cable connections.

KEY COMPONENTS

NOTE: *If the power supply is to be run continuously, air cooling of the converter and horn is required. Use clean, dry compressed air filtered down to 5 microns (supplied to converter fitting).*



NOTE: *Do not strain or kink the cables. When going around corners, allow as wide a bend as possible. Do not run the cables parallel to any power line within a distance of less than 1 foot (304.8mm).*

CONNECTIONS

When making the initial connections, make sure all power is disconnected.

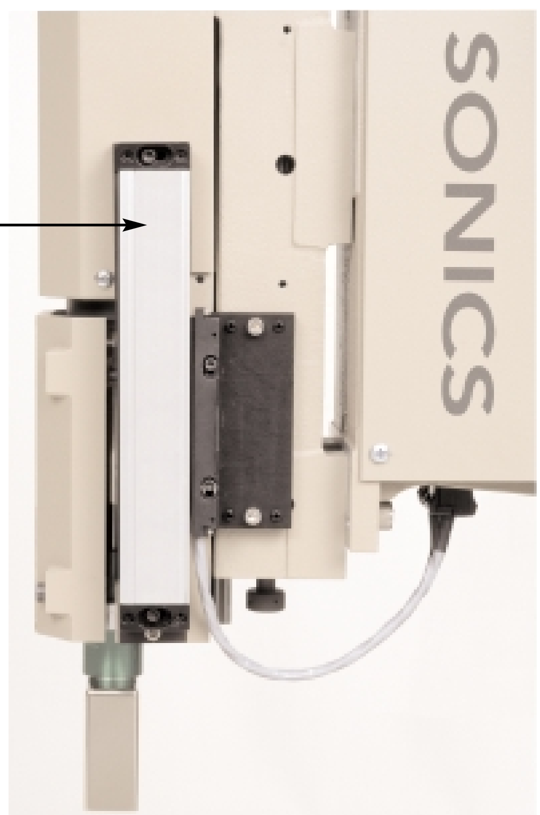
1. Connect the air supply source to the press air filter located at the right, rear of the press head, using a hose having a minimum inside diameter of 1/8 inch (6 mm).
2. Connect the RF and base (actuating) cables of the press (4095 only) to the power supply. (Consult your power supply instruction manual for details.)
3. Check with your electrician if you have any wiring questions.

OPTIONS

A Linear Encoder is available as an option for the 4095 and 4096 models. The Linear Encoder allows distance-controlled welding in incremental and absolute modes.

The Linear Encoder is supplied with a 9-pin male connector that connects to a matching 9-pin female connector on the power supply (factory installed).

LINEAR ENCODER



INITIAL EQUIPMENT SETUP

WARNING

Never tighten the horn to the booster using the housing door as the upper wrench as this may cause damage to the booster and/or converter.

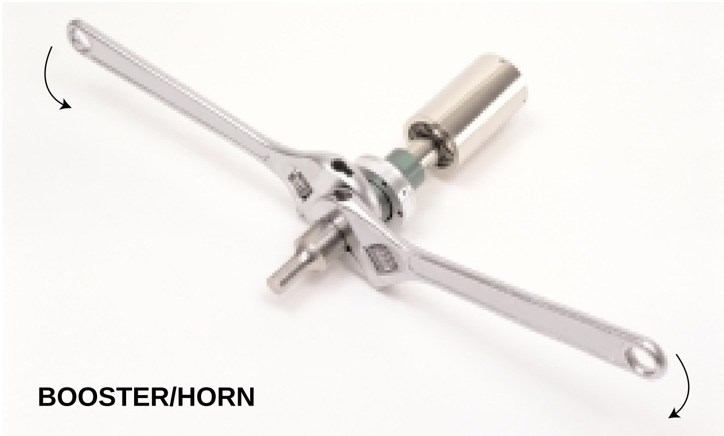
ASSEMBLING AND MOUNTING CONVERTER, BOOSTER, AND HORN

If the converter, booster, and horn are not already assembled, follow these instructions:

1. Clean the mating surfaces of the converter and booster, as well as the threaded stud and hole. Check that the stud is tight (see recommended torque requirements on page 11).
2. Hand assemble the converter and booster together. Using open-ended wrenches as shown below, tighten until snug. Then, using a torque wrench, tighten to 25-35 inch-lbs.(2.8-4.0 newton-meters). **Do not force or overtighten.**

CONVERTER/BOOSTER

3. Clean the mating surfaces of the booster and horn, as well as the threaded stud and hole. Check that the stud is tight. (See recommended torque requirements on next page.)
4. Hand assemble the horn to the booster. Using open-ended wrenches as shown below, tighten securely. Then, using a torque wrench, tighten to 25-35 inch-lbs. (2.8-4.0 newton-meters). **Do not overtighten.**

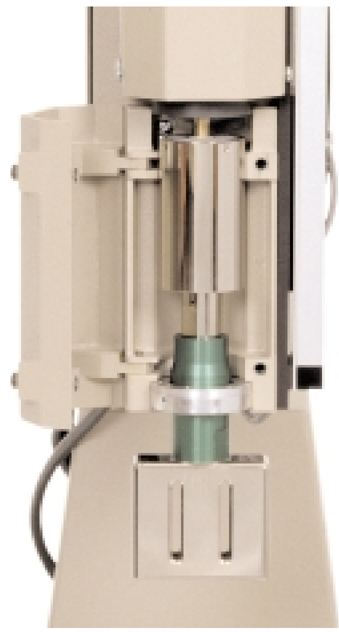


BOOSTER/HORN

NOTE: *When performing any of the operations described on this page and pages 12 and 13, DO NOT turn on the power supply.*

5. Using the 3/16” (4.7 mm) T-handle wrench provided, loosen (turn counterclockwise) the two cap screws screws on the hinged converter housing and open the door.
6. Place the converter / booster / horn assembly in the housing with the horn facing down. Fit the male brass button connector on the top of converter into the female brass connector in the bottom of the interior housing, and gently push the assembly up and in so that the booster mounting ring rests on the lower support ridge.

CONVERTER / BOOSTER HORN ASSEMBLY



WARNING

Never tighten the horn to the booster using the housing door as the upper wrench as this may cause damage to the booster and/or converter.

7. Close the converter housing door and tighten (turn clockwise) the two socket head cap screws just until they are snug. Do not tighten the horn to the booster using the door as the upper wrench. Hand-forcing the horn on and off in this manner can twist wires and cause a failure. If the horn is not in the correct position to make contact with your material, re-position the converter.

NOTE: *If you do not close the housing door once the assembly is in place, the assembly can fall out.*

RECOMMENDED TORQUE REQUIREMENTS

Component	Inch-Lbs.	Newton-Meters
Converter / Booster	25 - 35	2.8 - 4.0
Booster / Horn	25 - 35	2.8 - 4.0
Stud	45	5.1
Tips	25 - 35	2.8 - 4.0

WARNING

Support the head before releasing the column clamps so that it cannot crash down or fly up. Ignoring this warning might result in injury and/or damage to the equipment and part being welded.

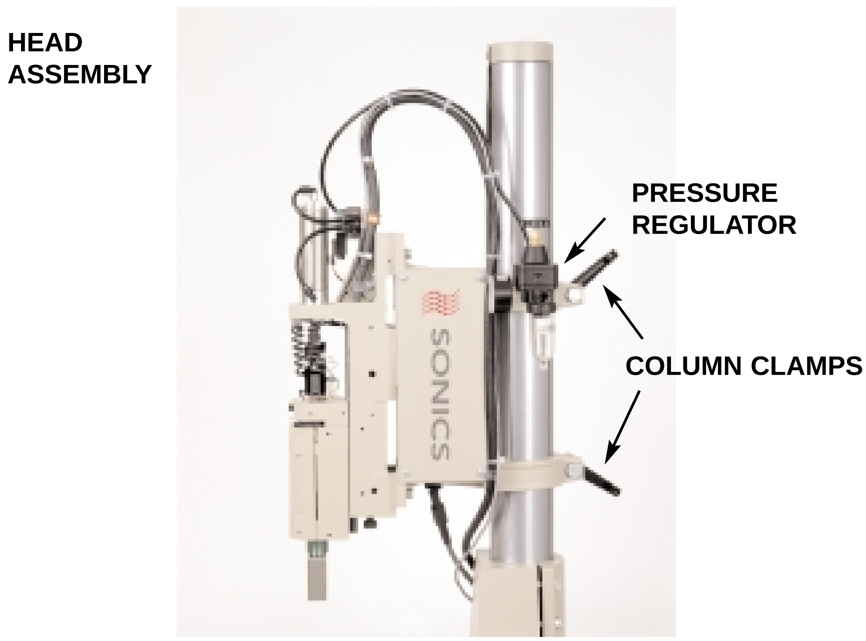
WARNING

When the air pressure is decreased, the converter housing can drop down to its limit, so be sure to either support it or remove anything in its path.

HORN AND FIXTURE ALIGNMENT

For maximum productivity, the clearance between the horn and the part should be at a minimum. However, adequate clearance should be provided to enable easy loading and unloading of the part from the holding fixture. (The maximum stroke distance is 3-1/2".) Ensure that the horn does not contact the part when the head is close to the limit of its down travel distance. Otherwise, the horn may not have sufficient distance to travel downwards to achieve a full depth of weld. Set welding height as described below:

1. Position the holding fixture loosely on the base plate using 3/8-16 screws.
2. Place the part to be welded in the fixture.

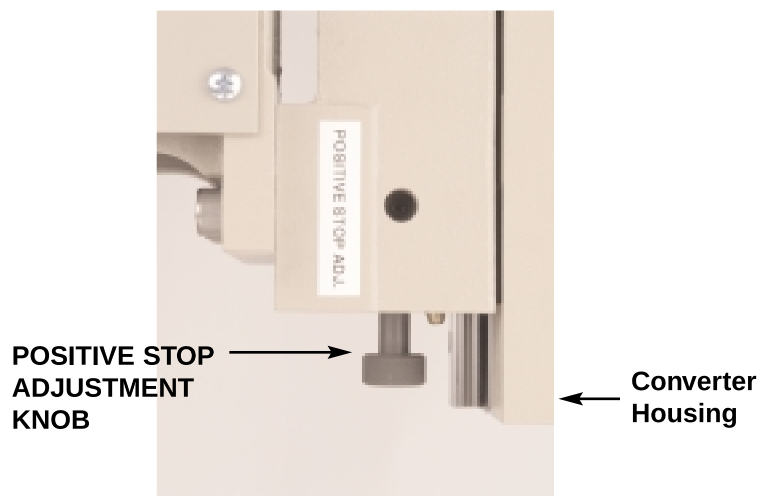


3. Before loosening the column clamps, hold onto the head assembly firmly as it can rise upwards rapidly once the clamps are released. While holding the head assembly, loosen the two column clamps (counterclockwise) and move the head up or down as required. Then tighten the column clamps.
4. Set the air pressure to zero by turning the PRESSURE regulator knob (located at the top of air filter/regulator assembly) fully counterclockwise.
5. Loosen the column clamps once again and manually lower the head until the horn contacts the part. Tighten the clamps.
6. Loosen the cap screws on the converter housing door and gently rotate the head and horn as required to ensure proper horn-to-part alignment.

7. Lock the two column clamps, tighten the converter housing door screws, and then tighten the fixture on the base plate.
8. Check for proper mating of fixture, parts, and horn. If the horn and part are not in parallel contact, shim the fixture or adjust leveling screws as required.
9. Set the PRESSURE regulator to a reading of 20 psig (140 kPa/1.4 bar) on the pressure gauge. (Turn the PRESSURE knob clockwise.)
10. To check that the horn and parts are properly aligned, the horn needs to be lowered. Read through the Operation instructions on the next page, and then proceed to lower the horn as detailed. If the horn and parts are not sufficiently aligned, then repeat steps 4 through 8 on the preceding page. However, if you are working with small, delicate parts, then fine adjustments can be made using the positive stop adjustment knob as explained below.

POSITIVE STOP ADJUSTMENT

The positive stop is set to limit the downward travel of the horn to approximately 75%. Readjustments may be required. Coarse adjustment of the clearance between the face of the horn and part should be made using the elevation control. Fine adjustment should be made using the positive stop.



The positive stop adjustment knob is located offset from the converter housing. Turning the knob clockwise will decrease downward travel distance. Turning the knob counterclockwise will increase the downward travel distance. A set screw located on the left side of the housing locks the positive stop adjustment in place. Use a 3/32 Allen wrench to lock and unlock this set screw.

NOTE: *For maximum safety and productivity, adjust the clearance between the horn and the part to a minimum that will still allow ease of loading and unloading.*

ACTUATION

WARNING

The equipment has safety devices that require both hands to be on the palm buttons until the horn contacts the workpiece. ***Do not defeat or modify these safety devices.***

The 4095 press is equipped with two maintained anti-repeat (non-tie-down) palm buttons, one located on the left and one on the right side of the base of the press. Both palm buttons must be pressed simultaneously to activate the press to cycle the welder. To operate the press, follow these simple steps:

1. Depress both black palm buttons simultaneously.
2. Once the horn comes in contact with the part and the ultrasonics are activated, release the palm buttons. If you release the buttons before contact is made, the head will immediately return to its “home” position.

The operation of the 4096 actuator is controlled by the automated system. A four-wire actuation cable is provided which ties into the output side of a PLC, or other system controlling device. Momentary two wire closure from a dry source will initiate the welder’s cycle. For more information, refer to the power supply manual and the included wiring diagrams.

EMERGENCY STOP

NOTE: *Power supply cannot be shut off once the weld cycle has started. Termination of cycle can only be achieved by using the EMERGENCY STOP button.*

To abort the 4095 press during welding, simply press the red EMERGENCY STOP button located at the front center of the press base.

Once the EMERGENCY STOP button has been depressed, the head will retract and return to its “home” position, remaining there until the button is released. Simply rotate the EMERGENCY STOP button to the right 1/4 turn to release the press for further operation.

For the 4095 actuator, a four-wire actuation cable contains two normally closed wires which control the emergency stop function. For more information, refer to the power supply manual and the included wiring diagrams.

WARNING

Do not use with a footswitch unless alternate means of pinch-point protection is provided.

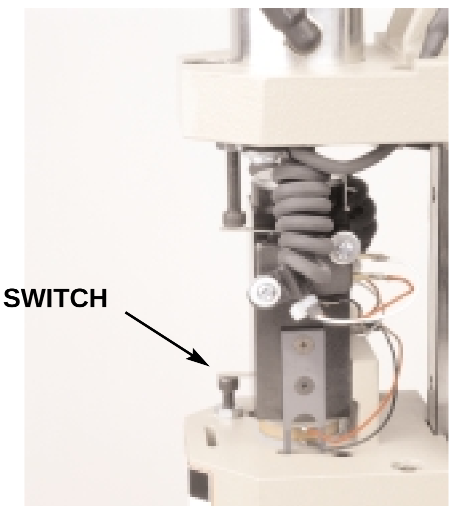
FINE ADJUSTMENTS

PRESSURE SWITCH ADJUSTMENT

For systems mounted in the normal vertical position with downward travel, no adjustment should be necessary. The minimum trigger pressure is factory set at 4-7 psig.

However, if the minimum trigger pressure requires recalibration or re-adjustment, observe the following procedure:

1. Maintain air pressure and unplug the power supply from the electrical source.
2. Remove the four screws holding the five-sided cover.
3. Loosen the jam nut holding the 8-32 cap screw in place.
4. Rotate the cap screw counter-clockwise (up) until the Pressure Switch closes.



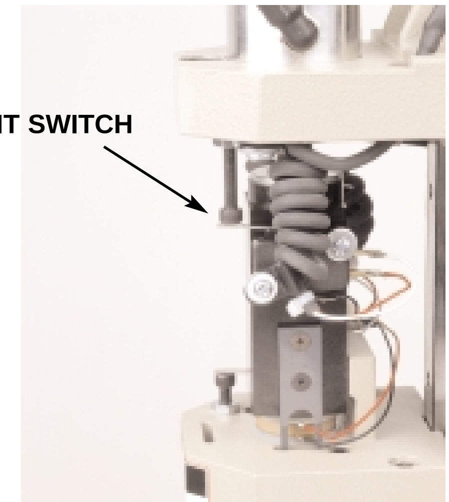
5. Next rotate the cap screw clockwise (down) until the Pressure Switch opens.
6. Rotate cap screw clockwise (down) 1/4 turn past the Pressure Switch open position.
7. Tighten the jam nut to lock cap screw in position.
8. Replace the cover and four screws.
9. Plug the power supply into the electrical source.
10. Cycle the welder.

The press is now set to trigger at the minimum trigger pressure of 4-7 psig.

A press actuating in an upward or horizontal direction should be set to trigger at a minimum of 8-10 psig. Lower values may affect trigger performance where false triggering may be observed.

UPPER LIMIT SWITCH

The optional Upper Limit Switch is used as a safety interlock in automation to prevent the movement of material handling equipment (indexing) when the horn is down. It also initiates the movement of material handling equipment when the horn is up.



The Upper Limit Switch is factory set and should be suitable for all applications. If for some reason you need to readjust it, observe the following procedure:

1. Maintain air pressure and unplug the power supply from the electrical source.
2. Remove the four screws holding the five-sided cover.
3. Loosen the jam nut holding the 8-32 cap screw in place.
4. Rotate the cap screw counter-clockwise (down) until the Upper Limit Switch closes.
5. Tighten the jam nut to lock cap screw in position.
6. Replace the cover and four screws.

The Upper Limit Switch is now set.

NOTE: Consult the Applications Manual or call our Applications Lab for proper booster selection.

WARNING

High gain boosters, such as silver and black in combination with high gain horns can result in the horn cracking or failing.

BOOSTER SELECTION

The first step in optimizing welding conditions is to select a booster which will provide the necessary amplitude. For parts one inch (25.4mm) in diameter or greater, start with a moderately high amplitude booster such as a gold. For smaller parts, start with a green booster. Determine optimum amplitude by welding a few parts, and repeat the procedure with boosters giving higher or lower amplitude. If there appears to be little or no difference, use the booster giving the highest amplitude.

Six standard boosters, color coded or engraved for ease of identification, are available either to increase or decrease the amplitude.

BOOSTER

Color	Part No.	Gain	Amplitude Effect
Black	BHN23TBK	2.50	Increase
Silver	BHN23TSI	2.00	Increase
Gold	BHN23GD	1.50	Increase
Brown	BHN23BR	1.25	Increase
Green	BHN23GR	0	No Change
Purple	BHN23PU	0.75	Decrease

PRESSURE

During the welding process, sufficient pressure should be applied to the part so that the mating surfaces contact each other. If the pressure is too low, the process will run inefficiently causing unnecessarily long weld time cycles, marking of the parts or poor welding. If the pressure is too high, the horn may stop vibrating, the part(s) might fracture, or the power supply might overload.

WARNING

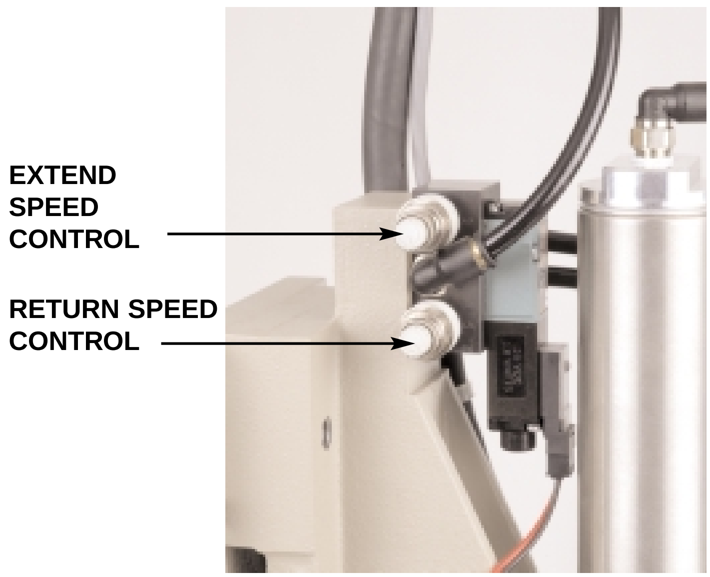
Excessive velocity may be unnecessary and harmful to the system.

STROKE SPEED ADJUSTMENT

The velocity at which the horn descends and returns can be adjusted via the speed controls. These controls are factory adjusted for average operating conditions and should not require further adjustment. However, if a minor adjustment is necessary, adjust in small degrees. Turn clockwise to slow the extend speed, and counterclockwise to increase the return speed.

The speed controls are 2 small threaded screws located at the top of the press and behind the air cylinder as shown below.

The top screw controls the extend speed – turn it clockwise to slow the speed, counterclockwise to increase the speed. The bottom screw controls the return speed – turn it clockwise to slow the speed, counterclockwise to increase speed.

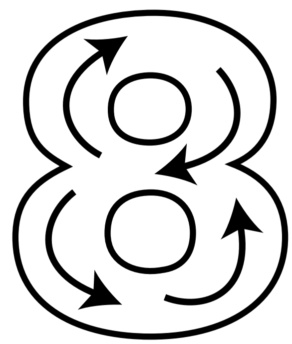


RE-ESTABLISHING PROPER BOOSTER / HORN INTERFACES

To re-establish proper interfaces, follow these instructions:

1. Using open-ended wrenches, separate the booster from the horn. Clean each item and then examine interfaces for irregularities (scoring).
2. If irregularities are present, remove the stud.
3. Tape a sheet of 400 grit emery cloth to a smooth, flat surface. (Do not use coarser than 400 grit.)
4. Grasp the lower portion of the booster or horn and move it across the emery cloth. To ensure proper lapping, a) hold the part straight, b) apply light downward pressure, and c) move in one direction only in a figure 8 pattern.

   Repeat the figure 8 pattern once more.



5. Then, rotate the booster or horn 1/3 of a turn in a clockwise direction and then repeat step 4.
6. Repeat step 5.
7. Using wire brush, clean stud, then replace securely. Tighten new stud to the recommended torque specifications on page 11.

***NOTE:** Contact between the booster and horn should be parallel. When encountering symptoms such as loud noises or tuning difficulties, examine the booster / horn interfaces for parallelism, corrosion, galling or foreign deposits. Also check the tightness of the stud.*

WARNING

DO NOT use anything coarser than 400 grit emery cloth.

***NOTE:** Machining of booster / horn may alter the ability to tune the component to the system. System inoperation may occur.*

MAINTENANCE

NOTE: If packing unit for return shipment, DO NOT use styrofoam “peanuts.”

REPAIRS / SERVICE

If problems are encountered, contact our Service Department as follows:

Phone: 1-800-745-1105 • 1-203-270-4600

Fax: 1-203-270-4610

E-Mail: service@sonicsandmaterials.com

It is suggested that a system in need of repair be sent back to the factory, with a written description pertaining to the nature of the problem.

Always contact the factory for return authorization before shipping any instrument. Include date of purchase, model number, and serial number. For units not covered by the warranty, a purchase order should be forwarded to avoid unnecessary delay. Care should be exercised to provide adequate packing to insure against possible damage in shipment. The system should be sent with all transportation charges prepaid and return method of shipment indicated.

WARRANTY

Sonics & Materials, Inc., hereinafter referred to as "Sonics," warrants its products for a period of one year from the date of shipment against defect in material and workmanship under normal installation, use, and maintenance as described in the operating instructions which accompany such equipment. During the warranty period, "Sonics" will, at its option, as the exclusive remedy, either repair or replace without charge for material and labor, the part(s) which prove upon our examination to be defective, provided the defective unit is returned to us properly packed with all transportation charges prepaid.

Ultrasonic welding horns constructed of titanium or aluminum are guaranteed against defects for a period of one year from date of shipment. "Sonics" will repair or replace a cracked or defective horn once without charge, if failure occurs within the warranty period.

Ultrasonic welding horns constructed of steel are guaranteed against defects for a period of ninety days from date of shipment. "Sonics" will repair or replace a cracked or defective steel horn once at a charge of 50% of the original purchase price, if failure occurs within the warranty period.

LIMITATION OF WARRANTY

This warranty is in lieu of any other warranties, either express, implied, or statutory. "Sonics" neither assumes nor authorizes any person to assume for it any other obligation or liability in connection with the sale of its products. "Sonics" hereby disclaims any warranty or 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 "Sonics" be liable to the purchaser or to any other person for any incidental or consequential damages or loss of profit or product resulting from any malfunction or failure of this "Sonics" product.

This warranty does not apply to equipment which has been subject to unauthorized repair, misuse, abuse, negligence or accident. Equipment which, in our judgment, 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.

No liability is assumed for expenses or damages resulting from interruptions in operation of the product or damages to material in process.

"Sonics" equipment is designed for maximum operator safety and incorporates built-in safety devices. Any modifications to these safety features will void the warranty. "Sonics" assumes no responsibilities for consequential damages incurred due to modifications to the said equipment.

“Sonics” reserves the right not to warrant horns of unusual or experimental design which in our judgment are more likely to fail in use.

This warranty does not cover equipment used for applications requiring metal-to-metal contact with weld time in excess of 1 second.

Data supplied in the instruction manual has been verified and validated and is believed adequate for the intended use of the equipment. If the equipment or procedures are used for purposes other than those specified herein, confirmation of their validity and suitability should be obtained in writing from “Sonics.”

SONICS

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Models 2050 / 2055 Presses

INSTRUCTION MANUAL

SONICS

Sonics & Materials, Inc.

WARNING

SAFETY PRECAUTIONS
READ BEFORE INSTALLING OR USING THE EQUIPMENT

Our systems have been designed to assure maximum operator safety. However, no design can completely protect against improper usage. For maximum safety and equipment protection, observe the following warnings at all times and read all applicable instruction manuals carefully before you attempt to operate any equipment.

– The equipment has safety devices that require both hands to be on the palm buttons until the horn contacts the work piece. Do not defeat or modify these safety devices.

– Do not use with foot switch or other means of actuation unless alternate means of pinch-point protection is provided.

– High voltage is present in the equipment. Disconnect plug before removing cover or servicing.

– Make sure equipment is properly grounded with a 3-prong plug. Before plugging in equipment, test outlet for proper earth grounding.

– High voltage potential may be present in the converter as a result of temperature changes. Do not touch the converter contact unless you first short both pins or the button to the converter case with an insulated tool.

– Never squeeze or grab a vibrating horn.

– Do not modify horn configurations.

– 20 kHz, 30 kHz and 40 kHz ultrasonic welders operate above normal audibility for most people. Ear protection is recommended. Consult the Appendix for a list of manufacturers of ear protectors.

– Do not affix any device to any portion of the horn.

Sonics & Materials, Inc.

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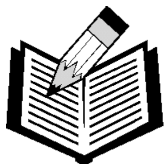
IMPORTANT SERVICE LITERATURE



NOTE: *Please read carefully before operating the equipment, then forward to your service department.*

The system 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.

MANUAL CHANGE INFORMATION

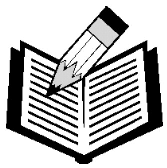
We continually strive to be at the forefront of the latest electronic developments by adding circuit and component improvements to our equipment as soon as they are developed and tested.

Sometimes, due to printing and shipping requirements, we cannot incorporate these changes immediately into printed manuals. Hence, your manual may contain new change information. Change information, if any, is located in the Appendix.

We reserve the right to make any changes in the design or construction of our equipment at any time, without incurring any obligation to make any change whatsoever in units previously delivered.

The technical data and schematics in the manual are for informational purposes only and may not reflect the current configuration being shipped from our factory. Upon formal request, complete and up-to-date information can be provided from the factory free of charge.

UNPACKING AND INSPECTION



***NOTE:** We recommend keeping all carton(s) and packing material in case it might be necessary to move the equipment, or to ship it for repair.*

Before unpacking the equipment, check the shipping carton for any visible damage. If you see any, be sure to follow the procedures described below under "Visible Loss or Damage." Otherwise, proceed to remove the equipment from the carton. Before disposing of any packing material, check it carefully for small parts. Then perform a visual inspection of the equipment to detect any evidence of damage which might have occurred during shipment. Check the following:

1. all components against the enclosed packing list,
2. all module plug-in units,
3. all wire plug-in connections.

The equipment was carefully packed and thoroughly inspected before leaving our factory. All units are tested and checked for problems prior to shipping. It is asked that when a problem does occur that all parts and components be inspected for damage (especially when the unit is not in working order when received). Responsibility for safe delivery was assumed by the carrier upon acceptance of the shipment. Claims for loss of damage sustained in transit must therefore be made upon the carrier, as follows:

VISIBLE LOSS OR DAMAGE

Any external evidence of loss or damage must be noted on the freight bill or express receipt, and signed by the carrier's agent. Failure to adequately describe such external evidence of loss or damage may result in the carrier's refusal to honor a damage claim. The form required to file such a claim will be supplied by the carrier.

CONCEALED LOSS OR DAMAGE

Concealed loss or damage means loss or damage which does not become apparent until the merchandise has been unpacked. The contents might have been damaged in transit due to rough handling even though the container may not show external damage. When the damage is discovered upon unpacking, make a written request for inspection by the carrier's agent within 48 hours of the delivery date. Then file a claim with the carrier since such damage is the carrier's responsibility. The form required to file such a claim will be supplied by the carrier. Do not destroy packing materials, or move material from one location to another before the carrier makes their inspection.

If the system or any unit is damaged, notify "Sonics." "Sonics" will arrange for repair or replacement of damaged equipment without waiting for the claim against the carrier to be settled, provided a new purchase order is issued to cover the repair or replacement costs. Should any damage, shortage or discrepancy exist, please notify us immediately.

INTRODUCTION

The models 2050 and 2055 presses are 20 kHz precision benchtop pneumatic actuators/presses used for ultrasonic plastics assembly. The 2050 and 2055 presses can be supplied with the following power supplies:

- FD ....Timer
- FDL ....Timer/Linear Encoder
- FM ....Microsonic Processor™
- FO/ML ....Microsonic Processor™/Linear Encoder*

*LE available on 2055 only.

OVERVIEW OF ULTRASONIC PLASTICS ASSEMBLY

WHAT IS ULTRASONICS?

Ultrasonics refers to vibrational waves with a frequency above the human audible range which is usually above 18,000 cycles per second (Hz).

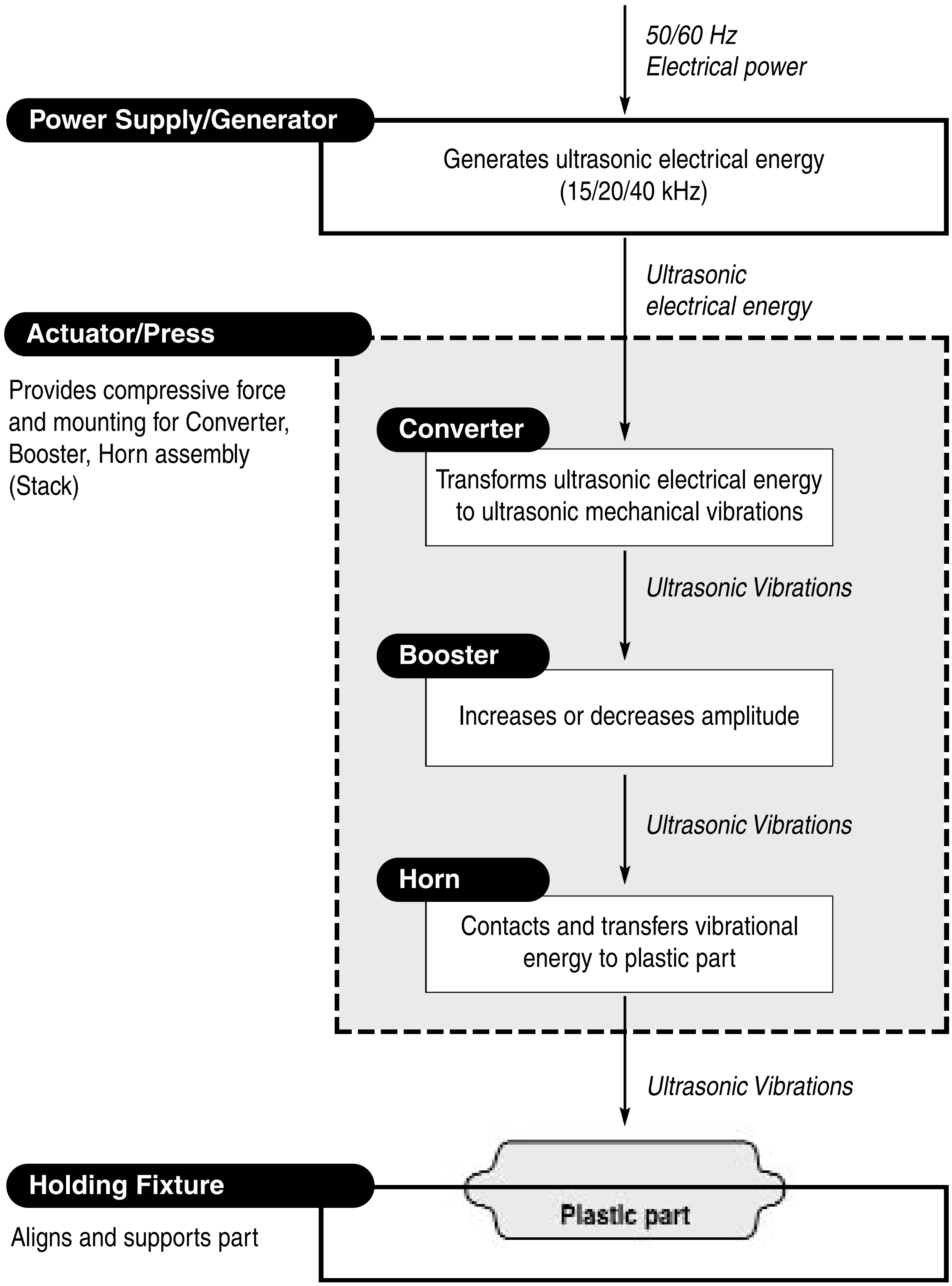
PRINCIPLE OF ULTRASONIC ASSEMBLY

The basic principle of ultrasonic assembly involves conversion of high frequency electrical energy to high frequency mechanical energy in the form of reciprocating vertical motion which, when applied to a thermoplastic, generates frictional heat at the plastic/plastic or plastic/metal interface. In ultrasonic welding, this frictional heat melts the plastic, allowing the two surfaces to fuse together; in ultrasonic staking or insertion, the controlled flow of molten plastic is used to capture or lock another material in place (staking) or encapsulate a metal insert (insertion).

ULTRASONIC ASSEMBLY SYSTEMS

"Sonics" ultrasonic assembly systems are generally composed of the following major elements: a power supply, converter, booster, horn, pneumatic press/actuator and holding fixture, as detailed in the diagram on the next page. A review of this diagram will help you understand the basic elements involved in the assembly process and their relation to each other.

"SONICS" ULTRASONIC ASSEMBLY SYSTEMS



GLOSSARY OF ULTRASONIC TERMS

POWER SUPPLY/GENERATOR – The solid state power supply converts standard 50/60 Hz electrical power to 15,000 Hz, 20,000 Hz, 30,000 Hz or 40,000 Hz (15/20/30/40 kHz) electrical energy (depending on frequency of model purchased).

ACTUATOR/PRESS – The pneumatic actuator provides compressive force and mounting for the converter, booster, and horn assembly. The benchtop press consists of a base assembly, column and actuator (head).

CONVERTER – The converter changes the high frequency electrical energy supplied by the power supply to high frequency mechanical vibrations.

BOOSTER – Successful ultrasonic welding often depends on having the right amplitude at the horn face. Often it is not possible to design a horn which has both the necessary shape and required gain (ratios of input amplitude to output amplitude). Therefore, a booster is placed between the converter and the horn to either increase or decrease the amplitude of the horn. In addition to changing/maintaining the amplitude, the booster provides support and alignment in the welding system. (See page 19 for booster selection.)

HORN – The horn is a tuned component of the system which comes in contact with the parts to be assembled. The horn 1) transfers the ultrasonic vibrations produced from the converter to the parts being welded, and 2) applies necessary force to the assembly while the material resolidifies.

HOLDING FIXTURE – The holding fixture or nest assures proper alignment and support of the parts being assembled.

MODEL 2050

MODEL 2055

ELECTRICAL POWER

The press is powered by the power supply. Consult your power supply instruction manual to determine power specifications.

WARNING

Do not connect the press to an air source supplied by a compressor lubricated with synthetic oils or oils containing phosphate esters or chlorinated hydrocarbons. This type of lubricant may cause the air filter to malfunction, and the plastic bowl to rupture.

AIR SUPPLY

The press requires a source of dry, filtered (5 micron), oil-free, compressed air capable of supplying a constant line pressure of 85 psig. (586 kPa / 6 bar) at a minimum capacity of 2 CFM.

SETTING UP

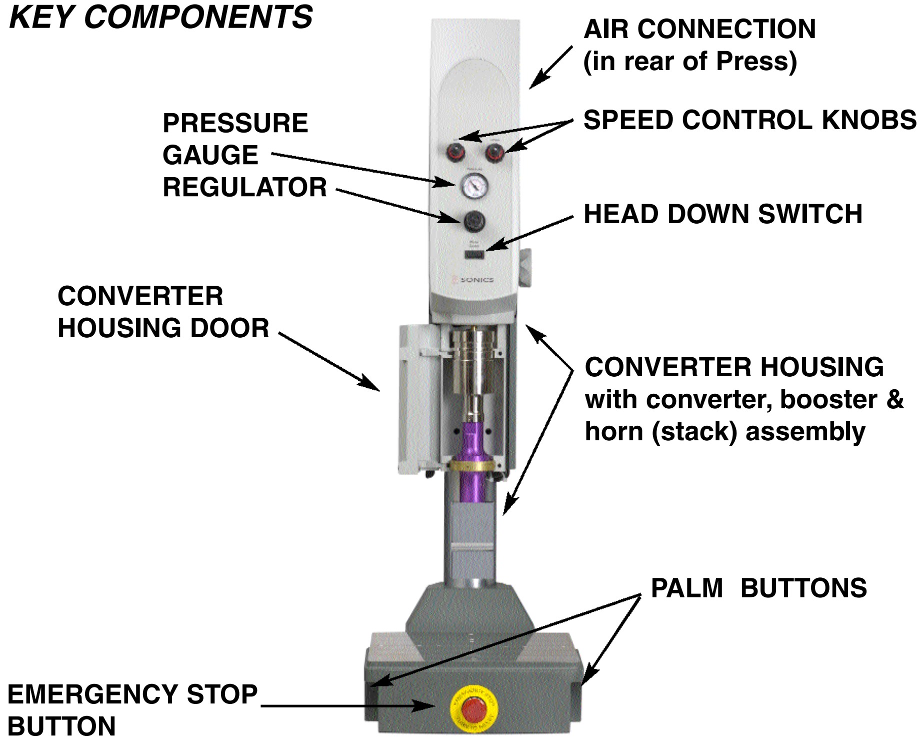
The press should be installed in a clear, uncluttered location that is free from excessive dirt, dust, corrosive fumes, and temperature and humidity extremes. The selected installation site should be near the electrical power and air supply sources and away from any equipment that generates abnormally high electrical transients. Observe the following additional instructions when installing the press:

a. The press should be placed on a sturdy, level table or bench capable of supporting a minimum of 500 pounds (227 kg).

b. Allow at least 6 inches (152.4mm) at the rear of the press for cable connections.

NOTE: *If the power supply is to be run continuously, air cooling of the converter and horn is required. Use clean, dry compressed air filtered down to 5 microns (supplied to converter fitting).*

KEY COMPONENTS



NOTE: Do not strain or kink the cables. When going around corners, allow as wide a bend as possible. Do not run the cables parallel to any power line within a distance of less than 1 foot (304.8mm).

CONNECTIONS

When making the initial connections, make sure all electrical power is disconnected.

1. Connect the air supply source to the press air connection located at the rear of the press head, using a hose having a minimum inside diameter of 1/8 inch (3 mm).

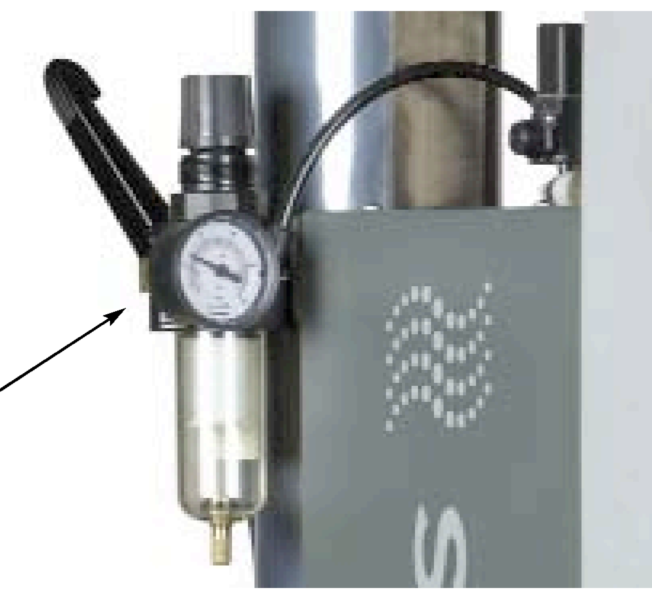
   A 1/4 NPT threaded female elbow connector is provided to attach your air line service. Connectors are typically an instant (push-to-connect) plastic tube fitting or a male sleeve lock type quick connect fitting.

MODEL 2050

CONNECTOR

MODEL 2055

AIR CONNECTOR (IN REAR)



2. Connect the RF and base (actuating) cables of the press to the power supply. (Consult your power supply instruction manual for details.)

3. Check with your electrician if you have any wiring questions.

OPTIONS

A Linear Encoder is available as an option on Model 2055 only. The Linear Encoder allows distance-controlled welding in incremental and absolute modes.

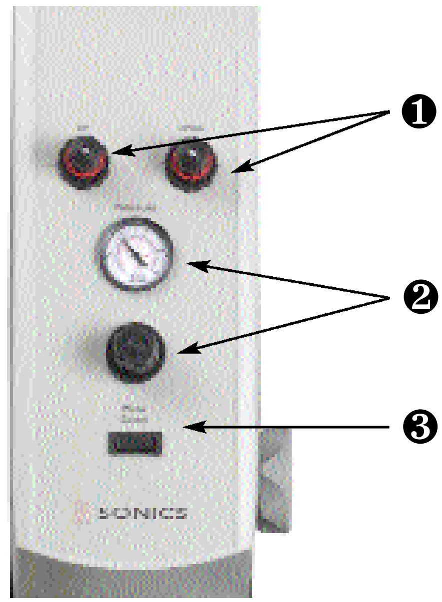
The Linear Encoder is supplied with a 9-pin male connector that connects to a matching 9-pin female connector on the FDL power supply (factory installed).

LINEAR ENCODER

OPERATING PROCEDURES

CONTROL PANEL (2050 PRESS)

Located above the converter housing on the 2050 press are the following controls:



Excessive velocity may be unnecessary and harmful to the system.

1. **SPEED CONTROL** knobs allow regulation of the velocity at which the horn descends and returns (stroke speed).

   These controls are factory adjusted for average operating conditions. When minor adjustments are necessary, be sure to adjust in small degrees.

   Pull the red ring out to release and push in to lock setting.

   The left knob, labeled "UP," controls the return speed - turn the knob clockwise to slow the speed, counterclockwise to increase speed.

   The right knob, labeled "DOWN," controls the descending speed – turn the knob clockwise to slow the speed, counterclockwise to increase speed.

2. **PRESSURE REGULATOR** with corresponding gauge that allows regulation of the (air) pressure with which the horn contacts the part(s). Pull the knob to make adjustments, and then push in to lock setting when desired pressure is displayed on the gauge. Once pulled, turning the knob clockwise increases pressure, and turning it counterclockwise decreases pressure.

3. **HEAD DOWN** switch when depressed, allows the head to move down under gauge pressure. (For set up only – this action does not cause ultrasonics to be activated.)

CONTROLS (2055 PRESS)

Located at the top rear of the 2055 press are the following controls:

1. **PRESSURE REGULATOR** with corresponding gauge that allows regulation of the (air) pressure with which the horn contacts the part(s). Pull the knob to make adjustments, and then push in to lock setting when desired pressure is displayed on the gauge. Once pulled, turning the knob clockwise increases pressure, and turning it counterclockwise decreases pressure.

WARNING

Excessive velocity may be unnecessary and harmful to the system.

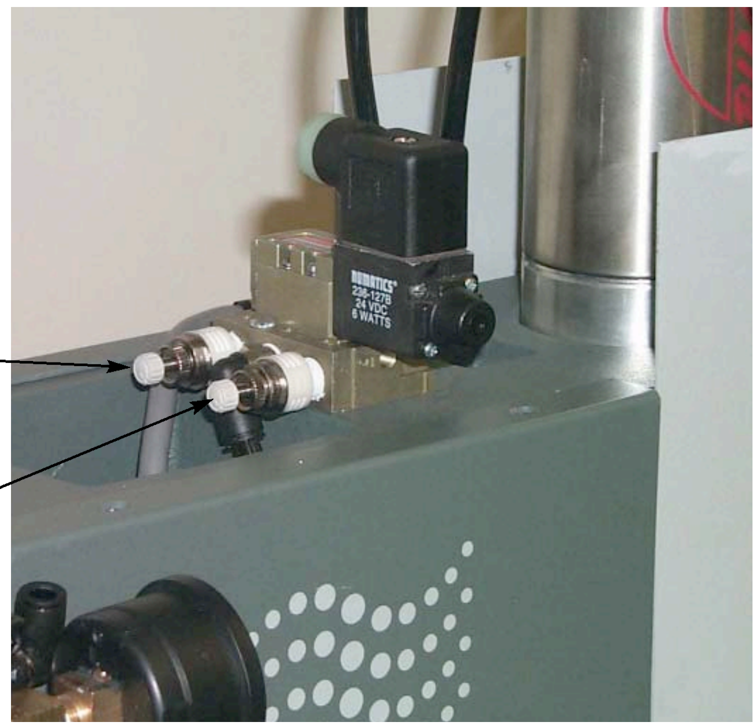
2. **SPEED CONTROLS**

The velocity at which the horn descends and returns can be adjusted via the two small threaded screws located at the top of the press as shown below. These controls are factory adjusted for average operating conditions. If a minor adjustment is necessary, adjust in small degrees.

Turn the Descend Speed Control screw clockwise to slow the descend speed, counterclockwise to increase the speed. Turn the Return Speed Control screw clockwise to slow the return speed, counterclockwise to increase speed.

DESCEND SPEED CONTROL

RETURN SPEED CONTROL



WARNING

Never tighten the horn to the booster using the housing door as the upper wrench as this may cause damage to the booster and/or converter.

ASSEMBLING AND MOUNTING CONVERTER, BOOSTER, AND HORN

If the converter, booster, and horn are not already assembled, follow these instructions:

1. Clean the mating surfaces of the converter and booster, as well as the threaded stud and hole. Check that the stud is tight (see recommended torque requirements on page 15).
2. Hand assemble the converter and booster together. Using spanner wrenches as shown below, tighten until snug. Then, using a torque wrench, tighten to 25-35 foot-lbs. (2.8-4.0 newton-meters).
   Do not force or overtighten.

CONVERTER/BOOSTER

3. Clean the mating surfaces of the booster and horn, as well as the threaded stud and hole. Check that the stud is tight. (See recommended torque requirements on next page.)
4. Hand assemble the horn to the booster. Using a spanner and an open-ended wrench as shown below, tighten securely. Then, using a torque wrench, tighten to 25-35 foot-lbs. (2.8-4.0 newton-meters).
   Do not overtighten.

CONVERTER/BOOSTER/HORN

NOTE: *When performing any of the operations described on this page and pages 16-17, DO NOT turn on the power supply.*

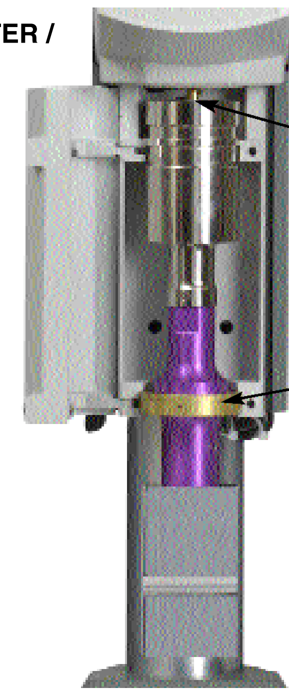
WARNING

Never tighten the horn to the booster using the housing door as the upper wrench as this may cause damage to the booster and/or converter.

NOTE: *If you do not close the housing door once the assembly is in place, the assembly can fall out.*

5. Using the 3/16" (4.7 mm) T-handle wrench provided, loosen (turn counterclockwise) the two cap screws on the hinged converter housing and open the door.

6. Place the converter / booster / horn assembly (stack) in the housing with the horn facing down. Fit the male brass button on the top of the converter into the female brass fitting in the bottom of the contact block assembly housing, and gently push the assembly up and in so that the booster mounting ring rests on the lower support ridge.



7. Close the converter housing door and tighten (turn clockwise) the two socket head cap screws until they are snug. Do not tighten the horn to the booster using the door as a clamp. Hand-forcing the horn on and off in this manner can twist wires in the converter and cause a failure. If the horn is not correctly oriented to the part, re-position the stack assembly by loosening the converter housing cover and rotating the stack.

RECOMMENDED TORQUE REQUIREMENTS

Component	Foot-Lbs.	Newton-Meters
Converter / Booster	25 - 35	2.8 - 4.0
Booster / Horn	25 - 35	2.8 - 4.0
Stud	45	5.1
Tips	25 - 35	2.8 - 4.0

HORN AND FIXTURE ALIGNMENT

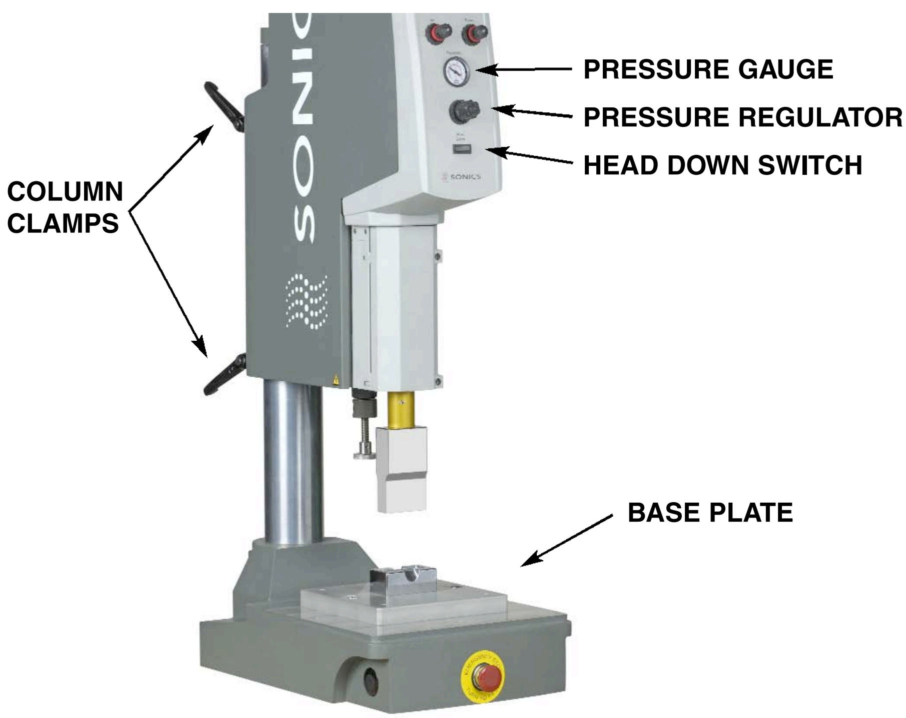
WARNING

Support the head before releasing the column clamps so that it cannot crash down or fly up. Ignoring this warning might result in injury and/or damage to the equipment and part being welded.

