UW-4

DIGITAL ULTRASOUND WATTMETER

Operator's Manual

BIO-TEK® INSTRUMENTS, INC.

BIO-TEK®
INSTRUMENTS, INC.

UW-4 Digital Ultrasound Wattmeter

Operator's Manual

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Revision B
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Notices

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Revision Record

Revision	Date	Change
A	4/00	First Issue
B	8/00	Renamed "power supply" in the preface to "power transformer". Corrected the 200 gm calibration range. Corrected the temperature range for operating and storage of the unit. Added Appendix B- Troubleshooting.

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Warnings

Use of this instrument is restricted to qualified personnel who recognize shock hazards and are familiar with safety precautions used when operating electrical equipment. Read the manual carefully before operating the UW-4.

☛ The following warning and informational symbols may be found on the UW-4:

Symbol	Description
	**Caution: Risk of electric shock**
	**Direct / Alternating Current**
	**Direct Current**
	**Alternating Current**
	**Protective Earth (ground)**
	**Caution: Refer to accompanying documentation**
	**Off (power: disconnection from Mains)**
	On (Power: connection to Mains)

Hazard Warnings

- **Warning! Power Rating.** The UW-4's mains power input must be connected to an external power transformer that provides voltage and current within the specified rating for the system.

  Use of an incompatible power transformer may produce electrical shock and fire hazards. See *Specifications* and *Optional Accessories* in Chapter 2.

- **Warning! Internal Voltage.** Always turn off the power switch and unplug the power cord before cleaning the UW-4's outer surface.

- **Warning! Liquids.** Avoid spilling liquids on the analyzer; fluid seepage into internal components creates a potential shock hazard. Do not operate the instrument if internal components are exposed to fluid.

Precautions

The following precautions are provided to help you avoid damaging the system:

- **Caution: Service. The UW-4 should be serviced by authorized service personnel. Only qualified technical personnel should perform troubleshooting and service procedures on internal components.**

- **Caution: Environmental Conditions. Do not expose the system to temperature extremes. Ambient temperatures should remain between 10-30°C operating; 5-40°C storage. System performance may be adversely affected if temperatures fluctuate above or below this range.**

- **Caution: Do Not Immerse. Clean only with a mild detergent, and wipe down with a gentle cloth.**

Electromagnetic Interference and Susceptibility

USA FCC CLASS A

Warning: Changes or modifications to this unit not expressly approved by the manufacturer could void the user's authority to operate the equipment.

This equipment has been tested and found to comply with the limits for a Class A digital device, pursuant to Part 15 of the FCC Rules.

These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. Like all similar equipment, this equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications. Operation of this equipment in a residential area is likely to cause interference, in which case the user will be required to correct the interference at his/her own expense.

Canadian Department of Communications Class A

This digital apparatus does not exceed Class A limits for radio emissions from digital apparatus set out in the Radio Interference Regulations of the Canadian Department of Communications.

Le present appareil numerique n'met pas du bruits radioelectriques depassant les limites applicables aux appareils numerique de la Class A prescrites dans le Reglement sur le brouillage radioelectrique edicte par le ministere des Communications du Canada.

CE Based on the testing standards below, this device bears the CE mark.

EC Directive 89/336/EEC Electromagnetic Compatibility

Emissions - CLASS A

The system has been type tested by an independent, accredited testing laboratory and found to meet the requirements of EN 61326-1:1998 for Radiated Emissions and Line Conducted Emissions. Verification of compliance was conducted to the limits and methods of the following:

CISPR 16-1:1993 and CISPR 16-2:1996

Immunity

The system has been type tested by an independent, accredited testing laboratory and found to meet the requirements of EN 61326-1:1998 for Immunity. Verification of compliance was conducted to the limits and methods of the following:

EN 61000-4-2 (1991) Electrostatic Discharge

EN 61000-4-3 (1995) Radiated EM Fields

EN 61000-4-4 (1995) Electrical Fast Transient/Burst

EN 61000-4-5 (1995) Surge Immunity

EN 61000-4-6 (1996) Conducted Disturbances

EN 61000-4-11 (1994) Voltage Dips, Short Interruptions and Variations

EC Directive 73/23/EEC Low Voltage (User Safety)

The system has been type tested by an independent testing laboratory and found to meet the requirements of EC Directive 73/23/EEC for Low Voltage. Verification of compliance was conducted to the limits and methods of the following:

EN 61010-1 (1993) & IEC 1010-1

"Safety Requirements for Electrical Equipment for Measurement, Control and Laboratory Use, Part 1: General requirements" (including amendments 1 & 2).

Warranty

This Warranty is limited and applies only to new products, except for computer-based software, which is covered under a separate Warranty Policy, manufactured by Bio-Tek Instruments, Inc. ("Bio-Tek"). Bio-Tek makes no warranty whatsoever regarding the condition of used products.

Bio-Tek warrants the instrument (hereinafter collectively referred to as "Products" or "Product") for a period of one (1) year from the original purchase date against defective materials or workmanship. This Warranty is limited to the original purchaser (the "Purchaser") and cannot be assigned or transferred. All claims under this Limited Warranty must be made in writing to Bio-Tek, Attention: Service Department. Purchaser must ship the Product to Bio-Tek, postage pre-paid. Bio-Tek shall either repair or replace with new or like new, at its option and without cost to the Purchaser, any Product which in Bio-Tek's sole judgment is defective by reason of defects in the materials or workmanship.

This Warranty is VOID if the Product has been damaged by accident or misuse, or has been damaged by abuse or negligence in the operation or maintenance of the Product, including without limitation unsafe operation, operation by untrained personnel, and failure to perform routine maintenance. This Warranty is VOID if the Product has been repaired or altered by persons not authorized by Bio-Tek, or if the Product has had the serial number altered, effaced, or removed. This Warranty is VOID if any of the Products has not been connected, installed or adjusted strictly in accordance with written directions furnished by Bio-Tek. Batteries, fuses, light bulbs, and other "consumable" items used in any of the Products are not covered by this Warranty. Software utilized in conjunction with any of the Products is not covered by the terms of this Warranty but may be covered under a separate Bio-Tek software warranty.

We will continue to stock parts for a maximum period of five (5) years after the manufacture of any equipment has been discontinued. Parts shall include all materials, charts, instructions, diagrams, and accessories that were furnished with the standard models.

THIS WARRANTY CONTAINS THE ENTIRE OBLIGATION OF BIO-TEK INSTRUMENTS, INC., AND NO OTHER WARRANTIES, EXPRESSED, IMPLIED, OR STATUTORY ARE GIVEN. PURCHASER AGREES TO ASSUME ALL LIABILITY FOR ANY DAMAGES AND/OR BODILY INJURY OR DEATH THAT MAY RESULT FROM THE USE OR MISUSE OF ANY EQUIPMENT OR INSTRUMENT BY THE PURCHASER, HIS EMPLOYEES, AGENTS, OR CUSTOMERS, OTHER THAN THE EXPRESS WARRANTY CONTAINED HEREIN. WE SHALL NOT BE RESPONSIBLE FOR ANY DIRECT OR CONSEQUENTIAL DAMAGES OF ANY KIND. THIS WARRANTY SHALL NOT BE CHANGED OR MODIFIED IN ANY WAY WITHOUT THE EXPRESS WRITTEN PERMISSION OF AN OFFICER OF BIO-TEK INSTRUMENTS, INC.

THIS WARRANTY IS VOID UNLESS THE PURCHASE REGISTRATION CARD HAS BEEN COMPLETED AND MAILED TO US WITHIN TEN (10) DAYS OF PURCHASE.