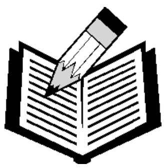
For maximum productivity, the clearance between the horn and the part should be at a minimum. However, adequate clearance should be provided to enable easy loading and unloading of the part from the holding fixture. The maximum stroke distance is 4" (101.6 mm). Ensure that the horn does not contact the part when the head is close to the limit of its down travel distance. Otherwise, the horn may not have sufficient distance to travel downwards to achieve a full depth of weld. Set welding height as follows:

First, position the holding fixture loosely on the machine base using 3/8-16 screws. Then, place the part to be welded in the fixture.

1. Prepare to loosen the column clamps, but be sure to hold onto the head assembly firmly as it can move rapidly up or down with heavy tooling once the clamps are released. While holding the head assembly, loosen the two column clamps (counterclockwise) and move the head up or down as required. Then tighten the column clamps.
2. Using the PRESSURE REGULATOR (turn counterclockwise) and corresponding gauge, set the air pressure to zero.
3. Loosen the column clamps once again and manually lower the head until the horn contacts the part. Tighten the clamps.
4. Loosen the cap screws on the converter housing door and gently rotate the head and horn as required to ensure proper horn-to-part alignment.



5. Lock the two column clamps, tighten the converter housing door screws, and then tighten the fixture on the base plate.
6. Check for proper mating of fixture, parts, and horn. If the horn and part are not in parallel contact, shim the fixture or adjust leveling screws as required.
7. Set the PRESSURE regulator to a reading of 20 psig (140 kPa/1.4 bar) on the pressure gauge. (Turn the PRESSURE knob clockwise.)
8. To check that the horn and parts are properly aligned, the horn needs to be lowered. Read through the Operation instructions on page 18, and then proceed to lower the horn as detailed. If the horn and parts are not sufficiently aligned, then repeat steps 4 through 8. However, if you are working with small, delicate parts, then fine adjustments can be made using the positive stop adjustment knob as explained below.



NOTE: *For maximum safety and productivity, adjust the clearance between the horn and the part to a minimum that will still allow ease of loading and unloading.*

POSITIVE STOP ADJUSTMENT

The positive stop is set to limit the downward travel of the horn to approximately 75%. Readjustments may be required. Coarse adjustment of the clearance between the face of the horn and part should be made using the elevation control. Fine adjustment should be made using the positive stop.

The positive stop adjustment knob is located offset from the converter housing. Turning the knob clockwise will decrease downward travel distance. Turning the knob counterclockwise will increase the downward travel distance. Rotate the knurled thumbscrew to lock and unlock the positive stop.

A different positive stop is available for oversize horns. Contact factory for details.

ACTUATION

Each 2050 and 2055 press is equipped with two maintained anti-repeat (non-tie-down) palm buttons, one located on the left and one on the right side of the base of the press. Both palm buttons must be pressed simultaneously to activate the press to cycle the welder. To operate the press, follow these simple steps:

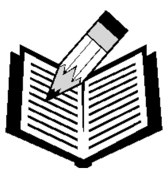
1. Depress both black palm buttons simultaneously.
2. Once the horn comes in contact with the part, the pressure switch closes and the ultrasonics are activated, release the palm buttons. If you release the buttons before contact is made, the head will immediately return to its "home" position.

EMERGENCY STOP

To abort the 2050 or 2055 press during welding, simply press the red EMERGENCY STOP button located at the front center of the press base.

Once the EMERGENCY STOP button has been depressed, the head will retract and return to its "home" position. Simply rotate the EMERGENCY STOP button clockwise 1/4 turn to release the press for further operation.

The equipment has safety devices that require both hands to be on the palm buttons until the horn contacts the workpiece. ***Do not defeat or modify these safety devices.***



NOTE: *Power supply cannot be shut off once the weld cycle has started. Termination of cycle can only be achieved by using the EMERGENCY STOP button.*

Do not use with a footswitch unless alternate means of pinch-point protection is provided.

FINE ADJUSTMENTS

NOTE: *Consult the Applications Manual or call our Applications Lab for proper booster selection.*

WARNING

High gain boosters, such as silver and black in combination with high gain horns can result in the horn cracking or failing.

BOOSTER SELECTION

The first step in optimizing welding conditions is to select a booster which will provide the necessary amplitude. For parts one inch (25.4mm) in diameter or greater, start with a moderately high amplitude booster such as a gold. For smaller parts, start with a green booster. Determine optimum amplitude by welding a few parts, and repeat the procedure with boosters giving higher or lower amplitude. If there appears to be little or no difference, use the booster giving the highest amplitude.

Seven standard boosters, color coded or engraved for ease of identification, are available either to increase or decrease the amplitude.

BOOSTER

Color	O-Ring Mount (standard) Part No.	Rigid Mount (optional) Part No.	Gain	Amplitude Effect
Black	BHN15TBK	BHNR15BK	2.50	Increase
Silver	BHN15TSI	BHNR15SI	2.00	Increase
Gold	BHN15GD	BHNR15GD	1.50	Increase
Brown	BHN15BR	BHNR15BR	1.25	Increase
Green	BHN15GR	BHNR15GR	0	No Change
Purple	BHN15PU	BHNR15PU	0.75	Decrease
Blue	BHN15BU	BHNR15BU	0.50	Decrease

PRESSURE

During the welding process, sufficient pressure should be applied to the part so that the mating surfaces contact each other. If the pressure is too low, the process will run inefficiently causing unnecessarily long weld time cycles, marking of the parts or poor welding. If the pressure is too high, the horn may stop vibrating, the part(s) might fracture, or the power supply might overload.

NOTE: *Contact between the booster and horn should be parallel. When encountering symptoms such as loud noises or tuning difficulties, examine the booster / horn interfaces for parallelism, corrosion, galling or foreign deposits. Also check the integrity and tightness of the stud.*

WARNING

DO NOT use anything coarser than 400 grit emery cloth.

WARNING

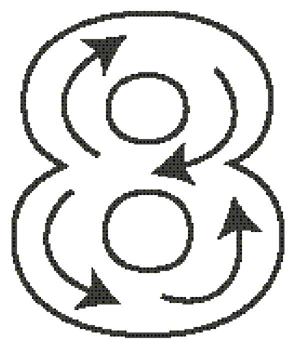
Machining of booster / horn may alter the ability to tune the component to the system. System inoperation may occur.

RE-ESTABLISHING PROPER BOOSTER / HORN INTERFACES

To re-establish proper interfaces, follow these instructions:

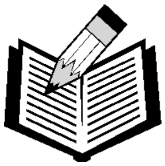
1. Using open-ended wrenches, separate the booster from the horn. Clean each item and then examine interfaces for irregularities (scoring).
2. If irregularities are present, remove the stud.
3. Tape a sheet of 400 grit emery cloth to a smooth, flat surface. (Do not use coarser than 400 grit.)
4. Grasp the lower portion of the booster or horn and move it across the emery cloth. To ensure proper lapping, a) hold the part straight, b) apply light downward pressure, and c) move in one direction only in a figure 8 pattern.

   Repeat the figure 8 pattern once more.



5. Then, rotate the booster or horn 1/3 of a turn in a clockwise direction and then repeat step 4.
6. Repeat step 5.
7. Using wire brush, clean stud, then replace securely. Tighten new stud to the recommended torque specifications on page 15.

MAINTENANCE



NOTE: If packing unit for return shipment, DO NOT use styrofoam "peanuts."

REPAIRS / SERVICE

If problems are encountered, contact our Service Department as follows:

Phone: 1-800-745-1105 • 1-203-270-4600 ext. 343 or 366

Fax: 1-203-270-4610

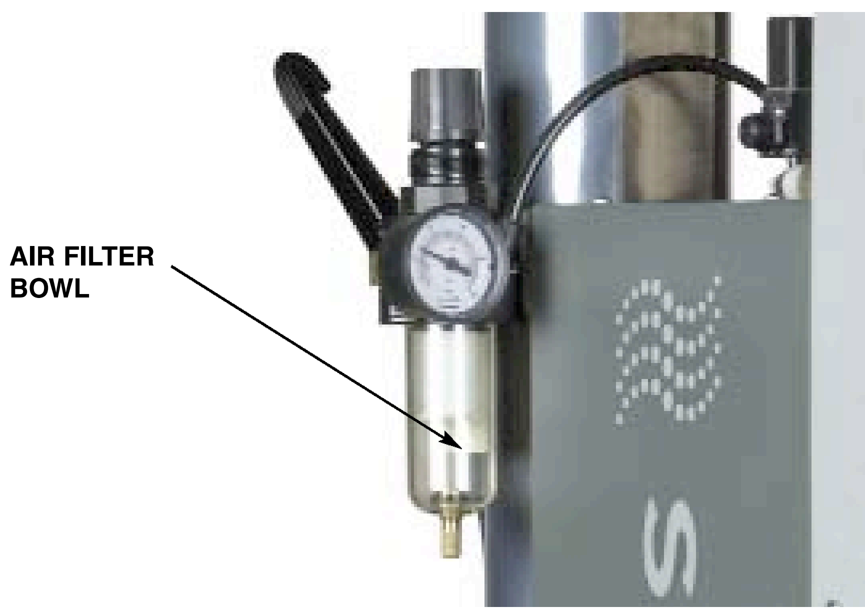
E-Mail: service@sonics.biz

It is suggested that a system in need of repair be sent back to the factory, with a written description pertaining to the nature of the problem.

Always contact the factory for return authorization before shipping any instrument. Include date of purchase, model number, and serial number. For units not covered by the warranty, a purchase order should be forwarded to avoid unnecessary delay. Care should be exercised to provide adequate packing to insure against possible damage in shipment. The system must be sent with all transportation charges prepaid and return method of shipment indicated.

DRAINING THE AIR FILTER BOWL

Periodically check the Air Filter Bowl for any moisture and/or condensation, and drain as necessary.



To drain, simply unscrew the knurled brass fitting at the bottom of the bowl. Drain any collected moisture, and then replace the fitting.

WARNING

Always disconnect the power supply from the electrical source before removing covers.

WARNING

Do not operate press without covers in place.

COVER REMOVAL

MODEL 2050 COVER REMOVAL

To remove the side panel cover:

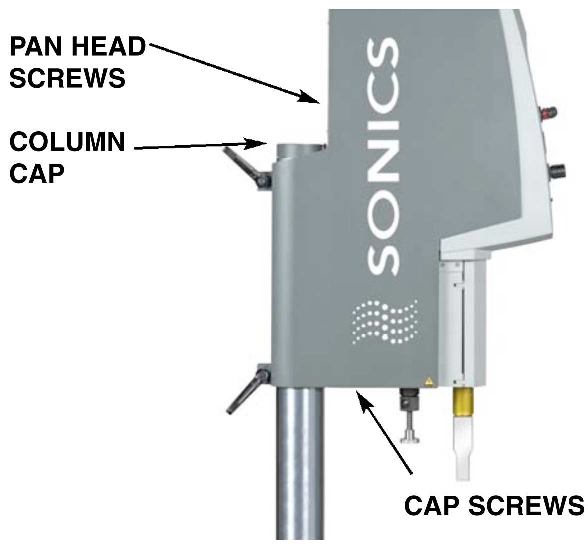
a. Maintain air pressure and unplug the power supply from the electrical source.

b. Loosen and remove the 2 Phillips pan head screws on the back of the cover.

c. Loosen and remove the 2 socket head cap screws at the bottom of the cover.

d. Loosen column clamps.

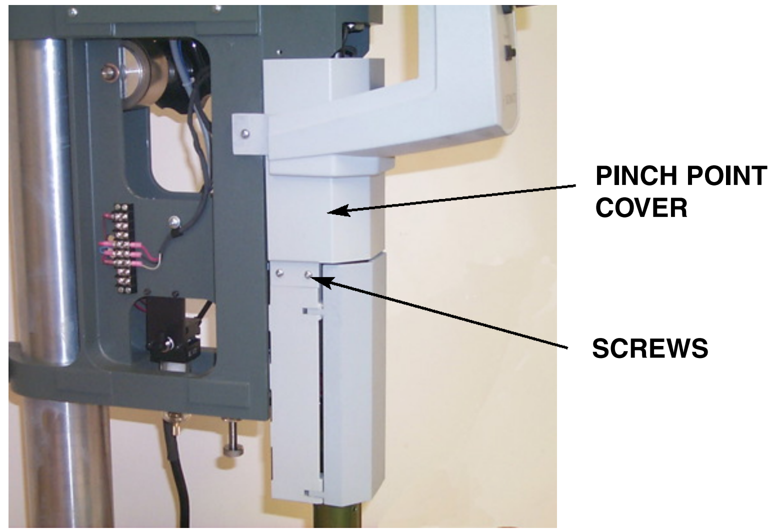
e. Raise head as shown below to bottom of column cap.



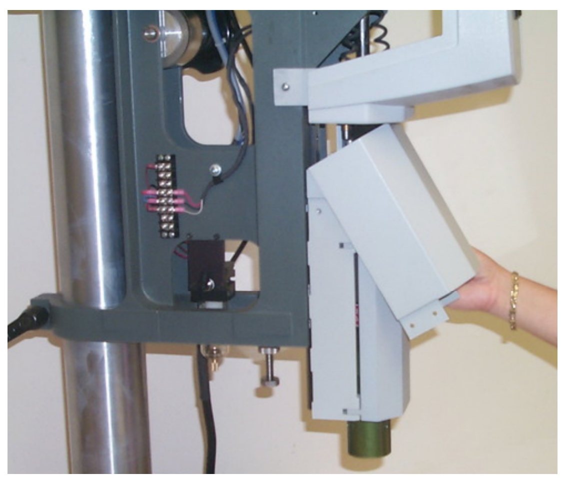
f. Slide the cover back and then lift it up and off.

To remove the pinch point cover:

a. Loosen and remove the cover's 4 screws - 2 on each side of the cover.



b. Pull the cover to the front and then pull it down and off as shown below.



MODEL 2055 COVER REMOVAL

To remove the side panel cover:

a. Maintain air pressure and unplug the power supply from the electrical source.

b. Loosen and remove the 4 Phillips pan head screws - 2 on the top of the cover and 2 on the bottom. (See photo on the next page.)

WARNING

Always disconnect the power supply from the electrical source before removing covers.

Do not operate press without covers in place.

__NOTE:__ Pressure switch is factory set and should not be adjusted unless authorized by Sonics Service Department.

PRESSURE SWITCH ADJUSTMENT

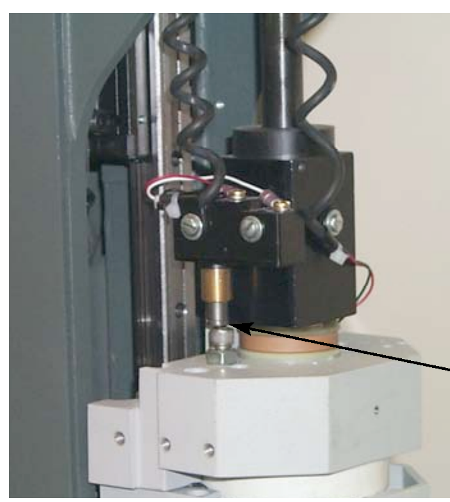
For systems mounted in the normal vertical position with downward travel, no adjustment should be necessary. The minimum trigger pressure is factory set at 4-7 psig.

However, if the minimum trigger pressure requires recalibration or re-adjustment, the pressure switch can be accessed and adjusted.

To access the pressure switch, it is first necessary to remove both the side panel cover and the pinch point cover as described above (for either the model 2050 or 2055 press). Then, observe the following procedure:

1. Loosen the jam nut holding the 1/4-20 cap screw in place.
2. Rotate the small, knurled, threaded rod upward until the Pressure Switch closes.

Do not operate press without covers in place.



3. Next rotate the cap screw down until the Pressure Switch opens.
4. Rotate cap screw down one turn past the Pressure Switch open position.
5. Tighten the jam nut to lock cap screw in position.
6. Replace pinch point cover and the side panel cover and position securely.
7. Plug the power supply into the electrical source.
8. Cycle the welder.

The press is now set to trigger at the minimum trigger pressure of 4-7 psig.

A press actuating in an upward or horizontal direction should be set to trigger at a minimum of 8-10 psig. Lower values may affect trigger performance where false triggering may be observed.

WARRANTY

Sonics & Materials, Inc., hereinafter referred to as "Sonics," warrants its products for a period of one year from the date of shipment against defect in material and workmanship under normal installation, use, and maintenance as described in the operating instructions which accompany such equipment. During the warranty period, "Sonics" will, at its option, as the exclusive remedy, either repair or replace without charge for material and labor, the part(s) which prove upon our examination to be defective, provided the defective unit is returned to us properly packed with all transportation charges prepaid.

Most ultrasonic welding horns constructed of titanium or aluminum are guaranteed against defects for a period of one year from date of shipment. Horns deemed by Sonics to be high risk are not covered by the standard warranty. "Sonics" will repair or replace a cracked or defective horn once without charge, if failure occurs within the warranty period.

Ultrasonic welding horns constructed of steel are guaranteed against defects for a period of ninety days from date of shipment. "Sonics" will repair or replace a cracked or defective steel horn once at a charge of 50% of the original purchase price, if failure occurs within the warranty period.

LIMITATION OF WARRANTY

This warranty is in lieu of any other warranties, either express, implied, or statutory. "Sonics" neither assumes nor authorizes any person to assume for it any other obligation or liability in connection with the sale of its products. "Sonics" hereby disclaims any warranty or 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 "Sonics" be liable to the purchaser or to any other person for any incidental or consequential damages or loss of profit or product resulting from any malfunction or failure of this "Sonics" product.

This warranty does not apply to equipment which has been subject to unauthorized repair, misuse, abuse, negligence or accident. Equipment which, in our judgment, 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.

No liability is assumed for expenses or damages resulting from interruptions in operation of the product or damages to material in process.

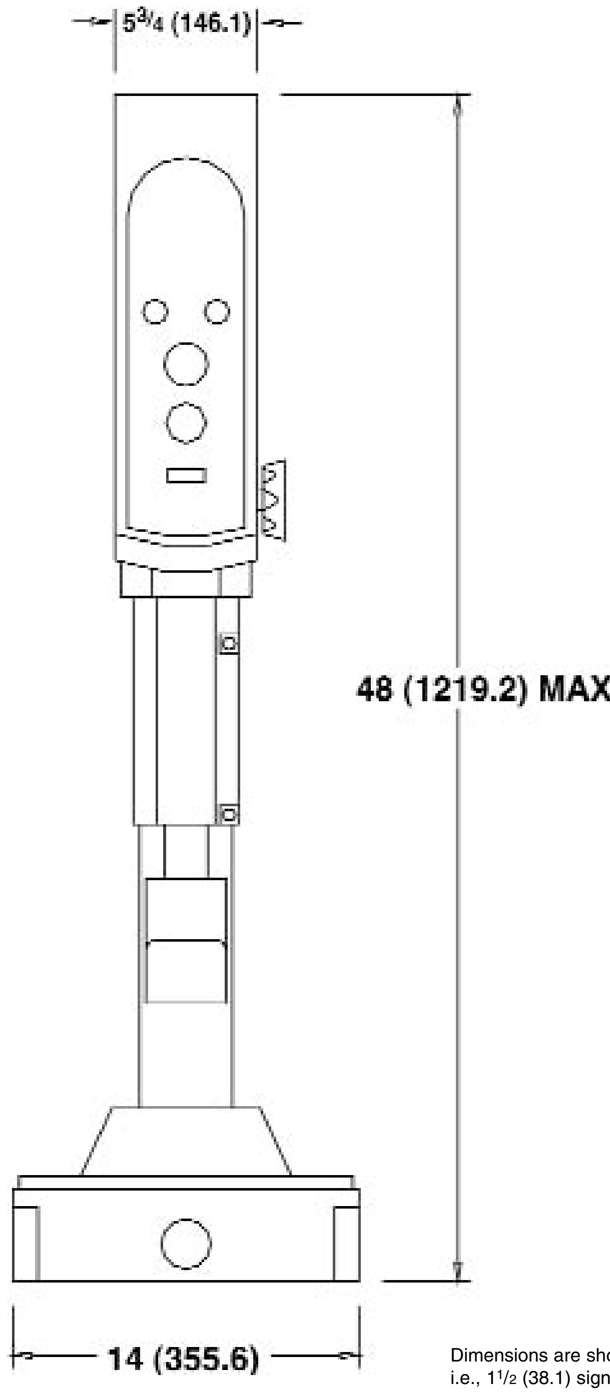
"Sonics" equipment is designed for maximum operator safety and incorporates built-in safety devices. Any modifications to these safety features will void the warranty. "Sonics" assumes no responsibilities for consequential damages incurred due to modifications to the said equipment.

"Sonics" reserves the right not to warrant horns of unusual or experimental design which in our judgment are more likely to fail in use.

This warranty does not cover equipment used for applications requiring metal-to-metal contact with weld time in excess of 0.5 seconds.

Data supplied in the instruction manual has been verified and validated and is believed adequate for the intended use of the equipment. If the equipment or procedures are used for purposes other than those specified herein, confirmation of their validity and suitability should be obtained in writing from "Sonics."

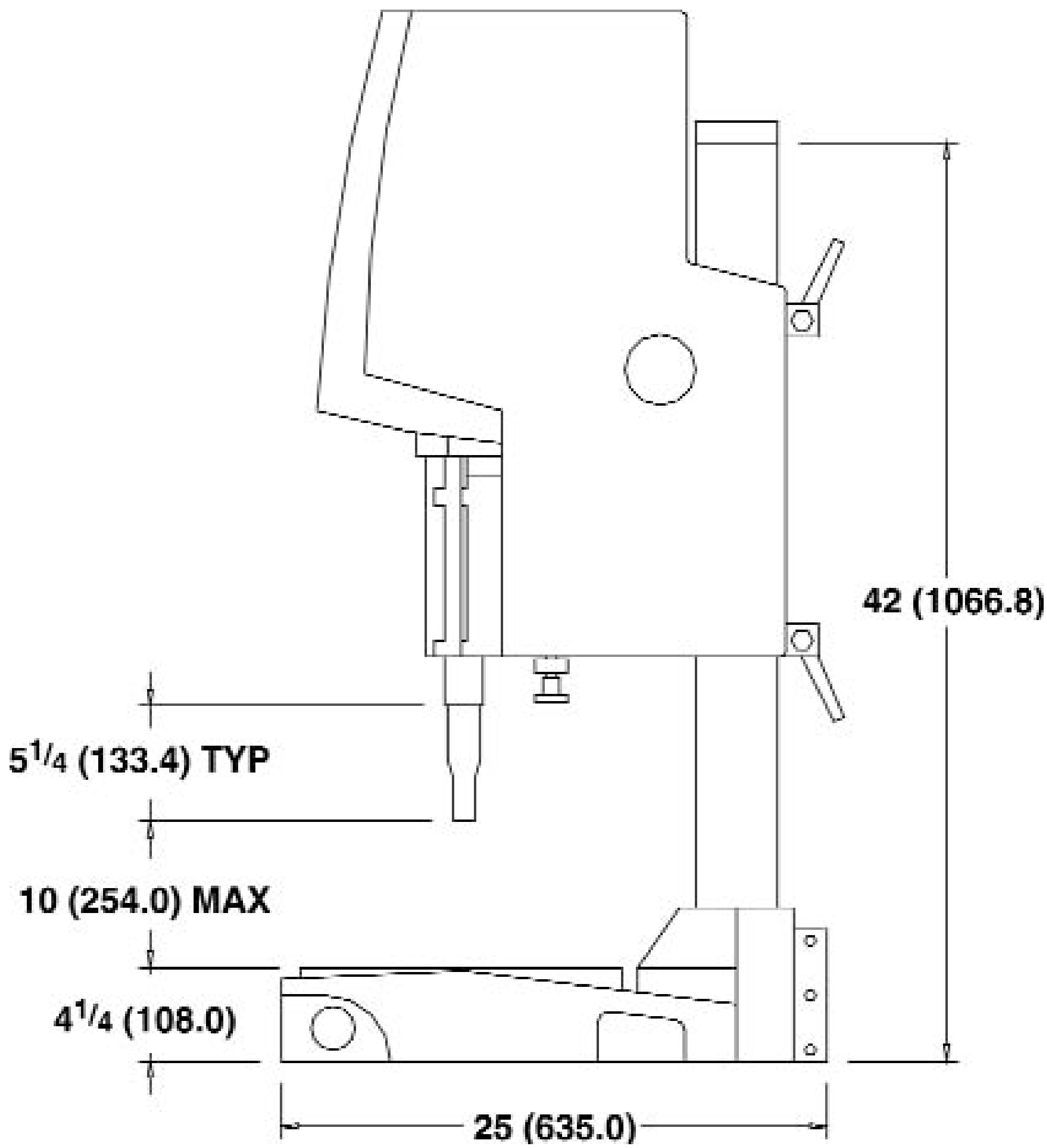
2050 LAYOUT
FRONT VIEW



Dimensions are shown in inches and millimeters, i.e., $1^1/_2$ (38.1) signifies $1^1/_2$" (38.1mm)

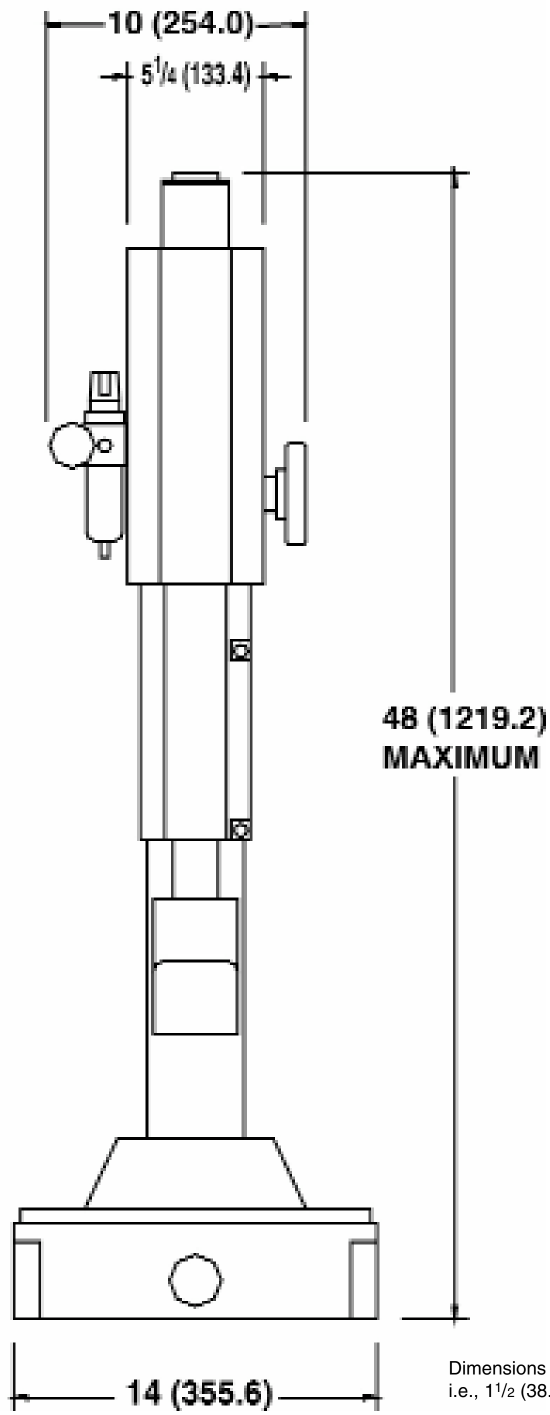
APPENDIX

2050 LAYOUT SIDEVIEW



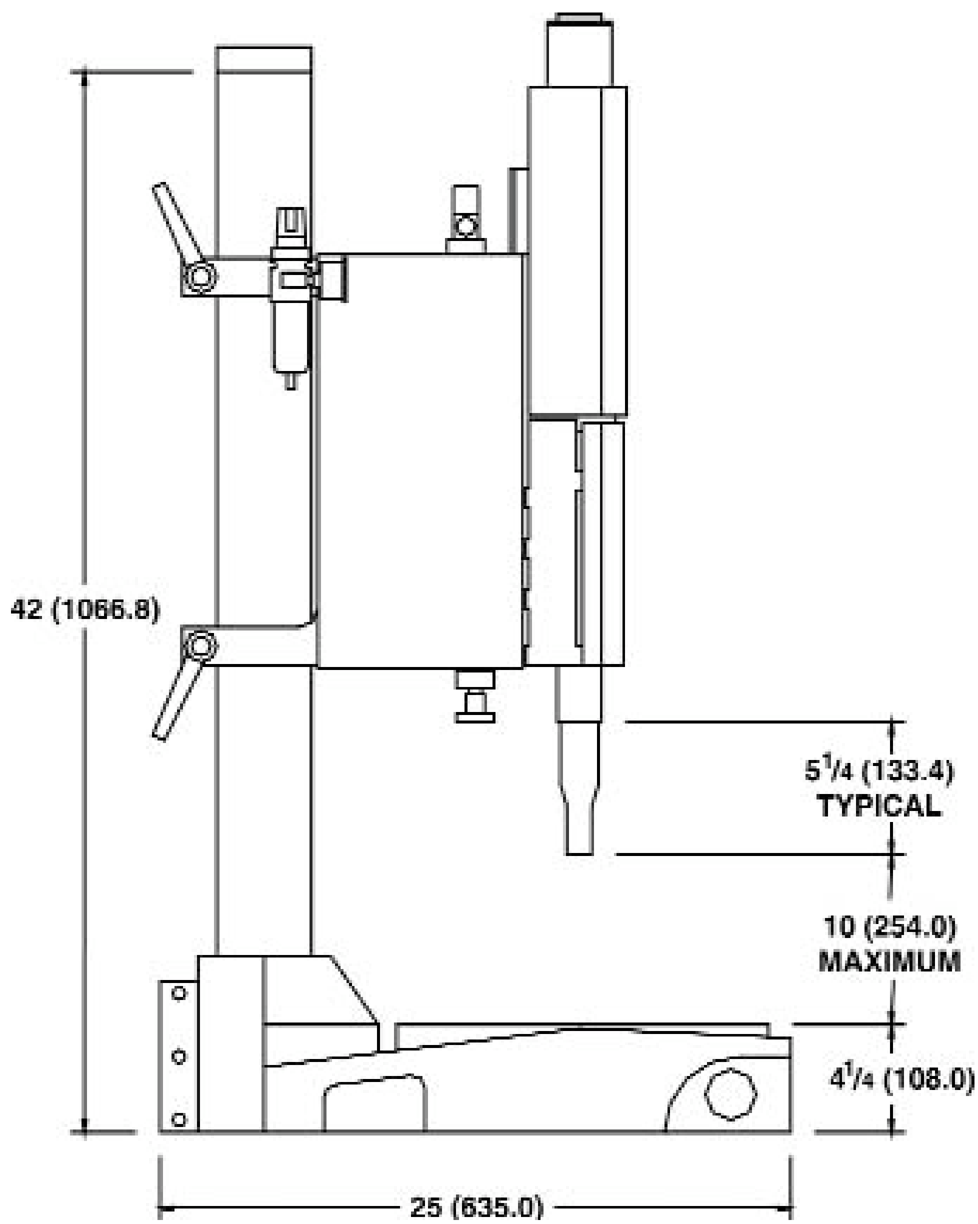
Dimensions are shown in inches and millimeters,
i.e., $1^{1}/_{2}$ (38.1) signifies $1^{1}/_{2}$" (38.1mm)

2055 LAYOUT
FRONT VIEW



Dimensions are shown in inches and millimeters, i.e., 1 1/2 (38.1) signifies 1 1/2" (38.1mm)

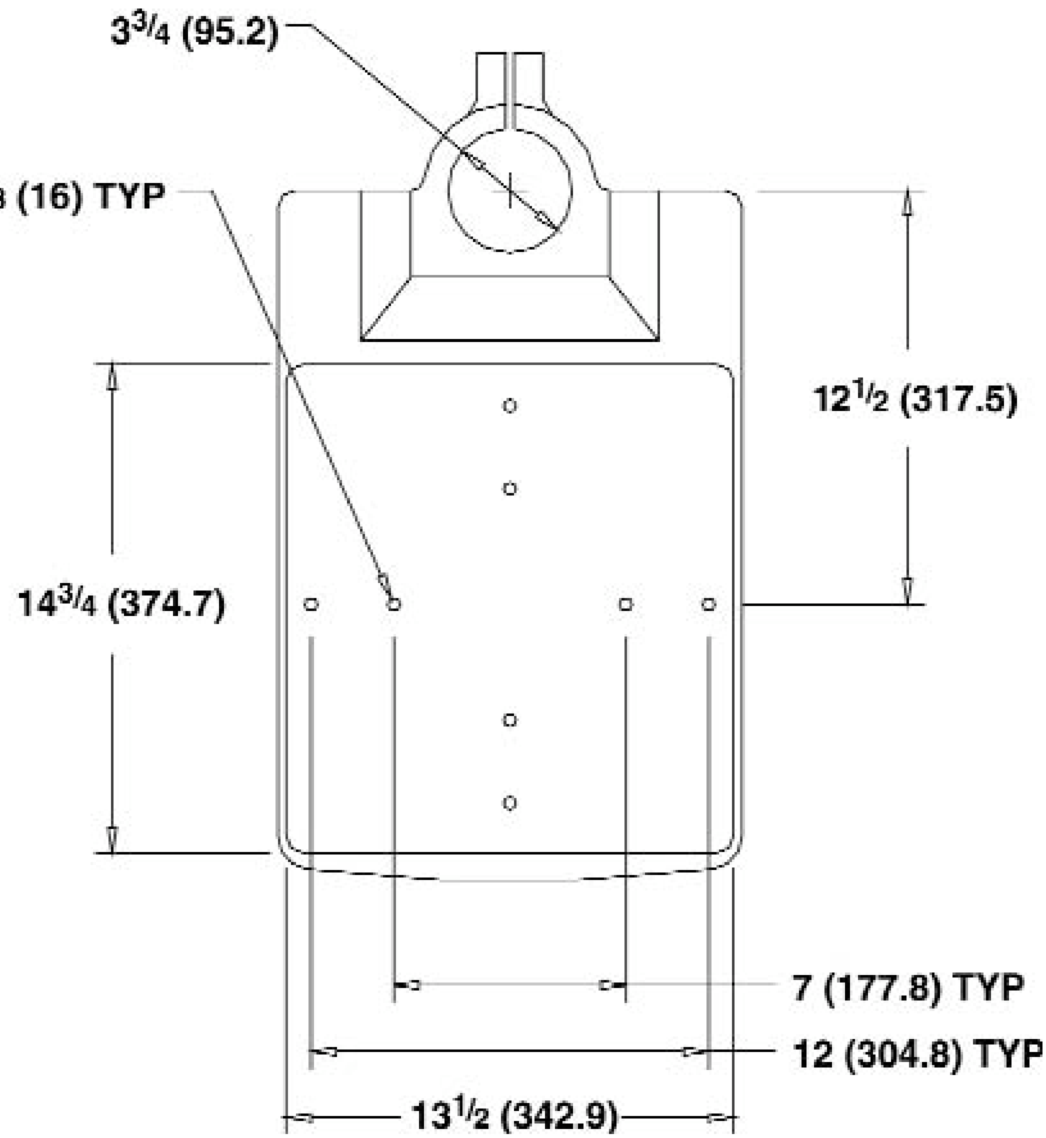
2055 LAYOUT SIDEVIEW



Dimensions are shown in inches and millimeters, i.e., 1 1/2 (38.1) signifies 1 1/2" (38.1mm)

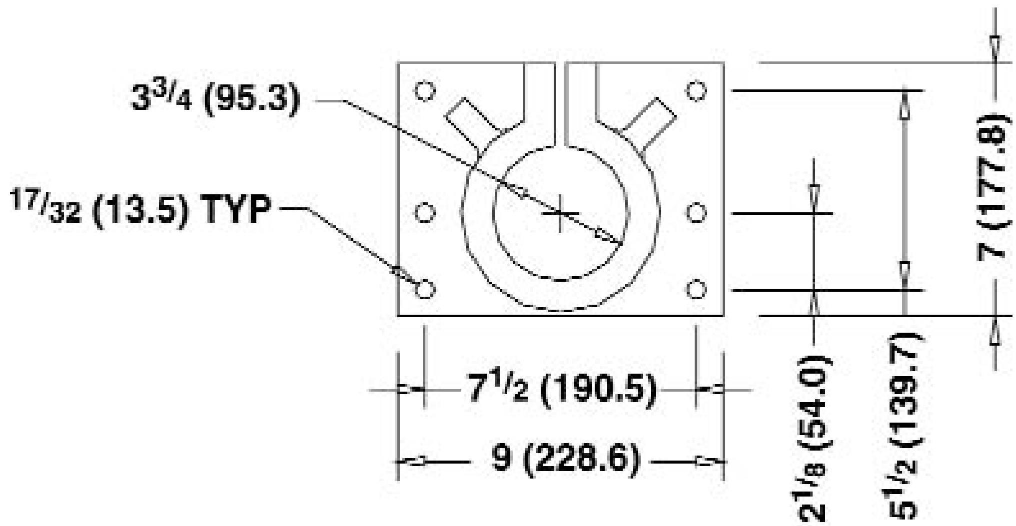
APPENDIX

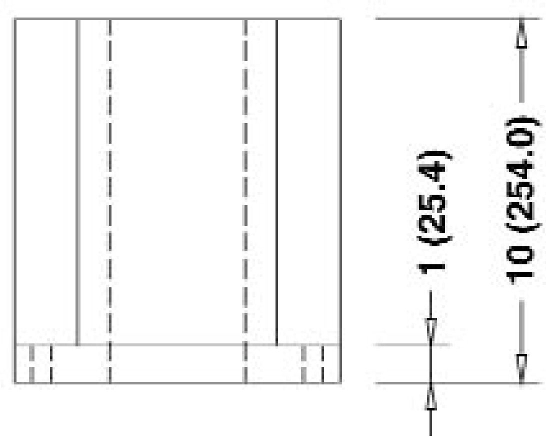
BASE LAYOUT



Dimensions are shown in inches and millimeters,
i.e., 1 1/2 (38.1) signifies 1 1/2" (38.1mm)

OPTIONAL STAND-ALONE MOUNTING HUB LAYOUT





Dimensions are shown in inches and millimeters, i.e., $1^1/_2$ (38.1) signifies $1^1/_2$" (38.1mm)

Model 1098 Press

INSTRUCTION MANUAL

SONICS

Sonics & Materials, Inc.

WARNING

SAFETY PRECAUTIONS
READ BEFORE INSTALLING OR USING THE EQUIPMENT

Our systems have been designed to assure maximum operator safety. However, no design can completely protect against improper usage. For maximum safety and equipment protection, observe the following warnings at all times and read all applicable instruction manuals carefully before you attempt to operate any equipment.

– The equipment has safety devices that require both hands to be on the palm buttons until the horn contacts the work piece. Do not defeat or modify these safety devices.

– Do not use with foot switch unless alternate means of pinch-point protection is provided.

– High voltage is present in the equipment. Disconnect plug before removing cover or servicing.

– Make sure equipment is properly grounded with a 3-prong plug. Before plugging in equipment, test outlet for proper earth grounding.

– High voltage potential may be present in the converter as a result of temperature changes. Do not touch the converter contact unless you first short both pins or the button to the converter case with an insulated tool.

– Never squeeze or grab a vibrating horn.

– Do not modify horn configurations.

– Ultrasonic welders operate above normal audibility for most people. Ear protection is recommended. Consult the Appendix for a list of manufacturers of ear protectors.

– Do not affix any device to any portion of the horn.

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Rev 00 8/01

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IMPORTANT SERVICE LITERATURE

***NOTE:** Please read carefully before operating the equipment, then forward to your service department.*

The system 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.

MANUAL CHANGE INFORMATION

We continually strive to be at the forefront of the latest electronic developments by adding circuit and component improvements to our equipment as soon as they are developed and tested.

Sometimes, due to printing and shipping requirements, we cannot incorporate these changes immediately into printed manuals. Hence, your manual may contain new change information. Change information, if any, is located in the Appendix.

We reserve the right to make any changes in the design or construction of our equipment at any time, without incurring any obligation to make any change whatsoever in units previously delivered.

The technical data and schematics in the manual are for informational purposes only and may not reflect the current configuration being shipped from our factory. Upon formal request, complete and up-to-date information can be provided from the factory free of charge.

UNPACKING AND INSPECTION

__NOTE:__ We recommend keeping all carton(s) and packing material in case it might be necessary to move the equipment, or to ship it for repair.

Before unpacking the equipment, check the shipping carton for any visible damage. If you see any, be sure to follow the procedures described below under “Visible Loss or Damage.” Otherwise, proceed to remove the equipment from the carton. Before disposing of any packing material, check it carefully for small parts. Then perform a visual inspection of the equipment to detect any evidence of damage which might have occurred during shipment. Check the following:

1. all components against the enclosed packing list,
2. all module plug-in units,
3. all wire plug-in connections.

The equipment was carefully packed and thoroughly inspected before leaving our factory. All units are tested and checked for problems prior to shipping. It is asked that when a problem does occur that all parts and components be inspected for damage (especially when the unit is not in working order when received). Responsibility for safe delivery was assumed by the carrier upon acceptance of the shipment. Claims for loss of damage sustained in transit must therefore be made upon the carrier, as follows:

VISIBLE LOSS OR DAMAGE

Any external evidence of loss or damage must be noted on the freight bill or express receipt, and signed by the carrier’s agent. Failure to adequately describe such external evidence of loss or damage may result in the carrier’s refusal to honor a damage claim. The form required to file such a claim will be supplied by the carrier.

CONCEALED LOSS OR DAMAGE

Concealed loss or damage means loss or damage which does not become apparent until the merchandise has been unpacked. The contents might have been damaged in transit due to rough handling even though the container may not show external damage. When the damage is discovered upon unpacking, make a written request for inspection by the carrier’s agent within 48 hours of the delivery date. Then file a claim with the carrier since such damage is the carrier’s responsibility. The form required to file such a claim will be supplied by the carrier. Do not destroy packing materials, or move material from one location to another before the carrier makes their inspection.

If the system or any unit is damaged, notify “Sonics.” “Sonics” will arrange for repair or replacement of damaged equipment without waiting for the claim against the carrier to be settled, provided a new purchase order is issued to cover the repair or replacement costs. Should any damage, shortage or discrepancy exist, please notify us immediately.

INTRODUCTION

The model 1098 press is a 20 kHz precision pneumatic actuator (tabletop version) used for ultrasonic plastics assembly. The 1098 press can be supplied with the following power supplies:

- FD . . . . .Timer
- FDL . . . . .Timer/Linear Encoder
- FM . . . . .Microsonic Processor™
- FO/ML . . . . .Microsonic Processor™/Linear Encoder

OVERVIEW OF ULTRASONIC PLASTICS ASSEMBLY

WHAT IS ULTRASONICS?

Ultrasonics refers to vibrational waves with a frequency above the human audible range which is usually above 18,000 cycles per second (Hz).

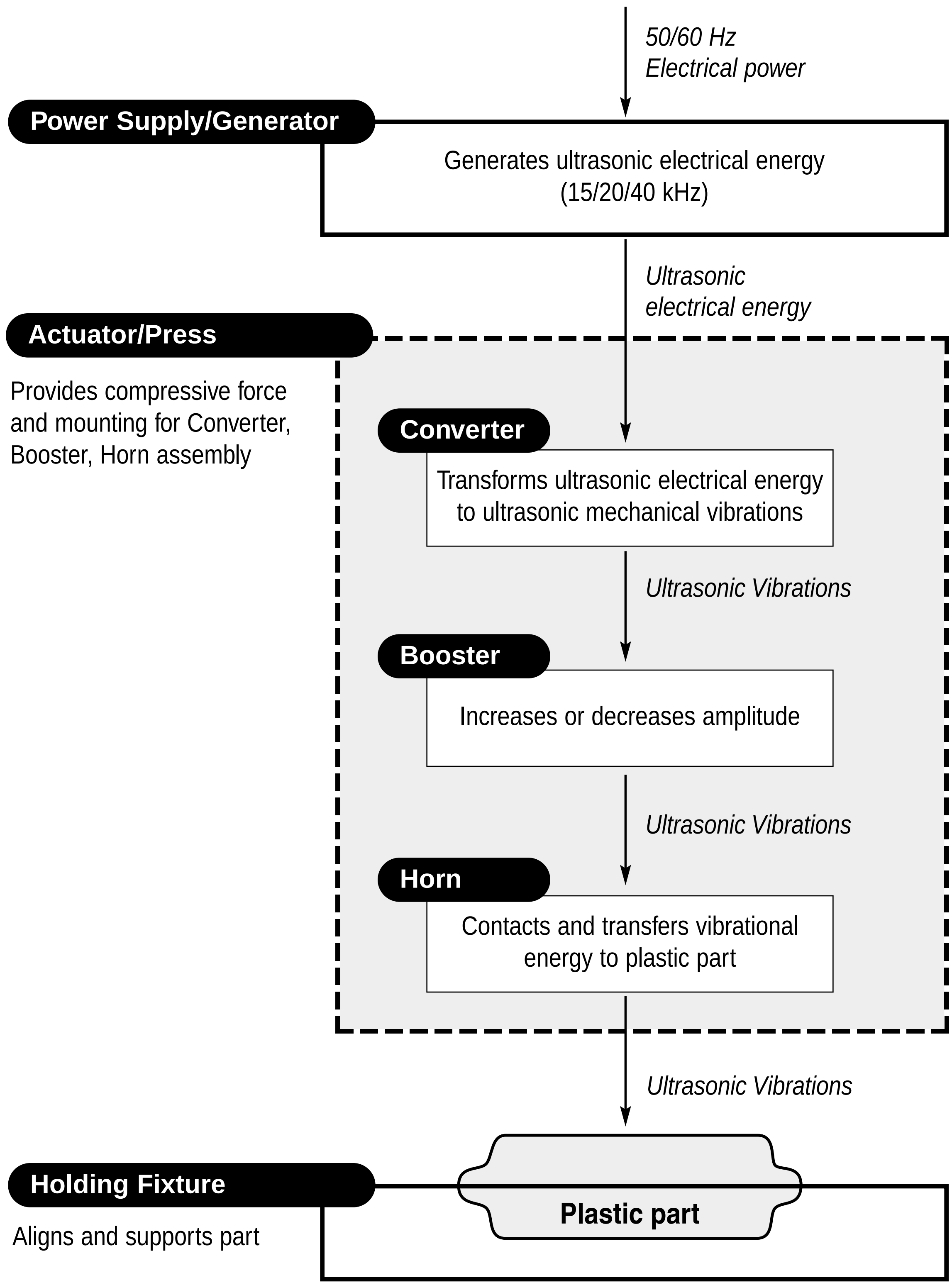
PRINCIPLE OF ULTRASONIC ASSEMBLY

The basic principle of ultrasonic assembly involves conversion of high frequency electrical energy to high frequency mechanical energy in the form of reciprocating vertical motion which, when applied to a thermoplastic, generates frictional heat at the plastic/plastic or plastic/metal interface. In ultrasonic welding, this frictional heat melts the plastic, allowing the two surfaces to fuse together; in ultrasonic staking or insertion, the controlled flow of molten plastic is used to capture or lock another material in place (staking) or encapsulate a metal insert (insertion).

ULTRASONIC ASSEMBLY SYSTEMS

“Sonics” ultrasonic assembly systems are generally composed of the following major elements: a power supply, converter, booster, horn, pneumatic press and holding fixture, as detailed in the diagram on the next page. A review of this diagram will help you understand the basic elements involved in the assembly process and their relation to each other.

"SONICS" ULTRASONIC ASSEMBLY SYSTEMS



GLOSSARY OF ULTRASONIC TERMS

POWER SUPPLY/GENERATOR – The solid state power supply converts standard 50/60 Hz electrical power to 15,000 Hz, 20,000 Hz, and 40,000 Hz (15/20/40 kHz) electrical energy.

ACTUATOR/PRESS – The pneumatic actuator provides compressive force and mounting for the converter, booster, and horn assembly. The tabletop press consists of a base assembly, column and actuator (head).

CONVERTER – The converter changes the high frequency electrical energy supplied by the power supply to high frequency mechanical vibrations.

BOOSTER – Successful ultrasonic welding often depends on having the right amplitude at the horn face. Often it is not possible to design a horn which has both the necessary shape and required gain (ratios of input amplitude to output amplitude). In such cases, a booster is placed between the converter and the horn to either increase or decrease the amplitude of the horn. In addition to changing/maintaining the amplitude, the booster provides support and alignment in the welding system. (See page 18 for booster selection.)

HORN – The horn is a tuned component of the system which comes in contact with the parts to be assembled. The horn 1) transfers the ultrasonic vibrations produced from the converter to the parts being welded, and 2) applies necessary force to the assembly while the material resolidifies.

HOLDING FIXTURE – The holding fixture or nest assures proper alignment and support of the parts being assembled.

MODEL 1098

ELECTRICAL POWER

The press is powered by the power supply. Consult your power supply instruction manual to determine power specifications.

WARNING

Do not connect the press to an air source supplied by a compressor lubricated with synthetic oils or oils containing phosphate esters or chlorinated hydro-carbons. This type of lubricant may cause the air filter to malfunction, and the plastic bowl to rupture.

AIR SUPPLY

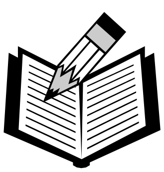
The press requires a source of dry, filtered (5 micron), oil-free, compressed air capable of supplying a constant line pressure of 85 psig. (586 kPa / 6 bar) at a minimum capacity of 2 CFM.

SETTING UP

The press should be installed in a clear, uncluttered location that is free from excessive dirt, dust, corrosive fumes, and temperature and humidity extremes. The selected installation site should be near the electrical power and air supply sources and away from any equipment that generates abnormally high electrical transients. Observe the following additional instructions when installing the press:

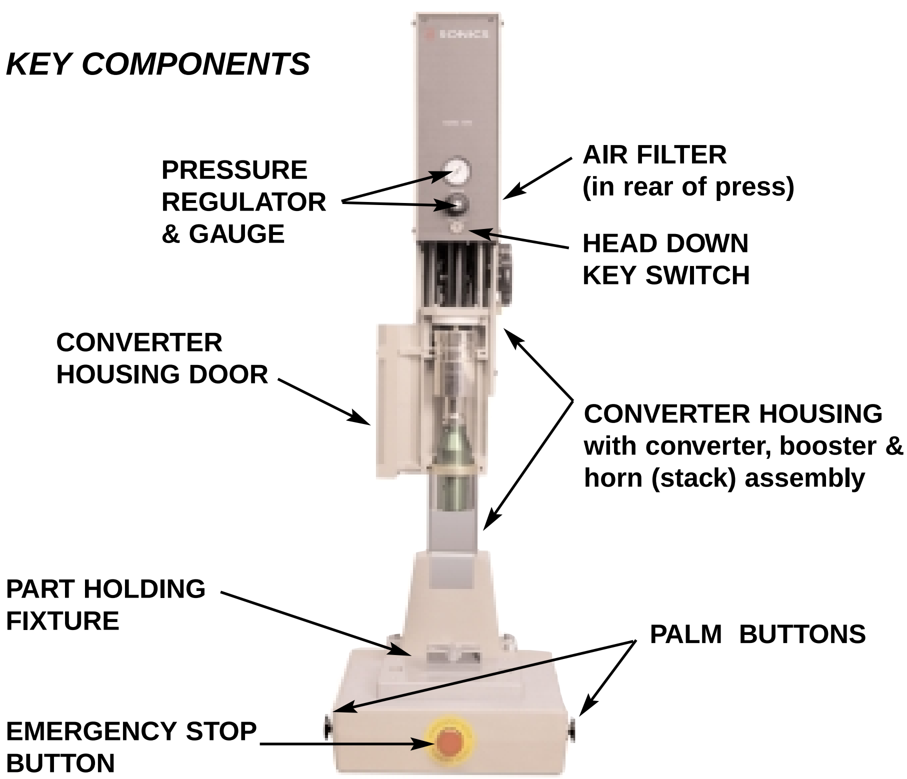
a. The press should be placed on a sturdy, level table or bench capable of supporting a minimum of 500 pounds (227 kg).

b. Allow at least 6 inches (152.4mm) at the rear of the press for cable connections.



NOTE: *If the power supply is to be run continuously, air cooling of the converter and horn is required. Use clean, dry compressed air filtered down to 5 microns (supplied to converter fitting).*

KEY COMPONENTS



NOTE: *Do not strain or kink the cables. When going around corners, allow as wide a bend as possible. Do not run the cables parallel to any power line within a distance of less than 1 foot (304.8mm).*

CONNECTIONS

When making the initial connections, make sure all power is disconnected.

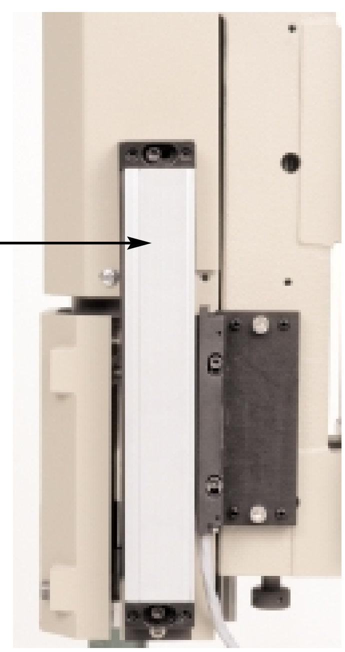
1. Connect the air supply source to the press air filter located at the right, rear of the press head, using a hose having a minimum inside diameter of 1/8 inch (3 mm).
2. Connect the RF and base (actuating) cables of the press to the power supply. (Consult your power supply instruction manual for details.)
3. Check with your electrician if you have any wiring questions.

OPTIONS

A Linear Encoder is available as an option. The Linear Encoder allows distance-controlled welding in incremental and absolute modes.

The Linear Encoder is supplied with a 9-pin male connector that connects to a matching 9-pin female connector on the power supply (factory installed).

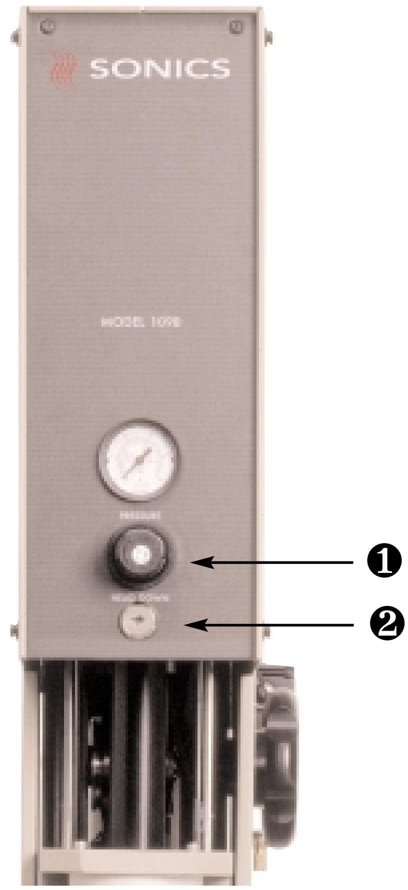
LINEAR ENCODER



OPERATING PROCEDURES

CONTROL PANEL

Located above the converter housing on the 1098 press are the following controls:



1. Black PRESSURE REGULATOR with corresponding gauge that allows regulation of the (air) pressure with which the horn contacts the part(s). Pull the knob to make adjustments, and then push in to lock setting when desired pressure is displayed on the gauge. Once pulled, turning the knob clockwise increases pressure, and turning it counterclockwise decreases pressure.

2. HEAD DOWN KEY SWITCH which when turned clockwise allows the head to move down under gauge pressure. (This action does not cause ultrasonics to be activated.)

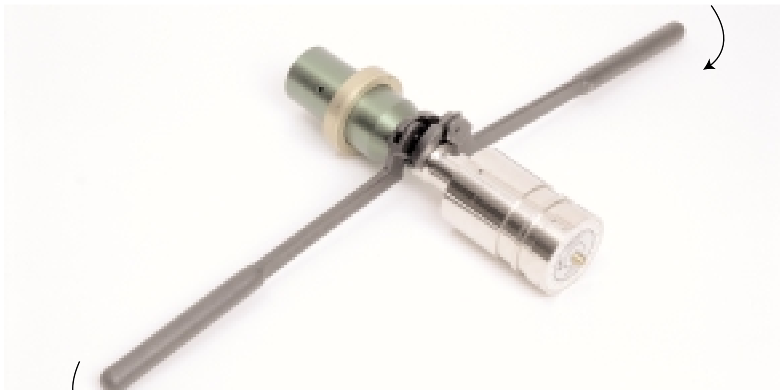
WARNING

Never tighten the horn to the booster using the housing door as the upper wrench as this may cause damage to the booster and/or converter.

ASSEMBLING AND MOUNTING CONVERTER, BOOSTER, AND HORN

If the converter, booster, and horn are not already assembled, follow these instructions:

1. Clean the mating surfaces of the converter and booster, as well as the threaded stud and hole. Check that the stud is tight (see recommended torque requirements on page 13).
2. Hand assemble the converter and booster together. Using spanner wrenches as shown below, tighten until snug. Then, using a torque wrench, tighten to 25-35 inch-lbs.(2.8-4.0 newton-meters). **Do not force or overtighten.**



CONVERTER/BOOSTER

3. Clean the mating surfaces of the booster and horn, as well as the threaded stud and hole. Check that the stud is tight. (See recommended torque requirements on next page.)
4. Hand assemble the horn to the booster. Using a spanner and an open-ended wrench as shown below, tighten securely. Then, using a torque wrench, tighten to 25-35 inch-lbs. (2.8-4.0 newton-meters). **Do not overtighten.**

CONVERTER/BOOSTER/HORN

NOTE: *When performing any of the operations described on this page and pages 14-15, DO NOT turn on the power supply.*

5. Using the 3/16” (4.7 mm) T-handle wrench provided, loosen (turn counterclockwise) the two cap screws screws on the hinged converter housing and open the door.
6. Place the converter / booster / horn assembly in the housing with the horn facing down. Fit the male brass button on the top of the converter into the female brass fitting in the bottom of the contact block assembly housing, and gently push the assembly up and in so that the booster mounting ring rests on the lower support ridge.

CONVERTER / BOOSTER / HORN ASSEMBLY

WARNING

Never tighten the horn to the booster using the housing door as the upper wrench as this may cause damage to the booster and/or converter.

7. Close the converter housing door and tighten (turn clockwise) the two socket head cap screws just until they are snug. Do not tighten the horn to the booster using the door as the upper wrench. Hand-forcing the horn on and off in this manner can twist wires and cause a failure. If the horn is not in the correct position to make contact with your material, re-position the converter.

NOTE: *If you do not close the housing door once the assembly is in place, the assembly can fall out.*

RECOMMENDED TORQUE REQUIREMENTS

Component	Inch-Lbs.	Newton-Meters
Converter / Booster	25 - 35	2.8 - 4.0
Booster / Horn	25 - 35	2.8 - 4.0
Stud	45	5.1
Tips	25 - 35	2.8 - 4.0

WARNING

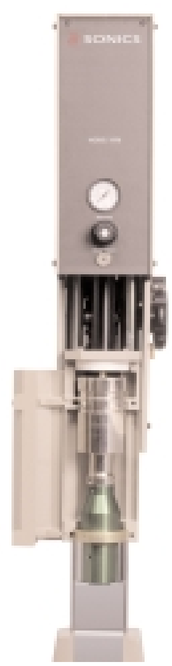
Support the head before releasing the column clamps so that it cannot crash down or fly up. Ignoring this warning might result in injury and/or damage to the equipment and part being welded.

HORN AND FIXTURE ALIGNMENT

For maximum productivity, the clearance between the horn and the part should be at a minimum. However, adequate clearance should be provided to enable easy loading and unloading of the part from the holding fixture. The maximum stroke distance is 4" (101.6 mm). Ensure that the horn does not contact the part when the head is close to the limit of its down travel distance. Otherwise, the horn may not have sufficient distance to travel downwards to achieve a full depth of weld. Set welding height as follows:

First, position the holding fixture loosely on the base plate using 3/8-16 screws. Then, place the part to be welded in the fixture.

1. Insert key and turn the HEAD DOWN key switch clockwise to allow head movement. Then, before loosening the column clamps, hold onto the head assembly firmly as it can move rapidly up or down with heavy tooling once the clamps are released. While holding the head assembly, loosen the two column clamps (counterclockwise) and move the head up or down as required. Then tighten the column clamps.
2. Using the PRESSURE REGULATOR (turn counterclockwise) and corresponding gauge, set the air pressure to zero.
3. Loosen the column clamps once again and manually lower the head until the horn contacts the part. Tighten the clamps.
4. Loosen the cap screws on the converter housing door and gently rotate the head and horn as required to ensure proper horn-to-part alignment.



5. Lock the two column clamps, tighten the converter housing door screws, and then tighten the fixture on the base plate.
6. Check for proper mating of fixture, parts, and horn. If the horn and part are not in parallel contact, shim the fixture or adjust leveling screws as required.
7. Set the PRESSURE regulator to a reading of 20 psig (140 kPa/1.4 bar) on the pressure gauge. (Turn the PRESSURE knob clockwise.)
8. To check that the horn and parts are properly aligned, the horn needs to be lowered. Read through the Operation instructions on page 16, and then proceed to lower the horn as detailed. If the horn and parts are not sufficiently aligned, then repeat steps 4 through 8. However, if you are working with small, delicate parts, then fine adjustments can be made using the positive stop adjustment knob as explained below.

NOTE: *For maximum safety and productivity, adjust the clearance between the horn and the part to a minimum that will still allow ease of loading and unloading.*

POSITIVE STOP ADJUSTMENT

The positive stop is set to limit the downward travel of the horn to approximately 75%. Readjustments may be required. Coarse adjustment of the clearance between the face of the horn and part should be made using the elevation control. Fine adjustment should be made using the positive stop.

The positive stop adjustment knob is located offset from the converter housing. Turning the knob clockwise will decrease downward travel distance. Turning the knob counterclockwise will increase the downward travel distance. Rotate the knurled thumbscrew to lock and unlock the positive stop.

ACTUATION

The 1098 press is equipped with two maintained anti-repeat (non-tie-down) palm buttons, one located on the left and one on the right side of the base of the press. Both palm buttons must be pressed simultaneously to activate the press to cycle the welder. To operate the press, follow these simple steps:

1. Depress both black palm buttons simultaneously.
2. Once the horn comes in contact with the part and the ultrasonics are activated, release the palm buttons. If you release the buttons before contact is made, the head will immediately return to its “home” position.

EMERGENCY STOP

To abort the 1098 press during welding, simply press the red EMERGENCY STOP button located at the front center of the press base.

Once the EMERGENCY STOP button has been depressed, the head will retract and return to its “home” position. Simply rotate the EMERGENCY STOP button to the right 1/4 turn to release the press for further operation.

WARNING

The equipment has safety devices that require both hands to be on the palm buttons until the horn contacts the workpiece. ***Do not defeat or modify these safety devices.***

NOTE: *Power supply cannot be shut off once the weld cycle has started. Termination of cycle can only be achieved by using the EMERGENCY STOP button.*

WARNING

Do not use with a footswitch unless alternate means of pinch-point protection is provided.

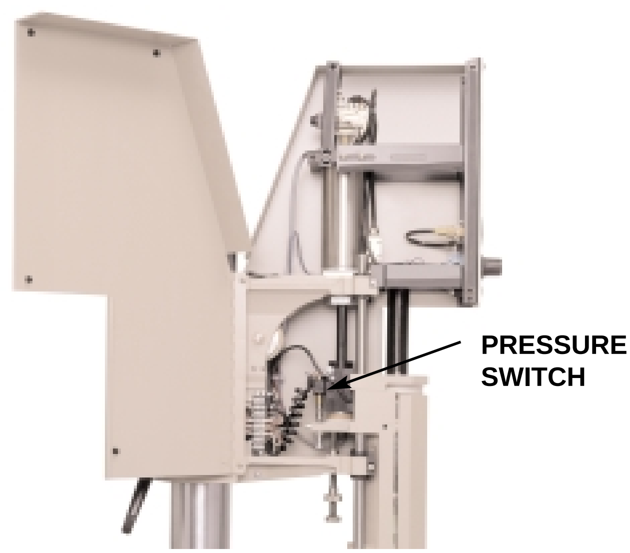
FINE ADJUSTMENTS

PRESSURE SWITCH ADJUSTMENT

For systems mounted in the normal vertical position with downward travel, no adjustment should be necessary. The minimum trigger pressure is factory set at 4-7 psig.

However, if the minimum trigger pressure requires recalibration or re-adjustment, observe the following procedure:

1. Maintain air pressure and unplug the power supply from the electrical source.
2. Release the four latches to open the hinged side cover.
3. Loosen the jam nut holding the 1/4-20 cap screw in place.
4. Rotate the small, knurled, threaded rod upward until the Pressure Switch closes.



5. Next rotate the cap screw down until the Pressure Switch opens.
6. Rotate cap screw down one turn past the Pressure Switch open position.
7. Tighten the jam nut to lock cap screw in position.
8. Close the hinged side cover and secure latches.
9. Plug the power supply into the electrical source.
10. Cycle the welder.

The press is now set to trigger at the minimum trigger pressure of 4-7 psig.

A press actuating in an upward or horizontal direction should be set to trigger at a minimum of 8-10 psig. Lower values may affect trigger performance where false triggering may be observed.

BOOSTER SELECTION

NOTE: Consult the Applications Manual or call our Applications Lab for proper booster selection.

The first step in optimizing welding conditions is to select a booster which will provide the necessary amplitude. For parts one inch (25.4mm) in diameter or greater, start with a moderately high amplitude booster such as a gold. For smaller parts, start with a green booster. Determine optimum amplitude by welding a few parts, and repeat the procedure with boosters giving higher or lower amplitude. If there appears to be little or no difference, use the booster giving the highest amplitude.

Seven standard boosters, color coded or engraved for ease of identification, are available either to increase or decrease the amplitude.

WARNING

High gain boosters, such as silver and black in combination with high gain horns can result in the horn cracking or failing.

BOOSTER

Color	Part No.	Gain	Amplitude Effect
Black	BHN15TBK	2.50	Increase
Silver	BHN15TSI	2.00	Increase
Gold	BHN15GD	1.50	Increase
Brown	BHN15BR	1.25	Increase
Green	BHN15GR	0	No Change
Purple	BHN15PU	0.75	Decrease
Blue	BHN15BU	0.50	Decrease

PRESSURE

During the welding process, sufficient pressure should be applied to the part so that the mating surfaces contact each other. If the pressure is too low, the process will run inefficiently causing unnecessarily long weld time cycles, marking of the parts or poor welding. If the pressure is too high, the horn may stop vibrating, the part(s) might fracture, or the power supply might overload.

STROKE SPEED ADJUSTMENT

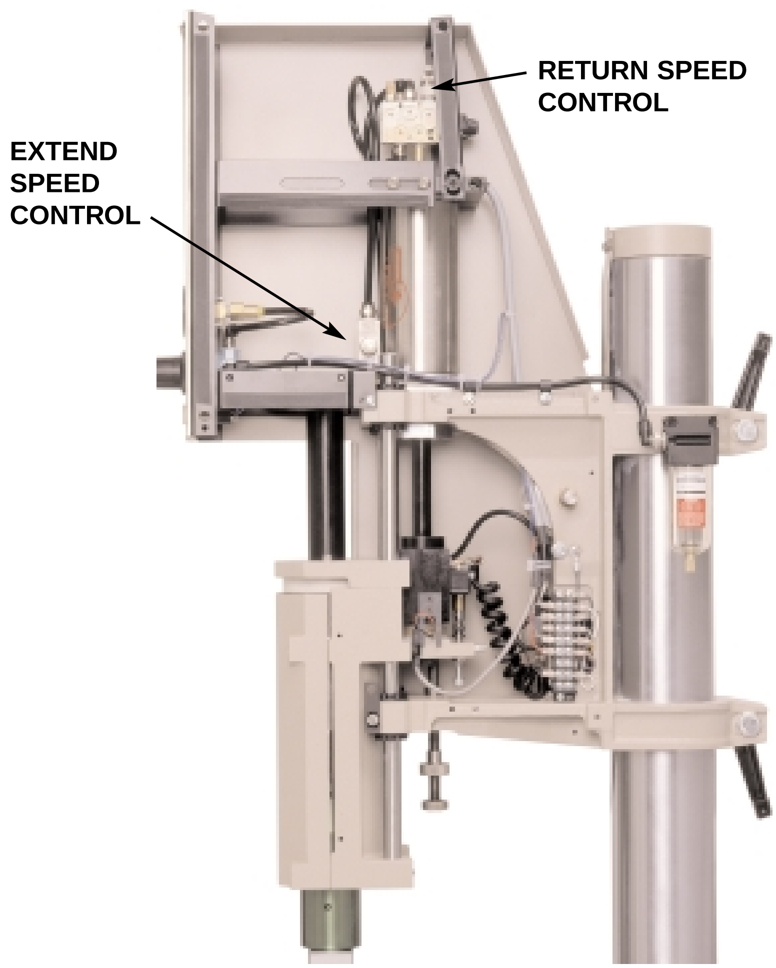
WARNING

Excessive velocity may be unnecessary and harmful to the system.

The velocity at which the horn descends and returns can be adjusted via the speed controls. These controls are factory adjusted for average operating conditions and should not require further adjustment. However, if a minor adjustment is necessary, adjust in small degrees. Turn clockwise to slow the extend speed, and counterclockwise to increase the return speed.

The speed controls are 2 small threaded screws located in the top of the press as shown below.

Turn the Extend Speed Control screw clockwise to slow the extend speed, counterclockwise to increase the speed. Turn the Return Speed Control screw clockwise to slow the return speed, counterclockwise to increase speed.



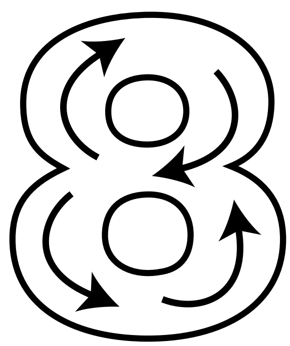
NOTE: *Contact between the booster and horn should be parallel. When encountering symptoms such as loud noises or tuning difficulties, examine the booster / horn interfaces for parallelism, corrosion, galling or foreign deposits. Also check the tightness of the stud.*

RE-ESTABLISHING PROPER BOOSTER / HORN INTERFACES

To re-establish proper interfaces, follow these instructions:

1. Using open-ended wrenches, separate the booster from the horn. Clean each item and then examine interfaces for irregularities (scoring).
2. If irregularities are present, remove the stud.
3. Tape a sheet of 400 grit emery cloth to a smooth, flat surface. (Do not use coarser than 400 grit.)
4. Grasp the lower portion of the booster or horn and move it across the emery cloth. To ensure proper lapping, a) hold the part straight, b) apply light downward pressure, and c) move in one direction only in a figure 8 pattern.

   Repeat the figure 8 pattern once more.



WARNING

DO NOT use anything coarser than 400 grit emery cloth.

5. Then, rotate the booster or horn 1/3 of a turn in a clockwise direction and then repeat step 4.
6. Repeat step 5.
7. Using wire brush, clean stud, then replace securely. Tighten new stud to the recommended torque specifications on page 13.

NOTE: *Machining of booster / horn may alter the ability to tune the component to the system. System inoperation may occur.*

MAINTENANCE

NOTE: *If packing unit for return shipment, DO NOT use styrofoam "peanuts."*

REPAIRS / SERVICE

If problems are encountered, contact our Service Department as follows:

Phone: 1-800-745-1105 • 1-203-270-4600

Fax: 1-203-270-4610

E-Mail: service@sonicsandmaterials.com

It is suggested that a system in need of repair be sent back to the factory, with a written description pertaining to the nature of the problem.

Always contact the factory for return authorization before shipping any instrument. Include date of purchase, model number, and serial number. For units not covered by the warranty, a purchase order should be forwarded to avoid unnecessary delay. Care should be exercised to provide adequate packing to insure against possible damage in shipment. The system should be sent with all transportation charges prepaid and return method of shipment indicated.

WARRANTY

Sonics & Materials, Inc., hereinafter referred to as “Sonics,” warrants its products for a period of one year from the date of shipment against defect in material and workmanship under normal installation, use, and maintenance as described in the operating instructions which accompany such equipment. During the warranty period, “Sonics” will, at its option, as the exclusive remedy, either repair or replace without charge for material and labor, the part(s) which prove upon our examination to be defective, provided the defective unit is returned to us properly packed with all transportation charges prepaid.

Ultrasonic welding horns constructed of titanium or aluminum are guaranteed against defects for a period of one year from date of shipment. “Sonics” will repair or replace a cracked or defective horn once without charge, if failure occurs within the warranty period.

Ultrasonic welding horns constructed of steel are guaranteed against defects for a period of ninety days from date of shipment. “Sonics” will repair or replace a cracked or defective steel horn once at a charge of 50% of the original purchase price, if failure occurs within the warranty period.

LIMITATION OF WARRANTY

This warranty is in lieu of any other warranties, either express, implied, or statutory. “Sonics” neither assumes nor authorizes any person to assume for it any other obligation or liability in connection with the sale of its products. “Sonics” hereby disclaims any warranty or 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 “Sonics” be liable to the purchaser or to any other person for any incidental or consequential damages or loss of profit or product resulting from any malfunction or failure of this “Sonics” product.

This warranty does not apply to equipment which has been subject to unauthorized repair, misuse, abuse, negligence or accident. Equipment which, in our judgment, 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.

No liability is assumed for expenses or damages resulting from interruptions in operation of the product or damages to material in process.

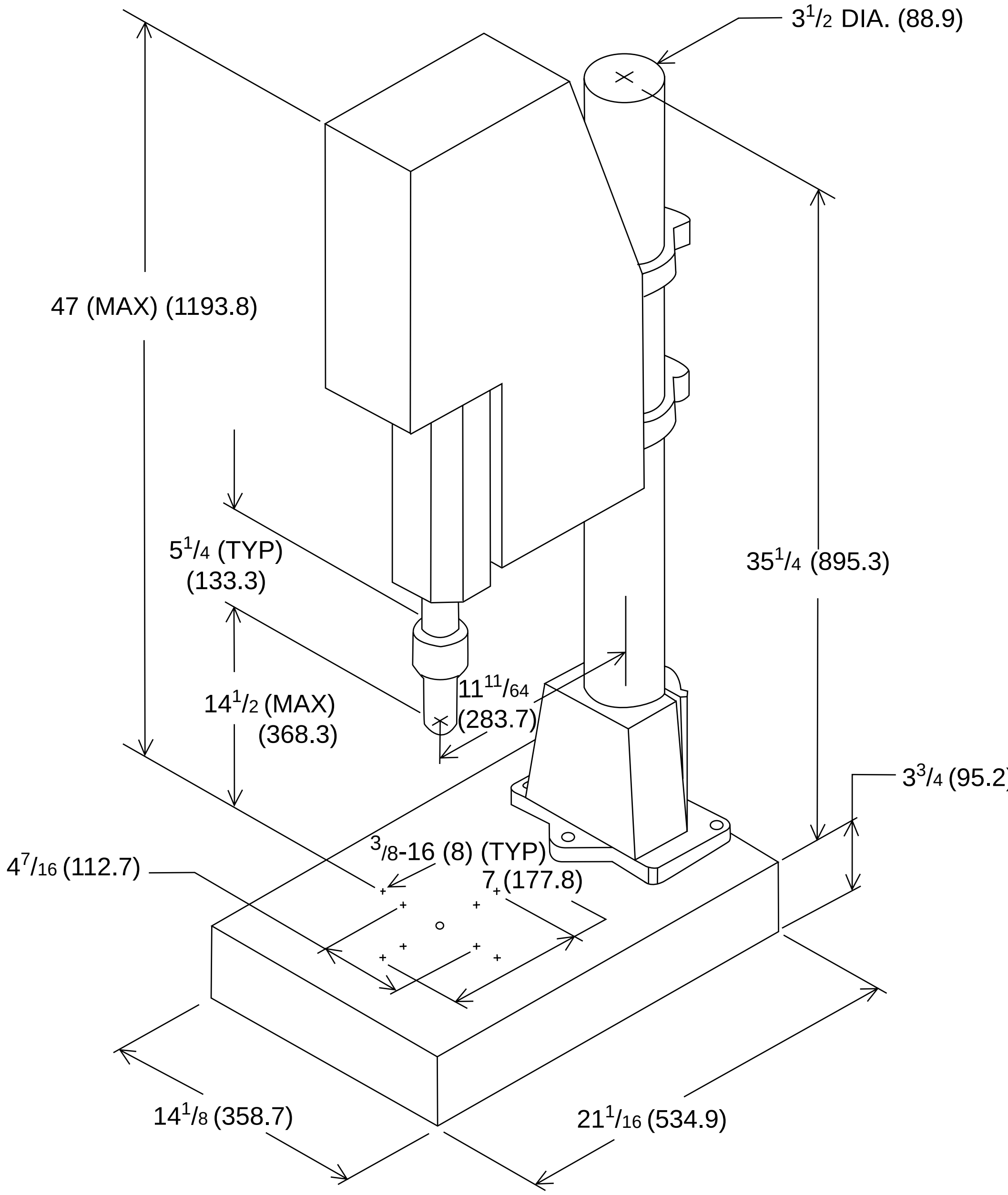
“Sonics” equipment is designed for maximum operator safety and incorporates built-in safety devices. Any modifications to these safety features will void the warranty. “Sonics” assumes no responsibilities for consequential damages incurred due to modifications to the said equipment.

“Sonics” reserves the right not to warrant horns of unusual or experimental design which in our judgment are more likely to fail in use.

This warranty does not cover equipment used for applications requiring metal-to-metal contact with weld time in excess of 1 second.

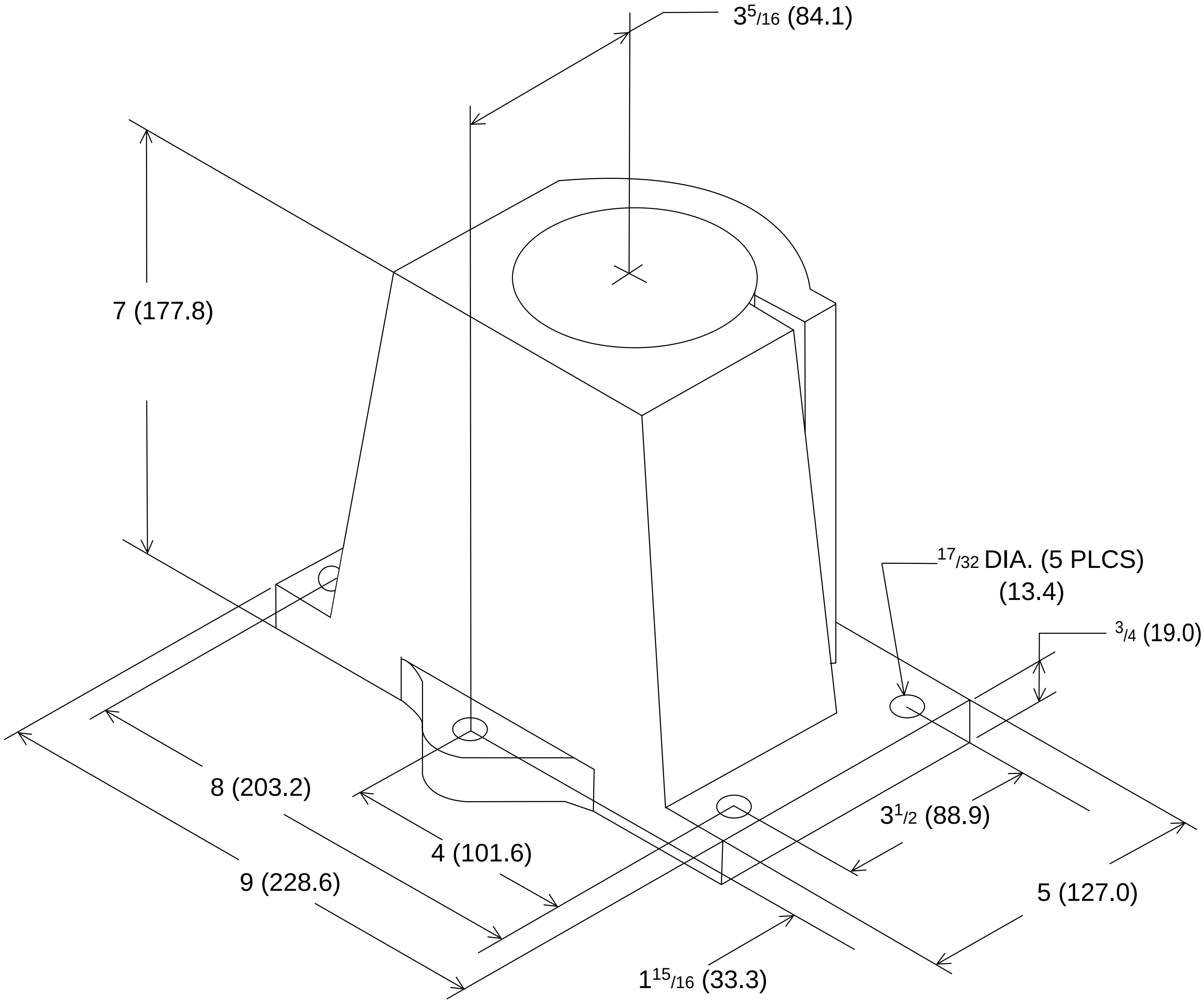
Data supplied in the instruction manual has been verified and validated and is believed adequate for the intended use of the equipment. If the equipment or procedures are used for purposes other than those specified herein, confirmation of their validity and suitability should be obtained in writing from “Sonics.”

1098 LAYOUT



Dimensions are shown in inches and millimeters,
i.e., 1 1/2 (38.1) signifies 1 1/2" (38.1mm)

MOUNTING HUB LAYOUT



Dimensions are shown in inches and millimeters,
i.e., 1 1/2 (38.1) signifies 1 1/2" (38.1mm)

Sonics & Materials, Inc.

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Models 1099 Press / 1096 Actuator

INSTRUCTION MANUAL

SONICS

Sonics & Materials, Inc.

WARNING

WARNING

SAFETY PRECAUTIONS
READ BEFORE INSTALLING OR USING THE EQUIPMENT

Our systems have been designed to assure maximum operator safety. However, no design can completely protect against improper usage. For maximum safety and equipment protection, observe the following warnings at all times and read all applicable instruction manuals carefully before you attempt to operate any equipment.

– The equipment has safety devices that require both hands to be on the palm buttons until the horn contacts the work piece. Do not defeat or modify these safety devices.

– Do not use with foot switch unless alternate means of pinch-point protection is provided.

– High voltage is present in the equipment. Disconnect plug before removing cover or servicing.

– Make sure equipment is properly grounded with a 3-prong plug. Before plugging in equipment, test outlet for proper earth grounding.

– High voltage potential may be present in the converter as a result of temperature changes. Do not touch the converter contact unless you first short both pins or the button to the converter case with an insulated tool.

– Never squeeze or grab a vibrating horn.

– Do not modify horn configurations.

– Ultrasonic welders operate above normal audibility for most people. Ear protection is recommended. Consult the Appendix for a list of manufacturers of ear protectors.

– Do not affix any device to any portion of the horn.

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Rev 00 8/01

TABLE OF CONTENTS

IMPORTANT SERVICE LITERATURE

NOTE: *Please read carefully before operating the equipment, then forward to your service department.*

The system 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.

MANUAL CHANGE INFORMATION

We continually strive to be at the forefront of the latest electronic developments by adding circuit and component improvements to our equipment as soon as they are developed and tested.

Sometimes, due to printing and shipping requirements, we cannot incorporate these changes immediately into printed manuals. Hence, your manual may contain new change information. Change information, if any, is located in the Appendix.

We reserve the right to make any changes in the design or construction of our equipment at any time, without incurring any obligation to make any change whatsoever in units previously delivered.

The technical data and schematics in the manual are for informational purposes only and may not reflect the current configuration being shipped from our factory. Upon formal request, complete and up-to-date information can be provided from the factory free of charge.

UNPACKING AND INSPECTION

NOTE: *We recommend keeping all carton(s) and packing material in case it might be necessary to move the equipment, or to ship it for repair.*

Before unpacking the equipment, check the shipping carton for any visible damage. If you see any, be sure to follow the procedures described below under "Visible Loss or Damage." Otherwise, proceed to remove the equipment from the carton. Before disposing of any packing material, check it carefully for small parts. Then perform a visual inspection of the equipment to detect any evidence of damage which might have occurred during shipment. Check the following:

1. all components against the enclosed packing list,
2. all module plug-in units,
3. all wire plug-in connections.

The equipment was carefully packed and thoroughly inspected before leaving our factory. All units are tested and checked for problems prior to shipping. It is asked that when a problem does occur that all parts and components be inspected for damage (especially when the unit is not in working order when received). Responsibility for safe delivery was assumed by the carrier upon acceptance of the shipment. Claims for loss of damage sustained in transit must therefore be made upon the carrier, as follows:

VISIBLE LOSS OR DAMAGE

Any external evidence of loss or damage must be noted on the freight bill or express receipt, and signed by the carrier's agent. Failure to adequately describe such external evidence of loss or damage may result in the carrier's refusal to honor a damage claim. The form required to file such a claim will be supplied by the carrier.

CONCEALED LOSS OR DAMAGE

Concealed loss or damage means loss or damage which does not become apparent until the merchandise has been unpacked. The contents might have been damaged in transit due to rough handling even though the container may not show external damage. When the damage is discovered upon unpacking, make a written request for inspection by the carrier's agent within 48 hours of the delivery date. Then file a claim with the carrier since such damage is the carrier's responsibility. The form required to file such a claim will be supplied by the carrier. Do not destroy packing materials, or move material from one location to another before the carrier makes their inspection.

If the system or any unit is damaged, notify "Sonics." "Sonics" will arrange for repair or replacement of damaged equipment without waiting for the claim against the carrier to be settled, provided a new purchase order is issued to cover the repair or replacement costs. Should any damage, shortage or discrepancy exist, please notify us immediately.

INTRODUCTION

The models 1096 and 1099 are 20 kHz precision pneumatic actuators used for ultrasonic plastics assembly. The 1099 is a tabletop version, and the 1096 can be mounted on a bridge or rigid structural member for use with automated systems. These presses can be supplied with the following power supplies:

- FD . . . . .Timer
- FDL . . . . .Timer/Linear Encoder
- FM . . . . .Microsonic Processor™
- FO/ML . . . . .Microsonic Processor™/Linear Encoder

OVERVIEW OF ULTRASONIC PLASTICS ASSEMBLY

WHAT IS ULTRASONICS?

Ultrasonics refers to vibrational waves with a frequency above the human audible range which is usually above 18,000 cycles per second (Hz).

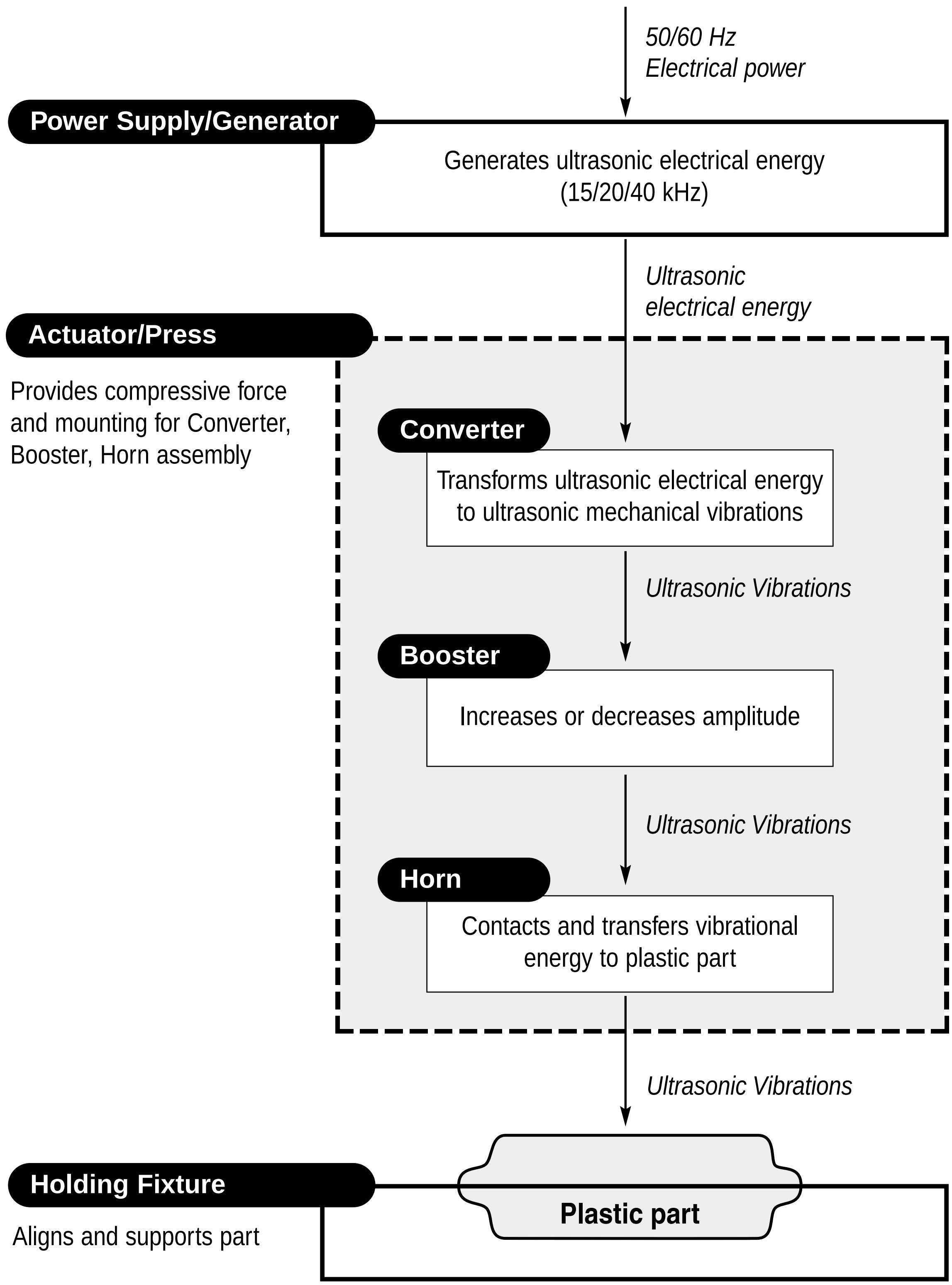
PRINCIPLE OF ULTRASONIC ASSEMBLY

The basic principle of ultrasonic assembly involves conversion of high frequency electrical energy to high frequency mechanical energy in the form of reciprocating vertical motion which, when applied to a thermoplastic, generates frictional heat at the plastic/plastic or plastic/metal interface. In ultrasonic welding, this frictional heat melts the plastic, allowing the two surfaces to fuse together; in ultrasonic staking or insertion, the controlled flow of molten plastic is used to capture or lock another material in place (staking) or encapsulate a metal insert (insertion).

ULTRASONIC ASSEMBLY SYSTEMS

"Sonics" ultrasonic assembly systems are generally composed of the following major elements: a power supply, converter, booster, horn, pneumatic press and holding fixture, as detailed in the diagram on the next page. A review of this diagram will help you understand the basic elements involved in the assembly process and their relation to each other.

"SONICS" ULTRASONIC ASSEMBLY SYSTEMS



GLOSSARY OF ULTRASONIC TERMS

POWER SUPPLY/GENERATOR – The solid state power supply converts standard 50/60 Hz electrical power to 15,000 Hz, 20,000 Hz, and 40,000 Hz (15/20/40 kHz) electrical energy.

ACTUATOR/PRESS – The pneumatic actuator provides compressive force and mounting for the converter, booster, and horn assembly. The tabletop press consists of a base assembly, column and actuator (head).

CONVERTER – The converter changes the high frequency electrical energy supplied by the power supply to high frequency mechanical vibrations.

BOOSTER – Successful ultrasonic welding often depends on having the right amplitude at the horn face. Often it is not possible to design a horn which has both the necessary shape and required gain (ratios of input amplitude to output amplitude). In such cases, a booster is placed between the converter and the horn to either increase or decrease the amplitude of the horn. In addition to changing/maintaining the amplitude, the booster provides support and alignment in the welding system. (See page 19 for booster selection.)

HORN – The horn is a tuned component of the system which comes in contact with the parts to be assembled. The horn 1) transfers the ultrasonic vibrations produced from the converter to the parts being welded, and 2) applies necessary force to the assembly while the material resolidifies.

HOLDING FIXTURE – The holding fixture or nest assures proper alignment and support of the parts being assembled.

MODEL 1099 **MODEL 1096**

ELECTRICAL POWER

The press is powered by the power supply. Consult your power supply instruction manual to determine power specifications.

WARNING

Do not connect the press to an air source supplied by a compressor lubricated with synthetic oils or oils containing phosphate esters or chlorinated hydrocarbons. This type of lubricant may cause the air filter to malfunction, and the plastic bowl to rupture.

AIR SUPPLY

The press requires a source of dry, filtered (5 micron), oil-free, compressed air capable of supplying a constant line pressure of 85 psig. (586 kPa / 6 bar) at a minimum capacity of 2 CFM.

SETTING UP

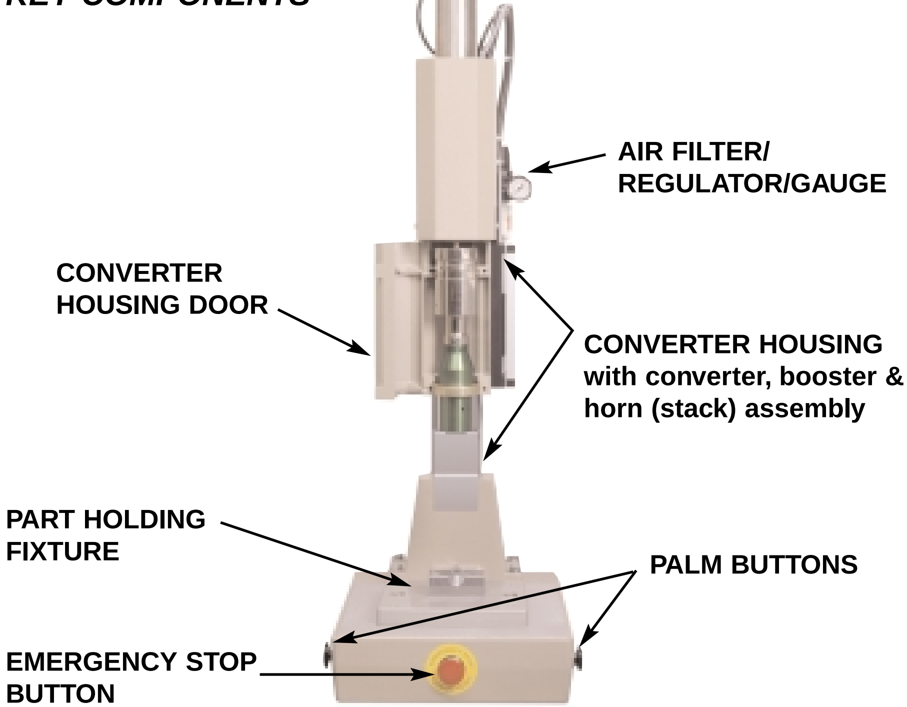
The press should be installed in a clear, uncluttered location that is free from excessive dirt, dust, corrosive fumes, and temperature and humidity extremes. The selected installation site should be near the electrical power and air supply sources and away from any equipment that generates abnormally high electrical transients. Observe the following additional instructions when installing the press:

a. The press should be placed on a sturdy, level table or bench capable of supporting a minimum of 500 pounds (227 kg).

b. Allow at least 6 inches (152.4mm) at the rear of the press for cable connections.

NOTE: *If the power supply is to be run continuously, air cooling of the converter and horn is required. Use clean, dry compressed air filtered down to 5 microns (supplied to converter fitting).*

KEY COMPONENTS



***NOTE:** Do not strain or kink the cables. When going around corners, allow as wide a bend as possible. Do not run the cables parallel to any power line within a distance of less than 1 foot (304.8mm).*

CONNECTIONS

When making the initial connections, make sure all power is disconnected.

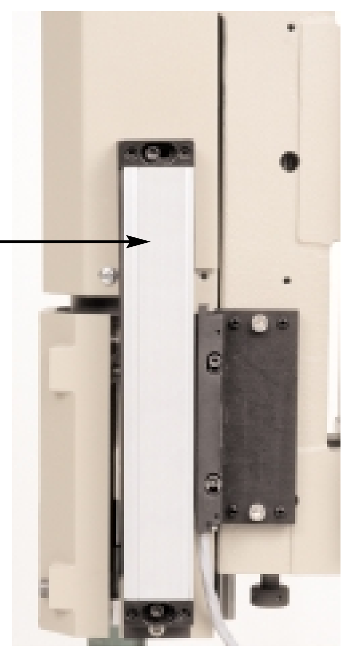
1. Connect the air supply source to the press air filter located at the right, rear of the press head, using a hose having a minimum inside diameter of 1/8 inch (3 mm).
2. Connect the RF and base (actuating) cables of the press to the power supply. (Consult your power supply instruction manual for details.)
3. Check with your electrician if you have any wiring questions.

OPTIONS

A Linear Encoder is available as an option. The Linear Encoder allows distance-controlled welding in incremental and absolute modes.

The Linear Encoder is supplied with a 9-pin male connector that connects to a matching 9-pin female connector on the power supply (factory installed).

LINEAR ENCODER



INITIAL EQUIPMENT SETUP

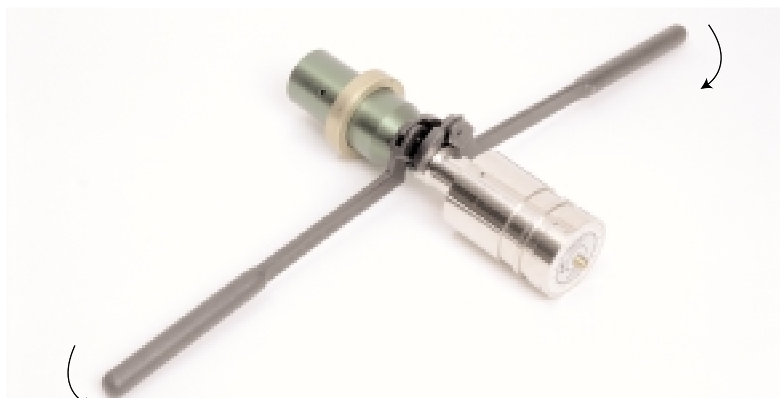
WARNING

Never tighten the horn to the booster using the housing door as the upper wrench as this may cause damage to the booster and/or converter.

ASSEMBLING AND MOUNTING CONVERTER, BOOSTER, AND HORN

If the converter, booster, and horn are not already assembled, follow these instructions:

1. Clean the mating surfaces of the converter and booster, as well as the threaded stud and hole. Check that the stud is tight (see recommended torque requirements on page 12).
2. Hand assemble the converter and booster together. Using spanner wrenches as shown below, tighten until snug. Then, using a torque wrench, tighten to 25-35 inch-lbs.(2.8-4.0 newton-meters). **Do not force or overtighten.**



CONVERTER/BOOSTER

3. Clean the mating surfaces of the booster and horn, as well as the threaded stud and hole. Check that the stud is tight. (See recommended torque requirements on next page.)
4. Hand assemble the horn to the booster. Using a spanner and an open-ended wrench as shown below, tighten securely. Then, using a torque wrench, tighten to 25-35 inch-lbs. (2.8-4.0 newton-meters). **Do not overtighten.**

CONVERTER/BOOSTER/HORN

NOTE: *When performing any of the operations described on this page and pages 13-15, DO NOT turn on the power supply.*

WARNING

Never tighten the horn to the booster using the housing door as the upper wrench as this may cause damage to the booster and/or converter.