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Chapter 1: General Information

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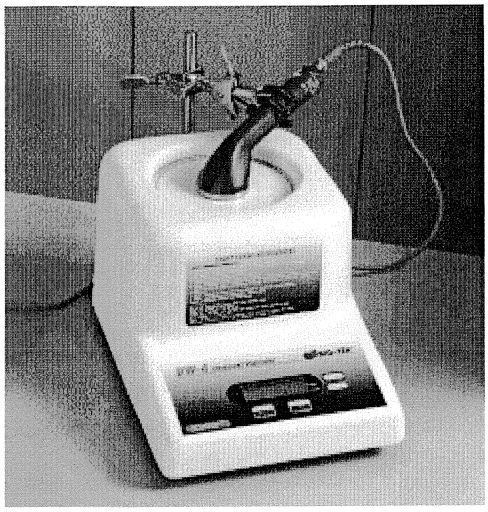

Inside This Chapter

- Summary of Features
- Ultrasound and its Applications
- Patient Treatment with Therapeutic Ultrasound

Summary of Features

Bio-Tek's Digital Ultrasound Wattmeter (UW-4) provides an accurate means of verifying and calibrating the output of therapeutic ultrasound devices. The instrument measures output through a strain gauge bridge transducer.

After the initial output is verified, the UW-4 is used to accurately calibrate the ultrasound unit under test.

In addition, the UW-4:

- Has a resolution of 0. 1 W and a repeatability of ±-3% of readings ± .2 watts from 0 - 30 W;
- Electrical accuracy of .01 grams throughout range;
- Features a liquid crystal display that enables the user to quickly and accurately make power measurements;
- Can accommodate a variety of transducer shapes and sizes without interfering with the measurement;
- Is housed in a sturdy Kydex® case.
- Is portable to meet the needs of service groups and biomedical engineers.
- A soft carrying case is a standard accessory for ease of transporting and storage.

Ultrasound and Its Applications

Human perception of sound waves is limited to frequencies of fewer than 20,000 vibrations per second. Higher frequency vibrations — between 0.7 and 3.3 MHz — are used for ultrasound therapy. (Most ultrasound equipment produces an output of between 1 and 3.3 MHz.)

An ultrasound unit produces electrical oscillations at a specified frequency that cause the transducer in the ultrasound applicator to generate sound waves. The resulting ultrasonic radiation is transmitted from the ultrasound applicator, or treatment head, through a coupling medium, to the patient's tissue.

Therapeutic Use of Ultrasound

The therapeutic use of ultrasonic energy is accepted worldwide, and most modern hospitals and clinics have ultrasound devices in their physical therapy departments.

Ultrasound therapy is primarily used in the treatment of sports-related injuries. Another common use is the treatment of circulatory disorders and rheumatic diseases of the musculoskeletal system and peripheral nerves. Ultrasound has been found to be extremely effective in treating body areas with a great deal of scar tissue.

Physiological Effects of Ultrasound Therapy

It is well documented that ultrasound therapy heals because of thermal, mechanical, and chemical effects. *

Thermal effects include *deep tissue heating* at depths to 5 cm or more. The thermal effects of ultrasound differ from diathermy (the use of electrical impulses to produce generalized vasodilation) in that the ultrasound beam heats only a small tissue area that approximates the cross-section of the beam. This heating effect is concentrated in muscles, ligaments, nerves, bones, and where the ultrasound beam crosses from one type of tissue to another.

The mechanical effects are best described as *micromassage,* a deep stirring action within the tissue. The benefit of this action is an increased circulation to the damaged tissue. In addition, ultrasound is capable of separating collagen fibers from one another and of changing the tensile strength of tendons, thereby increasing their extensibility.

The physiological benefits from ultrasound therapy are numerous. Ultrasound therapy affects the peripheral nerves by chemically changing the conduction velocity (this has been shown clinically *in situ).* Ultrasound alters the diffusion of *Na+* and *K+* (sodium and potassium) across red blood cell membranes. Ultrasound can also remove some salt deposits from irritated tissues.

* *Physical Agents for Physical Therapists, Second Edition, James E. Griffin and Terence Karselis, Charles C. Thomas Publishing Co., 1992.*

Patient Treatment with Therapeutic Ultrasound

The clinician working with ultrasound can ensure successful ultrasound treatment by assessing:

the physical condition of the patient,

the absorption coefficient of the tissue(s),

the energy output of the ultrasound unit (continuous and pulsed),

the massivity and location of the affected tissue, and

the spread pattern of the beam.

The most essential assurance that the clinician can have is the verification that the ultrasound unit is producing the ultrasound energy for which it was designed. The Bio-Tek Digital Ultrasound Wattmeter enables the clinician to accurately measure this output energy.

Chapter 2: Description

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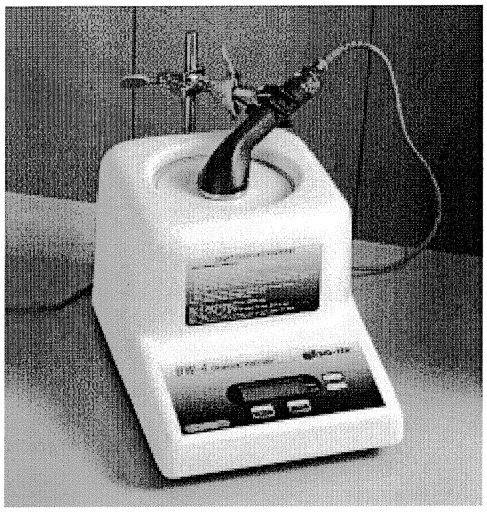

Inside This Chapter

- Specifications
- Overall Unit Layout
- Front Panel Description
- Back Panel Description
- Standard Accessories
- Optional Accessories

UW-4 Specifications

• Measurement range	0.1 to 30 Watts
• Input Power Level	0 - 30 W
• Input Frequency	0.5 - 10 MHz
• Resolution	0.1 W
• Accuracy, electrical	+/- .15 W (+/-.01 gms) throughout range
• Repeatability	± 3% of reading ± .2 watts
• Zero Shift	Auto Zero button
• Acceptable Transducer Size	up to 3" (7.6 cm) diameter
• Operating Temperature	10^0 - 30^0 C (50^0 - 86^0 F)
• Power Requirements	9 V alkaline battery (Duracell® MN1604 or equivalent)
• Battery Life	Maximum of 10 hours

Note: Unit will auto shut down after approximately 4 minutes of inactivity when on battery power. (A 12-volt DC 300 mA transformer unit is a standard accessory for longer-term test sessions) Refer to page 2-7.

Dimensions	9″ wide x 14 ½″ deep
Height	7 ½″ (10 ¾″ with Clamp Post)
Case	Kydex®

Overall Unit Layout

The top of the UW-4 Ultrasound Wattmeter is shown in *Figure 2-1.* It includes the following components.

- **Front Panel**: Includes LCD readout and keyboard.
- **Rear Panel:** Includes Battery compartment, RS-232 Connector and Power Transformer Jack.
- **Sound Tank:** To be filled with 850ml ± 50 ml of degassed and de-ionized water for each use.
- **Transducer Cone:** The cone is removable for safe transporting.
- **Leveling Bubble:** Used to help level the unit before turning it on.