NOTE: *If you do not close the housing door once the assembly is in place, the assembly can fall out.*

5. Using the 3/16” (4.7 mm) T-handle wrench provided, loosen (turn counterclockwise) the two cap screws screws on the hinged converter housing and open the door.
6. Place the converter / booster / horn assembly in the housing with the horn facing down. Fit the male brass button on the top of the converter into the female brass fitting in the bottom of the contact block assembly housing, and gently push the assembly up and in so that the booster mounting ring rests on the lower support ridge.

CONVERTER / BOOSTER / HORN ASSEMBLY

7. Close the converter housing door and tighten (turn clockwise) the two socket head cap screws just until they are snug. Do not tighten the horn to the booster using the door as the upper wrench. Hand-forcing the horn on and off in this manner can twist wires and cause a failure. If the horn is not in the correct position to make contact with your material, re-position the converter.

RECOMMENDED TORQUE REQUIREMENTS

Component	Inch-Lbs.	Newton-Meters
Converter / Booster	25 - 35	2.8 - 4.0
Booster / Horn	25 - 35	2.8 - 4.0
Stud	45	5.1
Tips	25 - 35	2.8 - 4.0

WARNING

Support the head before releasing the column clamps so that it cannot crash down or fly up. Ignoring this warning might result in injury and/or damage to the equipment and part being welded.

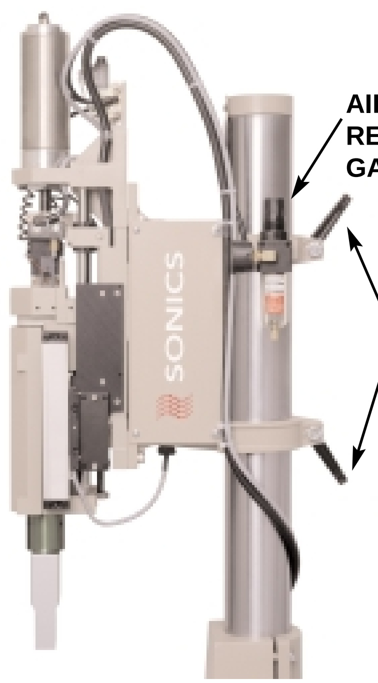
HORN AND FIXTURE ALIGNMENT

For maximum productivity, the clearance between the horn and the part should be at a minimum. However, adequate clearance should be provided to enable easy loading and unloading of the part from the holding fixture. The maximum stroke distance is 4" (101.6mm). Ensure that the horn does not contact the part when the head is close to the limit of its down travel distance. Otherwise, the horn may not have sufficient distance to travel downwards to achieve a full depth of weld. Set welding height as follows:

First, position the holding fixture loosely on the base plate using 3/8-16 screws. Then, place the part to be welded in the fixture.

FOR THE 1099 PRESS, FOLLOW THE INSTRUCTIONS BELOW:

1. Before loosening the column clamps, hold onto the head assembly firmly as it can rise upwards rapidly once the clamps are released. While holding the head assembly, loosen the two column clamps (counterclockwise) and move the head up or down as required. Then tighten the column clamps.
2. Set the air pressure to zero by turning the PRESSURE regulator knob (located at the top of air filter/regulator/gauge assembly) fully counterclockwise.
3. Loosen the column clamps once again and manually lower the head until



WARNING

When the air pressure is decreased, the converter housing can drop down to its limit, so be sure to either support it or remove anything in its path.

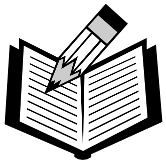
the horn contacts the part. Tighten the clamps.

4. Loosen the cap screws on the converter housing door and gently rotate the head and horn as required to ensure proper horn-to-part alignment.
5. Lock the two column clamps, tighten the converter housing door screws, and then tighten the fixture on the base plate.
6. Check for proper mating of fixture, parts, and horn. If the horn and part are not in parallel contact, shim the fixture or adjust leveling screws as required.
7. Set the PRESSURE regulator to a reading of 20 psig (140 kPa/1.4 bar) on the pressure gauge. (Turn the PRESSURE knob clockwise.)
8. To check that the horn and parts are properly aligned, the horn needs to be lowered. Read through the Operation instructions on page 16, and then proceed to lower the horn as detailed. If the horn and parts are not sufficiently aligned, then repeat steps 4 through 8. However, if you are working with small, delicate parts, then fine adjustments can be made using the positive stop adjustment knob as explained on page 15.

FOR THE 1096 PRESS, FOLLOW THE INSTRUCTIONS BELOW:

The operation of the 1096 actuator is controlled by the automated system. Rotate the stack assembly as required to ensure proper horn-to-part alignment. Check for proper mating of the fixture, parts and horn. If the horn and part are not in parallel contact, shim the fixture or adjust leveling screws as required.

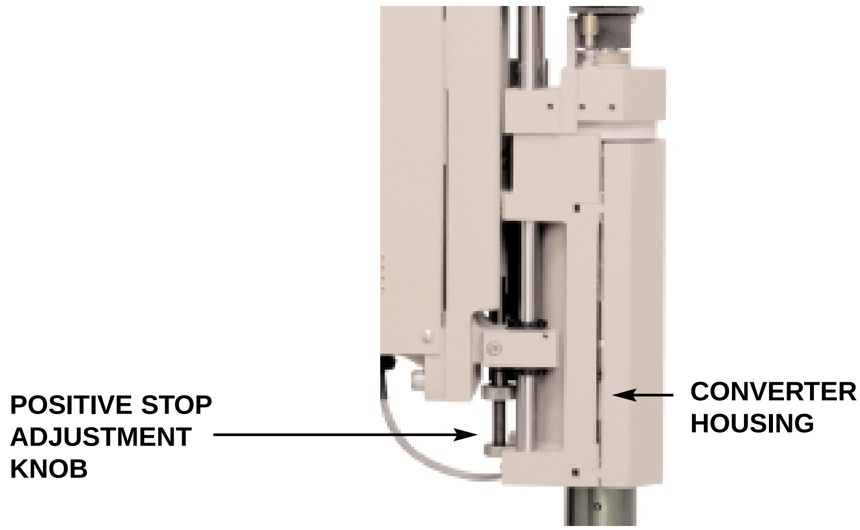
To check that the horn and parts are properly aligned, the horn needs to be lowered. If necessary, shim the fixture or adjust the leveling screw again. Fine adjustments can be made using the positive stop adjustment knob as explained on the next page.



NOTE: *For maximum safety and productivity, adjust the clearance between the horn and the part to a minimum that will still allow ease of loading and unloading.*

POSITIVE STOP ADJUSTMENT

The positive stop is set to limit the downward travel of the horn to approximately 75%. Readjustments may be required. Coarse adjustment of the clearance between the face of the horn and part should be made using the elevation control. Fine adjustment should be made using the positive stop.



The positive stop adjustment knob is located offset from the converter housing. Turning the knob clockwise will decrease downward travel distance. Turning the knob counterclockwise will increase the downward travel distance. Rotate the knurled thumbscrew to lock and unlock the positive stop.

WARNING

The equipment has safety devices that require both hands to be on the palm buttons until the horn contacts the workpiece. ***Do not defeat or modify these safety devices.***

NOTE: *Power supply cannot be shut off once the weld cycle has started. Termination of cycle can only be achieved by using the EMERGENCY STOP button.*

WARNING

Do not use with a footswitch unless alternate means of pinch-point protection is provided.

ACTUATION

The 1099 press is equipped with two maintained anti-repeat (non-tie-down) palm buttons, one located on the left and one on the right side of the base of the press. Both palm buttons must be pressed simultaneously to activate the press to cycle the welder. To operate the press, follow these simple steps:

1. Depress both black palm buttons simultaneously.
2. Once the horn comes in contact with the part and the ultrasonics are activated, release the palm buttons. If you release the buttons before contact is made, the head will immediately return to its “home” position.

The operation of the 1096 actuator is controlled by the automated system. A four-wire actuation cable is provided which ties into the output side of a PLC, or other system controlling device. Momentary two wire closure from a dry source will initiate the welder’s cycle. For more information, refer to the power supply manual and the included wiring diagrams.

EMERGENCY STOP

To abort the 1099 press during welding, simply press the red EMERGENCY STOP button located at the front center of the press base.

Once the EMERGENCY STOP button has been depressed, the head will retract and return to its “home” position. Simply rotate the EMERGENCY STOP button to the right 1/4 turn to release the press for further operation.

For the 1096 actuator, a four-wire actuation cable contains two normally closed wires which control the emergency stop function. For more information, refer to the power supply manual and the included wiring diagrams.

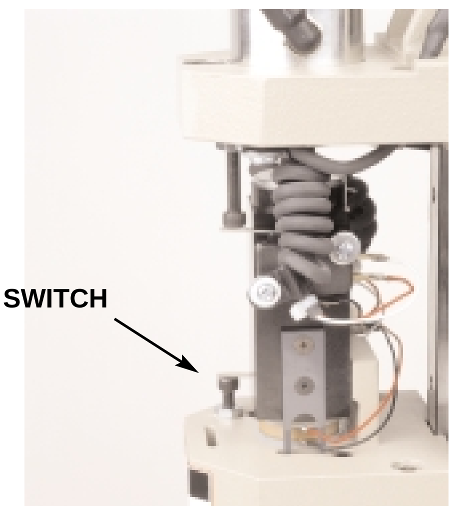
FINE ADJUSTMENTS

PRESSURE SWITCH ADJUSTMENT

For systems mounted in the normal vertical position with downward travel, no adjustment should be necessary. The minimum trigger pressure is factory set at 4-7 psig.

However, if the minimum trigger pressure requires recalibration or re-adjustment, observe the following procedure:

1. Maintain air pressure and unplug the power supply from the electrical source.
2. Remove the four screws holding the five-sided cover.
3. Loosen the jam nut holding the 8-32 cap screw in place.
4. Rotate the cap screw counter-clockwise (up) until the Pressure Switch closes.



Base of Air Cylinder Mount

PRESSURE SWITCH

Top of Converter Housing

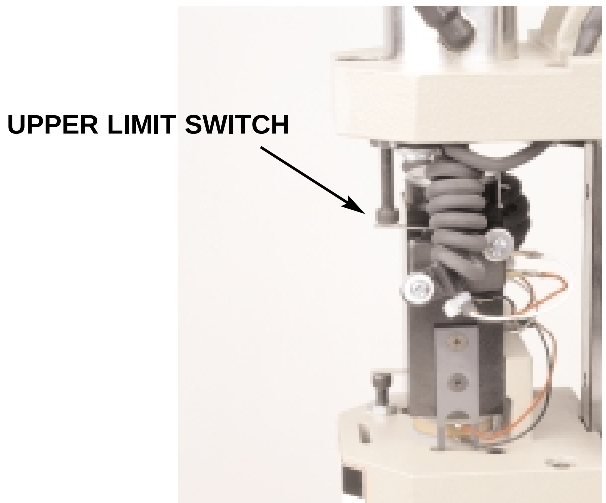
5. Next rotate the cap screw clockwise (down) until the Pressure Switch opens.
6. Rotate cap screw clockwise (down) one turn past the Pressure Switch open position.
7. Tighten the jam nut to lock cap screw in position.
8. Replace the cover and four screws.
9. Plug the power supply into the electrical source.
10. Cycle the welder.

The press is now set to trigger at the minimum trigger pressure of 4-7 psig.

A press actuating in an upward or horizontal direction should be set to trigger at a minimum of 8-10 psig. Lower values may affect trigger performance where false triggering may be observed.

UPPER LIMIT SWITCH

The optional Upper Limit Switch is used as a safety interlock in automation to prevent the movement of material handling equipment (indexing) when the horn is down. It also initiates the movement of material handling equipment when the horn is up.



The Upper Limit Switch is factory set and should be suitable for all applications. If for some reason you need to readjust it, observe the following procedure:

1. Maintain air pressure and unplug the power supply from the electrical source.
2. Remove the four screws holding the five-sided cover.
3. Loosen the jam nut holding the 8-32 cap screw in place.
4. Rotate the cap screw counter-clockwise (down) until the Upper Limit Switch closes.
5. Tighten the jam nut to lock cap screw in position.
6. Replace the cover and four screws.

The Upper Limit Switch is now set.

BOOSTER SELECTION

NOTE: *Consult the Applications Manual or call our Applications Lab for proper booster selection.*

The first step in optimizing welding conditions is to select a booster which will provide the necessary amplitude. For parts one inch (25.4mm) in diameter or greater, start with a moderately high amplitude booster such as a gold. For smaller parts, start with a green booster. Determine optimum amplitude by welding a few parts, and repeat the procedure with boosters giving higher or lower amplitude. If there appears to be little or no difference, use the booster giving the highest amplitude.

Seven standard boosters, color coded or engraved for ease of identification, are available either to increase or decrease the amplitude.

WARNING

High gain boosters, such as silver and black in combination with high gain horns can result in the horn cracking or failing.

BOOSTER

Color	Part No.	Gain	Amplitude Effect
Black	BHN15TBK	2.50	Increase
Silver	BHN15TSI	2.00	Increase
Gold	BHN15GD	1.50	Increase
Brown	BHN15BR	1.25	Increase
Green	BHN15GR	0	No Change
Purple	BHN15PU	0.75	Decrease
Blue	BHN15BU	0.50	Decrease

PRESSURE

During the welding process, sufficient pressure should be applied to the part so that the mating surfaces contact each other. If the pressure is too low, the process will run inefficiently causing unnecessarily long weld time cycles, marking of the parts or poor welding. If the pressure is too high, the horn may stop vibrating, the part(s) might fracture, or the power supply might overload.

WARNING

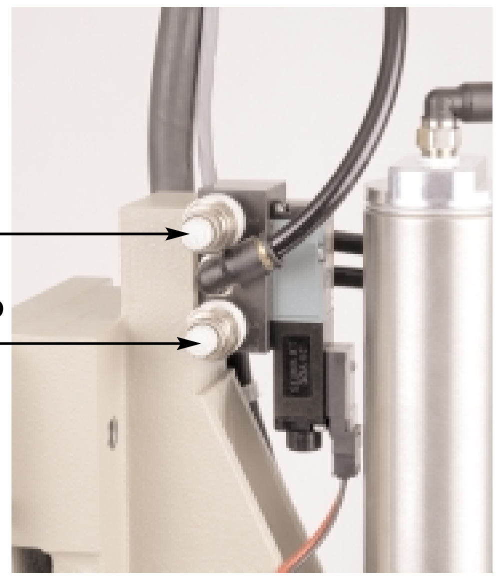
Excessive velocity may be unnecessary and harmful to the system.

STROKE SPEED ADJUSTMENT

The velocity at which the horn descends and returns can be adjusted via the speed controls. These controls are factory adjusted for average operating conditions and should not require further adjustment. However, if a minor adjustment is necessary, adjust in small degrees. Turn clockwise to slow the extend speed, and counterclockwise to increase the return speed.

The speed controls are 2 small threaded screws located at the top of the press and behind the air cylinder as shown below.

The top screw controls the extend speed – turn it clockwise to slow the speed, counterclockwise to increase the speed. The bottom screw controls the return speed – turn it clockwise to slow the speed, counterclockwise to increase speed.

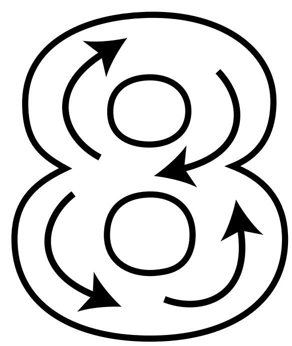


RE-ESTABLISHING PROPER BOOSTER / HORN INTERFACES

To re-establish proper interfaces, follow these instructions:

1. Using open-ended wrenches, separate the booster from the horn. Clean each item and then examine interfaces for irregularities (scoring).
2. If irregularities are present, remove the stud.
3. Tape a sheet of 400 grit emery cloth to a smooth, flat surface. (Do not use coarser than 400 grit.)
4. Grasp the lower portion of the booster or horn and move it across the emery cloth. To ensure proper lapping, a) hold the part straight, b) apply light downward pressure, and c) move in one direction only in a figure 8 pattern.

   Repeat the figure 8 pattern once more.



5. Then, rotate the booster or horn 1/3 of a turn in a clockwise direction and then repeat step 4.
6. Repeat step 5.
7. Using wire brush, clean stud, then replace securely. Tighten new stud to the recommended torque specifications on page 12.

NOTE: *Contact between the booster and horn should be parallel. When encountering symptoms such as loud noises or tuning difficulties, examine the booster / horn interfaces for parallelism, corrosion, galling or foreign deposits. Also check the tightness of the stud.*

WARNING

DO NOT use anything coarser than 400 grit emery cloth.

NOTE: *Machining of booster / horn may alter the ability to tune the component to the system. System inoperation may occur.*

MAINTENANCE

NOTE: *If packing unit for return shipment, DO NOT use styrofoam "peanuts."*

REPAIRS / SERVICE

If problems are encountered, contact our Service Department as follows:

Phone: 1-800-745-1105 • 1-203-270-4600

Fax: 1-203-270-4610

E-Mail: service@sonicsandmaterials.com

It is suggested that a system in need of repair be sent back to the factory, with a written description pertaining to the nature of the problem.

Always contact the factory for return authorization before shipping any instrument. Include date of purchase, model number, and serial number. For units not covered by the warranty, a purchase order should be forwarded to avoid unnecessary delay. Care should be exercised to provide adequate packing to insure against possible damage in shipment. The system should be sent with all transportation charges prepaid and return method of shipment indicated.

WARRANTY

Sonics & Materials, Inc., hereinafter referred to as "Sonics," warrants its products for a period of one year from the date of shipment against defect in material and workmanship under normal installation, use, and maintenance as described in the operating instructions which accompany such equipment. During the warranty period, "Sonics" will, at its option, as the exclusive remedy, either repair or replace without charge for material and labor, the part(s) which prove upon our examination to be defective, provided the defective unit is returned to us properly packed with all transportation charges prepaid.

Ultrasonic welding horns constructed of titanium or aluminum are guaranteed against defects for a period of one year from date of shipment. "Sonics" will repair or replace a cracked or defective horn once without charge, if failure occurs within the warranty period.

Ultrasonic welding horns constructed of steel are guaranteed against defects for a period of ninety days from date of shipment. "Sonics" will repair or replace a cracked or defective steel horn once at a charge of 50% of the original purchase price, if failure occurs within the warranty period.

LIMITATION OF WARRANTY

This warranty is in lieu of any other warranties, either express, implied, or statutory. "Sonics" neither assumes nor authorizes any person to assume for it any other obligation or liability in connection with the sale of its products. "Sonics" hereby disclaims any warranty or 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 "Sonics" be liable to the purchaser or to any other person for any incidental or consequential damages or loss of profit or product resulting from any malfunction or failure of this "Sonics" product.

This warranty does not apply to equipment which has been subject to unauthorized repair, misuse, abuse, negligence or accident. Equipment which, in our judgment, 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.

No liability is assumed for expenses or damages resulting from interruptions in operation of the product or damages to material in process.

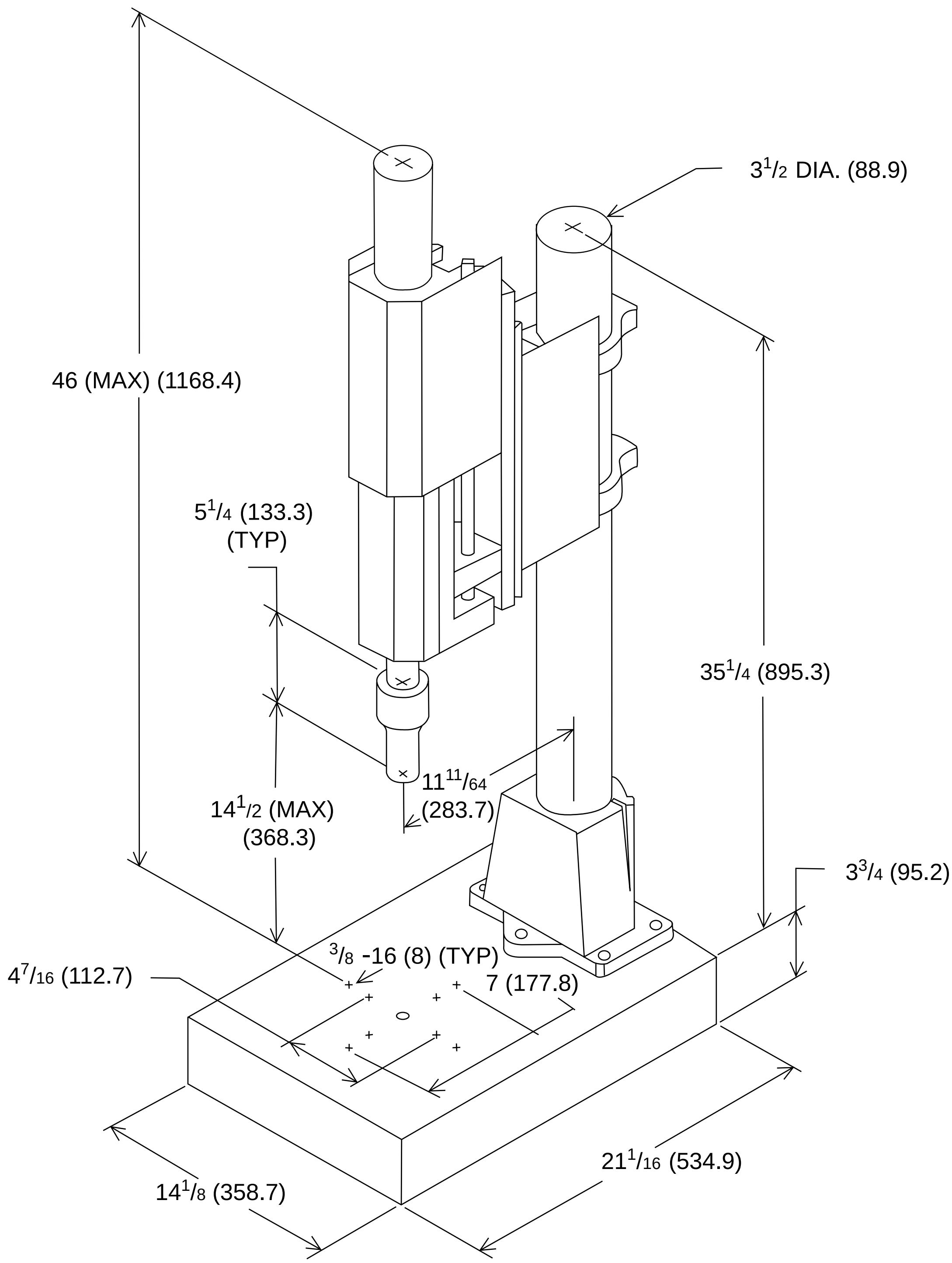
"Sonics" equipment is designed for maximum operator safety and incorporates built-in safety devices. Any modifications to these safety features will void the warranty. "Sonics" assumes no responsibilities for consequential damages incurred due to modifications to the said equipment.

"Sonics" reserves the right not to warrant horns of unusual or experimental design which in our judgment are more likely to fail in use.

This warranty does not cover equipment used for applications requiring metal-to-metal contact with weld time in excess of 1 second.

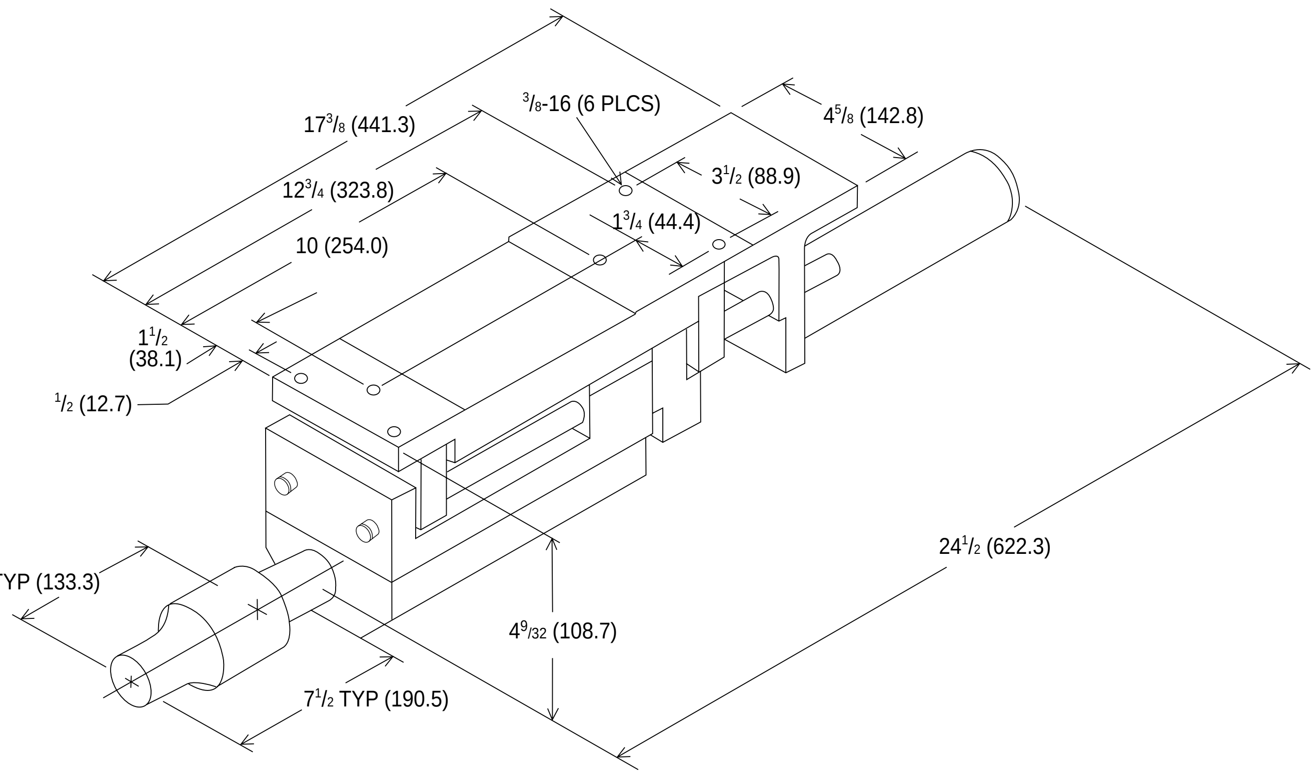
Data supplied in the instruction manual has been verified and validated and is believed adequate for the intended use of the equipment. If the equipment or procedures are used for purposes other than those specified herein, confirmation of their validity and suitability should be obtained in writing from "Sonics."

1099 LAYOUT



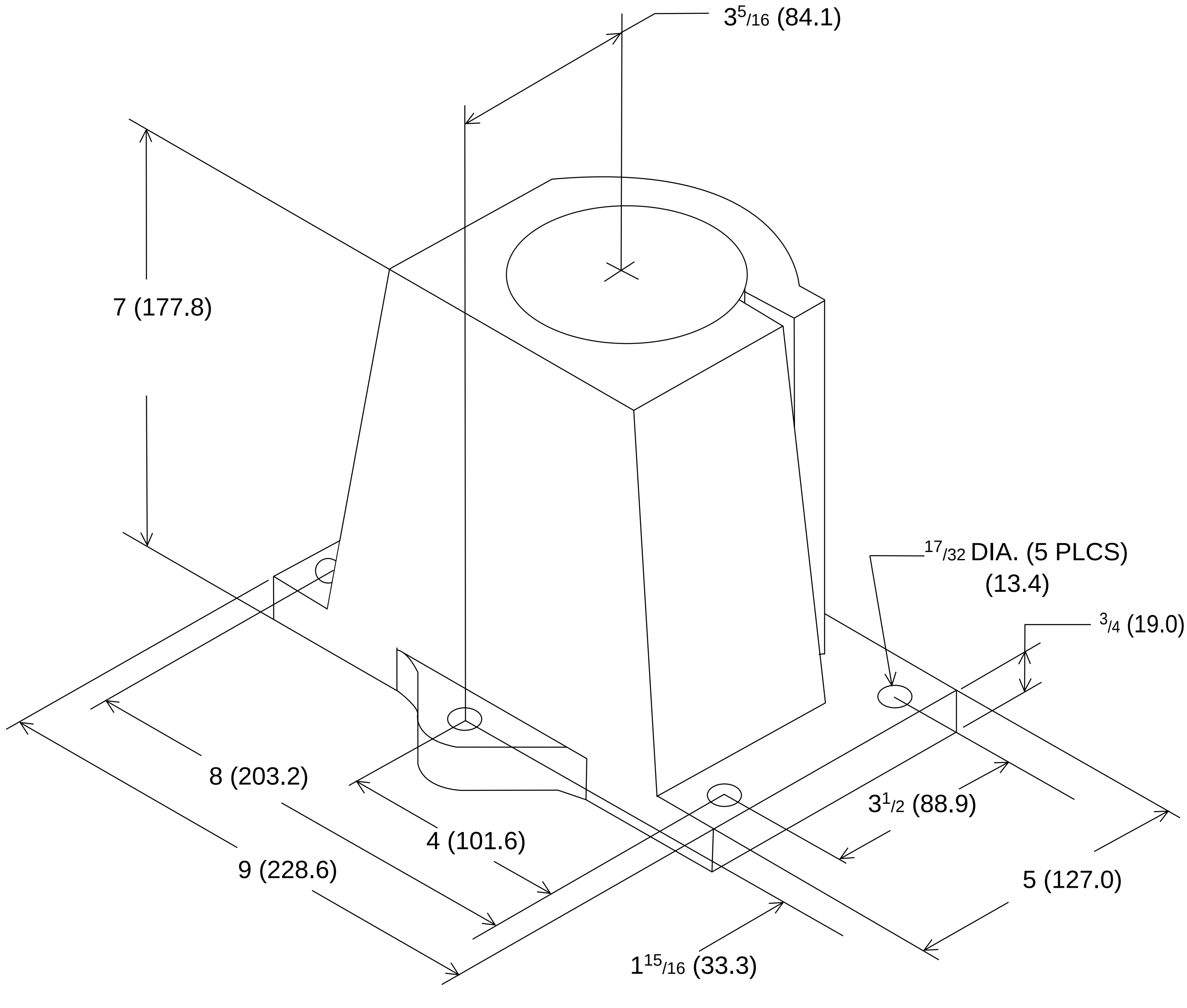
Dimensions are shown in inches and millimeters,
i.e., 1 1/2 (38.1) signifies 1 1/2" (38.1mm)

1096 LAYOUT



Dimensions are shown in inches and millimeters,
i.e., 1 1/2 (38.1) signifies 1 1/2" (38.1mm)

MOUNTING HUB LAYOUT



Dimensions are shown in inches and millimeters,
i.e., 1 1/2 (38.1) signifies 1 1/2" (38.1mm)

SONICS

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europe@sonicsandmaterials.ch

Models H520 and H540 Hand Held Welders

INSTRUCTION MANUAL

SONICS

Sonics & Materials, Inc.

WARNING

WARNING

SAFETY PRECAUTIONS
READ BEFORE INSTALLING OR USING THE EQUIPMENT

Our systems have been designed to assure maximum operator safety. However, no design can completely protect against improper usage. For maximum safety and equipment protection, observe the following warnings at all times and read all applicable instruction manuals carefully before you attempt to operate any equipment.

– High voltage is present in the equipment. Disconnect plug before removing cover or servicing.

– Make sure equipment is properly grounded with a 3-prong plug. Before plugging in equipment, test outlet for proper earth grounding.

– Never squeeze or grab a vibrating horn.

– Do not modify horn configurations.

– Ultrasonic welders operate above normal audibility for most people. Ear protection is recommended. Consult the Appendix for a list of manufacturers of ear protectors.

– Do not affix any device to any portion of the horn.

– Certain plastic materials, when ultrasonically welded, may emit fumes and/or gases hazardous to an operator's health. Where such materials are processed, proper ventilation of the work station should be provided. If in doubt about the toxicity of your plastic material, contact OSHA, U.S. Department of Labor, or material supplier.

– Do not operate the power supply unless it is connected to the hand gun.

– Maintenance should be performed only by a qualified electronic technician.

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IMPORTANT SERVICE LITERATURE

***NOTE:** Please read carefully before operating the equipment, then forward to your service department.*

The system 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.

MANUAL CHANGE INFORMATION

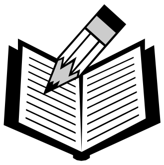
We continually strive to be at the forefront of the latest electronic developments by adding circuit and component improvements to our equipment as soon as they are developed and tested.

Sometimes, due to printing and shipping requirements, we cannot incorporate these changes immediately into printed manuals. Hence, your manual may contain new change information. Change information, if any, is located in the Appendix.

We reserve the right to make any changes in the design or construction of our equipment at any time, without incurring any obligation to make any change whatsoever in units previously delivered.

The technical data and schematics in the manual are for informational purposes only and may not reflect the current configuration being shipped from our factory. Upon formal request, complete and up-to-date information can be provided from the factory free of charge.

UNPACKING AND INSPECTION



__NOTE:__ We recommend keeping all carton(s) and packing material in case it might be necessary to move the equipment, or to ship it for repair.

Before unpacking the equipment, check the shipping carton for any visible damage. If you see any, be sure to follow the procedures described below under "Visible Loss or Damage." Otherwise, proceed to remove the equipment from the carton. Before disposing of any packing material, check it carefully for small parts. Then perform a visual inspection of the equipment to detect any evidence of damage which might have occurred during shipment. Check the following:

1. all components against the enclosed packing list,
2. all module plug-in units,
3. all wire plug-in connections.

The equipment was carefully packed and thoroughly inspected before leaving our factory. All units are tested and checked for problems prior to shipping. It is asked that when a problem does occur that all parts and components be inspected for damage (especially when the unit is not in working order when received). Responsibility for safe delivery was assumed by the carrier upon acceptance of the shipment. Claims for loss of damage sustained in transit must therefore be made upon the carrier, as follows:

VISIBLE LOSS OR DAMAGE

Any external evidence of loss or damage must be noted on the freight bill or express receipt, and signed by the carrier's agent. Failure to adequately describe such external evidence of loss or damage may result in the carrier's refusal to honor a damage claim. The form required to file such a claim will be supplied by the carrier.

CONCEALED LOSS OR DAMAGE

Concealed loss or damage means loss or damage which does not become apparent until the merchandise has been unpacked. The contents might have been damaged in transit due to rough handling even though the container may not show external damage. When the damage is discovered upon unpacking, make a written request for inspection by the carrier's agent within 48 hours of the delivery date. Then file a claim with the carrier since such damage is the carrier's responsibility. The form required to file such a claim will be supplied by the carrier. Do not destroy packing materials, or move material from one location to another before the carrier makes their inspection.

If the system or any unit is damaged, notify "Sonics." "Sonics" will arrange for repair or replacement of damaged equipment without waiting for the claim against the carrier to be settled, provided a new purchase order is issued to cover the repair or replacement costs. Should any damage, shortage or discrepancy exist, please notify us immediately.

INTRODUCTION

The models H520 and H540 are portable 500 watt, hand held ultrasonic welders used for plastics assembly. Both models consist of an ultrasonic power supply and a hand gun. These units are designed specifically for welding, staking, inserting and spot welding applications (refer to the Applications section of this manual beginning on page 22 for more information on these operations).

The model H520 is a 20 kHz power supply that comes with the CV52 hand gun. The CV52 hand gun is supplied with an integral 1/2" (12.7mm) diameter titanium front driver with a replaceable flat face tip. (Other standard or custom tips are available.)

The model H540 is a 40 kHz power supply that comes with the CV54 hand gun. The CV54 hand gun is supplied with a removable horn designed specifically for each customer's requirements. The higher frequency and lower amplitude of the 40 kHz system makes it ideal for welding small assemblies that require gentler action.

The power supplies of both models feature autotune circuitry.

OVERVIEW OF ULTRASONIC PLASTICS ASSEMBLY

WHAT IS ULTRASONICS?

Ultrasonics refers to vibrational waves with a frequency above the human audible range which is usually above 18,000 cycles per second (Hz).

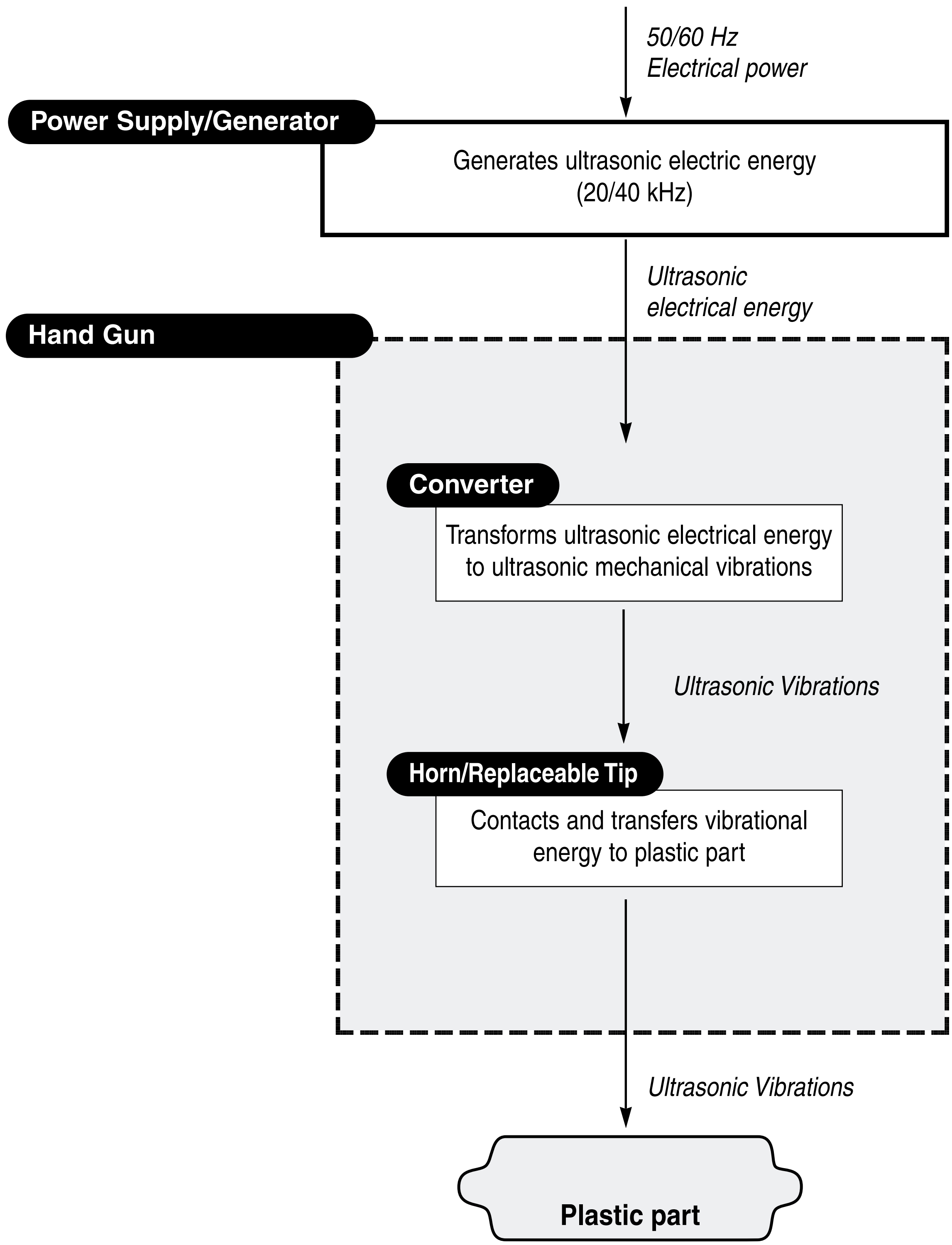
PRINCIPLE OF ULTRASONIC ASSEMBLY

The basic principle of ultrasonic assembly involves conversion of high frequency electrical energy to high frequency mechanical energy in the form of reciprocating vertical motion which, when applied to a thermoplastic, generates frictional heat at the plastic/plastic or plastic/metal interface. In ultrasonic welding, this frictional heat melts the plastic, allowing the two surfaces to fuse together; in ultrasonic staking or insertion, the controlled flow of molten plastic is used to capture or lock another material in place (staking) or encapsulate a metal insert (insertion).

ULTRASONIC HAND HELD WELDERS

"Sonics" ultrasonic hand held welders are generally composed of the following major elements: a power supply, hand gun (converter), and horn (H540 only) as detailed in the diagram on the next page. A review of this diagram will help you understand the basic elements involved in the assembly process and their relation to each other.

"SONICS" ULTRASONIC ASSEMBLY SYSTEMS



GLOSSARY OF ULTRASONIC TERMS

POWER SUPPLY/GENERATOR – The solid state power supply converts standard 50/60 Hz electrical power to 20,000 Hz or 40,000 Hz (20/40 kHz) electrical energy.

CONVERTER – The converter changes the high frequency electrical energy supplied by the power supply to high frequency mechanical vibrations.

TIP/HORN – The tip/horn is a tuned component of the system which comes in contact with the parts to be assembled. The tip/horn 1) transfers the ultrasonic vibrations produced from the converter to the parts being welded, and 2) applies necessary force to the assembly while the material resolidifies.

AMPLITUDE – The peak to peak excursion of a horn at its output face.

INSTALLATION AND SET UP

WARNING

The line cord of the controller/power supply is equipped with a 3-prong, grounding plug. Do not, under any circumstances, remove the ground prong. The plug must be plugged into a mating 3-prong, grounding type outlet.

ELECTRICAL POWER REQUIREMENTS

The power supply requires a fused, single-phase, standard 3-terminal grounding type receptacle capable of supplying the requisite voltage and current. (Standard 120 volts or optional 220 volts, 50/60 Hz, regulated between 95-135 volts or 190-265 volts, respectively.)

SETTING UP

The power supply is a free-standing assembly. It should be installed in a clear, uncluttered location that is free from excessive dirt, dust, corrosive fumes, and temperature and humidity extremes. The selected installation site should be near the electrical power source and away from equipment that generates abnormally high electrical transients. Observe the following additional instructions when installing the equipment:

a. Allow at least 6 inches (152.4mm) at the rear of the power supply for cable connections.

b. Position the power supply so that the front panel controls are visible and readily accessible.

c. The power supply is air cooled; allow sufficient space around the assembly to ensure adequate ventilation. If the power supply must be housed in a confined space, forced air cooling may be necessary to keep surrounding air within acceptable ambient temperature limits. Periodically check the ventilation grille and clean as necessary.

NOTE: *If power supply is to be run continuously, air cooling of the converter and horn is required. Use clean, dry compressed air filtered down to 5 microns.*

ELECTRICAL CONNECTIONS

When making the initial electrical connections, make sure the power is disconnected and follow these precautions.

1. Do not strain or kink the cables. When going around corners, allow as wide a bend as possible. Do not run the cables parallel to any power line within a distance of less than 1 foot (305mm).
2. To prevent the possibility of an electrical shock, ensure that the power supply line cord is properly grounded. Also make sure that the voltage rating of the electrical power source matches the power supply requirement.
3. Check with your electrician if you have any wiring questions.

NOTE: *Do not plug the power supply into an electrical outlet until all other connections have been made.*

CABLE CONNECTIONS:

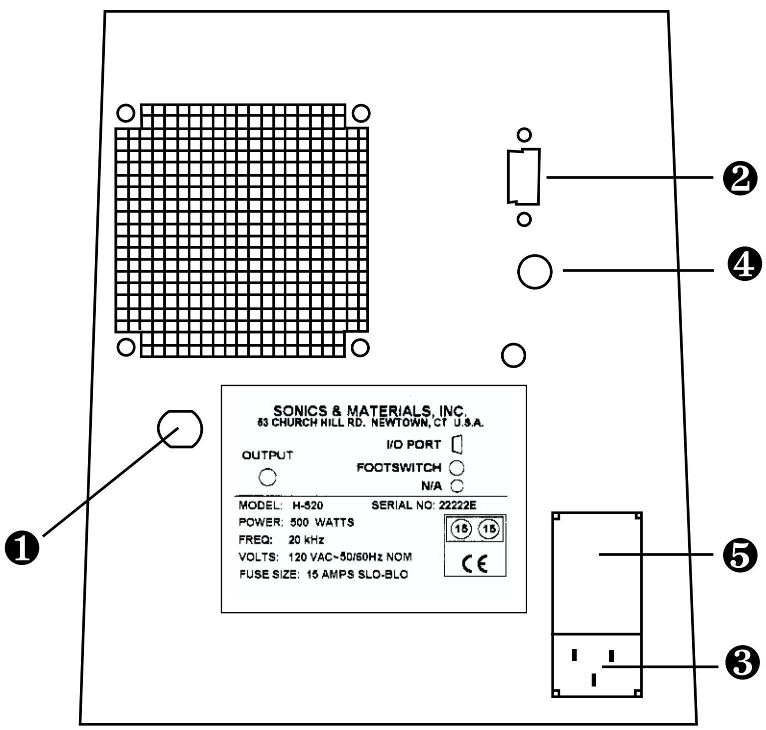
WARNING

*Make sure the ON/OFF switch is in the OFF position and the power supply line cord is **not** plugged in before making any cable connections.*

Located at the rear of the power supply are the cable connections as illustrated below. (The interconnecting cables will be supplied with your system.)

1. A round, 4-pin cable (with red locator dot) that connects the hand gun to the power supply.
2. A standard DB9 I/O connector that can interface with automated machines via a PC or PLC. (See drawing in the Appendix at the back of this manual.)
3. 3-prong inlet to connect the power supply with the appropriate electrical outlet. Do not make this connection until the hand gun is connected to the power supply.

Once these connections have been made, the power supply is ready for operation.



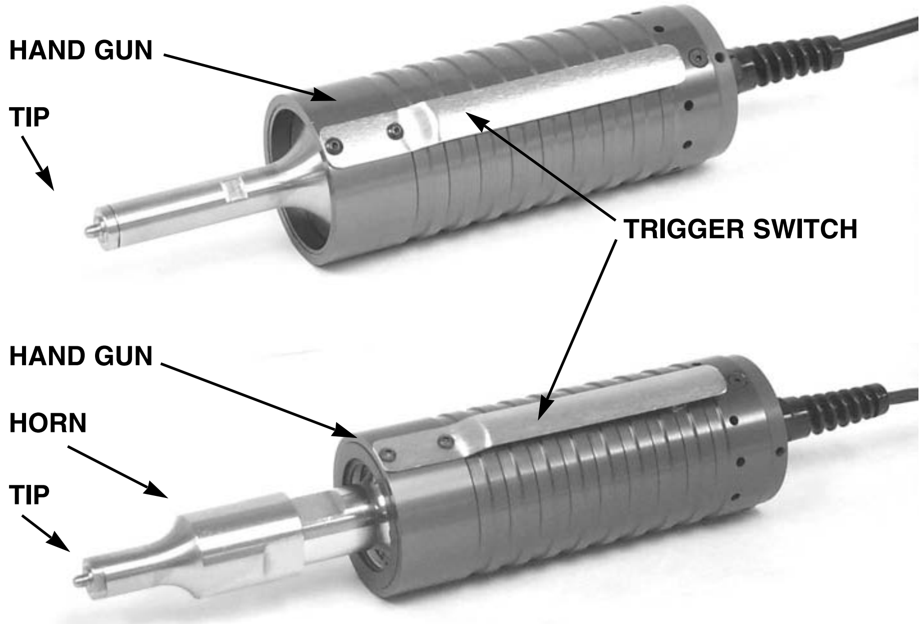
Also located at the rear of the power supply are the following:

4. Foot switch jack – connects foot switch cable to enable remote actuation.
5. Fuses – 120V = 15A slo-blo

   230V = 8A slo-blo

KEY COMPONENTS

Pictured below is the power supply with 2 hand gun options, 20 kHz (CV52) and 40 kHz (CV54).



WARNING

Never remove or install a tip by holding the hand gun case or rotating the tip with only one wrench as this may cause damage to the booster and/or converter.

NOTE: *Before using wrenches to assemble as shown, you should be able to seat the horn or tip without encountering resistance in the mating threads.*

TIP ASSEMBLY (CV52)

If the tip is not already assembled, follow the instructions below as applicable.

TIP REPLACEMENT (CV52)

1. Clean the mating surfaces, as well as the threaded stud and hole. Check that the stud is tight (see recommended torque requirements on page 13).
2. Hand assemble the tip to the titanium driver using open-ended wrenches as shown below. Tighten securely. **Do not force or overtighten.**

CV52 / TIP

HORN ASSEMBLY (CV54 ONLY):

1. Clean the mating surfaces of the converter and horn, as well as the threaded stud and hole. Check that the stud is tight (see recommended torque requirements on page 13).
2. Hand assemble the converter and horn together using open-ended wrenches as shown below. Tighten securely. **Do not force or overtighten.**

CV54 / HORN

TIP REPLACEMENT (CV54)

1. Clean the mating surfaces, as well as the threaded stud and hole. Check that the stud is tight. (See recommended torque requirements below.)
2. Hand assemble the tip to the horn using open-ended wrenches as shown below and tighten securely. **Do not force or overtighten.**

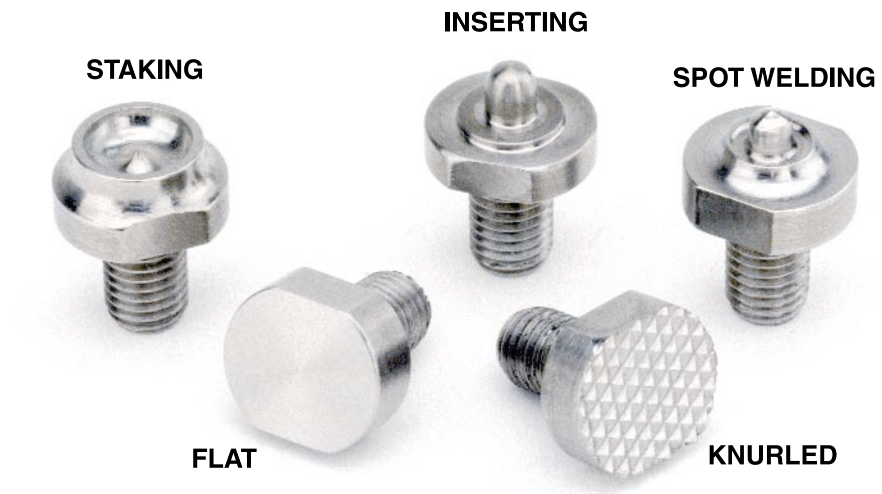
CV54 /HORN / TIP

RECOMMENDED TORQUE REQUIREMENTS

Frequency	Component	Thread Size	Inch-Lbs.
20 kHz	Converter / Tip	1/4-28	35
40 kHz	Converter / Horn	8 mm	35
40 kHz	Horn / Tip	1/4-28	35

TIP SPECIFICATIONS

A variety of replaceable tips – both custom and standard – are available for the hand held welding systems. Upon request, special carbide faced, wear resistant, flat, knurled, and custom faced tips are available.