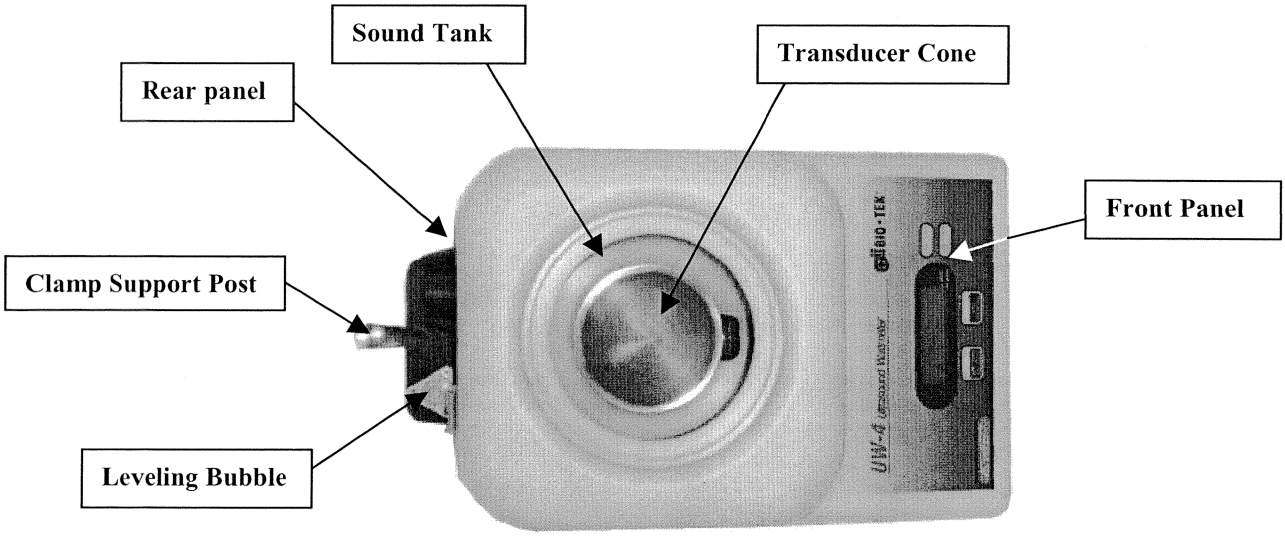

Figure 2-1: UW-4 general layout

- **Leveling Jacks:** Used to adjust the unit to a level position. (*Figure 2-4*)
- **Universal Transducer Clamp Support Post:** A removable vertically mounted bar that the transducer clamp is attached.

Front Panel Description

The front panel of the UW-4 ultrasound wattmeter is shown in *Figure 2-2.* It includes the following components.

- **LCD Display:** Indicates the meter reading in watts or grams.

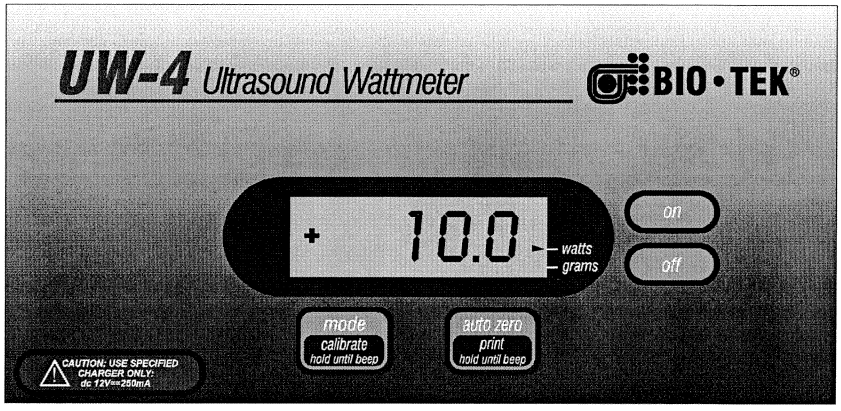

Figure 2-2: UW-4 Front Panel layout

- **Power On Switch:** Turns on the power provided by an alkaline battery (or transformer).
- **Power Off:** Turns off the power provided by an alkaline battery (or transformer).
- **Auto Zero Button:** Adjusts the LCD display to 00.0 watts or 0.00 grams depending on the mode selected. Holding the button down for three to four seconds will send the displayed reading to a computer or printer via an RS 232 hookup.
- **Mode button:** Switches the mode from watts to grams and back.

Back Panel Description

The back panel of the UW-4 is shown in *Figure* 2-3. It includes the following components:

- **Battery Compartment:** Allows access to the instrument's 9 V dc battery. The hinged plastic battery cover opens to expose the battery compartment during battery replacement. This cover should remain closed during normal operation of the instrument.
- **Wall Transformer Jack:** When using the wall-mounted transformer, simply plug into a receptacle.

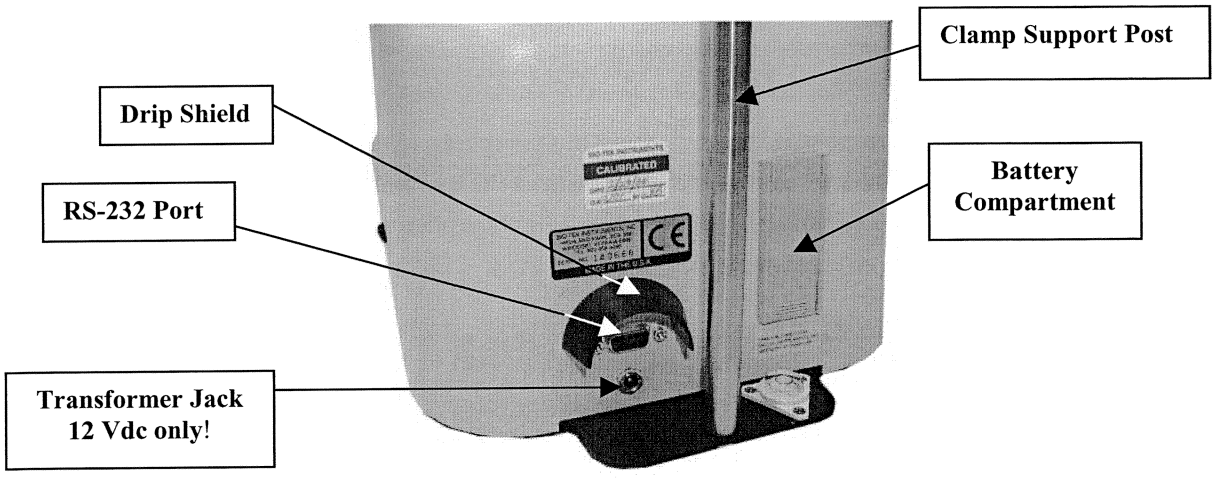

Figure 2-3: UW-4 back Panel layout

- **RS-232 Port:** To connect to a computer or a printer, use RS 232 cable **PN 75034**.
- **Drip Shield**: A drip shield is also provided to minimize the risk of water spillage from getting into the electrical connections. However, care should be exercised to minimize the amount of water spilling down the rear panel.

Bottom Panel Description

The bottom panel of the UW-4 is shown in **Figure 2.4**. It includes the following components:

- **Leveling Jacks:** There are three support legs located on the bottom panel, two of which are threaded to be able to act as leveling jacks for the height adjustment to level the unit.
- **Drain Hose:** There is an extendable drain tube mounted on the front right side on the bottom of the unit. This drain is used to empty the unit when testing is complete. Refer to *Chapter 4* for details on usage.

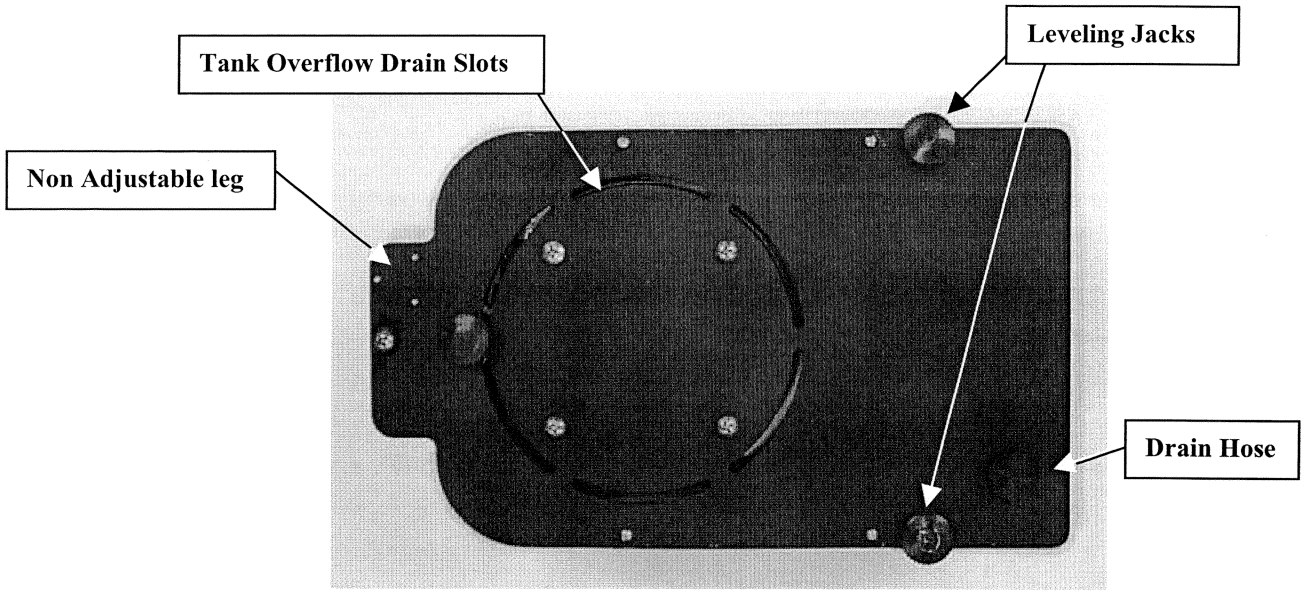

Figure 2-4: UW-4 Bottom Panel Layout

- **Tank Overflow Drain Slots:** In the event that excess water is poured into the sound tank, water will be directed down the sides of the tanks and exit through these slots onto the lab bench thus preventing water from getting into the electronics.