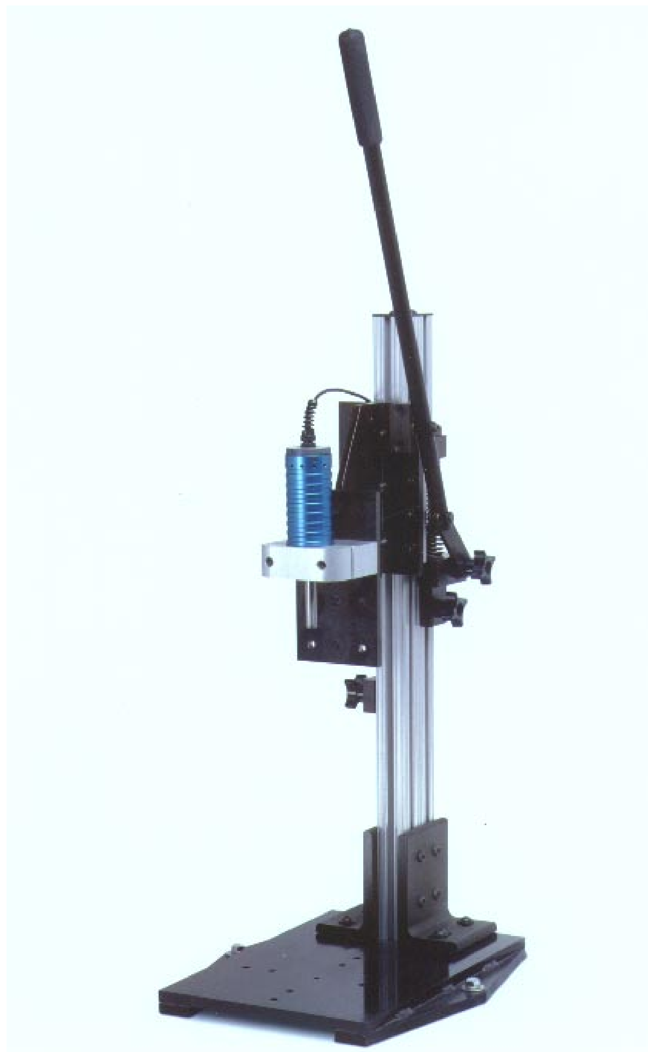


Refer to the various tables under staking, spot welding and insertion descriptions on pages 24-27 for lists of standard threaded tips. For custom tips, call our Sales Department at 203-270-4600.

OPTIONS

The following options and accessories are available for the H520 and H540 systems.

1. **FOOT SWITCH** for remote activation. (When foot switch actuation is used, the trigger handle is removed from the hand gun housing.)
2. **MANUAL ARBOR PRESS,** available with foot switch or cam actuation, is designed for assembling parts where production volume does not justify automated equipment. The press provides a more controlled motion of the welder than is possible by just holding the hand gun, resulting in more consistent assemblies.



MANUAL PRESS

3. **STAPLER** with special pivoting mechanism. Ideal for sealing low production rate clamshell packages.

4. **PISTOL GRIP** for more ergonomic handling of the hand gun in specialized applications.

OPERATING PROCEDURES

WARNING

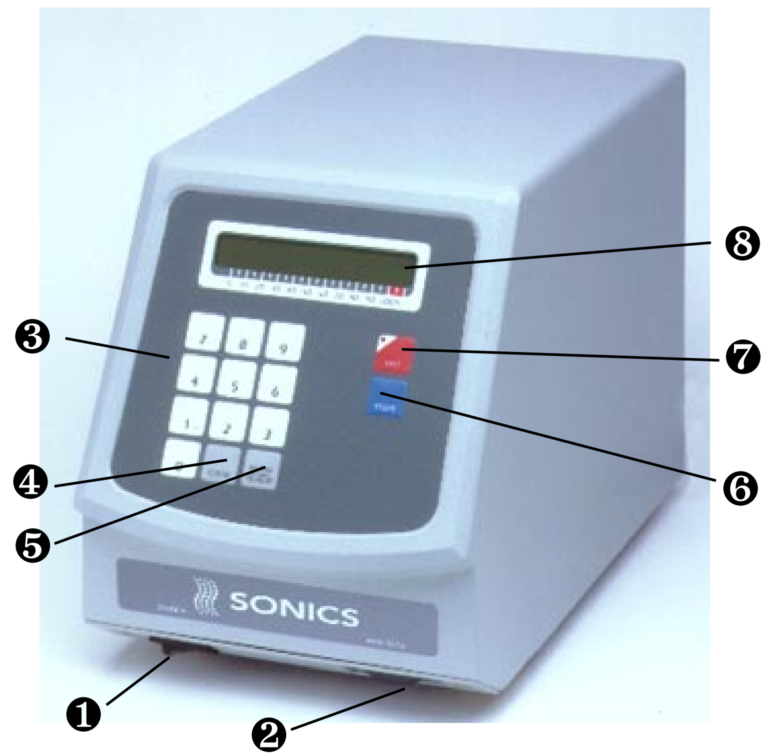
Do not operate the power supply unless it is connected to the hand gun.

NOTE: *The operating range of amplitude is 20-100%*

NOTE: *If ultrasonics are run continuously (time setting = 0), be sure to air cool the converter.*

FRONT PANEL CONTROLS AND INDICATORS

Located at the front of the power supply are the following controls:



1. **ON/OFF** switch which turns the unit on and off.
2. **AMPLITUDE** dial which controls adjustment of the amplitude of the system's high-frequency vibrations over the full operating range. Turning the dial clockwise increases amplitude, while turning it counterclockwise decreases the amplitude.
3. **0-9 NUMERIC KEYPAD** which allows input of numeric data by pressing the keys.
4. **CLEAR** key which clears the preceding entry when pressed.
5. **ENTER/REVIEW** key which serves to enter data into the system and/or to display data (or parameters) on the LCD screen.
6. **TIMER** key which, when used with the numeric keys, controls the duration of the ultrasonics. The minimum time setting is 0.1 seconds and the maximum is 9.9 seconds. At a time setting of 0, the ultrasonics will run continuously when the hand gun trigger switch is depressed.

7. **TEST** key which can be used to test the actual power output (watts). When this key is pressed, the ultrasonics are activated and will remain on (cycle) for 5 seconds. The red LED in the upper left corner lights up accordingly during the cycle. The number of watts will be displayed on the LCD screen and a line will display along the bar graph on the bottom of the LCD screen which will reflect the percentage of power output.
8. **LCD SCREEN** which displays various settings, parameters and prompts as detailed on the following pages.

INITIAL OPERATION

1. When all cable connections have been made, and the hand gun is connected to the power supply, turn the **ON/OFF** switch to the ON position.

   The LCD screen will briefly display the model number (in these examples, the H520), wattage and frequency as follows:

   SONICS & MATERIALS
   MODEL H520 500**W** 20 **KHZ**

   This display will be immediately followed by the SET UP screen, like the example below, that shows the Time and Amplitude parameters:

   H520 **SET UP**
   TIME 1.5 **SECONDS** **AMPL** 90%

2. The **TIMER** parameter controls the amount of time the ultrasonics will be activated. To enter the welding time value, press the TIMER key. The current time setting, such as the example below, will be displayed:

   TIME 1.5 **SEC**

   Use the numeric keypad to enter the number of seconds desired (a value between 0.1 and 9.9 seconds). To enter the keyed-in time value into the system, press the **ENTER/REVIEW** key.

3. Adjust the amplitude by turning the **AMPLITUDE** dial. Turning the dial clockwise to its limit will yield 100%, providing maximum amplitude. Turning the dial counterclockwise to its limit will yield approximately 20% amplitude.

4. Once the time parameter has been entered and the amplitude adjusted, the ultrasonics are ready to be tested. Make sure the tip is not in contact with anything.

5. Press the **TEST** key. The ultrasonics will be activated and the red LED will light up during the weld cycle. The actual wattage will be digitally displayed on the LCD screen and the bar graph line will indicate the corresponding power output percentage.

TEST 08 **WATTS**

6. Press the **ENTER/REVIEW** key after the TEST cycle is completed and the LCD screen will display the peak wattage consumed and the weld time, like the example below.

PEAK WATTS: 325
TIME: 2.0

WARNING

Readings on the bar graph should never exceed 20% during the test cycle.

The peak wattage should never exceed 25 watts. Use the amplitude control dial to adjust the output as necessary. When the switch on the hand gun is depressed, the LCD screen will display the amplitude percentage like the example below:

AMPLITUDE CONTROL 90%

NOTE: *Depressing the ENTER/REVIEW key during the ultrasonic cycle will cause the LCD screen displays to scroll between time, power and amplitude. Values shown are real time.*

7. If test readings do not exceed the maximum allowable values, proceed to actual weld operation as follows:

   a. Bring the hand gun in contact with the surface of the item(s) to be assembled and apply light guiding pressure.

   b. Depress the trigger switch on the hand gun to activate the ultrasonics.

8. Examine results, and if necessary, adjust time and amplitude settings, and/or force where applicable.

OVERLOAD PROTECTION

There are two overload protection circuits – one for the power supply and one for the hand gun – which will terminate the welding cycle when the system is operated under adverse conditions, such as excessive wattage, voltage or current, or a loose or failed horn/tip. These circuits will prevent damage to internal system components.

If an overload condition exists, turn the power supply off (using the ON/OFF switch) and wait for approximately 5 seconds. Then turn the power supply back on. If the overload condition continues to exist, contact our Service Department at 1-800-745-1105.

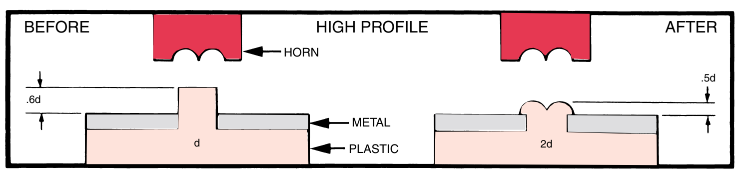
APPLICATIONS – STAKING

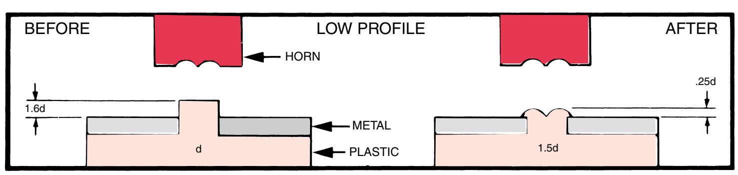
Ultrasonic staking, also referred to as ultrasonic “heading” or “riveting”, controls the flow of the molten plastic used to capture or retain another component in place. Ultrasonic staking provides an alternative to welding when the two parts consist of dissimilar materials that cannot be welded or when simple mechanical retention of one part relative to another is inadequate (i.e. as distinct from molecular bonding). A common application is the attachment of plastic to metal. Typically a metal part, with location holes, is placed over a plastic part with molded bosses. The horn tip is then pressed against the plastic boss and the vibratory motion creates friction and localized heating. As the boss melts, the light pressure from the horn forms a head to a shape determined by the horn tip configuration. When the vibrations stop, the plastic material solidifies, and the dissimilar materials are fastened together.

With staking, tight assemblies are possible because mating parts are clamped under pressure of the horn until the rivet head solidifies. There is no elastic recovery as is the case with heat staking or cold forming. A major advantage of ultrasonic staking over heat staking is that the ultrasonic staking tip remains relatively cool during the process, forming a clean head with no sticking or stringing during assembly.

STANDARD FLARED STAKE

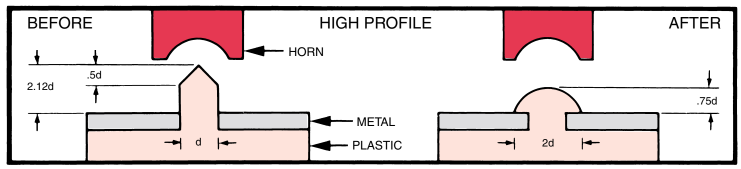
The standard flared stake satisfies the requirements of most applications. This stake is recommended for bosses with an O.D. of 1⁄16 inch (1.6 mm) or larger, and is ideally suited for low density, nonabrasive amorphous plastics.

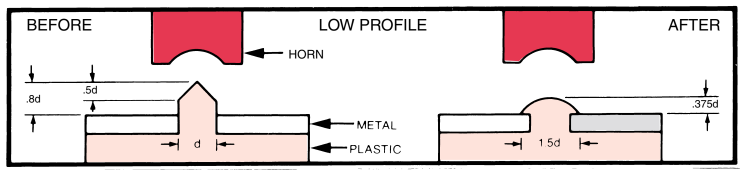




SPHERICAL STAKE

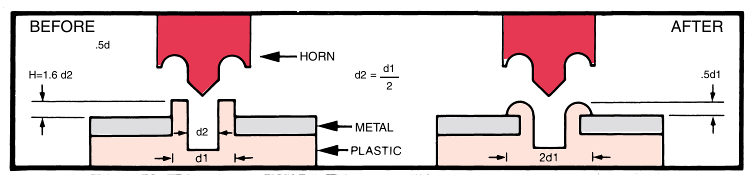
The spherical stake is preferred for bosses with an O.D. less than 1⁄16 inch (1.6 mm). It is also recommended for rigid crystalline plastics with sharp highly defined melting temperatures, for plastics with abrasive fillers, and for materials that degrade easily.





HOLLOW STAKE

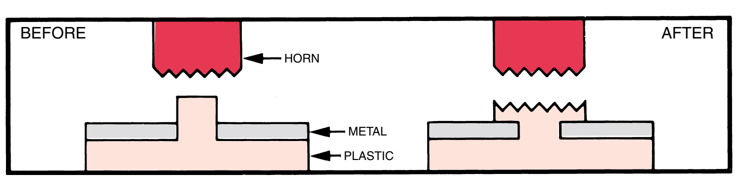
Bosses with an O.D. in excess of 5⁄32 inch (4 mm) should be made hollow. Staking a hollow boss produces a large, strong head without having to melt a large amount of material. Also, the hollow stake avoids sink marks on the opposite side of the component, and enables the parts to be reassembled with self-taping screws, should repair and disassembly be necessary.



KNURLED STAKE

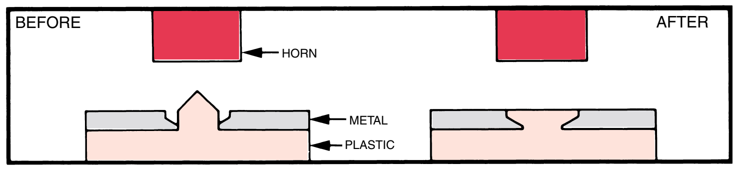
The knurled stake is used in applications where appearance and strength are not critical. Since alignment is not an important consideration, the knurled stake is ideally suited for high volume production, and is often recommended for use with a hand held ultrasonic spot welder.

Knurled tips are available in a variety of fine, medium and course configurations.



FLUSH STAKE

The flush stake is used for applications requiring a flush surface. The flush stake requires that the retained piece has sufficient thickness for a chamfer or counterbore.



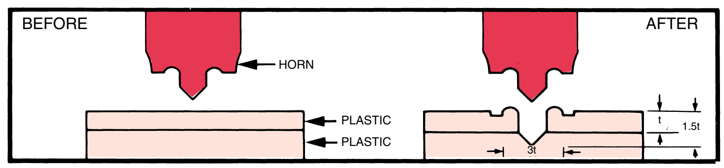
STANDARD THREADED TIPS FOR STAKING

STAKING

Plastic Boss Diameter		TIP CODE LETTER						
		Solid Boss Flare Head				Conical Boss Spherical Head		Hollow Boss
		High Profile		Low Profile				
inches	mm	Tip Size	Stud Height*	Tip Size	Stud Height*	High Profile	Low Profile	
1/32	0.793	A	.050	G	.019	AA	GG	—
1/16	1.587	B	.100	H	.0375	BB	HH	—
3/32	2.381	C	.150	I	.056	CC	II	—
1/8	3.175	D	.200	J	.075	DD	JJ	R
5/32	3.969	E	.250	K	.094	EE	KK	S
3/16	4.762	F	.300	L	.112	FF	LL	T

APPLICATIONS – SPOT WELDING

During spot welding, the horn tip penetrates through the top sheet and enters the bottom sheet to a depth of one half the top sheet thickness. The displaced molten plastic is shaped by a cavity in the tip to create an annular formation around the weld. Simultaneously, the molten plastic displaced from the second sheet flows into the preheated area and forms a permanent molecular bond. Large thermoplastic parts and applications with hard to reach joining surfaces can easily be welded together using an ultrasonic spot welder and standard replaceable tips.



STANDARD THREADED TIPS FOR SPOT WELDING

SPOT WELDING

Material Thickness		TIP CODE LETTER
inches	**mm**	
1/32	0.793	SA
3/64	1.190	SB
1/16	1.587	SC
5/64	1.984	SD
3/32	2.381	SE
7/64	2.778	SF

ORDERING INFORMATION

Specify tip required using code letter.

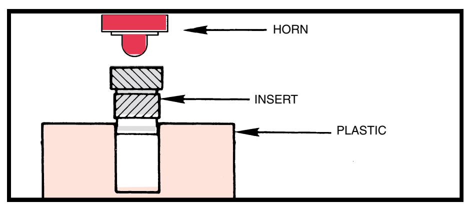
Example:

Spot weld tip “SA” indicates a tip used for spot welding – 1/32" thick material.

APPLICATIONS – ULTRASONIC INSERTION

Ultrasonic insertion involves a metal insert to be placed in a cored or drilled hole that is slightly smaller than the insert. This hole provides a certain degree of interference and also serves to guide the insert into place. The vibrating ultrasonic horn contacts the insert and the ultrasonic vibrations travel through the insert to the interface of the metal and plastic. Heat, generated by the insert vibrating against the plastic, causes the plastic to melt, and as the horn advances, the insert is embedded into the component. The molten plastic flows into the serrations, flutes, or undercuts of the inserts and, when the vibrations terminate, the plastic resolidifies and the insert is securely encapsulated in place. Inserts can be ultrasonically installed in most thermoplastics.

Ultrasonic insertion provides the high performance strength values of a molded-in insert while retaining all of the advantages of post-molded installation. Some of the advantages of ultrasonic insertion over other methods include rapid installation, minimal residual stresses in the component following insertion, elimination of potential mold damage, reduced mold fabrication costs and increased productivity as a result of reduced mold cycle times.



STANDARD THREADED TIPS FOR INSERTION

INSERTING

Insert Size	Inside Diameter of Insert	Pilot Diameter Of Tip
SAE		
4-40	0.088	0.078
6-32	0.106	0.096
8-32	0.133	0.123
10-24	0.147	0.137
10-32	0.160	0.150
1/4-20	0.200	0.190
1/4-28	0.211	0.201
5/16-18	0.262	0.252
METRIC		
2.5 x 0.45	0.079	0.069
3 x 0.5	0.097	0.087
3.5 x 0.6	0.114	0.104
4 x 0.7	0.129	0.119
5 x 0.8	0.165	0.155
6 x 1	0.195	0.185
8 x 1.25	0.265	0.255

REPAIRS / SERVICE

NOTE: *If packing unit for return shipment, DO NOT use styrofoam "peanuts."*

If problems are encountered, contact our Service Department as follows:

Phone: 1-800-745-1105 • 1-203-270-4600

Fax: 1-203-270-4610

E-Mail: service@sonicsandmaterials.com

It is suggested that a system in need of repair be sent back to the factory, with a written description pertaining to the nature of the problem.

Always contact the factory for return authorization before shipping any instrument. Include date of purchase, model number, and serial number. For units not covered by the warranty, a purchase order should be forwarded to avoid unnecessary delay. Care should be exercised to provide adequate packing to insure against possible damage in shipment. The system should be sent with all transportation charges prepaid and return method of shipment indicated.

WARRANTY

Sonics & Materials, Inc., hereinafter referred to as "Sonics," warrants its products for a period of one year from the date of shipment against defect in material and workmanship under normal installation, use, and maintenance as described in the operating instructions which accompany such equipment. During the warranty period, "Sonics" will, at its option, as the exclusive remedy, either repair or replace without charge for material and labor, the part(s) which prove upon our examination to be defective, provided the defective unit is returned to us properly packed with all transportation charges prepaid.

Ultrasonic welding horns constructed of titanium or aluminum are guaranteed against defects for a period of one year from date of shipment. "Sonics" will repair or replace a cracked or defective horn once without charge, if failure occurs within the warranty period.

Ultrasonic welding horns constructed of steel are guaranteed against defects for a period of ninety days from date of shipment. "Sonics" will repair or replace a cracked or defective steel horn once at a charge of 50% of the original purchase price, if failure occurs within the warranty period.

LIMITATION OF WARRANTY

This warranty is in lieu of any other warranties, either express, implied, or statutory. "Sonics" neither assumes nor authorizes any person to assume for it any other obligation or liability in connection with the sale of its products. "Sonics" hereby disclaims any warranty or 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 "Sonics" be liable to the purchaser or to any other person for any incidental or consequential damages or loss of profit or product resulting from any malfunction or failure of this "Sonics" product.

This warranty does not apply to equipment which has been subject to unauthorized repair, misuse, abuse, negligence or accident. Equipment which, in our judgment, 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.

No liability is assumed for expenses or damages resulting from interruptions in operation of the product or damages to material in process.

"Sonics" equipment is designed for maximum operator safety and incorporates built-in safety devices. Any modifications to these safety features will void the warranty. "Sonics" assumes no responsibilities for consequential damages incurred due to modifications to the said equipment.

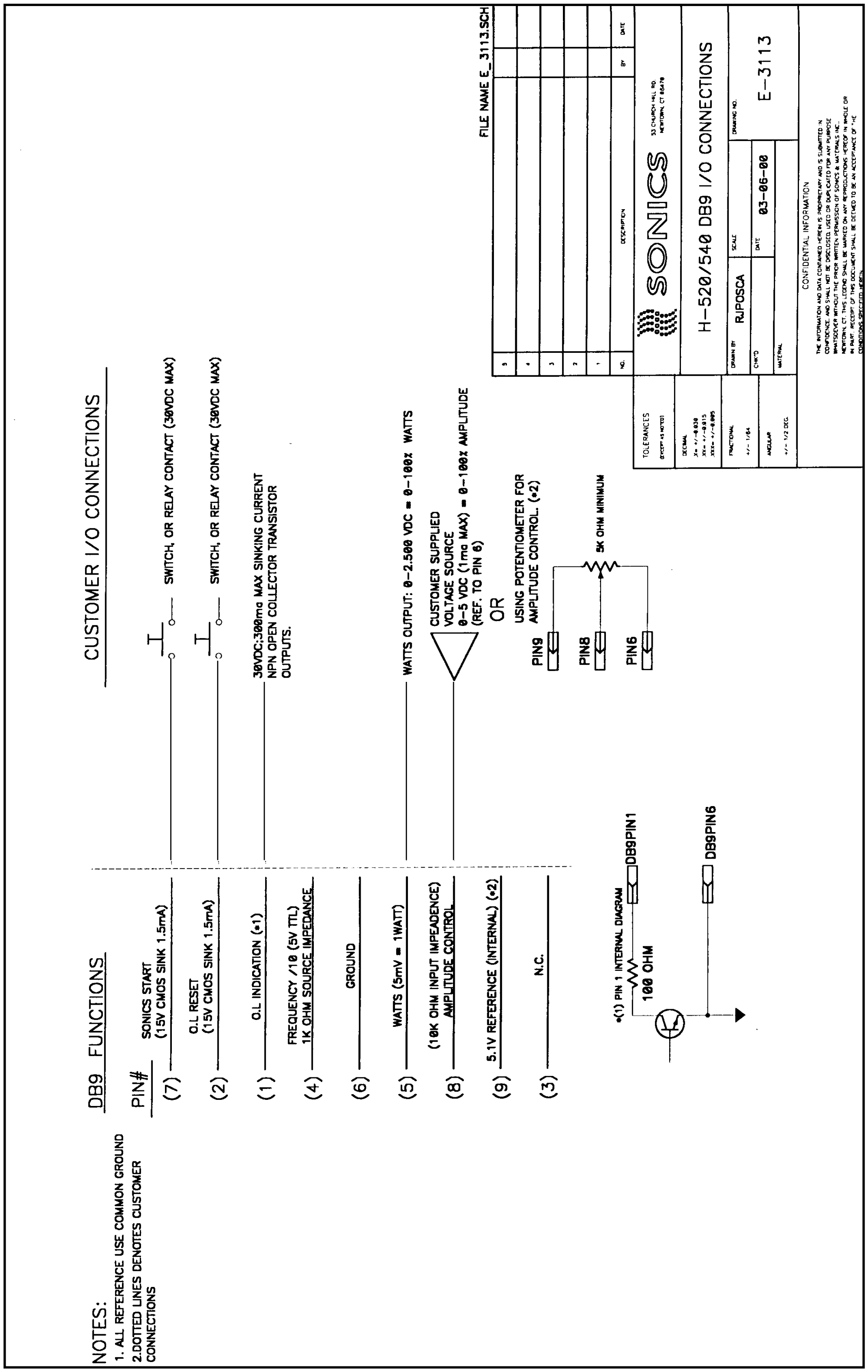
“Sonics” reserves the right not to warrant horns of unusual or experimental design which in our judgment are more likely to fail in use.

This warranty does not cover equipment used for applications requiring metal-to-metal contact with weld time in excess of 1 second.

Data supplied in the instruction manual has been verified and validated and is believed adequate for the intended use of the equipment. If the equipment or procedures are used for purposes other than those specified herein, confirmation of their validity and suitability should be obtained in writing from “Sonics.”

APPENDIX

DB9 I/O CONNECTIONS DIAGRAM



SONICS

Sonics & Materials, Inc.

Corporate Headquarters

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www.sonicsandmaterials.com • info@sonicsandmaterials.com

European Office

22 ch du Vernay • CH - 1196 Gland, Switzerland
(41) (0) 22/364 1520 • (41) (0) 22/364 2161 fax
europe@sonicsandmaterials.ch

Operators Manual

Electric Stepper Motor driven Actuator

20 EP
40 EP

Model Shown: 20EP-22

Sonics & Materials, Inc.
53 Church Hill Road • Newtown, CT 06470
Tel: 203-270-4600 • 800-745-1105 • Fax: 203-270-4610
e-mail: info@sonicsandmaterials.com   internet: www.sonicsandmaterials.com

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WARRANTY

Sonics & Materials, Inc., hereinafter referred to as "Sonics", warrants its products for a period of one year from the date of shipment against defect in material and workmanship under normal installation, use, and maintenance as described in the operating instructions which accompany such equipment. During the warranty period, "Sonics" will, at its option, as the exclusive remedy, either repair or replace without charge for material and labor, the part(s) which prove upon our examination to be defective, provided the defective unit is returned to us properly packed with all transportation charges prepaid.

Ultrasonic welding horns constructed of titanium or aluminum are guaranteed against defects for a period of one year from date of shipment "Sonics" will repair or replace a cracked or defective horn once without charge, if failure occurs within the warranty period.

Ultrasonic welding horns constructed of steel are guaranteed against defects for a period of ninety days from date of shipment. "Sonics" will repair or replace a cracked or defective steel horn once at a charge at 50% of the original purchase price, if failure occurs within the warranty period

LIMITATION OF WARRANTY

This warranty is in lieu of any other warranties, either express, implied, or statutory "Sonics" neither assumes nor authorizes any person to assume for it any other obligation or liability in connection with the sale of its products. "Sonics" hereby disclaims any warranty or merchant-ability 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 "Sonics" be liable to the purchaser or to any other person for any incidental or consequential damages or loss of profit or product resulting from any malfunction of failure of this "Sonics" product.

This warranty does not apply to equipment, which has been subject to unauthorized repair, misuse, abuse, negligence or accident. Equipment which, in our judgment, 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.

No liability is assumed for expenses or damages resulting from interruptions in operation of the product or damages to material in process.

"Sonics" equipment is designed for maximum operator safety and incorporates built-in safety devices. Any modifications to these safety features will void the warranty. "Sonics" assumes no responsibilities for consequential damages incurred due to modifications to the said equipment.

Horns supplied by "Sonics" are manufactured to exacting specifications and are tuned to vibrate at a specific frequency. Using an out-of-tune horn will cause damage to the equipment and may result in warranty nullification. "Sonics" assumes no responsibility for converters, horns, or fixtures not supplied by "Sonics" or for consequential damages resulting from their usage.

"Sonics" reserves the right not to warrant horns of unusual or experimental design which in our judgment are more likely to fail in use.

This warranty does not cover equipment used for applications requiring metal-to-metal contact with weld time in excess of 1 second.

Data supplied in the instruction manual has been verified and validated and is believed adequate for the intended use of the equipment. If the equipment or procedures are used for purposes other than those specified herein, confirmation of their validity and suitability should be obtained in writing from "Sonics".

WARNING
SAFETY PRECAUTIONS
READ BEFORE INSTALLING OR
USING THE EQUIPMENT

This system has been designed to assure maximum operator safety. However, no design can completely protect against improper usage. For maximum safety and equipment protection, observe the following warnings at all times and read the instruction manual carefully before you attempt to operate the equipment.

– The equipment has safety devices that require both hands to be on the palm buttons until the horn contacts the work piece. Do not defeat or modify these safety devices.

– Do not use with foot switch unless alternate means of pinch-point protection is provided.

– High voltage is present in the equipment. Disconnect plug before removing cover or servicing.

– Make sure equipment is properly grounded with a 3-prong plug. Before plugging in equipment, test outlet for proper earth grounding.

– High voltage potential may be present in the converter as a result of temperature changes. Do not touch the converter contact unless you first short both pins or the button to the converter case with an insulated tool.

– Never squeeze or grab a vibrating horn.

– Do not modify horn configurations.

– Ultrasonic welders operate above normal audibility for most people. Ear protection is recommended.

- Do not affix any device to any portion of the horn.

INSPECTION

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

The equipment 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 of damage sustained in transit must therefore, be made upon the carrier, as follows.

CONCEALED LOSS OR DAMAGE - Concealed loss or damage means loss or damage which does not become apparent until the merchandise has been unpacked. The contents might have been damaged in transit due to rough handling even though the container may not show external damage. When the damage is discovered upon unpacking, make a written request for inspection by the carrier's agent within 48 hours of the delivery date. Then file a claim with the carrier since such damage is the carrier's responsibility. The form required to file such a claim will be supplied by the carrier. Do not destroy packing materials, or move material from one location to another before the carrier makes their inspection.

VISIBLE LOSS OR DAMAGE - Any external evidence of loss or damage must be noted on the freight bill or express receipt, and signed by the carrier's agent. Failure to adequately describe such external evidence of loss or damage may result in the carrier's refusal to honor a damage claim. The form required to file such a claim will be supplied by the carrier.

If the system or any unit is damaged, contact the Sales Department at Sonics & Materials, Inc. "Sonics" will arrange for repair or replacement of damaged equipment without waiting for the claim against the carrier to be settled, provided a new purchase order is issued to cover the repair or replacement costs. Should any damage, shortage or discrepancy exist, please notify us immediately.

ELECTRICAL POWER

The ElectroPress motor controls require a fused, single phase, standard 3-terminal grounding type electrical receptacle capable of supplying 105-125 volts, 50/60 Hz, 15 amp service, or 200-240 volts, 50/60 Hz, 15 amp service, depending on the voltage option. See the Model Specification and Accessory List – section 3.0.

MODEL	@ 115 VAC	@ 230 VAC
20EP or 40EP	3 amps	1.6 amps

LOCATING THE EQUIPMENT

The system should be installed in proximity to the electrical source, it is supplied with an 8 Ft power cord. The area should be free from excessive dust, dirt, corrosive fumes and extremes of temperature and humidity.

Allow at least 10 inches (25 cm) in back of each unit for cabling convenience.

All welding press models should be placed on a sturdy level bench capable of supporting a minimum of 500 pounds (227 kg).

The power supply and motor controller should be located so that the front panel controls are visible and accessible. Sufficient space should be allotted around the unit to ensure adequate ventilation. If the power supply and motor controller must be housed in a confined space, forced air-cooling may be necessary to keep the surrounding air within acceptable ambient temperature. Periodically check the ventilation grille and clean if necessary. The distance between the welding press and motor controls should not exceed 9 feet (3m).

PREPARATION FOR USE - CONNECTIONS

Connect the power supply and press in accordance with the following procedure. See section 5.0 on page 14 for additional information and a connection diagram.

1. Using cables provided, connect the power supply to the press. Do not strain or kink the cables. When going around corners, allow as wide a bend as possible. Do not run the cables parallel to any power line within a distance of less than 1 foot (30 cm).

2. Plug the power supply line cords into the electrical outlets. To prevent the possibility of an electrical shock, ensure that the line cords are properly grounded.

IMPORTANT SERVICE LITERATURE

Please read carefully before operating the equipment

The plastics assembly system supplied with this instruction manual is constructed of the finest available components with workmanship that meets or exceeds our 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.

MANUAL INFORMATION

We continually strive to keep up with latest electronic developments by adding circuit and component improvements to our equipment as soon as they are developed and tested.

In order to move around the manual quickly, hyperlinks are provided in the following Table of Contents (TOC) for each major section. Click the hyperlink to move directly to the selected section. At the top of each linked heading you will find a TOC link to return to the Table of Contents. This should help to minimize continuous page up/down key-strokes to find a section of interest.

For the purposes of this manual, references to the "EM or FM controller" or to the "ultrasonic power supply" will mean the associated ultrasonic supply and microprocessor controller. References to the "motor controls" or "stepper system" will mean the transport controls for velocity and distance. Certain ultrasonic control parameters can effect the stepper control performance. These settings and considerations will be identified in RED text with page references to the ultrasonic manual. The FM Ultrasonic manual must be considered an integral part of understanding the Stepper Welding System.

Basic Windows™ familiarity is assumed. The user must be familiar with Windows™ based file selection and mouse operations. Consult a Windows tutorial if these operations are unfamiliar. Manual descriptions will not address these basic concepts.

Internet familiarity is also assumed. URL addresses have been included in a few sections to assist with downloads for viewing this manual and the provided DXF drawing files. If Internet access is not available these references may be ignored.

Manuals for all new Sonics & Materials products (after Jan99) are provided on CD in Microsoft Word97™ format. A printed manual may be ordered as an accessory item but shipment will not be guaranteed with the system components. Manuals will be printed on demand only (expect low volume pricing for hardcopy manuals).

Sometimes, due to printing and shipping requirements, we cannot incorporate these changes immediately into printed manuals. Hence, your manual may contain new change information. Change information, if any, is located at the end of this manual in the Maintenance section.

We reserve the right to make any changes in the design or construction of our equipment at any time, without incurring any obligation to make any change whatsoever in units previously delivered.

TABLE OF CONTENTS

GENERAL

System_Operation

MAINTENANCE

System Operation

TOC

1.0 Introduction to Plastic Welding TOC **-** For an introduction to ultrasonic plastic assembly – Refer to the FM Instruction Manual supplied with the ultrasonic power supply - pages 3 through 8. These sections discuss the basic principles of ultrasonic assembly and the major ultrasonic components – converter, booster and horn. The stepper welding system is identical except that a solid mount booster is used that will not flex under applied pressure. To achieve the best desired assembly accuracy of the stepper system; a solid mount booster is required.

2.0 The Stepper Welding System TOC **-** The Stepper Welder System (ElectroPress Model) is designed for precision plastic welding applications with dimensional requirements beyond the capabilities offered with a standard air actuated ultrasonic press. The system will control the final weld position with a tolerance of $\pm$0.0003 inches. Finished assemblies are produced with a weld repeatability that is not possible with any other plastic welding process. The advancing speed of the ultrasonic horn is controlled with a stepper motor drive, which exactly repeats the defined profile for position and velocity every time. The results are repeatable welds with exact final dimensions of the bonded components when compared with air driven actuators (material dependent). The system is offered as a transport option with standard Sonics & Materials 20 kHz and 40 kHz ultrasonic power supplies.

The ElectroPress actuator assembly is a completely rigid system. Solid booster technology is used to mount the stack assembly into the actuator head. These boosters do not contain O-rings, which are found in conventional ultrasonic boosters. O-rings can move and distort as pressure is applied resulting in horn movement on the parts and weld quality problems. With this rigid system the horn will not move and full capability of the stepper motion controls can be achieved.

Welding with an ElectroPress driven actuator is very unique, compared to a conventional pneumatic welder. With a pneumatic welder the applied force on a part is adjusted by changing the air pressure regulation to the cylinder which drives the horn assembly. Continuous pressure is applied to the parts during the welding process. Attempts to modify the applied pressure are only marginally successful due to the volume of air that is present. Pressure cannot be changed instantaneously as long as the air system has pressure. A notable lag will occur between changing the regulator settings and any actual pressure change. In most cases, the weld will be completed long before the pressure change could affect the weld in any appreciable way. With the stepper system, force can be controlled precisely through a digital velocity profile.

The ElectroPress system uses the programmed weld velocity to control the applied force directly. This applied force is also dependent on ultrasonic amplitude, which controls the level of heat available, and therefore the amount of molten plastic that will be produced between the parts. The resultant force will be a function of heat (ultrasonics) to melt the plastic and velocity to drive the parts together. The faster the horn moves into the parts the greater the force. The greater the heat that's available to melt the plastic the lower the force because the plastic will flow out from under the horn. Best application results will be provided by careful balance of velocity, distance and ultrasonic amplitude. With the velocity and distance precisely controlled, the actual weld cycle time will also be exactly repeatable because the velocity profile will be the same every time.

The ElectroPress controls are packaged in the same size chassis as the Sonics & Materials ultrasonic power supply so that they can be stacked together. This provides a standard ultrasonic supply whether the customer application requires velocity controls with the stepper transport or a standard air actuated system. Both units should be located so that they are accessible to the operator for initial setup and programming.

3.0 Model Specification and Accessory List TOC - The ElectroPress Model specification provides for two press sizes and two voltage specifications for the motor control package. One press size for the 20 kHz and a smaller size for 40 kHz. The press may be ordered for mounting on our standard round column base or on a rigid square column base. The Palm buttons may be mechanical or zero force photo types.

EP Model Specification

EP Model No: **xx EP-x x x x**

Frequency Selection
20 Kilohertz - **20**
40 Kilohertz - **40**

AC Service Voltage
1 - 120 VAC
2 - 230 VAC

Fixture Bolt Pattern
1 - English
2 - Metric

PB Option
1 - Mechanical - standard
2 - Photo Buttons

Column Option
1 - Round Column
2 - Square Column

***Example**: 20 EP-2211*

Booster Model#: **xx BHN x.xx - 2**

Solid Mount Booster

Frequency Selection
20 Kilohertz - **20**
40 Kilohertz - **40**

Gain
0.50
0.75
1.00
1.25
1.50
2.00
2.50

***Example**: 20 BHN 1.50-2*

Accessory List:

Cables:
PC to FM Controller ________________________________ **PCFM1**
PC to Stepper Controls ______________________________ **PCSC2**
Stepper Line Terminator _____________________________ **STX3**

Computer:
S&M to supply computer (Stepper Utility Loaded)_____ **PC1**
S&M will setup and test customer supplied PC ________ **PC2**
This Manual (printed version) _______________________ **PM100**

Sonics & Materials Sales personnel will verify that the appropriate ultrasonic power supply is ordered with the selected ElectroPress Model. A typical ElectroPress System order would contain at least five items plus accessories:

1. The ElectroPress order will specify the motor controls and appropriate size press. All press cables, power cords, communication cables, stepper line terminator, matching converter and the stepper utility software program are included. A PC is not included. A printed Manual is not included (It is provided as a Word97 doc file). A printed manual may be ordered as an accessory. A booster horn is not included.

2. A matching Ultrasonic Power Supply. F-Series (40 kHz 700 or 20 kHz 1000, 1500 or 2000 watt). See the Ultrasonic Power Supply manual or consult Sonics & Materials sales personnel to build a proper F-Series part number.

3. A Booster for the intended application. Gain specified.

4. An Ultrasonic Horn for the intended application. (if ordered)

5. Accessory – PC option (see below)

At this time, the computer system must be setup and tested by Sonics & Materials personnel. The user (PC2 option) may supply an appropriate system or Sonics & Materials will purchase and configure a base computer for this application (PC1 option). Due to the complexity of the system, unassisted customer configuration is not provided at this time.

4.0 System Specifications

TOC

Application Types

The ElectroPress Model is best applied to applications that require precise dimensional control, repeatability or improved bonding strength. Special materials and delicate components will also benefit from the velocity profile offered by the EP System.

Clean room applications that cannot allow the pressurized air systems required by conventional ultrasonic welders.

Marginal conventional ultrasonic applications may be stabilized to improve weld quality and reduce production reject rates.

Press (All):

Transport System:	Stepper Motor positioning system
Force Trigger Control:	10 – 150 lbs.; 1-lb. increments. (50 – 650 Newtons; 1 Newton increments).
Vertical Travel Velocity:	20 RPS; 2.66 in/sec (67.7mm/sec).
Weld Velocity 1 and 2:	0.01 – 10 RPS; 0.01 RPS increments. (0.0266 in/sec – 1.33 in/sec). (0.675 mm/sec – 33.782 mm/sec).
Weld Distance (Ref Parts Contact Diagram Pg. 20):	
Absolute	0.0500 – 2.7500 in. (1.000 – 70.000mm)
Incremental	0.0010 - 0.5000 in. (0.01 – 12.70mm)
Motor Position Accuracy:	± 0.0003 in. (± 0.007mm).
Parts search zone (Ref Parts Contact Diagram Pg. 20):	
Upper Tolerance	0.0010 – 0.1000 in. (0.025 – 2.500mm).
Lower Tolerance	0.0010 – 0.1000 in. (0.025 – 2.500 mm).
Search Speed:	0.083 in/sec (2.10 mm/sec).

Fixture Mounting Thread:	3/8 – 16 (10 mm).
Maximum Stroke:	2.75” (100 mm).
Motor Stall Force:	500 Lbs. (2225 Newtons).

20 EP-1 Press (20 kHz Round Column):

Size:	21.000” L x 14.000” W x 38.937” H
Press Height:	51.750”
Weight:	143 Lbs. (65 Kgs)
Maximum opening for parts and fixture:	14.750”(374.65 mm)
Depth (horn centerline to support column):	8.422” (213.916mm)
Maximum Deflection (150 LB-Force):	0.008” (0.20 mm).

20 EP-2 Press (20 kHz Square Column):

Size:	21.000” L x 14.000” W x 39.375” H
Press Height:	52.75” H
Weight:	165 Lbs. (75 Kgs)
Maximum opening for parts and fixture:	13.125” (333.37 mm).
Depth (horn centerline to support column):	8.422” (213.92 mm).
Maximum Deflection (150 LB-Force):	0.011” (0.28 mm).

40 EP-1 Press (40 kHz Round Column):

Size:	21.000” L x 14.000” W x 38.937” H
Press Height	48.500” H
Weight:	115 Lbs. (52 Kgs)
Maximum opening for parts and fixture:	17.625” (447.68 mm)
Depth (horn centerline to support column):	8.422” (213.916mm)
Maximum Deflection (150 LB-Force):	0.008” (0.20 mm).

40 EP-2 Press (40kHz Square Column):

Size:	21.000” L x 14.000” W x 39.375” H
Press Height:	63” H
Weight:	137 Lbs. (62 Kgs)
Maximum opening for parts and fixture:	24” (709.6mm)
Depth (horn centerline to support column):	8.422” (213.916mm)
Maximum Deflection (150 LB-Force):	0.011” (0.28 mm).

Motor Control:

AC Power:	115 VAC @ 3 amp fuse rating. 230 VAC @ 1.6 amp fuse rating.
Package size:	22” D x 17.5” W x 6.3” H. 558.8 mm D x 444.5 mm W x 160.0 mm H.
Weight:	12.5 Lbs. (5.7 Kgs).
Humidity:	20 – 90% non-condensing. Operating Temperature Range: 50°– 90° F (17° – 40° C)

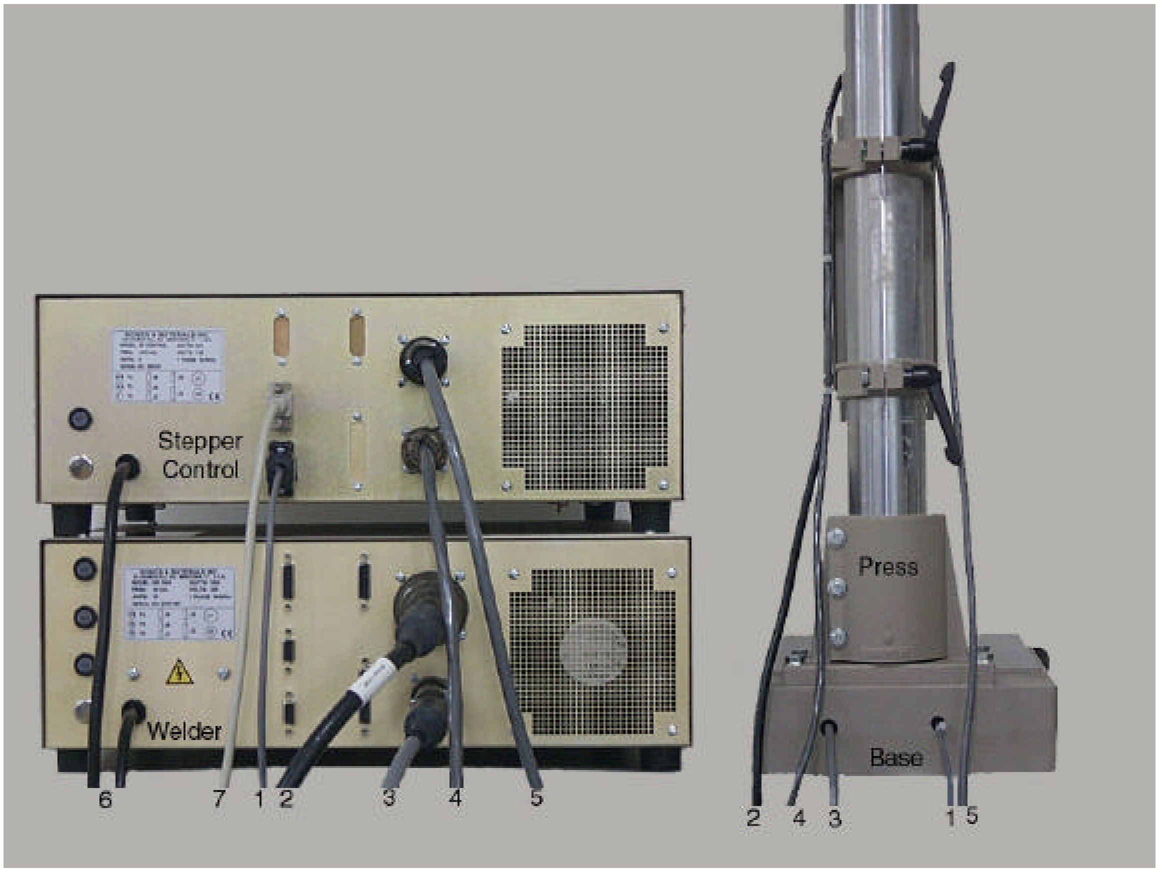
Programming:	Pentium Class PC required. See section 6
Stepper Motor Resolution:	96000 counts/inch. (0.0000104 in./count).
Encoder Resolution:	15000 counts/inch. (0.00006667 in./count).
Maximum Motor Case Temperature:	125°C
Display:	Two-line LCD reports final weld distance.
EMC:	The motor drive is not CE approved.
Noise:	58 dba. Max (transport motor noise during a move, ultrasonics off).

5.0 Physical System and Connections TOC **–** Physically the system is contained in three separate packages – The stepper controller, the ultrasonic power supply and the motor press assembly. Several cables are required to connect the various pieces together – see cable diagram on the following page. The ultrasonic supply and the motor controller are packaged in similar size chassis and should be positioned for easy programming access and cabling. The press assembly contains the motor, motor position encoder, force sensor, linear positioning actuator and ultrasonic converter with a solid mount booster. Additionally, a standard windows95 or 98 computer is required for programming the stepper system. Computer requirements have been previously described.

The press assembly has four cables, two connect to the ultrasonic supply (FM) and two connect to the stepper control box. The round cables cannot be interchanged and will only match the appropriate connector shell type on the back panels of the control units. The only 9 pin D type connector cable from the press contains the travel limit switches and is marked with a white paint dot on the connector shell. A similar white paint dot has been placed next to the appropriate mating connection on the stepper chassis. This connector can be confused and will plug into connections located on the ultrasonic supply for other signals which are not used by the stepper system! Be careful and match the colored dots where multiple choices exist!

The communications cables and the computer system, if supplied by Sonics & Materials, also have been color coded to assist with cable and port identification. The yellow dot is the stepper communication cable and the red dot is the ultrasonic port connection. The computer has also been marked with matching color dots to identify the Comm ports as tested by Sonics & Materials. Other port assignments can be used but will need to be configured the first time the stepper application is run. A termination connector is supplied and must be used on the stepper system if a computer will not be used to monitor the stepper controls. This connector terminates the hardware handshake lines. Drawings for these cables are contained in the Maintenance section of this manual and DXF files are included in the Sonics directory.

Stepper Hook Up Diagram



1. J7 - Base cable from base to Stepper Control. (Color Code - WHITE)
2. J1 - RF cable from press to the ultrasonic power supply (generator).
3. J2 - Base cable from press base to the ultrasonic power supply (generator).
4. J2 - Motor drive from press head to on the Stepper Control.
5. J1 - Control cable from press to on the Stepper Control.
6. AC power. To proper AC outlet.
7. J8 - RS232 Communication to PC. (Color Coded - YEL.LOW)
8. Terminal Connector. Used in place of Item #7 when RS232 cable is not used. (not shown)

This view shows the back connections of the Stepper and Ultrasonic controls. Match the cables from the press to the appropriate positions to the left. Follow the color-coded dots on the connector shells where multiple choices exist.

6.0 PC Software Installation TOC – A Pentium class PC is required as the programming and monitoring interface to the stepper welder system. The computer is used to program the stepper distance and velocity controls. Once the application is setup and running properly, the computer may be removed. The system will run the programmed profile without further commands from the computer. A termination jumper must be connected to the stepper controls in order to terminate the communication signals.

The following computer requirements should be considered when selecting a PC for the Stepper Utility Program. Sonics & Materials will purchase and setup a minimum based PC or the customer may provide a base computer with the appropriate requirements. See the Product Model Specification.