Standard Accessories:

- **Transducer Clamp:** The clamp frees the operator from holding the transducer head in the transducer well during **testing.**
- **Centering Rings:** Rings used to help ensure that transducers are centered and aimed at the cone properly. This is important for accurate readings.
- **Power Transformer:** An AC wall mounted transformer is provided for extended testing. The installation of this transformer will bypass the battery and allow the unit to stay powered on for extended use.
- **Calibration Check Weight:** A 200-gram OMIL class M1 weight is included. This is to be used to ensure the unit is operating properly and is in allowable calibration range.
- **Calibration support ring:** This is a 34-gram ring used in place of the cone when checking the unit's calibration and performance. It is roughly the same weight as the Transducer Cone when submerged in water and also provides a platform for the 200-gram check weight.
- **Carrying Bag:** A soft bag used for safely transporting and storing the unit.
- **Performance Record Labels** are included with the instrument. To reorder these labels, request Bio-Tek **PN 8920014** from our customer service representatives.
- **Shipping Container:** This box contains specifically designed foam inserts to ensure safe shipment of the UW-4 Wattmeter. Please save these for future shipment of the unit for service or calibration.

Note: The Carrying Case is an integral piece of the shipping container. Ship with the carrying case in its original packing. *See* ***Chapter 4- Repackaging and Shipping***

Optional Accessories

- **Dissolved Oxygen Test Kit:** Tests the dissolved oxygen content of the degassed and deionized water. To order this kit, request Bio-Tek **PN 48102.**
- **OTIS:** Software for enhancing data tracking.
- **RS-232 Cable:** Used for hooking the unit up to a computer or a serial printer.
- **Transformer Unit:**

  Output: **12V⎓ DC 300 mA**

  Input:

Description	Bio-Tek Part Number
120V~/60 Hz USA 2-Pin UL/CSA	61088
220 V~/50 Hz Euro 2-Pin CE	61089
220 V~/50 Hz UK 3-Pin CE	61090
110 V~/50 Hz Japan 2-Pin T-Mark	61091
220 V~/50 Hz AUS/NX 2-Pin T-Mark	61092

Chapter 3: Installation & The Operating Environment

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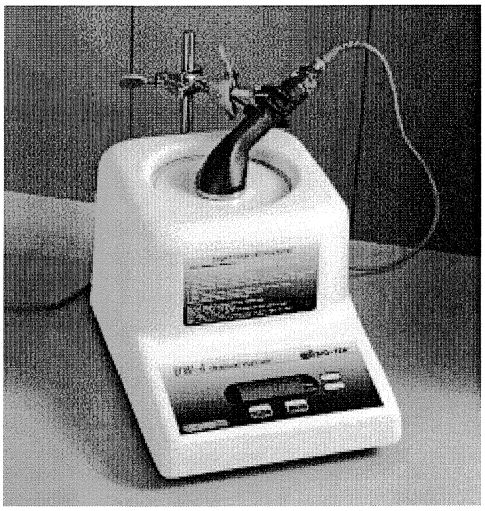


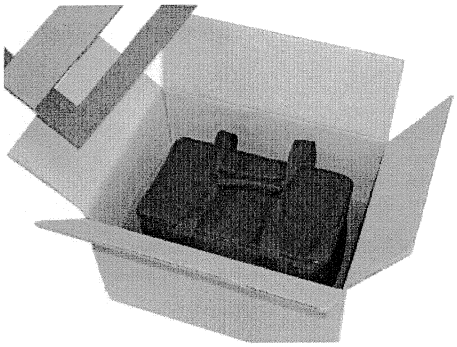
Inside This Chapter

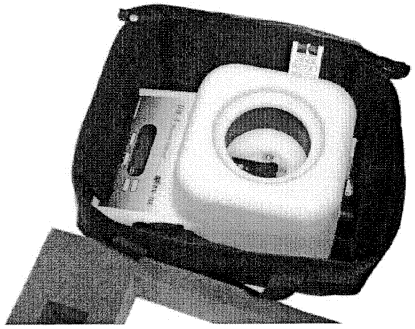
- Unpacking and Inspection
- Operation
- UW-4 Systems Check
- Beginning Ultrasound Power Measurements
- Ultrasound Unit Testing
- Using the RS232 Port

Unpacking and Inspection

When you receive the UW-4, inspect the shipping carton for damage. If the shipping carton is damaged, unpack the instrument and note any dents and scratches on the UW-4. **Immediately notify Bio-Tek that the UW-4 was damaged in shipping.** Bio-Tek will arrange repair or replacement of your instrument without waiting for settlement of the claim against the carrier. **Retain the damaged shipping carton and packing material for the carrier's inspection.**

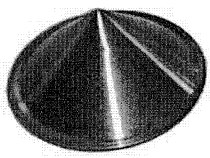
Be sure to save the box and packing materials. They will be needed when you return the UW-4 to Bio-Tek for recalibration or future service. (Refer to ***Chapter 4*** for shipping instructions.)



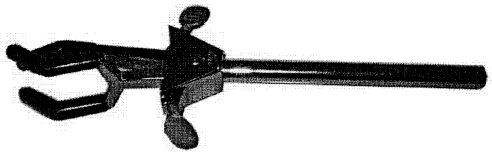


If there is no shipping damage, continue removing the carrying case, with the UW-4 in it, from the shipping case. Then check the carrying case for the following accessories that are shipped with every UW-4:

- UW-4 Operator's Manual (1)
- Warranty card (1)
- Transducer Cone



- Universal Transducer Clamp



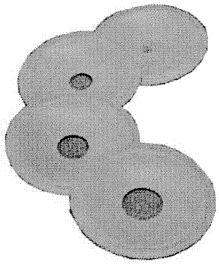
- Clamp Support Post

- Hook Clamp

- 200 gram calibration check weight

- Calibration weight adapter pedestal

- Centering Rings (4)



- 9 Volt Battery

- Power Transformer

- Carrying Case

Operation

When operated according to the instructions given in this chapter, the UW-4 Digital Ultrasound Wattmeter will quickly and accurately measure the energy output of ultrasound devices.

Operating Environment

The UW-4 **must be allowed to adjust to room temperature** before the unit can be operated. The relative humidity in the room should not exceed 90%.

Refer to ***Chapter 4*** for additional information on safety, storage and shipping requirements for the UW-4.

Precautions

- When using the UW-4 to test ultrasound devices, follow the safety precautions outlined by the ultrasound manufacturer.
- Do not use any coupling medium other than degassed and deionized water or degassed and distilled water.
- Do not spill water on the front or rear panel.
- Do not apply more than 30 W of input power to the UW-4.
- Do not operate the UW-4 for more than 1 hour during testing. Change water after one hour of use.
- Drain the unit completely after each test session.

Preparing the Deionized and Degassed Water

Deionized and degassed water must be used as the coupling medium to obtain stable and accurate readings with the UW-4. **The water must also be allowed to reach room temperature** before pouring into tank in order for unit to stabilize quickly.

Use the following procedure to obtain the best coupling medium:

1. Use a deionizer to deionize tap water or distilled water. (Distilled Water may be used if a deionizer is not available.)

The deionizer must:

- have a minimum purity capability of 50,000 ohms/cm, and

- use a cartridge for anion and cation removal with a typical resistivity of 2,000,000 ohm-cm in the pH range of 6.8 to 7.2.

2. Ensure that at least 3 liters of deionized water drains through the system before collecting the water in a clean inert container. This ensures that there is no contamination from the tubes, hoses, and container used.

3. Boil the deionized water for 30 minutes in a clean glass flask. This will force the oxygen and nitrogen from the water. Bottle the water as soon as possible.

4. Select some small glass bottles with good seals for storing the water. Glass canning jars work well.

5. Siphon the boiling degassed water into the bottles and fill each bottle to the brim. Leave no air space in the bottle.

6. Cap the bottles immediately.

7. Allow the water to cool in the bottles. As the water cools, it will contract and a vacuum will be formed if the bottles have been properly sealed. Allow the water to cool to room temperature.

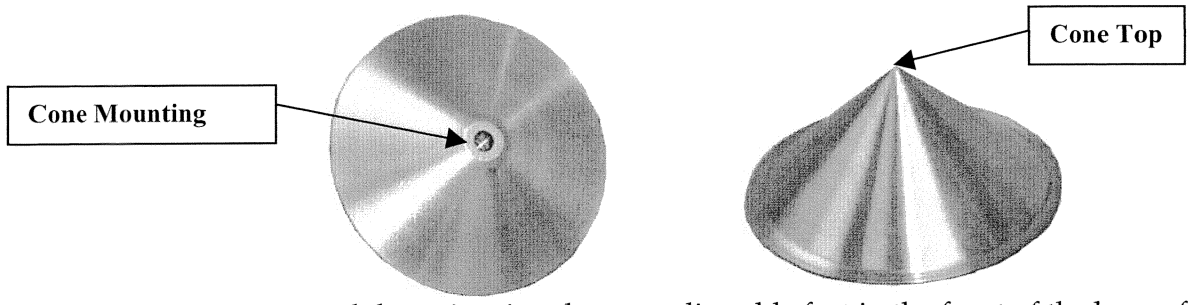
8. Label and date each bottle. The degassed water should remain good for a long time if the seal is not broken.

9. Test each bottle for oxygen content before it is to be used. The oxygen content should be less than 2 ppm. Dissolved oxygen test kits are available from Bio-Tek. (**PN 48102**)

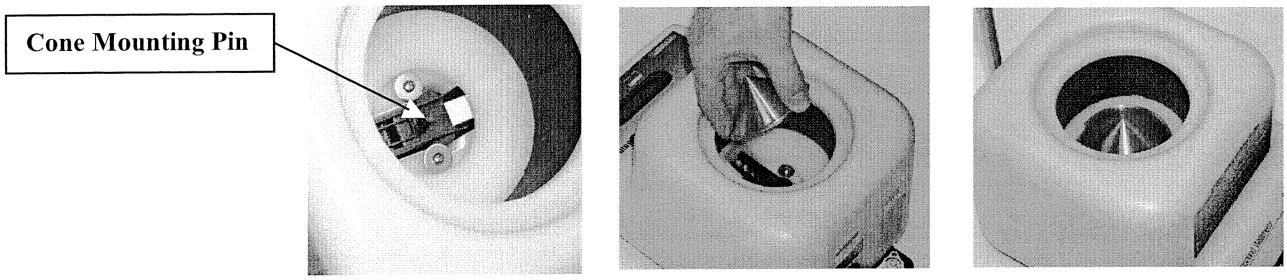
Note: When the bottle is opened and exposed to air, it can be used during the following 45 minutes. Exposure to air makes this water lose its excellent coupling property; therefore, the bottles should not be opened until tests with the UW-4 are ready to begin. Be sure to allow water to come to room temperature before use.

UW-4 Systems Check

1. Prior to testing, rinse the transducer well of the UW-4 to remove any foreign particles. Drain off using the drain tube located in the front bottom of the

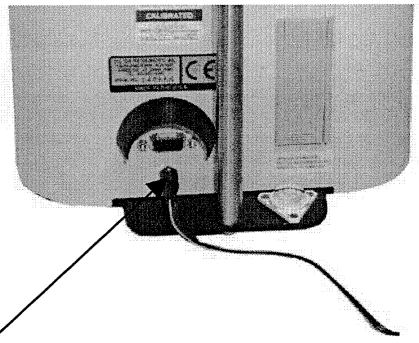


unit. Level the unit using the two adjustable feet in the front of the base of the unit. The unit is level when the bubble is centered. Inspect the transducer cone for dents and clean if needed. **Do not use a dented cone. Incorrect readings may result.** If the cone looks good, carefully install it on the transducer mount pin in the tank as shown above.



2. If a transformer is to be used, plug it into the jack located at the lower left rear of the unit. Then plug the transformer into a wall socket.

Note: There are transformers available for all plug and voltage configurations, which can be ordered separately.

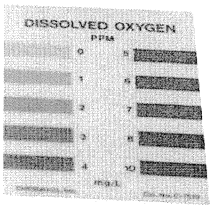


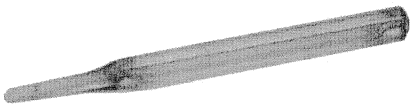
3. **Allow sufficient time for the UW-4 to fully adjust to room temperature.** If the unit is not at room temperature, the transducer will be slowly warming or cooling and will cause the readings to shift.

4. Obtain a bottle of the deionized/distilled and degassed water prepared following the procedures discussed earlier in this chapter, *Preparing the Deionized and Degassed Water*. **Be sure that the water is at room temperature before continuing with set up.**

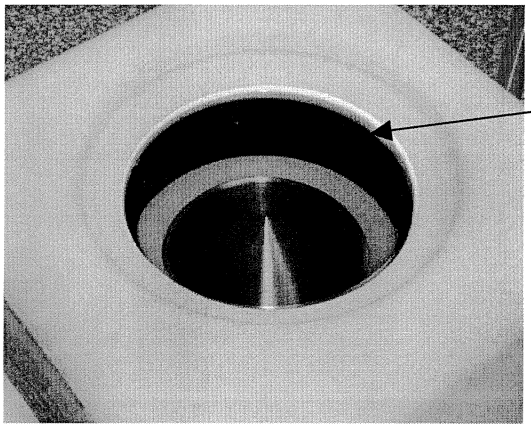
5. Open the bottle of degassed water. When the vacuum seal is broken you should be able to hear it. If you do not hear or feel the vacuum, discard the water.

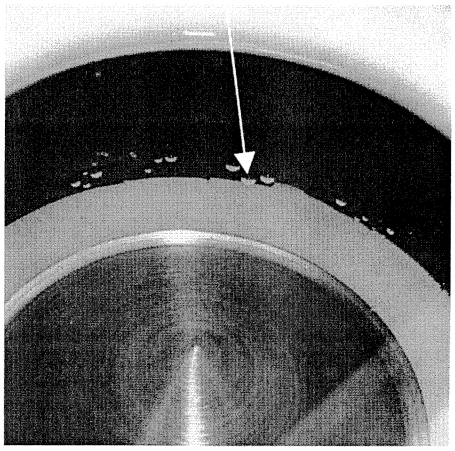
6. Use a Dissolved Oxygen Test kit to ensure that the oxygen content of the water is less than 2 ppm.





7. Fill the tank with 850 ml ± 50 ml of fresh deionized and degassed water. Do not spill water on the panel of the wattmeter. Fill until the water reaches slightly above the bottom lip of the well, as shown below.





Immediately replace the cap on the coupling water bottle.

Note: Be sure the water has been allowed to completely come to room temperature. If the water is lower or higher than the unit and room temperature, then the unit will be difficult, if not impossible, to achieve a stable zero setting.