Recommended minimum computer requirements for the ElectroPress welder:

1. Minimum Computer: Pentium 200 Mhz.; 32 Meg Ram; 2 Gig Drive; Windows95 or Windows98
2. The system must have two (2) Comm ports available: COMM1, 2, 3 or 4.
3. Program space required: Less than 20 Meg for the Stepper Program.
4. Data Space: Consider Storage space for accumulated Data. If you intend to open a disk file to save the Welding Status line after each weld then get the largest Disk drive possible. Each line will be about 90 text characters in length.
5. Software: Windows95 or 98; Office 97. The help file is a Word97.doc file.
6. Printer: If you intend to print the graphic charts then the Epson stylus series printers are required. The system has been developed and tested with the Epson Stylus 500, 600 and 800 printers. HP inkjets printers will NOT print the charts properly. Any printer will be fine for the Text only outputs.

The Stepper control programs are provided on CD. Select the appropriate directory and run the setup program from that directory. For the Stepper Control Utility, run the setup.exe program from the d:\sonics\stepper directory. A Sonics Directory will be created and the files will be installed in the standard installation technique. See section 11.0 to run the ElectroPress utility program.

7.0 Stepper Welding Operation TOC **–** The stepper welding process is similar to the conventional ultrasonic process. The application parts are positioned in the fixture and dual palm buttons are pressed simultaneously to initiate a weld. A cycle begins by advancing the horn to the parts at a fixed approach velocity. The approach velocity has been selected based on the mass of the head mechanism and the maximum acceleration that can be used without stalling the stepper motor.

Just above the parts, the velocity is reduced to a search speed in order to locate the parts for assembly. This protects the parts from impact damage that could result from a higher speed contact. The parts search will continue for a distance equal to the width of the programmed tolerance window or until the parts are found.

When the ultrasonic horn contacts the assembly, pressure will increase quickly. The applied force is measured and monitored until the trigger set-point is reached defining the parts' location and positively seating the plastic interface joints. The trigger is satisfied and ultrasonics will be turned on to begin the plastic weld. The defined weld motion profile will continue as the ultrasonic energy melts the plastic joints.

When the weld velocity and distance profiles have been executed, the weld is complete and ultrasonics will be turned off. If a hold time has been programmed, the motion will be stopped and the system will wait for the specified time period. Hold time is normally used to allow the plastic joint to solidify while the parts are held in position to complete the bonding process.

The system will retract to the home position to end the weld cycle. The final weld distance will be reported on the stepper controller display and the system will be ready for another weld operation.

The following sequence of events defines the "typical" weld cycle. See section 12.0 for the details of programming the stepper settings.

Typical Weld cycle:

1. The weld cycle is initiated by simultaneous palm button commands.

2. The stepper drive head assembly will descend at a high speed to the parts position taught by the "Teach Command", less the upper tolerance setting.

3. The system searches for the parts at a slower search speed. The parts are detected when the force builds to the programmed Force Trigger set-point. If the parts are not found by the time the system has traveled to the lower tolerance setting, the cycle is aborted and the head retracts automatically. Parts may not be positioned in the fixture.

4. When the parts are found, the specified incremental or absolute weld will begin. The ultrasonics is turned on and the motor continues to travel at the programmed Velocity #1 until the programmed Distance #1 is reached.

5. If a second weld distance has been entered (anything but a zero value) then the weld will continue after the first distance using the parameters for the second distance settings. The travel motion proceeds using welding Velocity #2 until Distance #2 is reached. Ultrasonics will be on or off during this period controlled by the Weld indicator associated with the Travel #2 parameters. If "Off" has been selected for ultrasonics during this period then the ultrasonic hold time must be set long enough to allow for the movement plus any additional Hold time is required by the application after the move is complete. See section 12.10.

6. When the distance has been satisfied, the ultrasonics will be turned off by a cutoff command issued to the FM Controls.

7. The system waits for the hold time specified for the welder controls. See section 12.1.10.

8. When the weld cycle is complete, the system ascends to the home position (up).

9. The stepper controller transmits the final distance report and the FM ultrasonic controller transmits the weld status information.

Power Up – The stepper system has two separate power switches. A green membrane key on the FM panel and a RED power switch on the ElectroPress Motor Control panel. Both units should be powered up before the computer system is turned on. The order is not critical.

Safety Note – The stepper welding system will retract to the head up position whenever the Red Emergency Stop button on the front of the press is engaged. The Stepper Controller will remain powered during an emergency stop condition in order to step the mechanism in the reverse direction. It does not power down with engagement of the Emergency Stop button. This action is necessary due to the force that can be applied by the screw mechanism! Just stopping all movement is not an acceptable action because the applied pressure will not be removed. The pitch of the screw mechanism is very small, it may not be easy to release the pressure by human intervention. It could be difficult for the operator to manually lift the press assembly. Depending on the customer application, additional protection may be required by local laws or the European community. In some applications where operators may be directly exposed to danger areas additional guarding may be required. The ultrasonic power supply section is CE marked and has been tested in standard air actuated ultrasonic systems. The motor controls are not CE marked.

Position Accuracy – The system uses a stepper motor drive which is controlled to 96000 counts per inch and a feedback encoder which reads to 15000 counts per inch (3779.5275 counts per millimeter and 590.55118 counts per millimeter respectively). Allowing for lower encoder resolution and a small backlash within the system, the position accuracy will be $\pm$ 0.0003 inch ($\pm$ 0.007 mm). The indicated position numbers on the stepper and logger screens represent the measured motor movement. Any mechanical deflection caused by large pressures applied to the “Parts to be Welded” will degrade the accuracy numbers (with respect to the parts dimensions). Typical deflection measurements for each type of press are provided in the Maintenance section at the end of the manual. The operator should be aware that large pressures approaching 500 LBS can be applied very quickly. If the ultrasonic amplitude is too low and the plastic is not hot enough to melt, then large pressures can be applied with only a few steps of the motor system. If pressures exceeding 500 LBS are applied, the motor system will stall. The system must be reset with the RESET button on the controller panel.

Applications – A stepper application project involves careful setting of the stepper and ultrasonic controls. Distance and velocity controls are set using the stepper setup utility program in combination with the Stepper Control panel switches and display. The ultrasonic controls are adjusted with the FM control panel.

An applications report form is included in the maintenance section, page 52, to assist the user during setup and to provide a checklist so that all pertinent parameters are considered for a stepper application.

8.0 Quick Start Setup Procedure for a Typical Application TOC **–** This section is intended to be a quick startup checklist for an operator who is familiar with the ElectroPress welding system. Users who are unfamiliar with the system should read both manuals, ultrasonic and stepper, prior to welding any parts. Then return to this section with a full understanding of the system interaction between distance, speed and ultrasonic controls.

Setting up the system to weld a typical part is really very easy but can seem involved due to the movement and ultrasonic controls required. In order to make full use of the precise distance and velocity welding functions, the ultrasonic power supply will be set so that the time or energy settings are beyond the expected weld requirements. The stepper movement should reach the programmed position before either time or energy settings are reached. Steps to prepare a typical part for welding are identified below. The computer interface must be connected and running properly to set up a part for welding. Once the machine is set up, the computer can be disconnected without effecting the welding process provided that the termination jumper supplied is installed on the back Stepper Controller chassis. Details of the settings are further described below, but the quick start directions can help the proficient user.

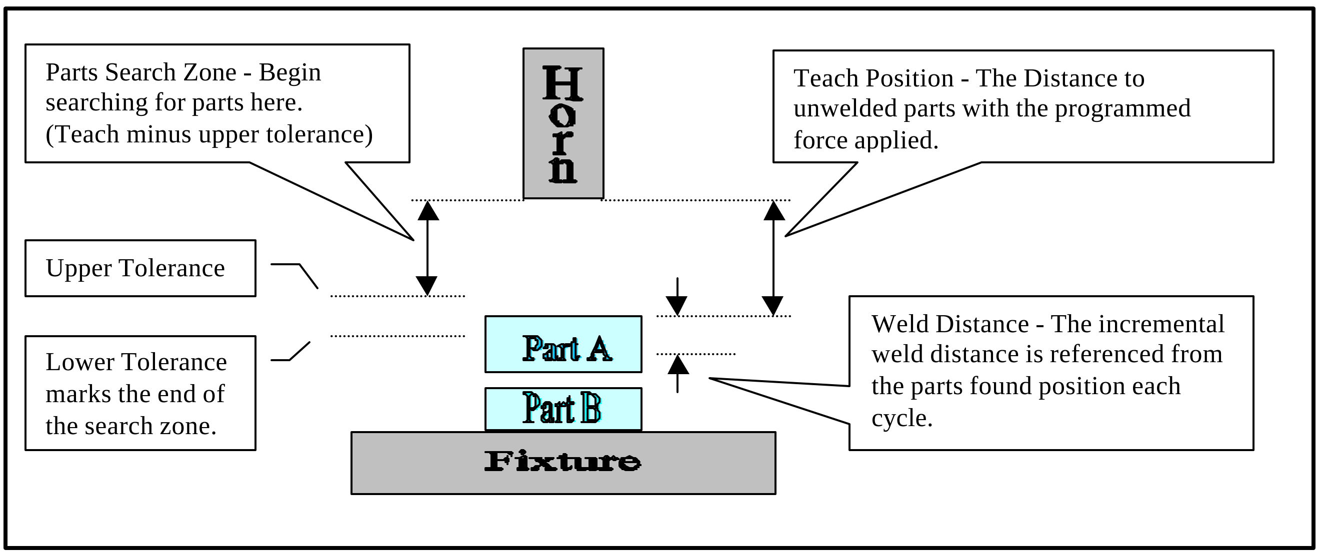
1. Install the horn and fixture on the machine.
2. Release the column locking clamps, raise the Ultrasonic head to provide clearance of at least 3 inches (76 mm) above the parts and fixture. Secure the clamps.
3. Set the parts into the fixture with proper orientation.
4. Set the desired travel and welding parameters using the stepper utility software program. (click SET function to transfer values). See section 9.0 for the stepper controls description. Set the travel distance value large enough to place and remove the parts.
5. Extend the ultrasonic horn using the Align function. Turn the key and press the Align button simultaneously. The system will extend the horn to the programmed the Travel Distance. Maintain the key and button command until the front panel Head-Down light turns on to indicate that the move is complete.
6. Again release the locking clamps and lower the head assembly so that the horn contacts the top of the unwelded parts. Now position and align the horn, parts and fixture. Lock the column clamps and secure the fixture.
7. Return the Head to the Home position using the HOME switch.
8. Enter the upper and lower tolerances expected. These numbers should account for the variation in the molded parts. Set the upper tolerance to 0.0100 in (0.300 mm); Set the lower tolerance to the thickness of the top part (0.100 inches max). This prevents the horn from contacting the fixture while looking for the parts.
9. Enter the force trigger level desired before sonics starts. This is the force applied to the parts before the weld begins. Again use the **SET** function to send these values to the machine.
10. Teach the system where the parts are located. Turn the KEY and press TEACH buttons. The system will move the horn to the unwelded parts and apply the programmed pressure. This contact distance will be remembered for the welding function.
11. Set the Weld mode for Incremental, the Weld Velocity #1 to 1 RPS and Weld Distance #1 to 0.0100 inches (let's go slow for the first weld). Set Weld Distance #2 to 0. Again use the **SET** function to send these values to the machine.
12. Set the FM ultrasonics for a longer weld time (T2) than necessary to complete the weld, FT must be disabled, T1 to 0.01 seconds (stepper controller needs this delay), Hold time (T3) to 1 second (or desired), shake-off pulse (T4) to 0.00 and the Timeout (T5) to 9.99 seconds. Set the FM amplitude dial to approximately 80% to assure sufficient melt. These parameters are programmed from the FM front panel. See the FM manual for further assistance.
13. Set the FM weld for a higher Energy number than will be delivered during the weld time. The distance should control the weld in most cases when using the Stepper system. If the ultrasonics times out or reaches the energy limit before the programmed distances are achieved, then the cycle will not be complete. The control parameter (distance, energy or time) which wins the race to its programmed setting will end the present weld cycle. If a distance is not achieved, check the time or energy settings to see that the programmed velocities can reach the desired position within the timer

settings. Velocity settings and distances, FM timers, limits and amplitude settings are all interactive and must be considered when setting up a stepper application.

14. The system should be ready to try a weld, be sure that parts are installed prior to initiating a weld cycle. Don't damage the fixture or horn.
15. Simultaneously press the left and right palm buttons (black buttons) on the press base to begin a weld cycle.

Further adjust the settings as necessary to produce the optimum weld cycle time by using the shortest practical travel distance. If the Upper Tolerance number can be made smaller, the parts will be found faster which also improves the cycle time. The Lower Tolerance number should be adjusted so that when no parts are installed, the system will not hit the lower fixture! This is the end of the parts search zone which will cause the system to retract if no parts are found! **Do not allowing the horn to contact the fixture.**

Parts Contact Diagram



9.0 The Stepper Control Panel TOC – The stepper front panel is shown below. It contains several switches and an LCD display necessary to initiate setup functions which are used to align the parts and fixture and to teach the system where the parts are located (the distance to the unwelded parts).

The "Align Function"is used first to extend the ultrasonic horn by the programmed travel distance toward the parts. Adjust the ultrasonic horn for proper fit against the unwelded parts and lock the head assembly into position using the column lock handle. Apply enough pressure to the lock handle so the head will not be able to move under normal welding pressures. Then use the "Home" switch to return the head to the home or full up position.

The operator must then execute the "Teach Function". This function must be used one time after initial alignment or whenever the column, fixture or parts are changed or adjusted. The system will learn where to find the parts by extending the head assembly until force is detected on the parts. This position will be remembered for subsequent weld cycles or until the teach function is repeated at a later time. The settings are preserved in permanent memory and will be saved during any non powered interval.

Once the system knows where the parts are located and the expected variation in their vertical dimension (upper and lower tolerance settings – see section 12) the production welding process will be accurately repeated for every weld cycle.

The Stepper Controls Front Panel

9.1 Key Switch – The Key Switch is used in coordination with the Align or Teach buttons to execute system functions which define the stroke length and parts position. The run position is the normal key location (spring loaded return). Once programmed, aligned and taught, the key may be removed to lock out the setup operations during production cycles.

9.2 LCD Display – The LCD display will show the weld distance report after every cycle. It is also used to examine the presently programmed weld parameters so that a computer is not required once a system has been setup for production operations.

9.3 Align/Display Button - The Align/Display button is used to initiate the Align function when used in coordination with the Key Switch or to examine the internal settings when the setup computer is not connected. Press and release the Display button repeatedly to roll through the present settings. Press the home or reset button to leave the parameter monitoring mode. The system must be returned to the ready screen prior to initiating the next weld cycle.

Align Function – The Align Function is initiated by simultaneously activating the front panel Keyswitch to "Setup" and the "Align" switch to momentary ON. If the switches are maintained until the machine motion is complete, the carriage will be extended to the programmed Travel Distance (see section 12 to program the travel distance) and the head down light will illuminate. If the switches are released early, then the motion will abort at the achieved position. When the move is complete, the Head Down Light will turn ON. The carriage will now remain extended for fixture alignment and adjustment. In order to return to the Home position, press the "Home" switch.

9.4 Home Button – The Home button is used to return the assembly to the up or home position after the teach or align function. It is also used to exit the parameter monitor mode as described.

9.5 Teach Button - The Teach button is used to initiate the Teach function when used in coordination with the Key Switch. It has no additional function when pressed alone.

Teach Function – The teach function is activated in a similar manner to the Align Function by simultaneously activating the front panel Keyswitch to "Setup" and the "Teach" switch to momentary ON. Unwelded parts should be positioned in the fixture with proper registration prior to initiating the teach function. Both switches should be maintained until the machine motion is complete. The carriage will extend by a distance equal to the programmed Travel Distance and then continue to search for the parts to be welded. The search will proceed until a force is detected (parts are found) or the tolerance distance is exceeded. If the parts are found within the specified tolerance window, the head down light will turn on and the distance will be reported on the display and to the PC. If the parts are not found, the search will terminate and no distance will be reported. If the parts are found successfully, then the new "Learned" distance is used for all subsequent welding cycles. Press the "Home" switch to return to Ready.

9.6 Head Down Light – The head down light will turn on to indicate that the parts have been detected.

9.7 Reset Button – Press the reset button to restart the motion controller after a motor stall, usually caused by excessive applied force. The distances or speeds have been set outside the practical application. Check the program settings and re-teach the system.

9.8 Power Button – The power button toggles the motor control power on and off. The light will be on when the system is powered.

10.0 The FM Control Panel TOC – The FM (also called EM by older documentation) control panel is shown below. This panel is used to program all ultrasonic parameters. The manual for the ultrasonic controls has been provided with any stepper system order and it should be read for the details pertaining to the ultrasonics power supply. Several items have special impact with respect to the stepper welder system. They are listed here with reference to the specific section or page numbers in the FM manual.

All References to the linear encoder in the FM manual are obsolete (FM manual Page 38 and 39). These pages should be stamped "Obsolete" or covered by addendum. The stepper system provides all motion controls for this system.

The FM Control Panel

1. Force Trigger on the FM will not functions with the stepper system. The force trigger function is executed in the stepper controls. It must be turned off in the FM. (See page 21, items 2 and 2a).

2. T1 must have a value of 0.01 sec. (See pages 20 and 23, items 1, 1a and 2b).

3. The weld time must be long enough so that the distance profile and velocity controls are in command of the cycle. If Weld time, T2, is programmed too short, the weld cycle may be cut off before the travel profile is complete. (See pages 20 and 23, items 1a and 2b).

4. The same comment is true for the constant energy mode. The energy limit must be set large enough so that the motor and velocity controls will have sufficient time to complete the weld. If energy limits are reached before the weld distance, the cycle may be cut short and the system may not reach the programmed distance. (See pages 23 and 24, items 3, 3b, 3c and 4).

5. The Hold timer (T3) must be set long enough to allow the second distance movement to take place. If ultrasonics is programmed to be "OFF" during the second move (Velocity #2 and Distance #2) then the hold must be set long enough to complete the movement and provide for additional hold time. If ultrasonics is programmed "ON" during the second move then the ultrasonic hold time, T3 , will not need to consider the time required for the second move. Hold timer T3 begins when the ultrasonic pulse is terminated. (See pages 20 and 24, items 1a and 4a).

5. Afterpulse (T4) and Abort (T5) timers will function as necessary.

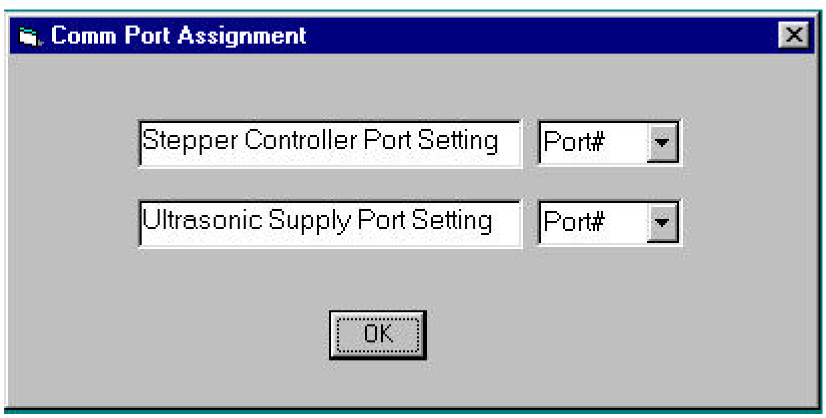
6. Automatic mode for rotary table operation will not work with the stepper press system. The system must be in manual mode. (i.e. T1 ZT NB IS 1 48 M) (See page 26, item 7).

11.0 Running the Stepper Utility Program

TOC - Both controllers; the Stepper Motor Controller and the Ultrasonic Power Supply, should be powered and connected before starting the Stepper Utility Program. The stepper utility program will be a file called stepper.exe located on the hard drive in c:\sonics directory. If the computer system has been supplied by Sonics & Materials, then the stepper software will have been preinstalled and a short cut icon created on the computer desktop. A standard stepper icon file is provided for that purpose.

Run the Stepper Utility Program by double clicking the ElectroPress icon on the desktop or by running the stepper.exe file using the Windows™ START button. A typical startup splash screen will first be displayed for a few seconds followed by the stepper programming form once the system has been identified. When the stepper form is displayed, make sure that the LED on the face of the microprocessor “PRT” key is on. Press the PRT key to toggle it’s setting. This is necessary for the microprocessor to provide data and transmit information to the computer.

Two communications ports are required in the users computer system as previously described. They must be Comm1, Comm2, Comm3 or Comm4. One port must be connected to the Stepper controller and a second to the FM ultrasonic power supply. When the program is run for the first time, an identification screen will prompt the operator to identify which ports are connected to each controller. Once the system has been identified and the ports exist within the computer, the configuration is stored in a small file that will be used the next time the welding system is powered up. The identification screen will not be displayed again provided that the control systems and computer ports are found and verified the next time the program is run. If the ports and controllers cannot be found, the identification screen will prompt the user to assign Comm ports again. If the identification screen is shown but the configuration has not changed the controllers may not be responding. Check the power and connections, terminate the program and start it again (see below). If the system is found and identified normally, it will take approximately 7 seconds to retrieve the presently programmed values from the stepper controller. The proper assigned ports and controllers must be found in order to continue beyond this identification screen. The system will continue to return to this screen until the proper conditions exist.



The COMM Port Identification Screen

Use the drop down arrows to specify the Comm port connections for the ElectroPress controller and ultrasonic power supply. The system will not allow the same selection for both ports or the specification of ports which do not exist in the users PC system. When the proper selection have been made, click OK to proceed with system communication.

Note – Several printing options are provided by selections on the following control forms. In some cases certain printers do not perform properly with the charting display outputs. Print driver compatibilities have not been explored beyond noting the potential problem. This utility software was developed in VB5.0 and has been tested with the Epson Series Ink Jet printers. The Epson 500, 600 and 800 series printers have been tested with the chart software and they will reproduce the screen displays exactly. The HP series printers **DO NOT** produce the graphs properly.

When the graphs have been produced on screen and the operator selects a print, a VB Printform command is issued which should to copy the screen image to the present print driver. (Note: Laser printers have not been tested. Text only printouts have worked correctly in most cases).

The proper type of printer should be used depending on production record keeping or setup and checkout. For setup and checkout the graphics presentation provides a useful comparison but this would not be appropriate for a production record after every weld (it can take 20 seconds to draw the graphic chart). A more appropriate tractor feed printer should probably be used for production monitoring or quality records. In either case, the installed printer may operate differently than the user intended! For instance, ink jet printers will wait for the page buffer to be filled or the print job to be closed before the physical print is started. This could cause some confusion in the printed logging output. The information is actually in the print buffer but may not be printed until printer logging is turned off, the page is full or the program is terminated. All three events cause the print buffer to print.

English or Metric – The system may be programmed in either system of Engineering Units. When the ElectroPress program begins, it will read the presently programmed entries and units from the machine. This data will be displayed on the stepper programming form when the system is identified. See section 12.0 below for ElectroPress form details.

Control Forms - Three Control Forms are available for programming and monitoring the ElectroPress system – the Stepper Setup Form, the Data Logger Form and the Graphical Chart Form. Only the presently visible screen receives or sends data to the communications ports so be sure to have the desired form displayed prior to executing a weld cycle. Forms cannot be switched once a weld cycle has been completed or any data is being transmitted. When data transmission is complete, form switching is allowed again.

The Stepper setup screen is the startup default screen and will normally be the first user screen displayed after initiating the stepper utility program.

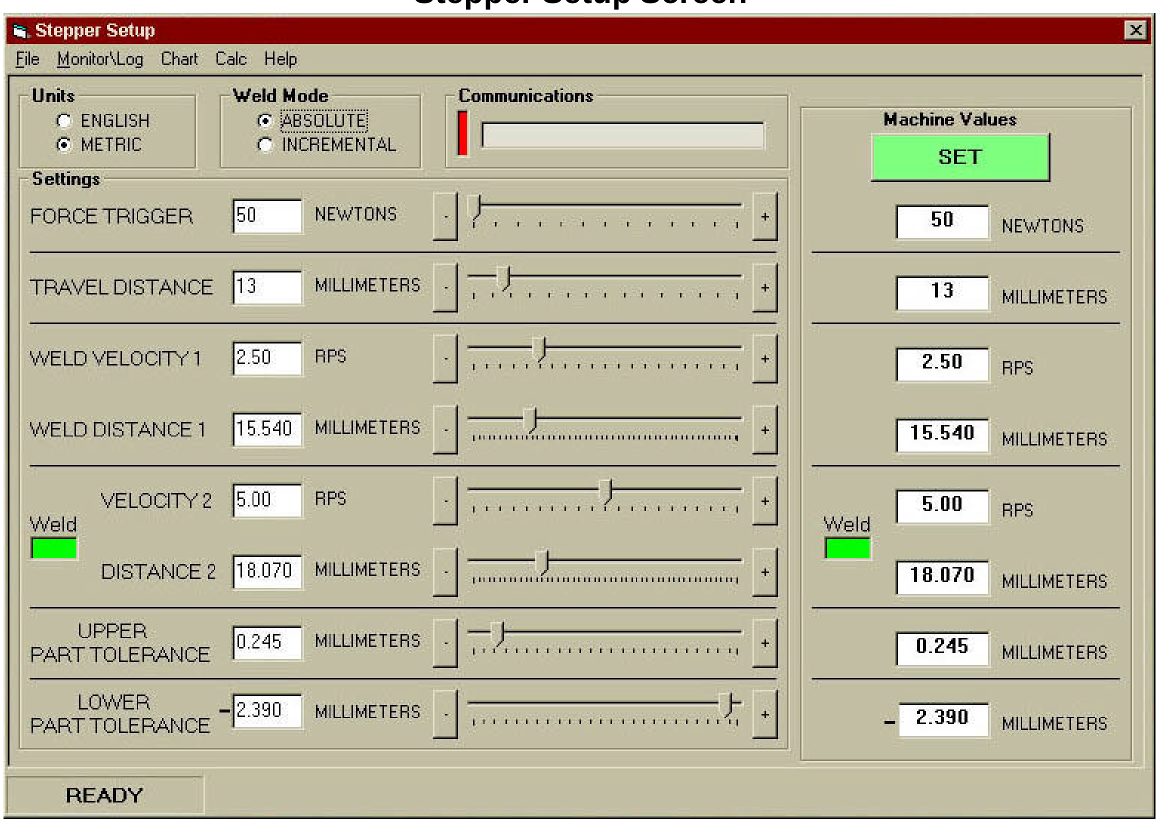
The following three sections present each of the major forms separately. A graphic of each form precedes a discussion of each item on the form and it's associated relevance to stepper welding. The order is generally from the top left side of the form proceeding left to right and top to bottom. The menu items are addressed last in each section.

12.0 The Stepper Setup Screen TOC **-** The ElectroPress motion settings are selected and programmed on the ElectroPress setup screen. These include several motion and speed controls as well as setup information to describe the welding application. The purpose for this screen is to type, slide or increment the control parameter values until the desired settings are obtained in each text box on the left side of the screen. Select the Units and Weld mode by clicking on the appropriate buttons. When the desired settings have been entered, they can be transferred to the machine for use during the next weld cycle using the SET button. This operation will take a few seconds to transfer and confirm. A progress bar will indicate a busy condition at the bottom of the screen during this transfer. ***Note:*** Welding should not be initiated until the bar has stopped. Upon completion of the SET function, the right hand side of the screen (Machine Values) will be identical to the left hand side (desired settings). This approach minimizes the required communications between controllers and preserves the non-volatile memory in the Stepper control system.

Note (FM Settings): The TAB mode in the FM ultrasonic controls should be set to OFF for this form. Data from the ultrasonic controls is not used. If the TAB is left ON a delay will be noticed before another weld can be initiated. Press the INFO key four times, then use the “6” key to toggle the TAB mode ON or OFF. The PRT key must be on to transmit data.

A typical setup screen is shown below and illustrates how the motion parameters are set and displayed. Each item on the setup screen will be discussed in the following sections as it pertains to the motion control and welding process. References to the ultrasonic FM manual will help guide the user in setting the associated ultrasonic controls. Several menu items are also available from the top toolbar for switching screens and maintaining the application. The programming and control items will be addressed first followed by the menu selections.

Stepper Setup Screen



Motion controls for Force, Weld Velocity and Weld Distance are settable using this screen. Numerical settings may be adjusted in several ways. They may be typed into text boxes for exact selection or they may be adjusted using the corresponding slide bar. These are standard controls that use the mouse to drag and drop the settings or to increment or decrement the adjustment by one least significant count. Once the appropriate selections have been made the settings are transferred to the motor controls using the SET button as previously described.

12.1 Units – Select the English or Metric system of units by clicking the appropriate indicator. This should be the first option selected when beginning an application because switching units will automatically default the associated parameters. If the programming units are changed by the operator, the weld parameters will be set to the minimum settings for the new Units selection. If the operator changes back to the original units prior to a SET button command, the displayed values will again be set to match the original machine values. The allowed programming limits provide different resolutions for Metric or English selection so that whole decimal positions can be used. This will avoid incrementing entries by 2.54 etc.

The programmer must provide all weld values. The system does not automatically convert from Metric to English or the reverse. The selection for Units and Weld Mode will determine the range of values allowed for welding and speed settings. See Table 12.1. Note: Reference calculator function.

12.2 Weld Mode – Select Absolute or Incremental Welding by clicking the appropriate circular indicator. Absolute welding is referenced from the encoder home position. Selecting absolute welding means that the reference weld distance is measured from home. Absolute distances must be coordinated when using the second weld distance control. This means that Weld Distance 2 must be greater than Weld Distance 1 etc. Ex: It would not be possible to weld first to 2.25 inches and then to 2.00 inches. Absolute welding would be used when the final dimension of a welded part is to be controlled.

Incremental Welding is referenced from the location where the parts are compressed by the horn and the applied force is equal to the Force Trigger setting. An incremental weld will first travel to Weld Distance 1 using Weld Velocity 1 and then continue for and additional Weld Distance 2 using Weld Velocity 2 (if Weld Distance 2 is set to a non-zero value).

12.3 Communications – The communications window does not contain any programmable parameters. This is an indicator box used to identify communications activity. It will turn green during communications activity and return to red when the data has terminated. It will normally flash after each weld to indicate that the weld data has been sent. Next to the communications indicator, a small text box shows the last message received from the stepper system. This allows the programmer to see the weld distance report during setup and adjustment of a welding application without switching back and forth to monitoring screens.

12.4 Machine Values – These are the present programmed parameters that have been sent to the motor controllor. The Green SET button is the only operator interaction on the right side of the screen as described above. When the SET button is clicked, the parameters that have been set by the programmer are transferred to the motor controllor. To recall the settings from the machine refer to the File Recall section below. The SET function will also attempt to qualify entries as much as possible. Appropriate messages will be displayed to help the operator select values that not would create operational errors.

12.5 Force Trigger – The force trigger value is the amount of force which will be applied before the ultrasonics is turned on and the weld begins. This is also the force applied during the teach mode described in 9.5. Force is measured by a load cell located between the actuator and the moving head assembly. The conditioned force signal is wired to the motion controller which moves the motor and monitors the force.

12.6 Travel Distance – This programmed distance is used for the Align function and will be the travel distance to unwelded parts during the welding cycle. The Align Function is initiated by simultaneous activation of the front panel Keyswitch and the Align switch (see Align Function). It extends the carriage by the programmed travel distance to allow for fixture alignment and adjustment. During a “Teach” operation, the system will find the actual distance to the parts.

12.7 Weld Velocity 1 – The weld velocities are entered as RPS (motor revolutions per second) values because actual weld velocity numbers would be too small to comprehend. The programmer would have to enter too many decimal digits to change a setting. Weld velocity 1 represents the speed which will be used during the first weld period. This weld begins after the force trigger has been satisfied and continues until Weld Distance 1 has been reached.

12.8 Weld Distance 1 – Weld distance 1 is the distance which ends the first weld period. When the system has advanced to Weld Distance 1, the velocity and distance set-points will be adjusted for the second weld parameters (Weld Velocity 2 and Weld Distance 2). The system does not stop between the distance 1 and 2 settings unless distance 2 is set to zero. A zero (0) setting for distance 2 means that it is OFF and will not be used. If Weld Distance 2 has a nonzero setting the system will accelerate/decelerate to the new velocity.

12.9 Weld Velocity 2 – Weld Velocity 2 is set the same way as weld velocity 1. The system switches to velocity 2 when distance 1 has been met and distance 2 is non-zero.

12.10 Weld Indicator (Green/Red Selection Box) – Ultrasonic vibration can be turned on or off for the second distance control. Clicking on the colored portion of the Indicator Box will toggle the color between Red and Green. Red is used to turn ultrasonics off and green is used for ultrasonics on. This control box is located at the extreme left edge of the form next to the Weld Velocity 2 and Weld Distance 2 settings. The operation is the same as all weld settings, select the desired condition and click the SET button to transfer the selections to the controller. If Weld distance 2 is equal to zero, then the distance 2 settings are not used (it's off) so the state of this Weld control does not matter. Ultrasonics cannot be turned off during weld distance 1.

The T3 timer of the FM Controls, or hold timer, must be long enough to allow the second distance movement. If ultrasonics is programmed to be "OFF" during the second move (Velocity 2 and Distance 2) then the hold must be set long enough to complete the movement and provide for additional hold time. If sonics is programmed "ON" during the second move then hold time will not need to consider the time required for the second move. Hold timer T3 begins when the ultrasonic pulse is terminated even if the head assembly is still in motion. (See pages 20 and 24, items 1a and 4a).

12.11 Distance 2 – Distance 2 is set the same way as weld distance 1 except that distance 2 is allowed to equal zero. When distance 1 has been met, the system will switch to velocity 2 until distance 2 is reached.

12.12 Upper Part Tolerance – The Upper Part Tolerance is set to allow for the variation in plastic part dimension. Its purpose is to provide a reference location above the teach position that will allow the motor controls to slow the head assembly and begin the search for the parts. This value should be large enough to cover the widest variation expected so that the parts do not get crushed by the advancing head assembly prior to the slow down point. This entry is always referenced from the "Teach Position". EX: An entry of 0.050 inches would tell the controller to slow down when the system reaches 0.050 inches above the normal unwelded parts dimension. The requirement is that the parts variation is expected to be less than 0.050 inches above the taught position.

12.13 Lower Part Tolerance – The Lower Part Tolerance is the same type of entry as the upper part tolerance but on the lower side of the taught position. i.e. An entry of 0.070 inches would tell the controller that the part should have been found prior to the taught location plus the lower part tolerance value. If the part has not been found between the Upper and Lower Part Tolerance entries then maybe it hasn't been loaded or is missing. When the parts are not found in the defined window, the weld cycle is terminated and the head assembly returns to the home position. Note that a permanent minus sign ("-") is placed in front of the Lower Part Tolerance entry and setting to help indicate that the reference means below the taught position. The values are always entered as positive numbers.

12.14 Ready Indication – This indicator displays the present status of save or recall operations. It will indicate any activity along with a progress bar which will appear along the bottom edge of the screen when file operation or communications are in process. This indicator does not have any associated operator interaction.

12.15 Scales and Limits –The following table shows the allowed ranges for programmed entries on the stepper controls screen. When switching from Metric to English (or the reverse), the entries are set to default conditions. The operator must select appropriate entries for the welding application. Scales are selected for closest whole digit resolution and presentation).

Table 12.1

Parameter	English-ABS	English-INC	Metric-ABS	Metric-INC
Force Trigger (FT)	010 – 150 LBS	010 – 150 LBS	50-650 Newtons	50-650 Newtons
Travel Distance (T1)	0.2 –2.7 In	0.2 –2.7 In	05– 70 mm	05– 70 mm
Weld Velocity 1 (R1)	0.01-10.00 RPS	0.01-10.00 RPS	0.01-10.00 RPS	0.01-10.00 RPS
Weld Distance 1 (WD)	0.0500 – 2.7500 In	0.0010 – 0.5000 In	1.000 – 70.000 mm	0.01 – 12.70 mm
Weld Velocity 2 (R2)	0.01-10.00 RPS	0.01-10.00 RPS	0.01-10.00 RPS	0.01-10.00 RPS
Weld Distance 2 (WD)	0.0000 – 2.7500 In	0.0000 – 0.5000 In	0.000 – 70.000 mm	0.000 – 12.700 mm
Upper Tolerance (P1)	0.0010 – 0.1000 In	0.0010 – 0.1000 In	0.025 – 2.500 mm	0.025 – 2.500 mm
Lower Tolerance (P2)	0.0010 – 0.1000 In	0.0010 – 0.1000 In	0.025 – 2.500 mm	0.025 – 2.500 mm

12.16 Menu Items - The top line of the stepper setup form contains drop down menus for file functions, screen switching, initiating the Windows calculator and a basic help utility.

1. File Job Open or Save – The File\ Job\ Open and Save functions allow the presently programmed values for the motor controls to be saved and recalled to or from a specified file. The file selection is handled in the standard windows style. When the user has selected a file for the open function, the data will automatically be retrieved from the computer file and loaded into the motor controls. The save function will capture the present motor control settings and save this data to the specified file for future recall using the Open menu selection. For either case the progress bar will indicate the activity and the Ready Text box will identify the operation.

2. File Print Settings – The Print Settings selection under the File menu will initiate a print operation. The present motor control settings will be sent to the printer along with a time and date stamp.

3. Recall Machine Settings – The present machine settings may be recalled from the stepper control process at any time by selecting the Recall Machine Settings option under the File menu. When the operation is complete, the selection side of the setup form will be set to match the present machine values. This action will retrieve the values from the controller and verify all display settings.

4. Monitor\Log – The Monitor\Log menu selection will unload the stepper setup form and display the Monitor\Logging form. The Monitor\Log form is intended to capture weld and distance data and present one status line after each weld. This data may be logged to a text data file and\or sent to the system print buffer. The TAB mode on the FM supply must be set to OFF.

5. Chart – The Chart menu selection will unload the stepper setup form and display the Chart form. The Chart form is intended for setup verification and initial monitoring to qualify an application. It can take up to 20 seconds to receive the power data from the Ultrasonic welder after each weld. The TAB mode on the FM supply must be set to ON.

6. Calc – The Calc selection will launch the windows system calculator intended to assist the operator with application setup. If the windows Calculator program cannot be found, a message box will indicate the condition.

7. Help\Manual(Word97) – The Help selection will launch this Manual using Word97 (not available as of 2-8-99). The manual file “Stepper.doc” is contained in the installation directory. For a non-redirected installation that will be the “C:\sonics “ directory. This option provides a means for a “working manual” to which the customer can add notes, remarks or clarifications. One idea is to use different colors or fonts for comments to clearly identify the original and allow the user to quickly find any changes. Exit the Word97 program and save the stepper.doc file to preserve any edits that have been made to the document. If the Word97 program cannot be found on the users computer, a message box will indicate the condition.

Bookmarks have been added to relevant descriptions of each form and each major section of this manual. Check the edit goto selection in Word97 (ctrl G for Word) and then select the bookmark of interest – Stepper Form etc. If the Stepper.doc file is unintentionally corrupted, move a copy from the provided CD into the installed directory. Note: Any user modifications will be lost. This file is not compressed on the CD so installation processing is not required.

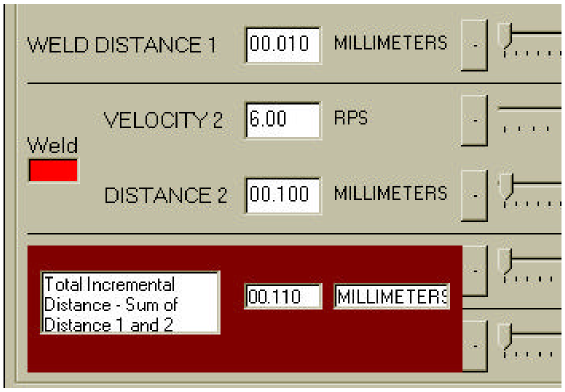
Word97 Viewer from Microsoft: http://officeupdate.microsoft.com/downloadCatalog/dldWord.htm

The Sonics & Materials ElectroPress Manual is provided on CD as a Word97 doc file. If Word97 is not available on the user’s computer, check this Microsoft internet site to download a free copy of the latest Word97 Viewer. Install this program to view and print the stepper.doc file which will be present in the c:/sonics directory. Microsoft provides this program free of charge to users who do not have Word97 so that word files can be read and exchanged easily. The viewer must be started separately using the Windows Start button. Then find and open the stepper.doc file to view this manual. The Word Viewer will not allow any file editing functions, Word97 will be required to add user notes or comments.

8. Help\ About Stepper Controls – This selection will display a message box to identify the present revision level of the stepper utility software.

12.17 Incremental Total Distance Window – When the incremental welding mode has been selected, a special Total Distance Window will be displayed when the Distance 1 or Distance 2 setting receives the focus. That means the Total Distance Window will appear when the cursor is clicked in either text window for Distance to highlight or change the numerical values. This window will display the sum of Weld Distance 1 and Weld Distance 2. When either distance is changed the Total Distance Window will automatically update and always show the total weld distance.

Total Distance Window



The section to the left shows the window as it would be displayed for a typical setting. It will only be displayed if Distance 2 has a non-zero value, incremental weld mode is selected and one of the distances has been given the focus as described above.

The window can be removed by clicking the mouse on any portion of the Total Distance Window. The underlying tolerance settings will be returned.

The Total Distance Window will not be displayed for the absolute welding mode because the weld numbers are referenced from home and do not effect each other as they would for an incremental setup.

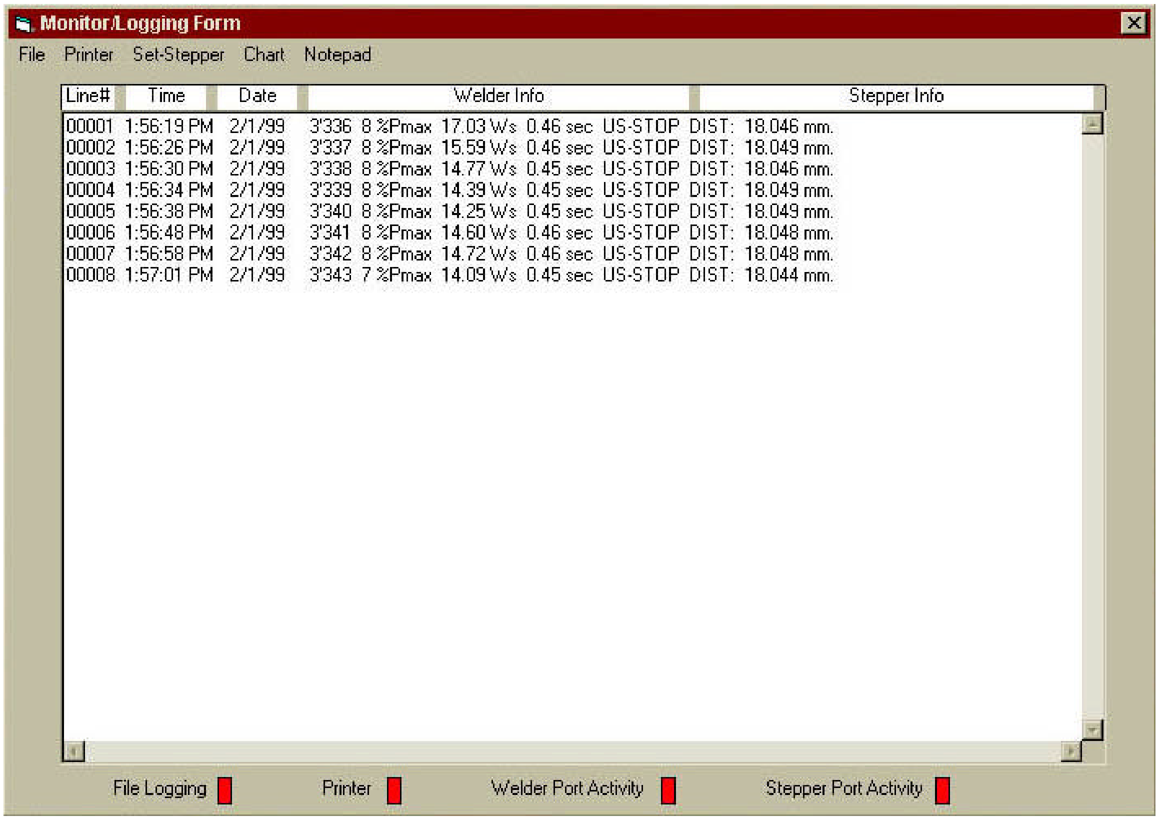
13.0 The Data Logging Form TOC **-** The Monitor/Logging Form is provided to monitor a production operation. When a weld has been completed, a status line is sent from the ultrasonic welder and a final distance report is sent from the stepper motor controller. This presentation combines the status line from each unit and displays one line after each weld.

Up to 100 lines will be retained on the form. They may be reviewed using the vertical slide bar on the right side of the text area. The slide bar will automatically be enabled when the viewable text area has been filled. Beyond 100 lines of history, the data will roll off the form and be lost to the active text area. To save all data lines see the File Logging option below. File logging allows all data to be logged to a file for later examination using any word processor or text editor.

A line number reference plus a time and date stamp are appended to the beginning of each line. The line number reference begins at one (1) each time the program begins, it cannot be set by the operator. The time and date stamp is taken from the computer system information.

Note (FM Settings): The TABULAR mode in the FM ultrasonic controls must be set to OFF for this form. Press the INFO key four times, then press the “6” key to toggle the TABULAR mode ON or OFF. The PRT key must be ON to transmit data.

Monitor \ Logging Form



The simulated indicator lights along the lower edge of this form show the present status for file logging, printing and communication activity. When the indicators are green, the adjacent function is active. When they are red, the condition is turned off or waiting for data. These indicators are not used for operator selection, all selections for this form are made using the menu system along the top line of the form.

13.1 Content of A typical status line (as displayed on the previous page) – The content of a typical status line is displayed below with a brief description of each element.

```
00008 1:57:01 PM  2/1/99  3'343 7%Pmax 14.09Ws 0.45sec US-STOP  DIST: 19.044 mm.
_________________________ _____  _____ _______ ________ ______   ________________
            1               2      3      4       5       6             7
```

1. "00008 1:57:01 PM 2/1/99" - This is the standard Reference # plus the time and date stamp of this weld.
2. " 3'343" - A reference number from the ultrasonic welder indicating the total ultrasonic cycles.
3. "7% Pmax" - Indicates the maximum power (peak) delivered during the weld.
4. "14.09 Ws" – Weld energy – Watt seconds (Ws.)
5. "0.45 sec" - Weld time for the last weld.
6. "US-STOP" - Indicates that the stop command was received from the motor controller. **
7. "DIST: 19.044 mm." - The total weld distance. It should be very close to the programmed setpoint values.

** The US-STOP command should be issued for each weld when using the stepper motor distance controls. If distance and velocity are intended to be the controlling parameters then the ultrasonic parameters for time and energy should be set outside the expected ranges. If time or energy win the race to their settings, the weld will be cut short and the programmed distances will not be achieved.

If the communications is lost from either the motor controls or the ultrasonic supply after a weld has been completed, the system will wait for the other unit to respond for about 0.4 seconds. At the end of that time whatever information has been received will be added to the status line (one of the units has not responded for some reason). This will result in a shortened line of information until the condition is corrected. The most likely cause for this condition is that the FM PRT button has not been selected resulting in the absence of ultrasonic information.

13.2 Menu Items - The menu items are used to select File Logging, Printing, screen switching and can also be used to initiate the standard windows notepad program.

1. Open Log File – The "Open Log File" option under the File menu selection allows the user to specify a data file to receive the status line described above. File specification is handled in the familiar windows manner. Once a file has been selected, every status line that follows will be also written to the specified file as well as to the displayed text window.

If the selected file already exists the operator will be provided the option of appending to the end of the existing file or replacing the entire file. While the file logging option is active the File Logging indicator at the lower left edge of this form will turn green. The file will remain open and in use by this function until file logging is turned off or the stepper utility program is closed. It will be available for any other program to use once it has been closed.

The status line is written as text characters and therefore may be read by any word processor or text editor program. A normal line will be approximately 85 characters long. Be aware that a fast duty cycle operation could build very large data files!

2. Close Log File – The "Close Log File" option under the File menu will terminate the logging operation and close any open file. The File Logging indicator will turn red.

3. Printer - The “Print On” and “Print Off” options are available under the Printer menu selection. The same file logging status line will be sent to the system printer after each weld if the “Print On” option has been selected. Note that the system printer may not print a physical line on the page until the print buffer has at least a page of characters in the queue. Printer options and buffer settings are available under the windows control panel settings. Some print characteristics will be a function of the users installed printer.

Any characters that have not been printed will automatically print when the option this turned off or the stepper utility program is closed. The Printer indicator at the lower left center of this form will turn green while the printer option is ON. It will be red when the selection is OFF.

4. Set-Stepper – The Set-Stepper menu selection will unload the monitor \ logging form and display the Stepper Setup form. The Set-Stepper form is used to program the motor controls as previously described. The TABULAR mode on the FM supply must be set to OFF.

Note (FM Settings): The TABULAR mode in the FM ultrasonic controls must be set to OFF for this form. Press the INFO key four times, then press the “6” key to toggle the TABULAR mode ON or OFF. The PRT key must be ON to transmit data.

5. Chart – The Chart menu selection will unload the monitor \ logging form and display the Chart form. The Chart form is intended to be used for setup verification and initial monitoring to qualify an application. It can take up to 20 seconds to receive the power data from the Ultrasonic welder after each weld. The TABULAR mode on the FM supply must be set to ON.

Note (FM Settings): The TABULAR mode in the FM ultrasonic controls must be set to OFF for this form. Press the INFO key four times, then press the “6” key to toggle the TABULAR mode ON or OFF. The PRT key must be ON to transmit data.

6. Notepad– The Notepad selection is an easy way to launch the windows system Notepad program. Notepad can be used to view the data file created by the file logging operation. If the windows Notepad program cannot be found, a message box will indicate the condition.

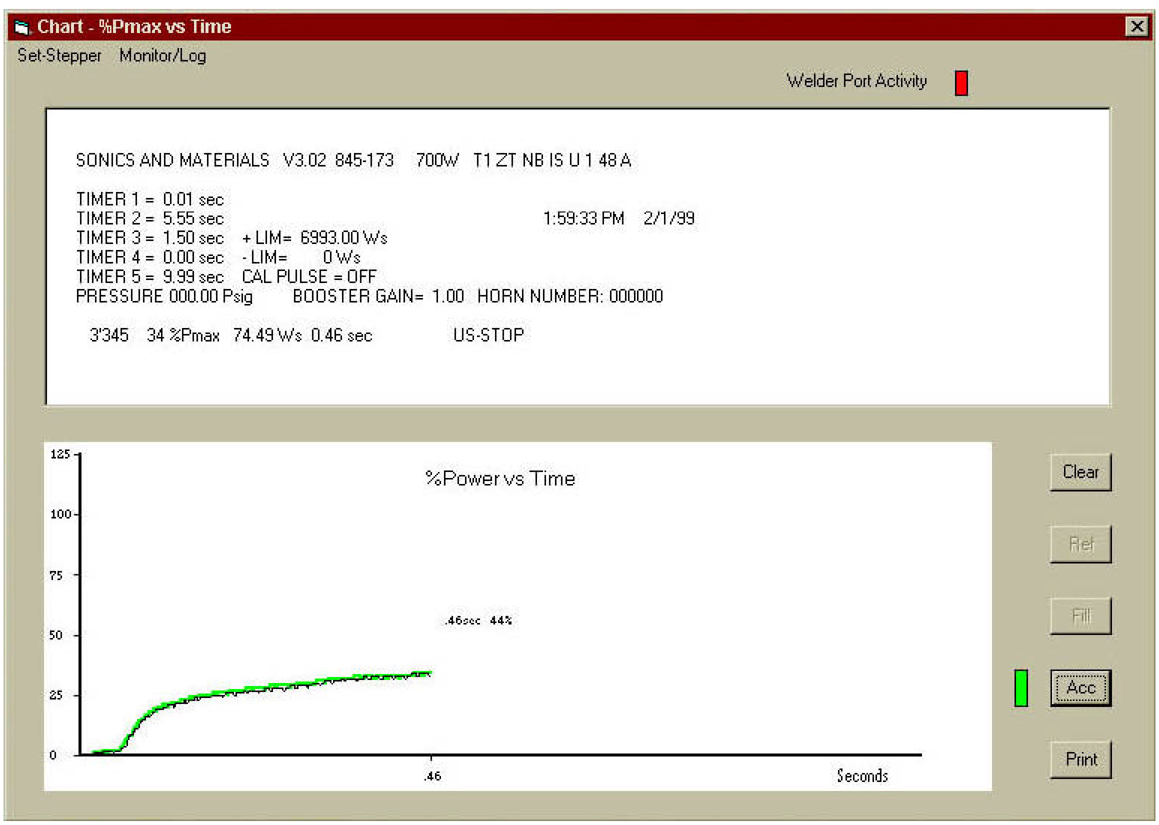
14.0 Chart Form TOC**:** The Chart Form is used to monitor an application during setup and qualification. When this form is displayed, a graphic representation of ultrasonic power verses time will be produced at the end of each weld. This power profile provides a visual indication that can directly show the impact of distance and velocity control on plastic applications. Power level changes due to part variations will also be dramatically displayed. A trace accumulation mode is available and can be used to gauge the repeatability of a weld power profile.

The Chart Form displayed below is a typical representation of a power profile. The upper text area will update first at the end of each weld. It shows the present ultrasonic supply settings and ultrasonic status information. Once the text information has been updated, the graphic will begin to draw. It will be drawn as the data is received and processed. The drawing process can take up to 20 seconds depending on the time scale setting in the FM controller and the length of the weld time. Once the chart is complete, a time scale will be updated along the lower edge of the chart. The cursor will be changed to a cross-hair marker that will show the power and time coordinates at the cursor location anywhere in the graphic area.

The buttons at the right of the graphic area can be used to turn on special graphic effects that aid in the presentation and examination of the chart data. These effects include block and fill, trace accumulation and reference band examination.

Note (FM Settings): The FM ultrasonic controls must be set to TAB mode so that the graphic data will be sent to the computer. Press the INFO key four times, then use the "6" key to toggle the TAB mode ON or OFF. The PRT key must be on to transmit data.

Chart Form



14.1 Welder Port Activity – A simulated indicator light for the Welder Port activity is presented above and to the right side of the text area. When data is received from the ultrasonic welder, the indicator will be green. When the indicator is red, the system is waiting for data and the port is stopped (standby).

14.2 Text Area – The text area above the power graph displays the present ultrasonic settings transmitted from the welder as described above. This information area will be erased and redisplayed as the information from the welder is received. Additional user comments or information may also be typed into the text area manually by positioning the cursor and typing anywhere in the text box. All information in the text box is printed (including user edits) when the print button operation is selected.

14.3 Graph Area – The energy graph is generated immediately following the text information. As soon as the incoming data is identified, it will be processed and the graph will begin to draw. If the Acc function is activated, the previous trace will be changed to the selected color (indicator next to the Acc Button). The new trace will be drawn in Black over the top of any prior trace. The historical trace is also redrawn using a thicker pen so that the new trace does not blend into the older trace.

The incoming data rate is relatively slow so the graph begins drawing as soon as possible to indicate activity on the computer display. If the system waited for the complete data packet to be received it may appear that the computer is not responding.

The vertical scale is always from 0 to 125% of rated power. The horizontal scale will change with the length of the weld time and the scale settings in the FM welder. See the FM manual page 31 (bottom) to set the length of the time axis. This setting controls the time interval between data readings and will determine the amount of data taken for each weld graph.

Once the graph has been completed, the horizontal axis will be marked with the final weld time. The cross-hair cursor will be enabled and will show the coordinates of it's present position as previously described above. It is intended to aid in the examination of the power graph. The coordinates will be displayed adjacent to the cursor and can be positioned at each quadrant around the cursor by pressing either mouse button while the cursor is in the graph area. One click will move the coordinates 90 degrees clockwise around the cross-hair. Four clicks and the numbers are back where they started. Depending on the shape of the present graph one position may be easier to view than another.

The display can be modified by the selections to the right of the graph. Click on the appropriate selection buttons to change the presentation. The "Ref", "Fill" and "Acc" buttons are toggle settings. Click once to turn the option ON and again to turn it OFF.

14.4 Clear – The clear button to the right of the graph is used to erase and reset the graphic display. Historical traces are saved on the display in order to compare the present weld with previous welds. The screen can get cluttered with old data traces. Click the clear button to initiate a clean start.

14.5 Reference – Click the "Ref" button to turn on the reference band examination once a good weld (the Reference weld) has been made and its associated graph is on the screen. Reference lines will be drawn above and below the present data trace by the selected percentage value. If the user has selected 10% for the reference band, then the reference lines will be drawn 10% above and 10% below the present graph. All subsequent traces will be examined for any points which violate the reference band. If any subsequent traces exceed the selected band limit, an alarm indicator will flash.

Any time a new band selection is made, the last or most recent trace will be used as the reference (not the original first selection). The bands will be positioned with respect to this last trace.

The color of the band lines may be changed by clicking on the indicator light to the left of the Ref button. Repeated clicks will cycle the user through the available colors.

Once an alarm condition has been detected, a user click on the flashing alarm is required to clear the alarm. It is not automatically reset for each weld.

14.6 Fill – Click the "Fill" button to turn on the block and fill operation. Once selected, the next data trace will be filled in with the user selected color. The fill will occur above the time axis and below the data trace. This is a single trace presentation, the graphic screen area will be erased prior to redrawing the next received data trace.

The color of the fill may be changed by clicking on the indicator light to the left of the "Fill" button. Repeated clicks will cycle the user through the available colors.

14.7 Accumulate traces – Click the "Acc" button to turn ON the accumulate trace option. This option will save all subsequent traces on the screen in the user selected color. Repeatability is easily gauged by examining the present trace compared to the last trace.

When new trace data is detected, the last trace is redrawn using the selected color in a wider pen width. Then the new trace is drawn on top of the old trace using the finer pen size in black. If the traces exactly repeat, the selected color will be visible on both sides of the new line. A clear indication that the welds and part tolerances are very repeatable!

The historical trace color is changed in the same way as the previously discussed Fill and Ref options. Click on the indicator light to the left of the "Acc" button. Repeated clicks will cycle the user through the available colors.

14.8 Print - Click the "Print" button once to send this form to the system print buffer exactly as it is displayed. This includes the text area with any user typed comments and the graphic display with any historical traces etc. A complete representation of the form will be printed.

14.9 Menu Items – Only two menu items are provided on this form for switching to the stepper or logger forms. This is an application setup form, no file logging or chart saving options are provided other than the ability to print the display. Attempting to save each point of a graphic display would take too much storage area and would not be a practical data storage function.

1. **Set-Stepper** – The Set-Stepper menu selection will unload the chart form and display the Stepper Setup form. The Set-Stepper form is used to program the motor controls as previously described. The TAB mode on the FM supply must be set to ON. Note (FM Settings): The TABULAR mode in the FM ultrasonic controls must be set to OFF for this form. Press the INFO key four times, then press the "6" key to toggle the TABULAR mode ON or OFF. The PRT key must be ON to transmit data.

2. **Monitor \ Log** – The Monitor \ Log menu selection will unload the chart form and display the Monitor \ Logging form. The Monitor \ Log form is intended to capture weld and distance data and present one status line after each weld. The TAB mode on the FM supply must be set to OFF. Note (FM Settings): The TABULAR mode in the FM ultrasonic controls must be set to OFF for this form. Press the INFO key four times, then press the "6" key to toggle the TABULAR mode ON or OFF. The PRT key must be ON to transmit data.

MAINTENANCE

TOC

Stepper Trouble-Shooting Guide TOC:

The following list contains the most common problems associated with the stepper welding system and the most probable cause. The potential problem is in **Bold Red** and the associated discussion should help lead to a solution.

1. The **Chart screen doesn't make a chart**. The FM controller must be set to TAB mode in order to send the data correctly: On the FM microprocessor front panel, press the INFO key four times and then toggle the TABULAR Mode to ON using the "6" key. Press the "PRT" key on the FM panel so that the small LED in the PRT key is on. This toggles the FM print option ON or OFF. It must be ON to send data to the computer for display etc.

2. The **Logger screen doesn't add a status line** after the last weld. TAB mode must be "OFF". Refer to item #1 above to adjust the TABULAR Mode and make sure that the PRT key LED is ON.

3. The **Weld seems to be cut short** and does not achieve the distance setpoint. Check the FM weld time settings, they must be programmed long enough for the ElectroPress system to complete all programmed moves. If sonics is programmed OFF during the second move (Distance #2 and Velocity #2) then the FM hold time (T3) must be long enough for the second move plus any desired Hold time. The ultrasonic welder will be in HOLD when sonics shuts OFF.

4. The Stepper screen **will not let the operator initiate another weld** for many seconds. Again TABULAR Mode must be set to match the chart function. The data points are being transmitted by the FM microprocessor which can take 20 seconds depending on the length of the previous weld cycle. Even though the ElectroPress screen does not use the chart data, another weld cannot be initiated until the data has been transmitted. The data space within the FM is then used for data collection during the next weld cycle. It has limited data space. When the TAB mode is OFF, chart data is not sent by the FM.

5. The motor **starts to weld but there is a grinding sound**. Then it stops and stays in position. The system has stalled for any one of several reasons causing the stepper motor to slip. This slipping makes clicking noises but does not harm the motor. Use the RESET button on the ElectroPress front panel to reset the motor system. The head assembly will move up to the home position. This condition could be caused by excessive velocity settings or low ultrasonic amplitude. Check the velocity settings on the Stepper Screen and verify that the ultrasonic amplitude is sufficient to melt plastic.

6. The **computer does not find the Stepper or FM controller**. These devices must be connected to the two COMM Ports. They must be standard PC ports as COMM1 through COMM4 and each unit must be wired with the proper cables. The stepper system must be in the ready screen: "**SONICS & MATERIALS**" Press HOME or RESET to return to the ready screen. "**SYSTEM READY**"

7. The **head assembly does not find the home position** and keeps trying to run into the upper stop. This could happen at initial startup or after a stall has taken place. The system has missed the upper limit home signal and is trying to run until it finds it. Press the Emergency Stop button and physically move the carriage down from the stop, approximately one inch. Restart or RESET the system and the HOME position should be detected.

8. The **Chart Graph does not print** out properly, it seems to be cut off in the middle of the graph. There is a problem with some print drivers that do not seem to handle the visual basic "Print screen" command. Tested printers include: Epson stylus 500, 600 and 800. Text output modes should work properly with most printers but the graphics will need Epson printers at this time.

9. **Screens are not updating properly.** Due to internal limitations, only the presently displayed screen will receive data for analysis and display. The other available screen displays will not receive any data. Select the proper screen and then initiate a weld. Note that screens cannot be changed during a weld due to the required processing operations. The screen selection process is re-enabled when the weld data has been transmitted and displayed.

10. The System seems to find the parts but then **welds in the upward direction.** This can happen if Absolute Welding mode has been selected and the parts tolerance settings are large. If the parts are found near the end of the specified tolerance window (the sum of the upper and lower tolerance settings) and the absolute weld setting is before that point, the system will weld in the reverse direction or up to the setting. This would obviously be an incorrect application setup but it can be confusing. The part tolerances could not meet the final desired depth after welding if they are already too short to be welded!

11. The machine seems to weld 10 or 15 pieces and then **stops in the middle of the weld while down on the parts.** If the PC port is not connected with the stepper utility program running or the cable has been disconnected without installing the terminator plug, the stepper controller can get into an internal buffer full condition. Install the terminator connector or check the cables and run the utility program.

Glossary of Terms

TOC

Align – The horn moves to the travel distance in order to position the unwelded parts and fixture.

Chart Form – Programming form which plots the power (watts) output verses time data from the Ultrasonic welder.

Creep Speed - A very slow final approach speed used to find the plastic parts. It is used to avoid impact damage to the parts that would occur if the travel speed were to be used all the way to the parts.

Deflection – A measurement taken at the parts position which indicates the expected bending of the ultrasonic press with applied pressure. Deflection will degrade the position accuracy of the system.

Delay Time – The programmed duration which the horn is on the part before the weld begins.

ElectroPress – The Stepper Press Motor control system.

FM – The Ultrasonic Power Supply with microprocessor.

Encoder – Provides optical position feedback of the motor position. This is the number presented in the position data screens.

Force Trigger – The amount of force applied before the weld begins. Foce is measured with a load cell mounted in-line to the stack assembly and the screw actuator.

Hold Time – The programmed duration which the horn is held on the part after the weld ends and before the horn travels home.

Home Position – The full upward start position.

Logger Form – Programming form which prints a status line after every weld. Data may also be sent to a file for later examination or simultaneously to a printer.

Lower Tolerance – The search window position below the taught position which is the expected minimum limit where the parts will be found. If parts are not found before the lower limit position, the cycle will be aborted.

Press – The mechanical assembly which holds the ultrasonic stack and provides a rigid platform to hold the parts and fixtures.

Status Line – The Printed line on the logger form. Also the distance report on the LCD display.

Stall/Slip – When the stepper motor cannot maintain phase lock with the rotating magnetic fields within the motor. Caused by too much applied force or a field velocity too high to maintain physical alignment.

Stepper Motor – A special type of rotary positioning motor. Alternately energized phase coils will magnetically move the rotor in order to control its final position.

Stepper Setup Form – Programming form used to input the control settings for velocity and position.

Tab Mode – A property of the ultrasonic controls which determines what type of data will be sent by the FM. The Tab Mode must be ON when using the Chart form and Off when using the Stepper Setup or Logger forms.

Teach – The method used to define the precise position of the parts to be welded. The system moves downward at slow speed until force is detected by the load cell. This defines the top of the parts!

Travel Velocity – Initial velocity used to approach the parts. The system will switch to a creep speed just above the parts and slowly find the parts.

Upper Tolerance – The search window position above the taught position which is the expected maximum limit where the parts will be found. This position is used to end the travel approach speed and defines the start of the creep speed zone used to detect the parts.

Ultrasonic controls – The FM ultrasonic controller.

Weld Time – The programmed ultrasonic time, T2 in the FM Controller.

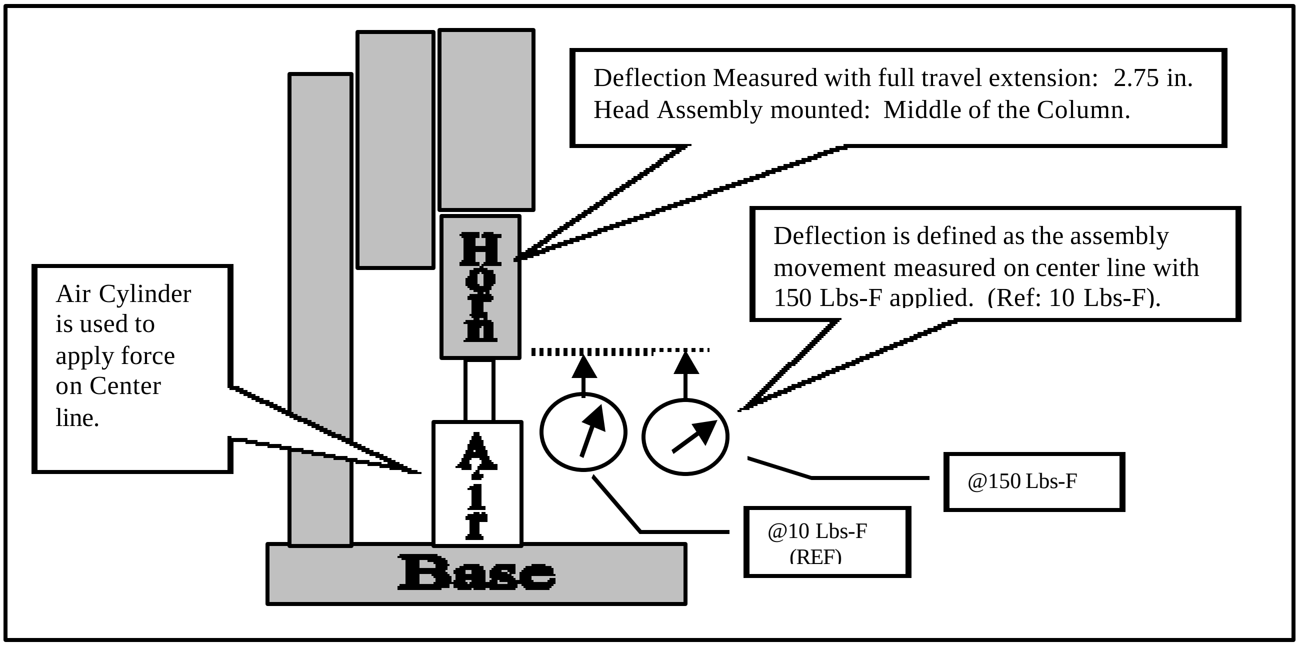
Weld Velocity – The programmed speed used to advance the head assembly during the weld time. Two speed changes can be programmed during the weld and/or hold times.

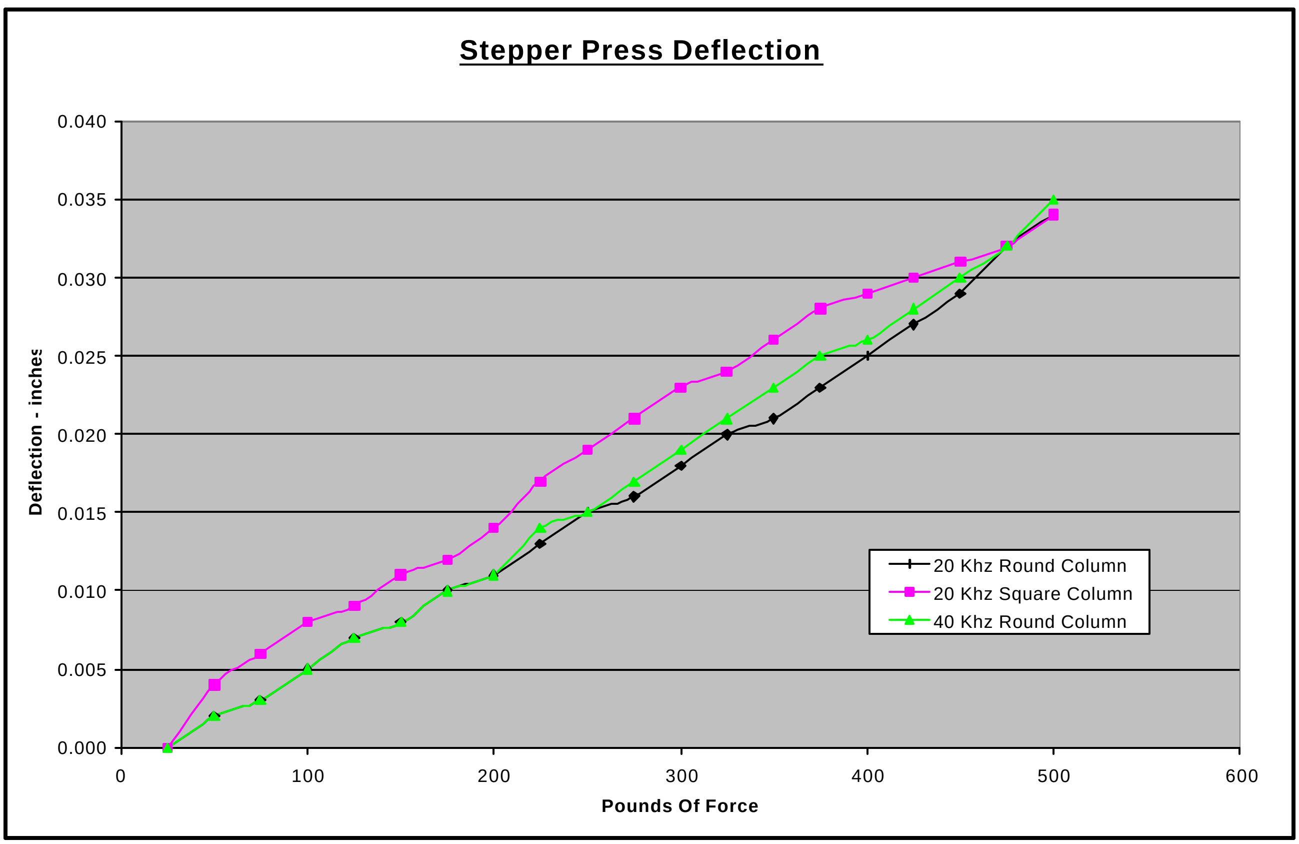
Weld Distance – The distance to travel during the weld. Two weld distance steps can be programmed during the weld time.

Deflection Measurement Diagram

TOC

Deflection is defined as the upward assembly movement measured on center line with 150 Lbs-F applied. This number is referenced to the position with 10 Lbs-F applied to take out any backlash in the mechanical components.





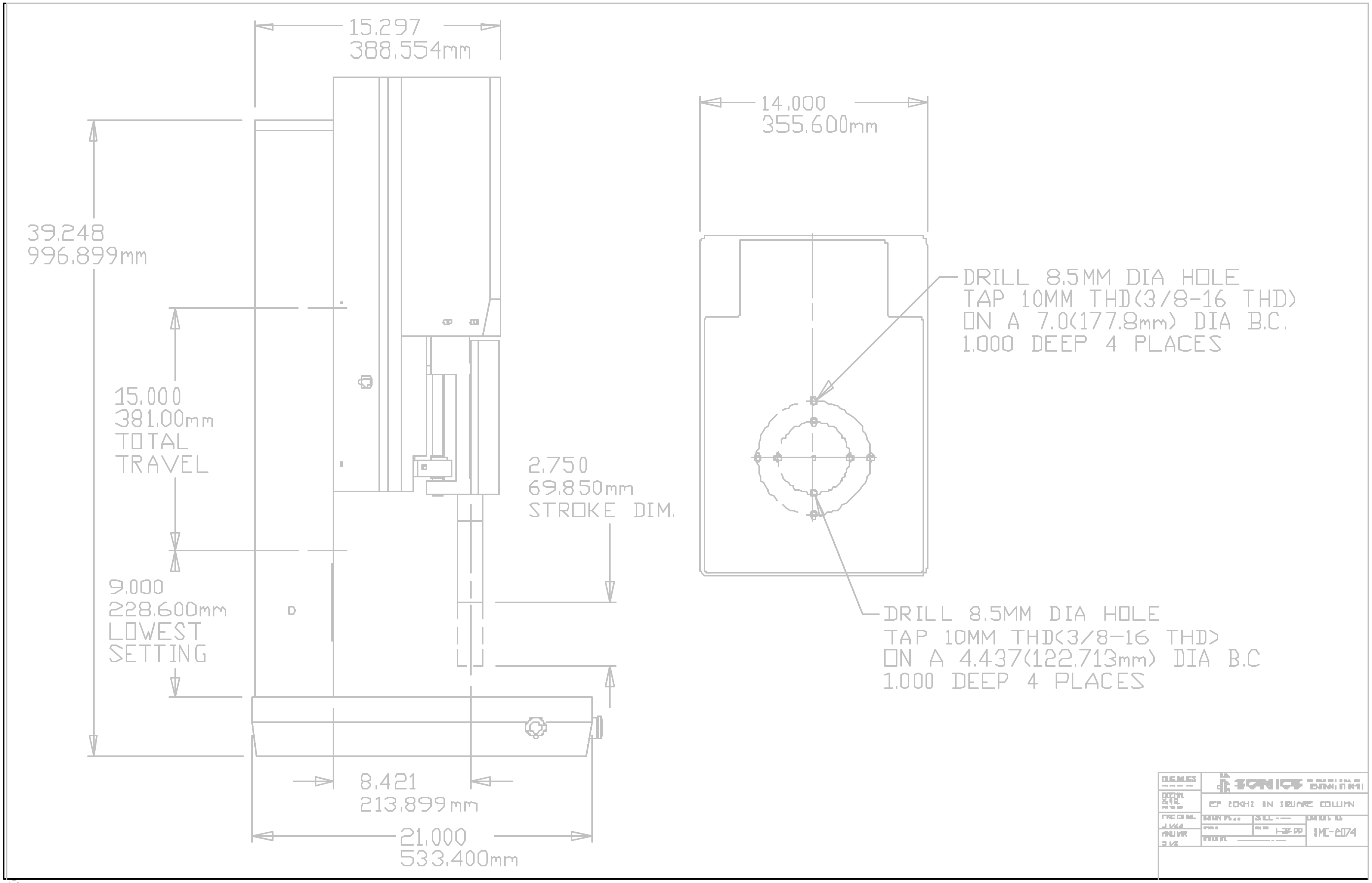
Drawing List TOC – The following drawings are contained in this document for user reference and maintenance purposes. In certain cases, details are difficult to read because these drawings have been reduced to fit on one page. DXF files for each drawing have been included so that closer examination is possible using CAD zoom and pan functions. See the "DXF Viewer" below to download a demo reader if Autocad is not available.

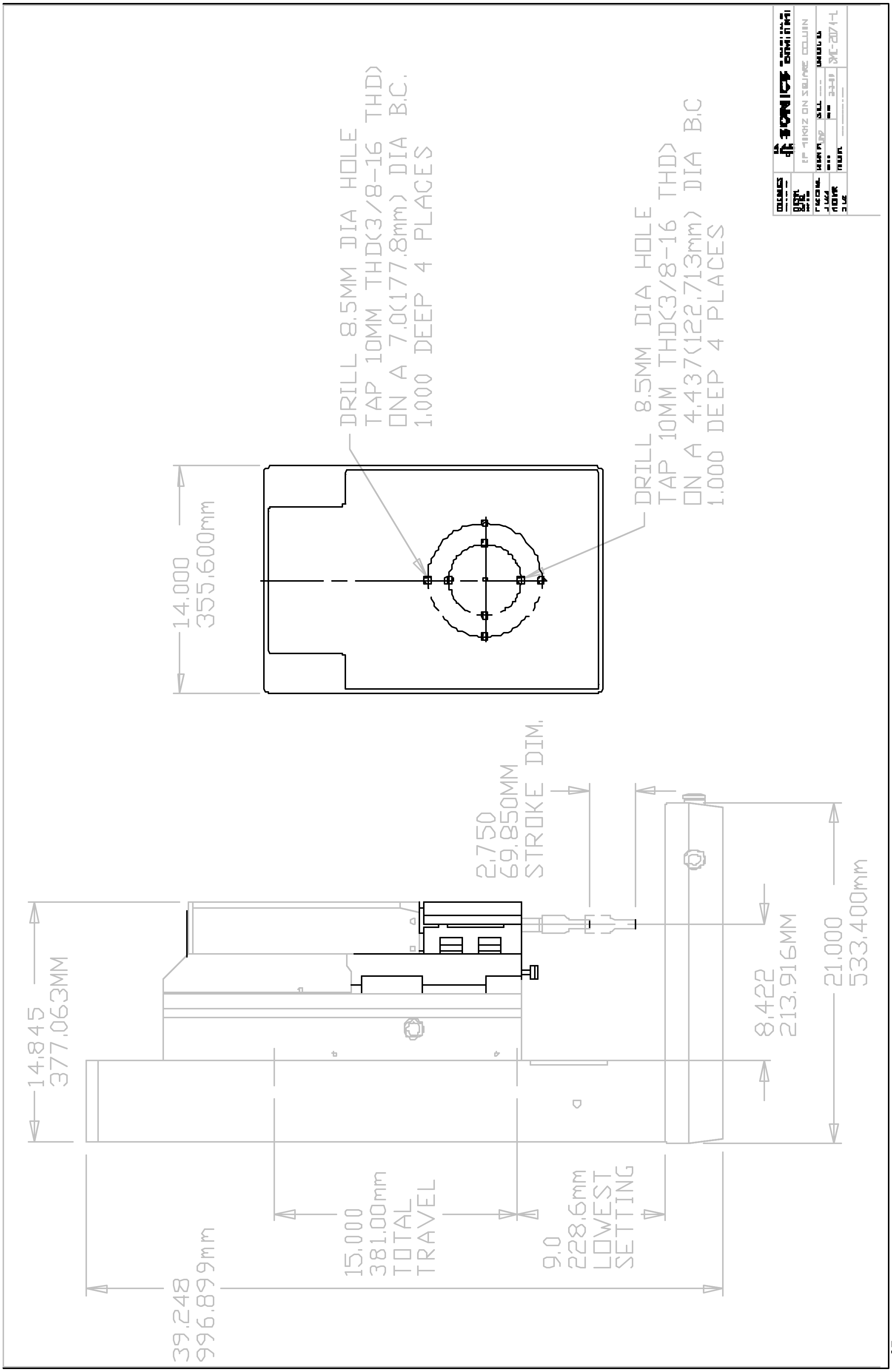
1. SMI-2074 EP 20 kHz Square Column
2. SMI-2074-1 EP 40 kHz Square Column
3. SMI-2074-2 EP 20 kHz Round Column
4. SMI-2074-3 EP 40 kHz Round Column
5. E-2998 DMC 1510 I/O Interface
6. E-3003 Electric Press Wiring (EP_Stand.dxf)
7. E-3075 EM/PC Port Cable
8. E-3088 Cable Stepper RS232 (EP)
9. E-3092 Stepper Line Terminator

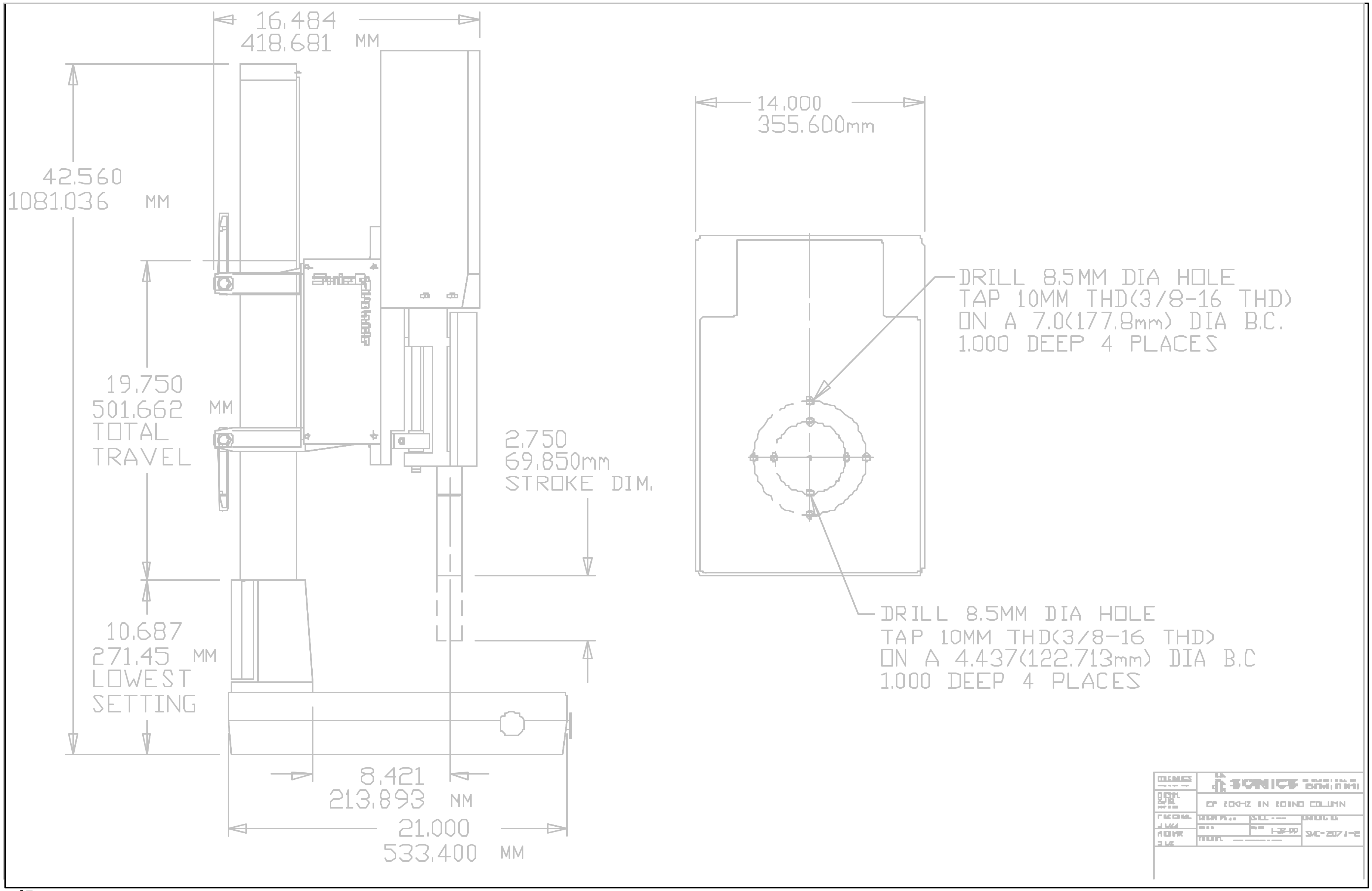
DXF Viewer: http://www.infograph.com/products/MyriadXDwg/default.htm

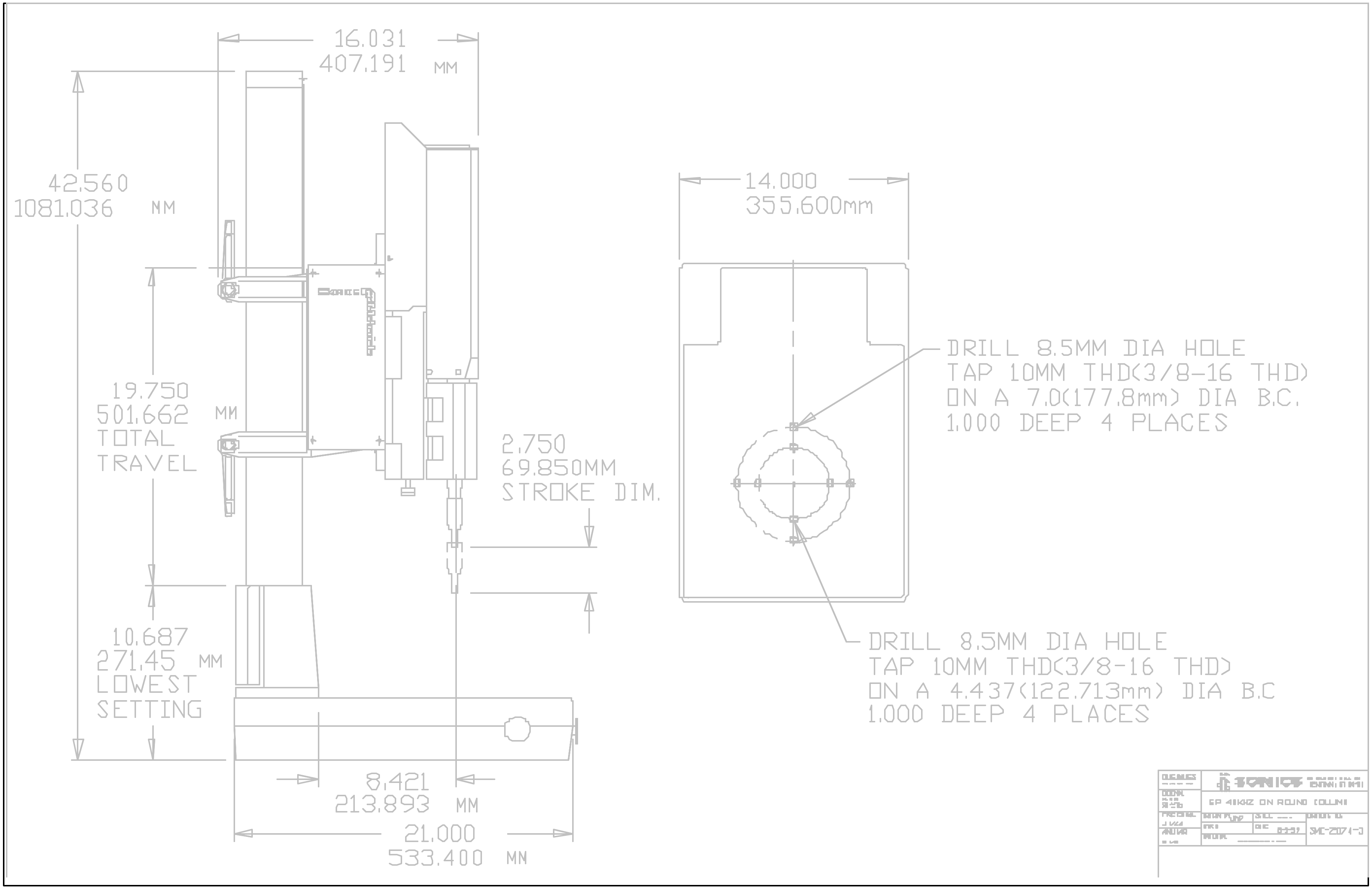
Several DXF files are provided for the cable and press drawings used with the stepper system. They are available in the c:/sonics directory once the setup installation is complete. These files may be viewed with any compatible DXF viewer program. The link above provides a demo DXF viewer for downloading which can be used to examine these files if AutoCad 14 is not available on the users system. The demo is time limited to 30 days but does allow zoom and pan functions to aid in examining the S&M drawings. Many other viewers are available, use a major search engine to search for "DXF+Viewer", most have a small fee for full operation and printing. Be sure to select the 32 bit versions for Windows. The viewer above has been tried and it works with all drawings provided.

Applications Report – Following the drawings, an applications report form is included. It is used by the Sonics & Materials applications department when evaluating a customer project for stepper welding. It is included here to assist the user during setup and to provide a checklist so that all pertinent parameters are considered for a stepper application.

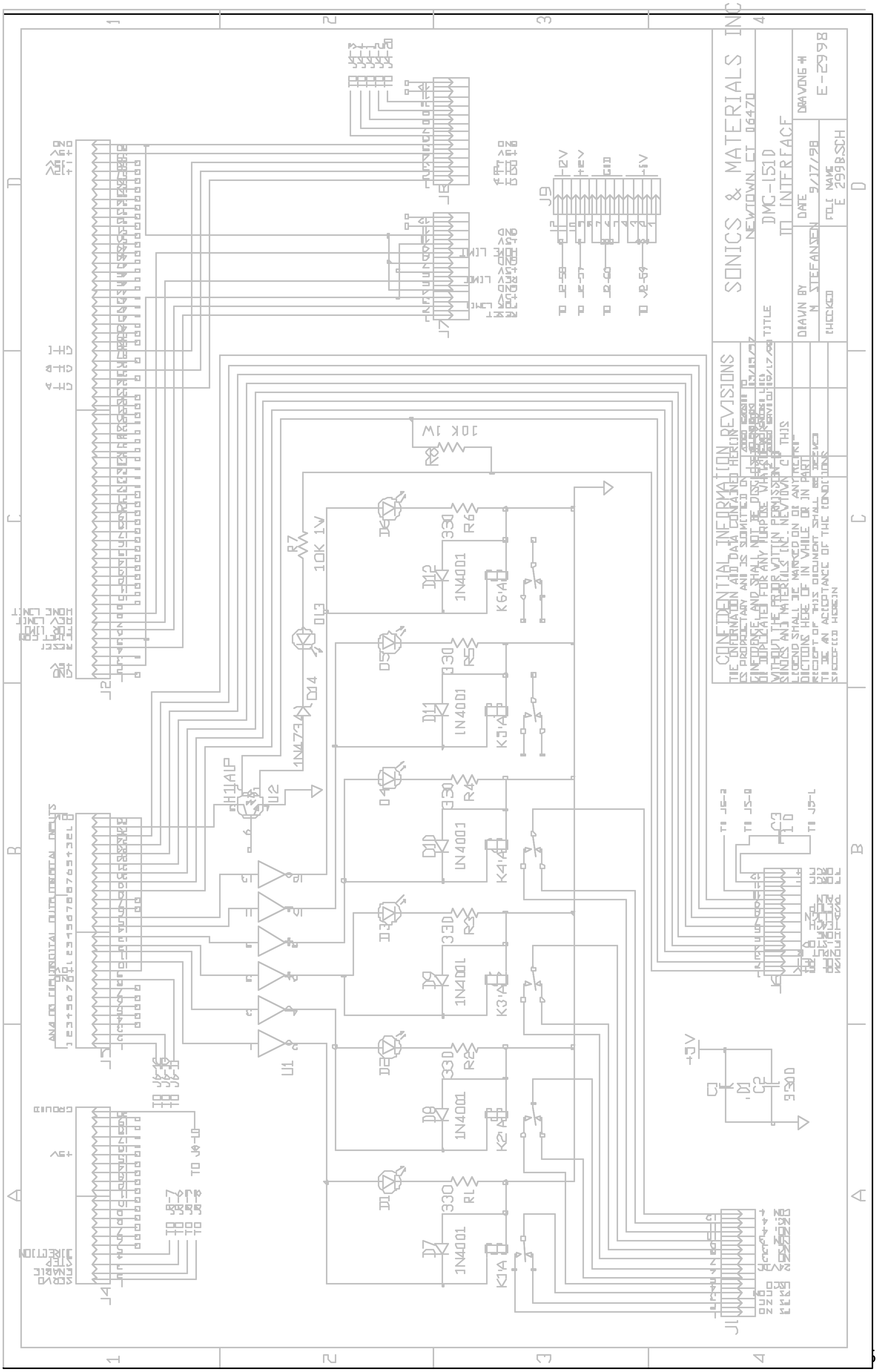

15.297
388.554mm
39.248
996.899mm
15.000
381.00mm
TOTAL
TRAVEL
9.000
228.600mm
LOWEST
SETTING
2.750
69.850mm
STROKE DIM.
8.421
213.899mm
21.000
533.400mm
14.000
355.600mm
DRILL 8.5MM DIA HOLE
TAP 10MM THD(3/8-16 THD)
ON A 7.0(177.8mm) DIA B.C.
1.000 DEEP 4 PLACES
DRILL 8.5MM DIA HOLE
TAP 10MM THD(3/8-16 THD)
ON A 4.437(122.713mm) DIA B.C
1.000 DEEP 4 PLACES

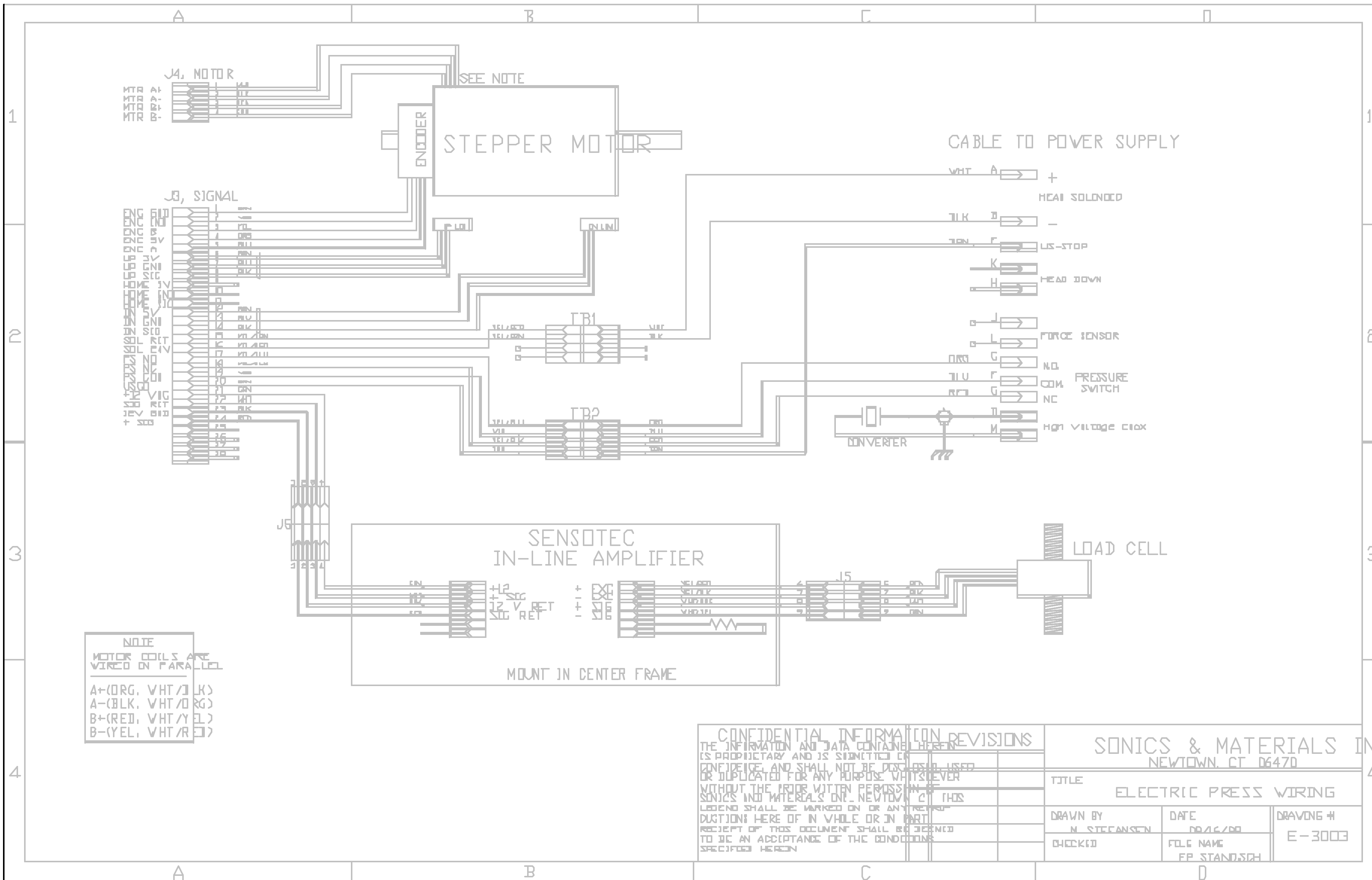

DRILL 8.5MM DIA HOLE
TAP 10MM THD(3/8-16 THD)
ON A 7.0(177.8mm) DIA B.C.
1.000 DEEP 4 PLACES
DRILL 8.5MM DIA HOLE
TAP 10MM THD(3/8-16 THD)
ON A 4.437(122.713mm) DIA B.C
1.000 DEEP 4 PLACES
14.000
355.600mm
2.750
69.850MM
STROKE DIM.
14.845
377.063MM
8.422
213.916MM
21.000
533.400mm
15.000
381.00mm
TOTAL
TRAVEL
9.0
228.6mm
LOWEST
SETTING
39.248
996.899mm


16.484
418.681 MM
42.560
1081.036 MM
19.750
501.662 MM
TOTAL
TRAVEL
10.687
271.45 MM
LOWEST
SETTING
2.750
69.850mm
STROKE DIM.
8.421
213.893 MM
21.000
533.400 MM
14.000
355.600mm
DRILL 8.5MM DIA HOLE
TAP 10MM THD(3/8-16 THD)
ON A 7.0(177.8mm) DIA B.C.
1.000 DEEP 4 PLACES
DRILL 8.5MM DIA HOLE
TAP 10MM THD(3/8-16 THD)
ON A 4.437(122.713mm) DIA B.C
1.000 DEEP 4 PLACES

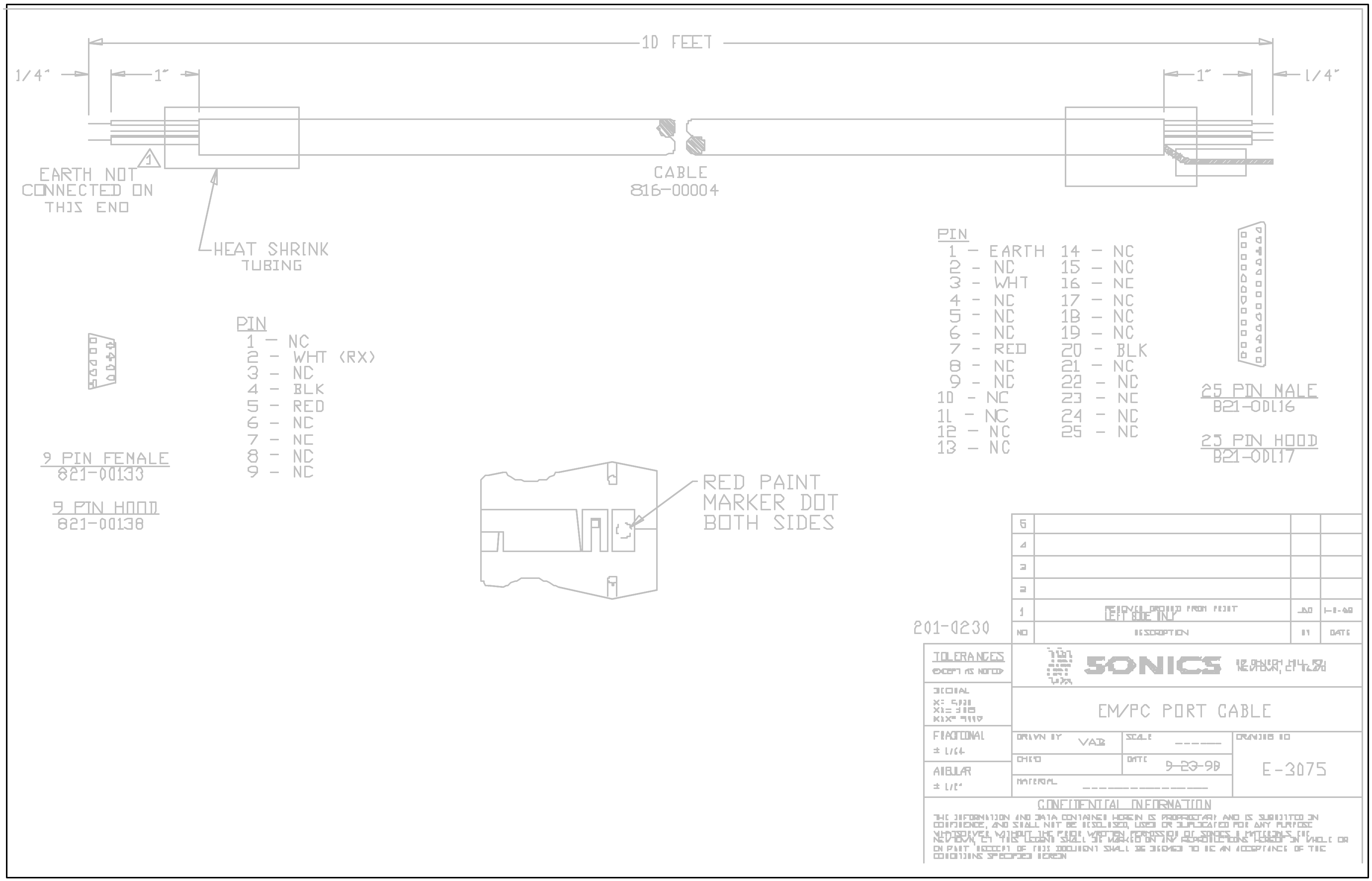


16.031
407.191 MM
42.560
1081.036 MM
19.750
501.662 MM
TOTAL
TRAVEL
10.687
271.45 MM
LOWEST
SETTING
2.750
69.850MM
STROKE DIM.
8.421
213.893 MM
21.000
533.400 MN
14.000
355.600mm
DRILL 8.5MM DIA HOLE
TAP 10MM THD(3/8-16 THD)
ON A 7.0(177.8mm) DIA B.C.
1.000 DEEP 4 PLACES
DRILL 8.5MM DIA HOLE
TAP 10MM THD(3/8-16 THD)
ON A 4.437(122.713mm) DIA B.C
1.000 DEEP 4 PLACES