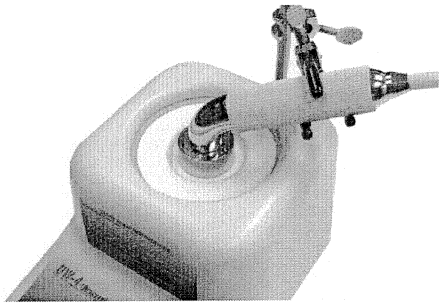
8. Insure that there are no air bubbles on or under the transducer cone and stuck to the rubber sound absorber surrounding the cone in the tank. **Air bubbles may induce some reading errors due to buoyancy changes of the transducer cone, erratically bouncing some of the sound beam in the wrong directions or away from the sound absorber.** Tilting the unit forward and backwards slightly and lightly tapping the side of the unit may help dislodge air bubbles.

9. Allow 5 minutes for the electronics to warm up and settle down.

Beginning Ultrasound Power Measurements

Measurements

1. Place the transducer in the coupling medium partially submerged so that the head is facing directly downward. Use the centering ring and clamp as needed so that the transducer is exactly centered and is vertical (see section on universal clamp and centering rings below). If the transducer is off center, or not aligned vertically, the reading will be low and possibly out of tolerance. The transducer head should be completely coupled with the deionized and degassed water and there should be no bubbles beneath the radiating head of the transducer.



Note: The coupling water in the transducer well must be changed every 45 minutes or when the readings become unstable. A bottle of opened deionized and degassed water will only be usable for approximately 45 minutes to 1 hour.

2. Turn on the UW-4 using the ON switch on the front panel. Ensure that the unit is in the Watts mode, if not press MODE button once.

3. Allow five minutes for the unit to warm up and stabilize before starting the readings. Once the unit is warmed up, set the digital reading to 00.0 by pressing the AUTO ZERO button. This may take several tries until the unit settles down. Avoid any vibration or movement of the test head, since the unit is VERY sensitive. If the unit cannot be zeroed, refer to the *Troubleshooting* in **Appendix B.**

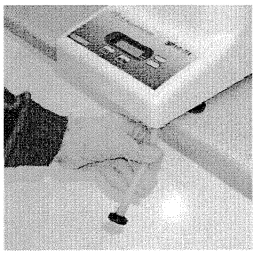
4. Turn on the ultrasound unit following the manufacturer's instructions. Adjust it to the desired level. Never exceed thirty watts

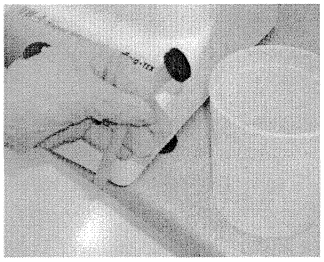
5. Read the actual output power in WATTS on the LCD of the UW-4.

6. After all of the readings are completed, shut off the ultrasound unit.

7. Remove the water from the transducer well when the measurements are complete. Using the drain tube located in the right front bottom, completely drain the well. Start this process by gently pulling downward on the drain cap and sliding the drain tube out. Then raise the tube end until drain cap is above the level of water in the tank and then remove the drain cap. This will minimize water spillage. Once the drain cap is off, aim the drain tube into a container and lower both below the unit. The unit will drain. When the water stops flowing, tilt the whole unit forward, as shown, to drain the last bit of water from the tank.

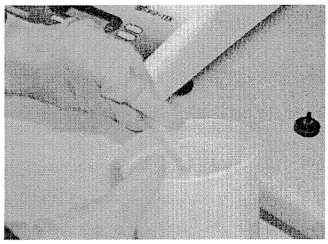
It is important to fully drain the unit if it is to be stored. This will to prevent bacterial growth and other potential water related damage.





Pull the tube out and raise the tube end above the level of water in the tank before removing the drain cap, to avoid getting wet.

8. Dispose of any water left in the opened bottle of degassed and deionized water. The water will absorb oxygen overtime, rendering it ineffective as a coupling medium.



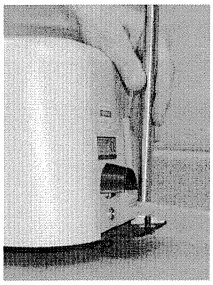
Lower the drain tube and container until it is below the unit and the water flows out.

Tip the unit forward to drain the last bit of water.

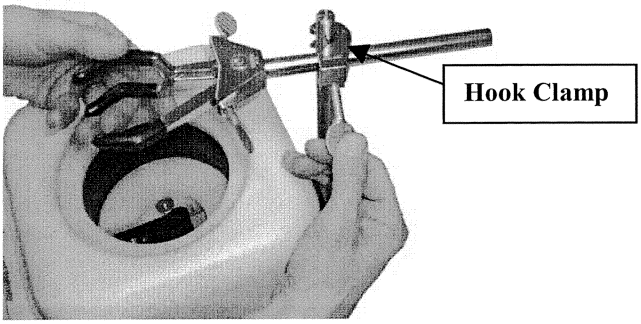
Using the Universal Transducer Clamp Assembly and Centering Rings

The universal transducer clamp assembly frees the operator from holding the transducer treatment (radiating) head in the coupling water and preventing transducer movement ensuring more accurate and stable readings. The centering rings help to properly center and aim the transducer head in the tank.

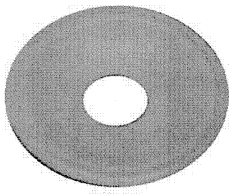
1. Screw the clamp support post on the screw stud located at the rear of the unit. Securely tighten by ***hand.*** Do not use pliers to tighten post.



2. Center the transducer clamp assembly over the transducer well, as shown, using the hook clamp to tighten it into place.



3. Place a centering ring, with the hole sized to fit the transducer, on top of the well. The centering ring helps assure that the sound head is properly centered and aimed vertically toward the transducer cone. If there are no centering rings with the proper hole size, one can be cut one to the proper size. Just be sure that the enlarged hole is centered in the ring.



4. Loosen the side screw of the clamp assembly so that clamp rotation is easy, and roughly center the clamp opening with the transducer well for vertical transducers without handles (as shown in A), or position it such that it aligns with the transducer handle (as shown in B).

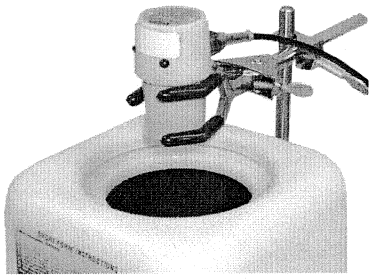


Figure A
Clamp orientation transducer without handle

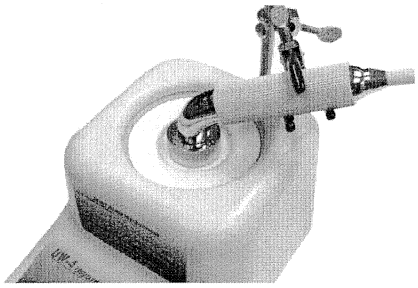


Figure B
Clamp orientation transducer with handle

5. Open the clamp by turning the clamp thumbscrews counterclockwise to fit the desired transducer head or handle.

6. Tighten the clamp screw to effectively grab the transducer head or handle. Make sure that the transducer radiating head (or crystal) remains completely submerged in the coupling water.

7. Re-center the transducer head directly over the middle of the transducer well using the centering ring to assure alignment for accurate readings. Make sure the transducer surface is entirely in the coupling medium. The transducer head should be completely coupled with the deionized and degassed water and there should be no bubbles beneath the radiating head of the transducer. **Any bubbles beneath the transducer head will create a low reading.**

Caution

Do not ship the wattmeter with the transducer clamp assembly mounted on the unit. Damage to the unit will result and the warranty will be void.

Ultrasound Unit Testing

Use some form of performance record labels or sheets for record keeping during testing, or OTIS[tm] software. Refer to ***Chapter 2: Accessories***, for part numbers and ordering information.

Testing Using Discrete Values (Method I)

1. Follow the procedures in this section on operating the UW-4. Review the Precautions.

2. Affix a record performance label to the ultrasound unit.

3. Set the Ultrasound Unit on discrete values such as 5, 10, 15 or 20.

4. Record these values under Ultrasound Setting on the label.
5. Measure the output on the UW-4.
6. Record the UW-4 reading under Actual Output in Watts on the performance label, or in OTIS .

Testing Using Exact Meter Settings (Method II)

When this method is used, an exact meter setting is obtained for each power desired. This enables the physical therapist to select exactly the ultrasound output that the patient requires.

1. Follow the procedures in this section on UW-4 operation. Review the Precautions.
2. Affix a performance label to the ultrasound unit.
3. Adjust the ultrasound unit to read a desired value on the UW-4.
4. Record the Ultrasound Setting and the actual UW-4 reading on the label.

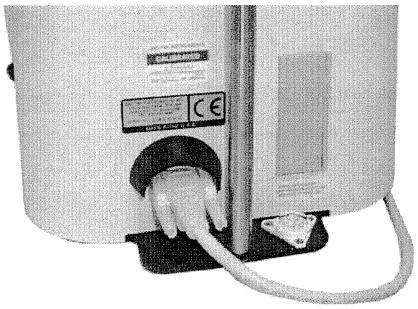
Using the RS232 Port

The UW-4 is equipped with a standard 9-pin female RS-232 port located at the rear of the instrument. A serial printer or a computer may be connected to the UW-4 via this port. Printing with the UW-4 means that the LCD contents are sent to the printer whenever the Print key is pressed. Connecting the UW-4 to a computer enables the instrument to be used with OTIS for Windows to enhance equipment management.

Connecting to the Seiko DPU 411 Printer

Using a printer in conjunction with the UW-4 requires the following steps:

1. Be certain that the power is off on both printer and UW-4.
2. Attach the UW-4 to the printer using a serial interface cable (**PN75034**) or its equivalent.



3. Configure the Seiko DPU 411 printer's communications settings. The correct configuration settings are described in ***Appendix A: Seiko DPU 411 Printer Configuration.***
4. Turn on the UW-4, then the printer.
5. To print, press the **Print** key on the UW-4 until an audible beep is heard. The LCD contents will then be sent to the printer.

Connecting to a Computer

Using a computer in conjunction with the UW-4 requires the following steps:

1. Be certain that the power is off on both the computer and UW-4.
2. Attach the UW-4 to the computer using a serial interface cable (**PN75034**) or its equivalent.
3. Turn on the computer then the UW-4.
4. You will need software in order to communicate with the UW-4. ***OTIS for Windows™*** is the preferred choice, although terminal emulation (e.g. ***Windows Hyper Terminal™***) or custom software may be used.
5. Configure the software's communications settings for the port you are using to a baud rate of 9600 bps, 7 data bits, no parity, 1 stop bit, and select "hardware handshaking" if that setting is available. Refer to your computer software's documentation or seek help for the correct procedure.
6. What happens next depends upon the specific software you are using. Refer to its documentation for operating procedures. If you are creating software to interface with the UW-4, then refer to the protocol information below.

Communications Protocol

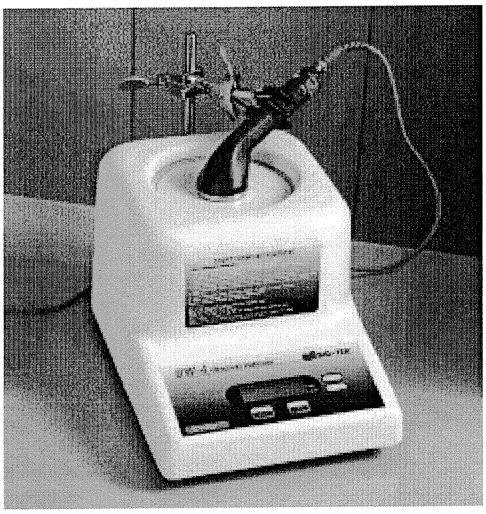
Communication with the UW-4 is bi-directional. There are two commands that may be sent to the UW-4 in the form of two byte 7-bit ASCII strings:

Escape P returns the current LCD contents as 16 ASCII characters including terminating return and linefeed characters.

Escape T zeroes the UW-4 display but returns no characters.

Chapter 4: Safety, Maintenance & Storage

4



Inside This Chapter

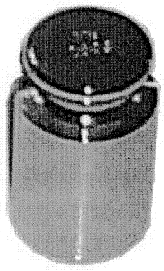
- Recommended Procedures and Precautions
- Calibration Check Procedures
- Maintenance
- Service
- Returning the UW-4 for Calibration
- Battery Replacement
- Storage
- Repackaging and Shipping

Recommended Procedures and Precautions

When using the UW-4 to test ultrasound devices, follow the safety precautions specified by the ultrasound manufacturer.

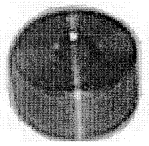
- Do not use any coupling medium other than degassed and deionized water or degassed and distilled water.
- Do not spill water on the front or rear panel.
- Do not apply more than 30 W of input power to the UW-4.
- Do not operate the UW-4 for more than 1 hour during testing. Change the water between hour-long tests.

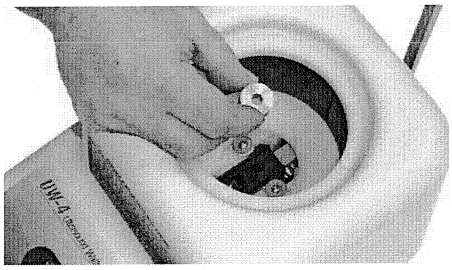
Calibration Check Procedures



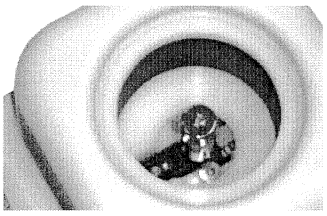
UW-4 calibration can be verified using the 200-gram weight supplied with the unit to insure that the unit is in good working order. **This procedure is NOT intended to substitute for a regular calibration.** The weight supplied is an OMIL class M1 weight that will weigh between 200.000 and 200.010 grams

1. The unit should be off at the beginning of this procedure. Remove the cone. Place the calibration weight adaptor pedestal on the cone-mounting pin. This provides an equivalent weight of the cone when buoyed in water.





2. Turn the unit on and allow it to warm up for 5 minutes.
3. Press the MODE button until the unit displays in grams.
4. Zero the display.
5. Place the calibration check weight on the pedestal. Allow the reading to settle down for 30 seconds to 1 minute. Take the reading.



6. Remove the calibration check weight. It is normal for the unit to take 30 seconds to 1 minute to completely return to zero.

7. If the reading was 198.0 to 202.0 grams, then the unit is in good working order. If the unit is outside of this range, then the unit should be returned for repair and/or calibration.

Maintenance

Maintenance of the UW-4 Wattmeter is straightforward requiring little more than keeping it clean. It is important to keep dust and dirt out of the transducer tank. Rinsing the tank with very clean water before use, along with proper storage in the carrying case, is all that is required.

Do not use ***any type*** of cleaner in the tank or on the transducer cone. The use of a light detergent and non-abrasive cleaning pad is acceptable on the exterior of the unit.

Service

The mechanical assembly of the wattmeter contains no parts that can be serviced by the user. The unit should be returned to Bio-Tek Instruments for repair or calibration. The alignment and adjustment parameters are critical to the performance of the UW-4 and can be performed only at the factory or designated distributor.

For service, pack the UW-4 according to the Storage and Shipping instructions in this chapter. **Failure to do so may void warranty.**

Address the unit to:

Service and Repair
1420 75th Street SW
Everett, WA 98203
888-99FLUKE (888-993-5853) • 425-446-5560
http://www.flukebiomedical.com • sales@flukebiomedical.com

Call 1-800-242-4685 if you have any questions on UW-4 maintenance or service.

Returning the UW-4 for Recalibration

The UW-4 should be recalibrated annually. The instrument should be returned to Bio-Tek. Call Bio-Tek's Service Department to obtain a Return Authorization Number (800-242-4685).