SONICS & MATERIALS INC.
NEWTOWN, CT 06470
DMC-151D
IO INTERFACE
DRAWING #
E-2998
DRAWN BY
M. STEFANSEN
DATE
9/17/98
FILE NAME
E 2998.SCH
CHECKED
TITLE
CONFIDENTIAL INFORMATION
REVISIONS



STEPPER MOTOR
ENCODER
SEE NOTE
J4, MOTOR
J3, SIGNAL
CABLE TO POWER SUPPLY
HEAD SOLENOID
US-STOP
HEAD DOWN
FORCE SENSOR
PRESSURE SWITCH
N.O.
COM.
NC
HGH VOLTAGE CBOX
CONVERTER
TB1
TB2
J5
J6
LOAD CELL
SENSOTEC
IN-LINE AMPLIFIER
MOUNT IN CENTER FRAME
NOTE
MOTOR COILS ARE WIRED IN PARALLEL
A+(ORG, WHT/BLK)
A-(BLK, WHT/ORG)
B+(RED, WHT/YEL)
B-(YEL, WHT/RED)
CONFIDENTIAL INFORMATION
REVISIONS
SONICS & MATERIALS INC.
NEWTOWN, CT 06470
TITLE
ELECTRIC PRESS WIRING
DRAWN BY
DATE
DRAWING #
E-3003
CHECKED
FILE NAME



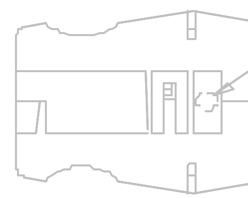
10 FEET
1/4"
1"
1"
1/4"
EARTH NOT CONNECTED ON THIS END
HEAT SHRINK TUBING
CABLE
816-00004
PIN
1 - NC
2 - WHT (RX)
3 - NC
4 - BLK
5 - RED
6 - NC
7 - NC
8 - NC
9 - NC
9 PIN FEMALE
821-00133
9 PIN HOOD
821-00138
PIN
1 - EARTH
2 - NC
3 - WHT
4 - NC
5 - NC
6 - NC
7 - RED
8 - NC
9 - NC
10 - NC
11 - NC
12 - NC
13 - NC
14 - NC
15 - NC
16 - NC
17 - NC
18 - NC
19 - NC
20 - BLK
21 - NC
22 - NC
23 - NC
24 - NC
25 - NC
25 PIN MALE
821-00116
25 PIN HOOD
821-00117
RED PAINT MARKER DOT BOTH SIDES
201-0230
REMOVED GROUND FROM PRINT LEFT SIDE ONLY
NO
DESCRIPTION
BY
DATE
TOLERANCES
SONICS
EM/PC PORT CABLE
DRAWN BY VAB
SCALE
DRAWING NO
DATE 9-23-98
E-3075
MATERIAL
CONFIDENTIAL INFORMATION

9 PIN FEMALE
B21-00133

9 PIN HOOD
B21-0013B

PIN
1 - BRN
2 - RED
3 - ORG
4 - YEL
5 - GRN
6 - BLU
7 - VIO
8 - GRY
9 - WHT

BOTH ENDS



NOTES:

1. CUT BLACK WIRE AND SHIELD FROM BOTH ENDS
2. PUT LABEL ON HOOD

201-0229

NO	DESCRIPTION	BY	DATE
5			
4			
3			
2			
1			

TOLERANCES EXCEPT AS NOTED

DECIMAL
X= [illegible]
XX= [illegible]
XXX= [illegible]

FRACTIONAL ± 1/64

ANGULAR ± 1/2°

SONICS [illegible] NEWTOWN, CT [illegible]

CABLE, STEPPER RS232 (EP)

DRAWN BY JAC

SCALE ———

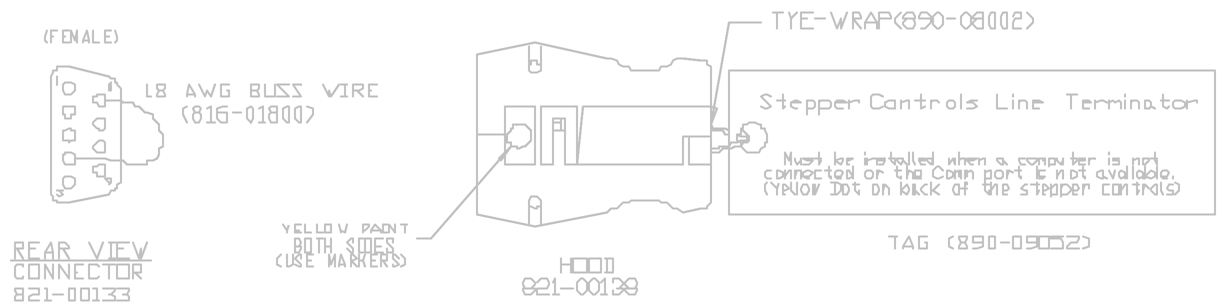
CHK'D

DATE 2-16-99

MATERIAL ———

DRAWING NO E-308B

CONFIDENTIAL INFORMATION



NOTES:

1. MAKE LOOP ON BUSS WIRE LARGE ENOUGH FOR TYE-WRAP
2. MAKE SURE TYE-WRAP END IS NOT EXSPOSED(AS SHOWN)

201-0237

NO	DESCRIPTION	BY	DATE
5			
4			
3			
2			
1			

TOLERANCES EXCEPT AS NOTED	SONICS		
DECIMAL	STEPPER LINE TERMINATOR		
FRACTIONAL ± 1/64	DRAWN BY JAC	SCALE -----	DRAWING NO
	CHK'D	DATE 2-12-90	E-3092
ANGULAR ± 1/2°	MATERIAL ---------		

CONFIDENTIAL INFORMATION

THE INFORMATION AND DATA CONTAINED HEREIN IS PROPRIETARY AND IS SUBMITTED IN CONFIDENCE, AND SHALL NOT BE DISCLOSED, USED OR DUPLICATED FOR ANY PURPOSE WHATSOEVER WITHOUT THE PRIOR WRITTEN PERMISSION OF SONICS & MATERIALS INC NEWTOWN, CT. THIS LEGEND SHALL BE MARKED ON ANY REPRODUCTIONS HEREOF IN WHOLE OR IN PART. RECEIPT OF THIS DOCUMENT SHALL BE DEEMED TO BE AN ACCEPTANCE OF THE CONDITIONS SPECIFIED HEREIN

Sonic Weld Set-up Parameters – Electro-Press Welding System TOC

Report No.:		**Date:**	
Customer:		**Contact:**	
Telephone No.:		**Fax No.:**	
Prod. Description:		**Material:**	
Representative:		**Lab Tech:**	

(EXAMPLE)	PARAMETERS	SETTINGS
FM-740 / 40EP	**WELDING EQUIPMENT**	
T1 ZT NB IS 1 48 A	**MODE CODE**	
GOLD (+ 1.5)	**BOOSTER COLOR**	
H0065	**HORN DESCRIPTION / NUMBER**	
N0078	**FIXTURE DESCRIPTION / NUMBER**	
YES	**LEVELING PLATES**	
NO	**AIR COOL HORN**	
ON	**CALIBRATION PULSE**	
80	**OUTPUT CONTROL**	
12 LBS	**FORCE TRIGGER (10 - 150 LBS.)** [1]	
1.5 INCHES	**TRAVEL DISTANCE (0.2 – 2.7 INCHES)** [1]	
2.00 RPS	**WELD VELOCITY1 (0.01 - 10.00 RPS)** [1]	
0.025 INCHES	**WELD DISTANCE1 (0.001-0.500 INCHES)** [1]	
2.00 RPS	**VELOCITY2 (0.01 - 10.00 RPS)** [1]	
0.025 INCHES	**DISTANCE2 (0.001-0.500 INCHES)** [1]	
ON	**WELD2 ON/OFF** [1]	
0.010 INCHES	**UPPER PART TOLERANCE** [1]	
- 0.025 INCHES	**LOWER PART TOLERANCE** [1]	
0.10 SEC.	**DELAY TIME (TIMER 1)**	
N/A	**PRE-TRIGGER (TIMER 1)**	
0.25 SEC.	**WELD TIME (TIMER 2)** [2]	
N/A	**ENERGY (REF)** [2]	
0.25 SEC.	**HOLD TIME (TIMER 3)**	
0.15 SEC.	**AFTERPULSE TIME (TIMER 4)**	
9.99 SEC.	**ABORT TIME (TIMER 5)**	
15.00 Ws.	**+ LIM**	
10.00 Ws.	**- LIM**	

Notes:

1. Programmed values only through a PC utilizing Sonics & Materials software.
2. Program value twice nominal to allow sufficient time to reach " WELD DISTANCE " value.
3. 1 RPS = 0.133 inches per second

RETURN/REPAIR NOTES

It is suggested that a system in need of repair be sent back to the factory, with a written description pertaining to the nature of the problem.

In order to receive prompt service, always contact the factory before returning any instrument. Include date of purchase, model number and serial number. For units not covered by the warranty, a purchase order should be forwarded to avoid unnecessary delay. Care should be exercised to provide adequate packing to insure against possible damage in shipment. The system should be sent with all transportation charges prepaid and return method of shipment indicated.

SHIPPING

Because of the problems in the handling of our equipment during shipment, it is asked that all customers check the following:

1. All module plug in units.

2. All wire plug in connections.

3. All I. C.

4. Sonics & Materials makes every effort to ship our units in proper working order. All units are tested and checked for problems prior to shipping. It is asked that when a problem does occur that all parts and components be inspected for damage (especially when the unit is not in working order when received).

Stepper Utility Programs and Manual

Recommended minimum computer requirements for stepper motor welder:

1. Minimum Computer: Pentium 200 Mhz.; 32 Meg Ram; 2 Gig Drive; Windows95 or Windows98
2. The system must have two comm ports available: COMM1, 2, 3 or 4.
3. Program space required: 47M for the Stepper Programs and Manual.

Install: The Stepper control programs and manual are provided on CD. To install the Stepper files and manual, use the windows start command to run the setup.exe program from the Installation CD. A Stepper directory will be created under the standard Program Files directory. All necessary files will be installed in the standard installation technique.

Read and Print the Manual: Use Word97 to read and print the **Electropress Operators Manual.doc** file that will be located in the C:\Program Files\Stepper\Manual directory. A free Word97 viewer is available from Microsoft below for users who do not have Word97.

Running the Stepper Utility Program: Run the Stepper Utility using the windows95/98 start button (Start; Programs; Sonics; Stepper). Both controllers should be powered and connected before starting the stepper program. The stepper utility system will be a file called **stepper.exe** located in the C:\Program Files\Stepper directory. A windows default printer must be installed even if you do not intend to print data or charts.

Word97 Viewer from Microsoft: http://officeupdate.microsoft.com/downloadCatalog/dldWord.htm
If Word97 is not available on the user's computer, check this Microsoft site to download a free copy of the latest Word97 Viewer. Install this program to view and print the **Electropress Operators Manual.doc** file. Microsoft provides this program free of charge to users who do not have Word97 so that word files can be read and exchanged easily.

FOR IMMEDIATE RELEASE

Contact: Carolyn Bown
MarCom Manager
203-270-4600

Sonics Opens Sonics & Materials UK Ltd.

(January 12, 2005 – Newtown, CT) Sonics & Materials, Inc. is pleased to announce the opening of Sonics & Materials UK Ltd. in Stowmarket, Suffolk, England. Headed by Malcolm Hayward, who has worked internationally in the ultrasonic plastics assembly industry for over 20 years, this new distributorship further strengthens Sonics' ability to serve its overseas customers.

"We are actively expanding our market reach across the globe and are excited to have this opportunity to provide an increased level of solutions, service and response to our European customers," said Robert Soloff, President. "Coupled with our European HQ, located in Switzerland, and our growing presence in emerging markets, the announcement of this new UK distributor signals our continued commitment to offering customers superior access and ease of doing business."

A world leader in the field of ultrasonic technology, Sonics has over 25 international distributors, with locations in Europe, Asia, Africa, South America and Australia.

For more information, contact Sonics & Materials UK Ltd. directly at sales@sonicsandmaterials.co.uk or by phone at 011-44-1449770055.

About Sonics

Since 1969, Sonics & Materials, Inc. has been a world leader in the field of 15-, 20- and 40 kHz ultrasonic welding technology and other plastics joining methods. The company, which is ISO 9001 certified, designs and builds a complete line of hand-held, bench-top and semi-automated plastics assembly systems, which include microprocessor controlled ultrasonic welders, vibration welders, hot plate welders and spin welders. Sonics offers in-house application assistance, materials testing laboratory service, global sales and distribution network, on-site field service and the industry's most advanced welding systems. Automotive, industrial, medical, packaging, toy, appliance, consumer and synthetic textile manufacturers around the world use Sonics' standard or customized equipment to weld the full spectrum of commodity and engineering polymers.

FOR IMMEDIATE RELEASE

Contact: Mark Caldwell
National Sales Manager
203-270-4600

Sonics Introduces New Rigid 20kHz Plastic Welding Press

Model 2055 Offers Super-Rigid Design for More Demanding Plastics Welding Applications

(November 23, 2004 – Newtown, CT) Sonics & Materials, Inc. introduces its new Model 2055 20 kHz pneumatically-actuated ultrasonic welding press. Featuring significant engineering upgrades, the 2055 press has been specifically designed to provide increased rigidity for minimized deflection and enhanced precision and performance. The press will be on display at WestPack in Anaheim this January.

Sonics Model 2055
20 kHz Ultrasonic Welder

For more demanding applications, the Model 2055 Press incorporates a newly designed rigid base casting with integrated hub, increased column diameter and column wall thickness, increased throat depth for larger tooling capability, CNC precision-machined components, and THK rails and bearings. Additional features include an in-line 2.5-inch bore, a 4-inch stroke pneumatic cylinder (with an optional 6-inch stroke available), speed controls, and a pressure regulator with gauge.

Quick release column clamps and a head-adjust hand wheel with counterbalance head spring are included to streamline tooling set-ups and changeovers. Further simplifying radial horn alignment is a high-efficiency snap-in converter that rotates 360 degrees. Distance-controlled welding in incremental and absolute modes is also possible with the optional Linear Encoder. A threaded positive stop provides for fine adjustment and limits the downward travel of the horn.

Available in 1000, 1500 and 2000 watts, Sonics' FM Series microprocessor-controlled power supplies can weld in time or energy modes and offer automatic tuning, memory storage, line voltage/load regulation and automatic reject signals. Similarly-featured FD model power supplies are available for time-based welding only.

About Sonics

Since 1969, Sonics & Materials, Inc. has been a world leader in the field of 15-, 20- and 40 kHz ultrasonic welding technology and other plastics joining methods. The company, which is ISO 9001 certified, designs and builds a complete line of hand-held, bench-top and semi-automated plastics assembly systems, which include microprocessor controlled ultrasonic welders, vibration welders, hot plate welders and spin welders. Sonics offers in-house application assistance, materials testing laboratory service, global sales and distribution network, on-site field service and the industry's most advanced welding systems. Automotive, industrial, medical, packaging, toy, appliance, consumer and synthetic textile manufacturers around the world use Sonics' standard or customized equipment to weld the full spectrum of commodity and engineering polymers.

Sonics & Materials, Inc., 53 Church Hill Road, Newtown, CT 06470, USA
Phone: (203) 270-4600, Fax: (203) 270-4610, Toll Free in USA: (800) 745-1105
Email: info@sonics.biz, or visit the company's website at **www.sonics.biz**

Contact: Lois Baiad
Sales Administrator
203-270-4600

Agency Contact: Peter Howland
Photos/Media Coord.
203-270-6699 x110

Sonics Expands Reach in U.S. and Overseas

New Sales Reps Announced for Arizona, India and Germany

(December 30, 2003 – NEWTOWN, Conn.). As part of the company's continued growth, **Sonics & Materials, Inc.** has contracted additional U.S. and international sales representatives to manage new and developing territories for its line of leading ultrasonic plastic welding equipment, president and CEO **Robert Soloff** announced today.

The independent manufacturer representatives for the company's popular 15kHz, 20kHz and 40kHz ultrasonic welders are based in Tempe, Arizona, here in the U.S., and overseas in Mumbai, India and Munster, Germany.

"It was time to provide focused, regional sales and service to these expanding areas," said Soloff, "and we have selected manufacturer representatives who will help us deliver our products and fulfill our mission of providing the very best ultrasonic equipment available."

The Pentar Group of Tempe, AZ, will be selling Sonics' ultrasonic plastic assembly systems in Arizona, Colorado, Utah and Nevada; **Feintechnik R. Rittmeyer, GmbH** of Munster will manage sales throughout Germany; and **Bhupesh Chavan** of Mumbai is the new representative in India.

The new sales representatives, who each have several years of industry expertise, augment an experienced international sales team currently managed by **Mark Caldwell** in the U.S., and **Alex Slakta** in Europe.

For more information on Sonics' equipment or to reach a representative in your area, please contact **Lois Baiad** at **+203-270-4600** or email **lbaiad@sonics.biz**.

About Sonics

Sonics & Materials, Inc. is a world leader in the field of 15-, 20- and 40 kHz ultrasonic welding technology and other plastics joining methods. The company, which is ISO 9001 certified, designs and builds a complete line of hand-held, bench-top and semi-automated plastics assembly systems, which include microprocessor controlled ultrasonic welders, vibration welders, hot plate welders and spin welders. Sonics offers in-house application assistance, materials testing laboratory service, global sales and distribution network, on-site field service and the industry's most advanced welding systems. **Automotive, industrial, medical, packaging, toy, appliance, consumer** and **synthetic textile manufacturers** around the world use Sonics' standard or customized equipment to weld the full spectrum of commodity and engineering polymers.

FOR IMMEDIATE RELEASE / Special MD&M West 2004 Focus (Booth 1133)

Contact: Mark Caldwell
National Sales Manager
203-270-4600

Agency Contact: Peter Howland
Media Coordinator
203-270-6699 x110

Sonics Introduces New Rigid 20kHz Plastic Welding Press

New Model 2050 Offers Super-Rigid Design for Higher Quality Ultrasonic Welds

(November 3, 2003 – NEWTOWN, Conn.) Sonics & Materials, Inc. announces its new 20 kHz pneumatically actuated ultrasonic welding press. The new Model 2050 welding press has been redesigned to provide increased rigidity for minimized deflection and enhanced precision and performance.

The model's enhanced rigidity is well suited for more demanding applications where precision welds, enhanced quality and efficiency are desired. The new press features a newly designed base casting with integrated hub, CNC precision-machined components, THK rails and bearings, increased throat depth and increased column diameter and wall thickness. Also features an in-line 2.5-inch bore, 4-inch stroke pneumatic cylinder, with an optional 6-inch stroke available. The redesigned front panel features speed controls, pressure regulator and gauge, and a head down switch for ease of set up. The improved, high-efficiency snap-in converter rotates 360 degrees to simplify radial horn alignment, while a quick-release threaded positive stop provides fine adjustment and limits the downward travel of the horn.

Sonics Model 2050
20 kHz Ultrasonic Rigid Welder

Available FM microprocessor-controlled power supply can weld in time or energy modes and offers automatic tuning, memory storage, line voltage/load regulation and automatic reject signals. Similarly featured FD model power supplies are available for time-based welding only.

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Sonics & Materials, Inc. is a world leader in the field of 15-, 20- and 40 kHz ultrasonic welding technology and other plastics joining methods. The company, which is ISO 9001 certified, designs and builds a complete line of hand-held, bench-top and semi-automated plastics assembly systems, which include microprocessor controlled ultrasonic welders, vibration welders, hot plate welders and spin welders. Sonics offers in-house application assistance, materials testing laboratory service, global sales and distribution network, on-site field service and the industry's most advanced welding systems. Automotive, industrial, medical, packaging, toy, appliance, consumer and synthetic textile manufacturers around the world use Sonics' standard or customized equipment to weld the full spectrum of commodity and engineering polymers.

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Email: info@sonics.biz, or visit the company's website at **www.sonics.biz**

FOR IMMEDIATE RELEASE

Contact:	Lois Baiad Sales Administrator 203-270-4600	**Agency Contact:**	Peter Howland Photos/Media Coord. 203-270-6699 x110

Sonics Offers New Rigid-Mount 30kHz and 40kHz Converters for Automated & Semi-Automated Ultrasonic Plastics Welding

Improved Precision, Durability, Reliability and Efficiency to Benefit Automotive, Medical Device, Consumer Electronics and Other Industries

(January 29,2004 - NEWTOWN, Conn.) **Sonics & Materials, Inc.** announces its development of a new series of durable, high-efficiency, rigid-mount converters for automated and semi-automated ultrasonic plastics welding applications. The new, rigid-mount converters are available in 30kHz and 40kHz models, with power handling capabilities of up to 1,000 watts.

“These new converters eliminate the previous O-ring mount arrangement, giving the user a true reference in aligning the converter and horn assembly exactly on the weld location,” said **Robert Soloff**, president.

In addition to providing improved precision and accuracy, the rigid-mount converters can tolerate higher pressures without sustaining damage. Field tests have shown the rigid-mount converter to be extremely durable and reliable, especially versus traditional O-ring mount converters.

“There is no O-ring to come loose,” Soloff said. “This should be of particular interest to automotive parts fabricators and others who apply direct force to the back of the converter.”

New CVR233 Rigid-Mount Converter

Photo Available on Request

Proprietary assembly methods also allow the converters to operate with high efficiency and extremely low power loss, minimizing heat gain and, in most cases, eliminating the need for air cooling.

The new Model CVR233 is available with either a side-mounted, BNC-type electrical connector for use in multi-headed automated systems, or a rear-mounted electrical connector. An acorn-style connector is provided for converters that are used in a welding press.

For more information on Sonics' equipment, custom application engineering assistance, or to reach a representative in your area, please contact **Lois Baiad** at +203-270-4600 or email lbaiad@sonics.biz.

About Sonics

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SONICS
Newtown, CT USA

Press Release

Date: August 17, 2000
Contact: Lois Baiad, Manager, Sales Administration, Sonics & Materials, Inc., Newtown, CT 06470
203-270-4600

NEW LITERATURE FOR 20 kHz ULTRASONIC PLASTICS ASSEMBLY SYSTEMS

A new, four color brochure is now available for Sonics' 20 kHz ultrasonic plastics assembly systems. This new literature describes in detail the features and benefits of their systems. Specifications and dimensional drawings are also included to help the customer decide which system will best suit their needs.

These systems can be used for welding, staking, inserting and forming thermoplastic components in order to fulfill the customer's unique application needs. In addition to the 20 kHz systems, Sonics also offers 15 kHz and 40 kHz bench mounted systems as well as 20 and 40 kHz ElectroPress systems and hand held welders. Sonics is dedicated to providing total customer satisfaction and the highest quality products before, during, and especially after the sale through continuous support and service.

Sonics & Materials, Inc. is a global leader in the field of ultrasonic technology and other plastics joining methods. The company, which is ISO 9001 certified, designs and builds a complete line of hand-held, bench-top, and semi-automated plastics assembly systems, which include microprocessor controlled ultrasonic welders, vibration welders, hot plate welders and spin welders. Sonics offers in-house application assistance, materials testing laboratory service, global sales and distribution network, on-site field service, and the industry's most advanced welding systems. Automotive, industrial, medical, packaging, toy, appliance, consumer, and synthetic textile manufacturers around the world use Sonics' standard or customized equipment to weld the full spectrum of commodity and engineering polymers.

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Press Release

Date: June 10, 2003
Contact: Mark Caldwell, National Sales Manager, Sonics & Materials, Inc., Newtown, CT
203-270-4600

SONICS' NEW 6000 WATT 15 kHz POWER SUPPLY DESIGN FOR ULTRASONIC PLASTICS ASSEMBLIES

Rated at 6000 watts, Sonics new Model FC6015 is the most powerful ultrasonic generator available in the industry. It is also available in 2500 and 4000 watt versions..

This new power supply has been designed with auto tune circuitry, which automatically matches the power supply to the "stack" frequency. Line voltage regulation circuitry provides constant RF voltage to the converter regardless of incoming voltage fluctuations, resulting in constant amplitude. Load regulation maintains constant amplitude regardless of power draw.

This new power supply is designed to start under heavy loads and to drive larger size or complex shaped horns available for 15 kHz assembly applications. Adjustable soft start circuitry is provided to minimize the possibility of horn stalling during the weld cycle. Overload protection circuitry provides system shutdown in nanoseconds if it is operated under adverse conditions. The power factor control assures maximum power delivery from the AC source. An external amplitude control is located on the front panel. Input/Output ports are provided to control and/or monitor the power supply functions via remote PLC or PC.

A non-controller type power supply is available to operate in time cycled or continuous duty mode for incorporation into automated systems where control of the ultrasonics, multiple weld time and amplitude functions can be programmed externally. A microprocessor controller will also be available to weld in the time, distance or energy modes.

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SONICS
Newtown, CT USA

Date: June 19, 2003
Contact: Brian Gourley, Manager - Applications Laboratory, Sonics & Materials, Inc., Newtown, CT 203-270-4600

Sonics Introduces an Ultrasonic 40 kHz Hand Held Welder, Model H-540

Sonics & Materials, Inc. now offers a 40 kHz, 500 watt hand held welder, Model H-540, for the thermoplastics industry. This system is ideally suited for smaller applications requiring lower amplitude than the 20 kHz. It is an excellent choice for applications with a class "A" surface since the lower amplitude of the 40 kHz system reduces the possibility of marking the surface. The compact unit is rugged, reliable, and easy to operate. The hand held welder is designed specifically for staking, inserting, and spot welding applications and is suited for manual operations with low volume production or for assembling parts with difficult to reach weld areas. The 40 kHz, 1.5 lbs. hand gun converter is designed to accept a wide variety of 40 kHz horns. These horns can be designed to accept standard replaceable tips or can be supplied with a custom face configuration to meet specific customer applications requirements.

The Model H540 power supply features autotune circuitry which eliminates the need for tuning the system when changing horns for different applications. This newly designed power supply circuitry provides constant amplitude to the part being assembled resulting in consistent welds. The hand held welder features a microprocessor based programmable timer for weld times from 0.1 to 9.9 seconds. A DB9 I/O connector is provided to interface with automated machines via a PC or PLC and allows the user to control or monitor functions such as amplitude, ultrasonics on/off, and overload reset. The Model H540 features overload protection circuitry for both the power supply and hand gun.

Optional accessories available for the Model H-540 ultrasonic hand held welder include a Manual Arbor Press which provides better ergonomic movement and control of the final welded part and a Pistol Grip accessory designed to provide better handling of the handpiece for certain applications. The Pistol Grip is a lightweight device that simply slips onto the standard model hand gun and allows the operator to actuate the ultrasonics by pulling on the "trigger".

Sonics & Materials, Inc. is a world leader in the field of ultrasonic technology and other plastics joining methods. The company, which is ISO 9001 certified, designs and builds a complete line of hand-held, bench-top, and semi-automated plastics assembly systems, which include microprocessor controlled ultrasonic welders, vibration welders, and spin welders. Sonics offers in-house application assistance, materials testing laboratory service, global sales and distribution network, on-site field service, and the industry's most advanced welding systems. Automotive, industrial, medical, packaging, toy, appliance, consumer, and synthetic textile manufacturers around the world use Sonics' standard or customized equipment to weld the full spectrum of commodity and engineering polymers.

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Email: info@sonics.biz, or visit the company’s website at www.sonics.biz

SONICS
Newtown, CT USA

Press Release

Date: June 19, 2003
Contact: Mark L. Caldwell National Sales Manager Sonics & Materials Inc.
(203) 270-4600 Ext. 336

NEW Wide Bed Vibration Welder for Large Thermoplastic Parts

Sonics & Materials Inc., Newtown, CT. now offers a wide bed linear vibration welder for welding and bonding large thermoplastic parts. The wide bed machine, which offers a 72" (1829 mm) wide, two speed, variable force hydraulic lift table, incorporates all of the features and benefits of Sonics' standard EH Series vibration welders. These features include an industrial computer with 10.4" (264 mm) operator touch panel and, Windows based software which is interfaced with an Allen-Bradley PLC. Capable of welding by time, distance or energy, upper and lower limit settings allow the system to weld within a precise process window and, a weld graph screen charts wattage, energy, and distance trending. The system's lower tool weight and travel distance detection promotes ease in set-up and, a modem is provided for remote factory communications. Additional features and benefits include - up to four independent weld pressure, time and amplitude settings, 200 to 250 Hz variable output frequency, .040" (1mm) to .070" (1.8mm) amplitude setting, digitally controlled electromagnetic drive system with four spring head bridge for large upper tool capacity, quick recall job storage, oversized and hinged rear service doors for easy tool access and changeover, safety light curtain, single button touch-and-go cycle start and, Sonics' patented auto-tune function which automatically detects, sets and locks the upper tool's optimum frequency in seconds.

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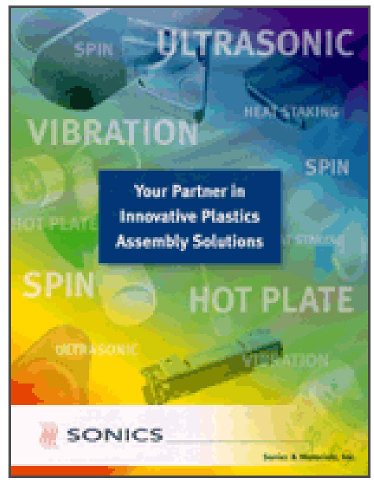
Press Release
Date: August 17, 2000
Contact: Lois Baiad, Manager, Sales Administration, Sonics & Materials, Inc., Newtown, CT 06470
203-270-4600

Sonics Features A Rainbow Effect Within Its New Corporate Brochure



Sonics introduces a new twist to its product literature concerning its thermoplastic assembly equipment and systems. The design is vibrant and intended to increase awareness of Sonics colorful range of capabilities and solutions. This 8-page color brochure highlights the latest technological breakthroughs and product enhancements within its plastics assembly product line. Ultrasonic, vibration, spin, hot plate welding and heat staking equipment as well as the unparalleled service that Sonics provides as your plastics assembly partner are detailed. In addition to Sonics plastic assembly equipment, tooling, power supply and additional plastics assembly techniques can also be found within this corporate collateral material.
These systems can be used for welding, staking, inserting and forming thermoplastic components in order to fulfill the customer's unique application needs. Sonics is dedicated to providing total customer satisfaction and the highest quality products before, during, and especially after the sale through continuous support and service.

Sonics & Materials, Inc. is a global leader in the field of ultrasonic technology and other plastics joining methods. The company, which is ISO 9001 certified, designs and builds a complete line of hand-held, bench-top, and semi-automated plastics assembly systems, which include microprocessor controlled ultrasonic welders, vibration welders, hot plate welders and spin welders. Sonics offers in-house application assistance, materials testing laboratory service, global sales and distribution network, on-site field service, and the industry's most advanced welding systems. Automotive, industrial, medical, packaging, toy, appliance, consumer, and synthetic textile manufacturers around the world use Sonics' standard or customized equipment to weld the full spectrum of commodity and engineering polymers.

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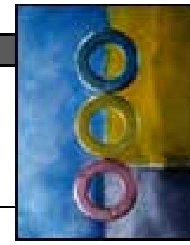

Press Release

Date: July 2000
Contacts: Brian Gourley, Technical Services Manager, or
Lois Baiad, Sales Administration Manager,
Sonics & Materials, Inc., Newtown, CT 06470
203-270-4600

Sonics' Announces A Pistol Grip Attachment For Its Ultrasonic Hand Held Welder

Sonics offers a pistol grip attachment that is compatible with its 20 kHz and 40 kHz 500 watt ultrasonic hand held welders. The pistol grip is designed to provide a more ergonomic handling of the handpiece for certain applications. It is a lightweight device that simply slips onto the hand guns. The operator activates the ultrasonics by simply pulling on the "trigger". This pistol grip is ideal for welding, spot welding, staking, and inserting. In addition, applications that require manual operations with low volume production requirements or when assembling parts with difficult to reach weld areas this system is very successful.

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The unit is supplied with a power supply, hand gun, and pistol grip attachment. The 20 kHz hand guns contain an integral ½" diameter titanium front driver with a replaceable flat face tip. Other standard tips and custom tips are available for various application requirements. The 40 kHz hand gun is supplied with a removable horn designed specifically for each customer's requirements.

The autotune feature enables the use of different style tips without the need to retune the system for each application. The power supply regulates the line voltage and provides constant amplitude throughout the weld process. The hand held welders contain a microprocessor based programmable timer for weld times from 0.1 to 9.9 seconds. Another function of the microprocessor includes digital amplitude control. The hand guns can operate at a standard 120 volts or optional 220 volts nominal input voltage.

The 500 watt welders contain two overload protection circuits. The response time is less than 2 micro seconds, enabling the circuits to prevent internal component damage to the power supply and converter. The power supply also has a standard DB9 I/O connector that can interface with automated machines via a PC or PLC.

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Email: info@sonics.biz

Newtown, CT USA

Press Release

Date: July 5, 2000
Contact: Contacts: Brian Gourley, Technical Services Manager
Sonics & Materials, Inc., Newtown, CT
203-270-4600

Sonics Announces a Patent For Producing Fabric Covered Plastics

Sonics introduces its new patent invented by Robert Soloff, the company's founder and CEO. This cost effective welding process proves once again Sonics leadership ability within the plastics assembly industry. The patent number is 6,066,217. This technology is made possible by using Sonics' Vibration Welder, Model EH 5020 and tooling which incorporates a proprietary coating to grip the carpet and the plastic to accomplish the final weld.

This process bonds unbacked carpet to plastic; in this instance for an automobile map pocket. In the past, only backed carpet could be vibration welded through the use of pin type tooling. This created unacceptable visible marks on the carpet after the weld cycle. The pin marks needed to be manually combed out, costing additional labor dollars. With this revolutionary patented process, not only will the pins and the marking be eliminated, but also both backed and unbacked carpet can be welded. Using unbacked carpet in an assembly process can typically yield significant savings to the manufacturer of approximately three dollars per part.

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[Vibration Welder]

Press Release

Date: June 9, 2000
Contact: Brian Gourley, Technical Services Manager, Sonics & Materials, Inc.
203-270-4600

Sonics' Stapler Attachment Is Ideal For Sealing Low Volumes Of Clamshell Packages

Sonics & Materials, Inc. offers a lightweight stapler attachment as an optional accessory for its Model CV52 and CV54 hand guns. It is easy to operate and has the ability to seal various sizes of clamshell packages. The accessory can be used to spot weld applications as well. The stapler is designed with a special pivoting mechanism that is attached to the standard hand held welders.

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The mechanism contains a steel anvil that applies pressure to a small area on the flanged outer edge of the clamshell package, yielding simple manual operations. Another feature that makes the stapler more versatile is that the anvil contains two sealing patterns. The standard pattern consists of a medium diamond knurl on one end and a coarse diamond knurl on the other. In order to switch from one sealing pattern to the other, the anvil can be rotated 180 degrees. This is done by merely loosening the mounting screw, turning the anvil, and then re-tightening the screw.

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SONICS Newtown, CT USA

Press Release

Date: June 30, 2000
Contact: Brian Gourley, Technical Services Manager, Sonics & Materials, Inc.
203-270-4600

Sonics Announces New Windows Based Controls For Its Vibration Welder

Sonics Vibration Welder, Model EH 5020, offers state-of-the-art technology through its new touch panel computer. This computer contains many benefits that will enhance productivity and captivate accuracy for plastics assembly. This system is designed with an application wizard that helps set the initial control parameters based on plastic type and contact area. There are four weld times and two hold times capable of up to 120 seconds of weld time. This feature provides additional precision and control over the weld cycle. In addition, energy welding can be measured in kilojoules with a maximum of 1200 kJ. The system also contains an improved application programming interface.

This touch panel computer has a new patent pending autotune procedure that selects tune frequency in 15 seconds maximum. The windows based controls are capable of producing an automatic table and fixture weight compensation for strategic analysis. Distance welding can also be measured for meltdown control. Visual representations of the weld cycle can be presented in chart form representing energy, watts, and distance trending. Lines can be printed and data can be logged after each weld cycle and can be accessed through a compatible database.

A key benefit of these controls is its security measure. There is part in place sensing so that a cycle cannot be initiated without a part in place. There is also a resetable batch counter to ensure accurate inventory. Remote diagnostics over a modem link are used to diagnose problems and update the machine logic and computer programs when necessary.

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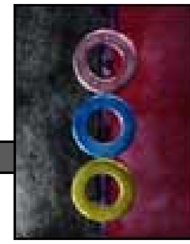
[Vibration Welder]



Press Release

Date: June 30, 2000
Contact: Brian Gourley, Technical Services Manager, Sonics & Materials, Inc.
203-270-4600

Sonics Introduces A Servo-Controlled HotPlate Welder

Sonics offers to the plastics assembly industry a solution for welding single and multi-cavity parts produced by injection, extrusion, or blow molding. Sonics' hot plate welder, Model HPS 152/152, utilizes servo-motor actuation technology instead of traditional pneumatic or hydraulic actuation. Thus, the system is capable of welding parts with wall thickness down to 1 mm.

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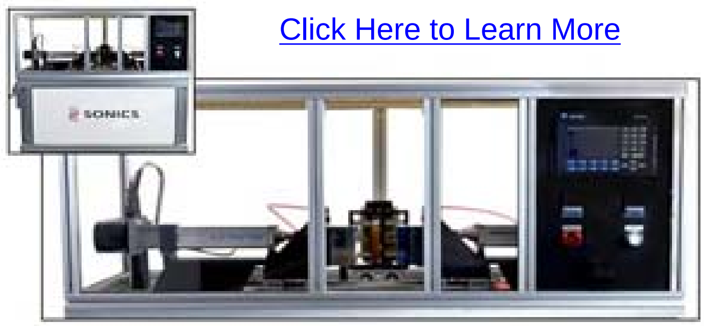

The servo control system is compact, accurate, flexible, and reliable. In addition, it is sold at a price competitive with the pneumatic and hydraulic technologies. The Servo-Controlled Hot Plate Welder can be designed or modified to meet your application requirements. There are many inherent features incorporated in the Servo-Controlled Hot Plate Welder that make it advantageous for these welding processes. There are no mechanical stops within its configuration. Therefore, through a keypad interface that contains password protection, all system actuation can be programmed. The welder can be rapidly set-up due to its ability to store and retrieve programs through this keypad. The tooling on the system is designed with a couple of bolts to eliminate the usual lengthy set-up procedure, making this unit even more simple to operate and set-up.

There is dual axis positioning within the welder, yielding independent control of the part melt depth. It also ensures accuracy to +/- .001" for more precision over the weld cycle. To ensure even more accuracy there is variable speed control. This can be programmed for a precise melt during heating and assembly cycles.

The Servo-Controlled Hot Plate Welder contains radiant or conductive heating modes. These modes are ideal for abrasive materials or for materials that tend to stick or string. The system can be quickly and simply programmed in order to avoid contact of the parts with the platen during the heating phase.

There are also independent heating zones that can be achieved with this Model HPS 152/152. When welding parts of different materials, temperatures for separate heated platens can be digitally controlled and modified. A safety mechanism is in place to restrict the machine operation if temperatures fall below the target range. This is accomplished through feedback sensors.

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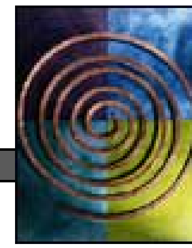

Press Release

Date: June 30, 2000
Contact: Lois Baiad, Manager, Sales Administration, Sonics & Materials, Inc.
Brian Gourley, Technical Services Manager, Sonics & Materials, Inc.
203-270-4600

20Hz Electropress

Sonics Exhibits Remarkable Control

Sonics & Materials, Inc. introduces its revolutionary ElectroPress Ultrasonic Plastics Assembly System. This new, ultra-precision welder features a stepper motor transport that controls the advancing speed and final position of the ultrasonic horn. The ElectroPress is designed for high precision, close tolerance applications. Welding applications that use special materials or delicate components may also achieve improved results with the ElectroPress. Combined with Sonics' FM Power Supply and linear feedback encoder, the new press is capable of controlling the final weld position to a tolerance of 0.0003" (0.008 mm) through a broad range of velocities. This yields repeatable welds with exact final dimensions of the bonded components. This high level of precision is perfect for the assembly demands of many customers, such as medical and electronic manufacturers.

Sonics' new design provides dimensional accuracy capabilities far beyond those of the conventional pneumatic welders. Precision control in an ElectroPress is further enhanced through a rigid mount booster that prevents horn deflection. The rigid mount booster has zero resilience and stack deflection. This unique booster construction eliminates springs, o-rings, and other flexible components. Those components, typically found in pneumatic presses, can cause displacement errors and performance deterioration.

The ElectroPress is supplied with a software interface package for programming the trigger force, weld velocity, and weld distance parameters. The software also provides a monitor/log menu selection. This selection will display a form intended to capture weld and distance data and present a one-line status after each weld. A power vs. time graph can be used to collect data for output and statistical analysis in text format. This graph monitors an application during the set-up and qualification period illustrating the impact of distance and velocity controls on the weld.

Sonics & Materials, Inc. is a world leader in the field of ultrasonic technology and other plastics joining methods. The company, which is ISO 9001 certified, designs and builds a complete line of hand-held, bench-top, and semi-automated plastics assembly systems, which include microprocessor controlled ultrasonic welders, vibration welders, and spin welders. Sonics offers in-house application assistance, materials testing laboratory service, global sales and distribution network, on-site field service, and the industry's most advanced welding systems. Automotive, industrial, medical, packaging, toy, appliance, consumer, and synthetic textile manufacturers around the world use Sonics' standard or customized equipment to weld the full spectrum of commodity and engineering polymers.

Contact Information: Sonics & Materials, Inc., 53 Church Hill Road, Newtown, CT 06470, USA,
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SONICS
Newtown, CT USA

Press Release
Date: June 30, 2000
Contact: Brian Gourley, Technical Services Manager, Sonics & Materials, Inc., Newtown, CT
203-270-4600

Sonics Introduces an Enhanced Ultrasonic 20 kHz Hand Held Welder, Model H-520

Sonics & Materials, Inc. now offers an improved 500 watt hand held welder, Model H-520, for the thermoplastics industry. The compact unit is rugged, reliable, and easy to operate. The hand held welder is designed specifically for staking, inserting, and spot welding applications and is suited for manual operations with low volume production or for assembling parts with difficult to reach weld areas. The 20 kHz 1.5 lbs. hand gun is supplied with an integral ½" diameter titanium front driver with a replaceable flat face tip. Other standard tips are available for various application requirements. Tips can also be custom designed to meet specific customer applications.

The autotune feature of the enhanced hand held welder enables the use of different style tips without the need to retune the system for each application. The power supply regulates the line voltage and provides constant amplitude throughout the weld process. The hand held welder contains a microprocessor based programmable timer for weld times from 0.1 to 9.9 seconds. Another function of the microprocessor includes digital amplitude control. All of these beneficial features yield a more consistent cycle. The hand gun can operate at a standard 120 volts or optional 220 volts nominal input voltage.

The Model H-520, 500 watt welder contains two overload protection circuits, one for the power supply and the other for the converter. The system's overload circuit protects the power supply from exceeding its maximum wattage. The advanced converter protection circuit is designed to protect against excessive voltage or current caused by the application. The response time is less than 2 micro seconds, enabling the protection circuits to prevent internal component damage to the power supply and converter.

The power supply has a standard DB9 I/O connector that can interface with automated machines via a PC or PLC. This connector allows the user to control amplitude and ultrasonics on/off times, as well as reset overload conditions. Users can, with the DB9 connector, monitor the power in watts and frequency.

There are several optional accessories available for the Model H-520 ultrasonic hand held welder. The Manual Press provides better ergonomic movement and control of the final welded part. This press is available with foot switch actuation or cam actuation. The Stapler attachment is ideally suited for sealing low production rate clamshell packages. It is designed with a special pivoting mechanism that is attached to the standard hand gun. The mechanism contains a steel anvil that applies pressure to a small area on the flanged outer edge of the clamshell package. The Pistol Grip accessory is designed to provide better handling of the handpiece for certain applications. It is a lightweight device that simply slips onto the standard model hand gun. The operator activates the ultrasonics by pulling on the "trigger".

The standard hand piece is supplied with a 10' hardwired cable. This straight diameter cable is small and light. Cables of up to 25' are available for the hand gun. Sonics will soon introduce a 40 kHz Ultrasonic Hand Held Welder that will have the same features as the 20 kHz model. The 40 kHz welder is capable of welding small applications that require gentle action.

Sonics & Materials, Inc. is a world leader in the field of ultrasonic technology and other plastics joining methods. The company, which is ISO 9001 certified, designs and builds a complete line of hand-held, bench-top, and semi-automated plastics assembly systems, which include microprocessor controlled ultrasonic welders, vibration welders, and spin welders. Sonics offers in-house application assistance, materials testing laboratory service, global sales and distribution network, on-site field service, and the industry's most advanced welding systems. Automotive, industrial, medical, packaging, toy, appliance, consumer, and synthetic textile manufacturers around the world use Sonics' standard or customized equipment to weld the full spectrum of commodity and engineering polymers.

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SONICS
Newtown, CT USA

Press Release

Date: June 30, 2000
Contact: Brian Gourley, Technical Services Manager, Sonics & Materials, Inc.
203-270-4600

Sonics' Manual Press Offers Precision for Small Quantities of Plastics Assembly

Sonics & Materials, Inc. brings to the ultrasonic plastics assembly markets a state-of-the-art Manual Press. The press is designed specifically for assembling parts where production volume does not justify more expensive pneumatic presses. It provides a more controlled motion of the welder than is possible by just holding the hand gun, resulting in more consistent assemblies. The Manual Press enables flexibility for the experienced operator and ease of use for the novel user. This unit is small, therefore minimal space is required within a manufacturing or assembly environment.

The Manual Press can be used in conjunction with Sonics' 20 kHz 500-watt ultrasonic hand held welder. The unit is available with foot switch actuation or cam actuation to ensure precise and consistent welds.

Sonics & Materials, Inc. is a world leader in the field of ultrasonic technology and other plastics joining methods. The company, which is ISO 9001 certified, designs and builds a complete line of hand-held, bench-top, and semi-automated plastics assembly systems, which include microprocessor controlled ultrasonic welders, vibration welders, hot plate welders and spin welders. Sonics offers in-house application assistance, materials testing laboratory service, global sales and distribution network, on-site field service, and the industry's most advanced welding systems. Automotive, industrial, medical, packaging, toy, appliance, consumer, and synthetic textile manufacturers around the world use Sonics' standard or customized equipment to weld the full spectrum of commodity and engineering polymers.

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Press Release

Date: November 15, 1999
Contact: Mark Caldwell, National Sales Manager, Sonics & Materials, Inc.
(203) 270-4600

Sonics Offers a New Innovative Spin Welder Design for Thermoplastic Assembly

Click Here to Learn More

Sonics & Materials, Inc. has introduced three new models to compliment its standard line of spin welding equipment and systems. The LTR3000, 4000, and 5000 Series Spin Welding machines are small footprint systems that are designed for bench top production. The LTR Series Spin Welders can also be custom designed and manufactured for automated in-line assembly systems.

Specifically designed for plastics assembly applications of up to 3" in diameter, the new LTR Series Spin Welders include variable speed digital RPM control with PLC timed power supply for maximum efficiency and control. Other standard features include an adjustable stroke control to cushion and maintain spin feed rate at part-to-part contact point, a 1" thick aluminum fixture plate, and ¾" aluminum anodized finished frame construction. For maximum operator safety, the units include dual anti tie-down cycle start switches with a front-and-center emergency stop.

The LTR spin welders are designed with a 1/3 to 3 horsepower electric motor drive system that is capable of a maximum of 7100 revolutions per minute. The pneumatic head has a down stroke of up to 7.5". The hard stop feature enables positive weld depth control. Other available options for the LTR3000, 4000, and 5000 Series Spin Welders are external wiring for spin start and stop, depth control, and head home position for automation.

Sonics & Materials, Inc. is a world leader in the field of ultrasonic technology and other plastics joining methods. The company, which is ISO 9000 certified, designs and builds a complete line of hand-held, bench-top, and semi-automated plastics assembly systems, which include microprocessor controlled ultrasonic welders, vibration welders, and spin welders. Sonics offers in-house application assistance, materials testing laboratory service, global sales and distribution network, on-site field service, and the industry's most advanced welding systems. Automotive, industrial, medical, packaging, toy, appliance, consumer, and synthetic textile manufacturers around the world use Sonics' standard or customized equipment to weld the full spectrum of commodity and engineering polymers.

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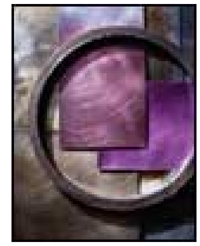

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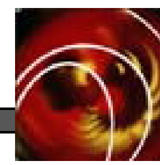

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