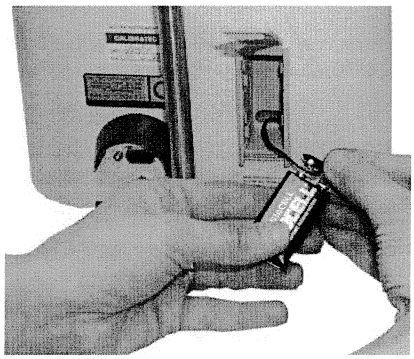
For recalibration, pack the UW-4 according to the *Storage and Shipping* procedures outlined in this chapter. **Failure to do so may void warranty.**

Address the box to:

Service and Repair
1420 75th Street SW
Everett, WA 98203
888-99FLUKE (888-993-5853) • 425-446-5560
http://www.flukebiomedical.com • sales@flukebiomedical.com

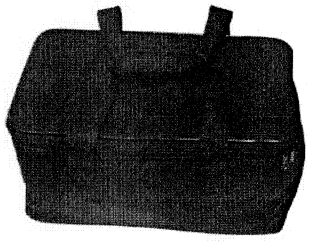
Battery Replacement

When the display blinks several times and turns off shortly after it is turned on, the battery is low and should be replaced. Be aware that the unit will shut down within 3 to 5 minutes automatically, when not actively used. If the battery is low, it will shut down within seconds of turning on. The alkaline battery (9 V Duracell MN 1604 or equivalent) must be replaced or alternatively a wall mounted transformer unit may be used. To replace the battery, open the hinged plastic battery cover on the instrument's back panel to expose the battery compartment. Replace the battery, and close the battery cover.



Storage

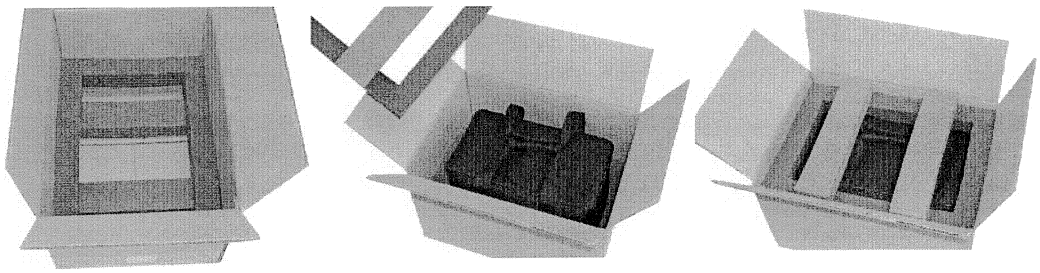
- The UW-4 ***must*** be stored in an upright position on a flat surface that is relatively free of vibration. The unit should be stored in the carrying bag supplied with the unit. The storage environment should be free of dust and other foreign particles.



- The UW-4 must be fully drained for storage. Permanent damage may result if this is not done.
- The UW-4 can be stored under the following environmental conditions:
    - Temperature: 5° -40° C (41.3° -106.4° F)
    - Humidity: up to 90% relative humidity
- The UW-4 should be protected from temperature extremes that can cause condensation within the unit and stored away from corrosive fumes and vapors.

Repackaging and Shipping

When the UW-4 is shipped to Bio-Tek Instruments for service or repair, the unit **must** be shipped in the original packing and carrying case; other forms of commercially available packing are not recommended and can void the warranty.



If the original packing has been damaged or lost, contact Bio-Tek for replacement packing.

Repackage the instrument according to the following procedures:

- Unplug the wall transformer from the unit, if used. Store it in the left pocket, as shown in ***Figure 4-1***.
- Remove the universal transducer clamp from the clamp support post. Store in front pocket of carrying bag along with the hook clamp.
- Remove all the centering rings from the tank. Store the centering rings in right side pocket of the carrying bag.
- Unscrew the transducer clamp support bar. Store it in front pocket of the carrying bag.

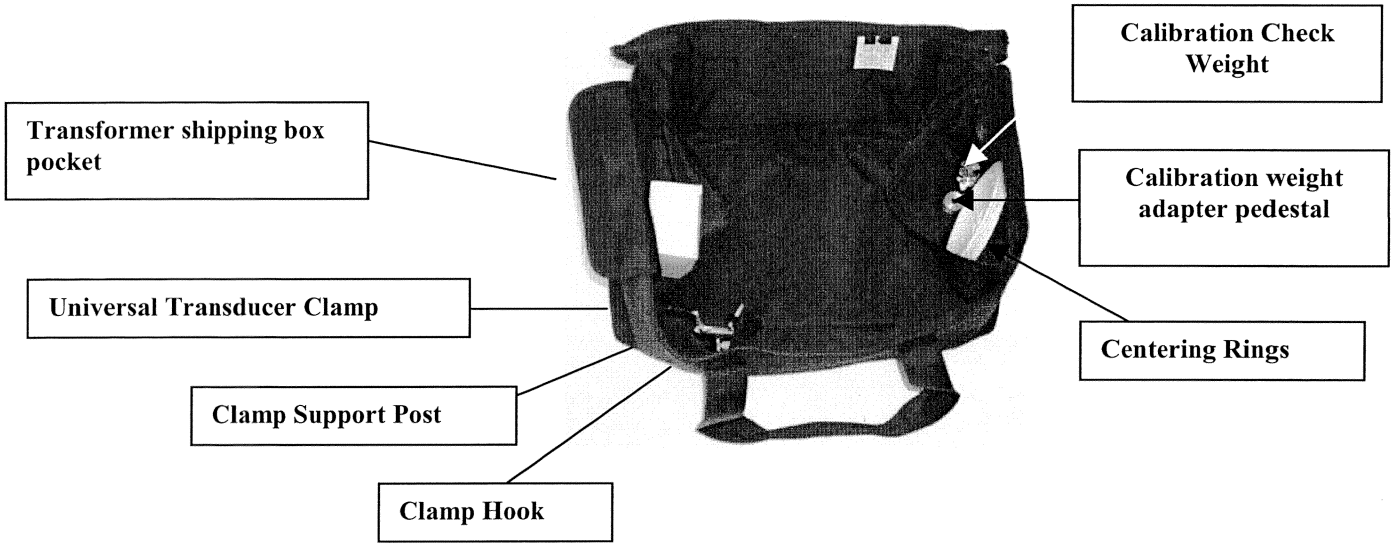
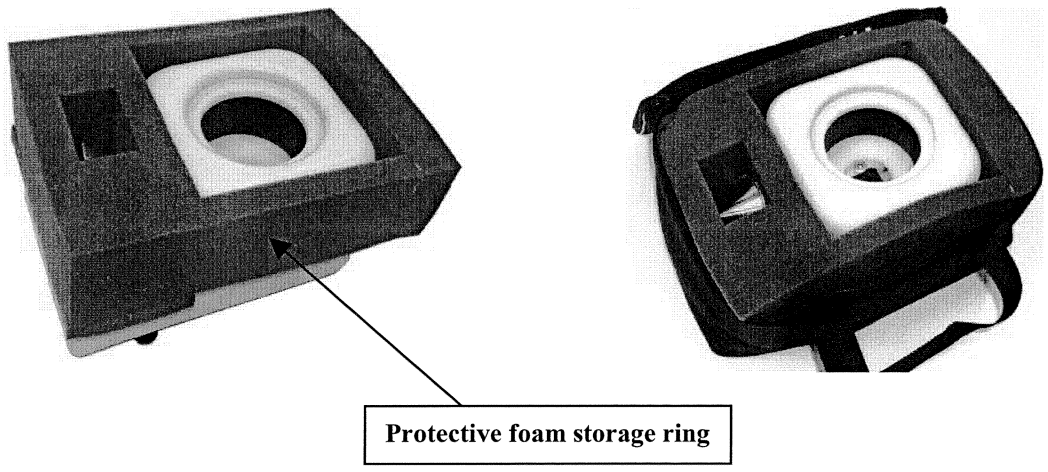
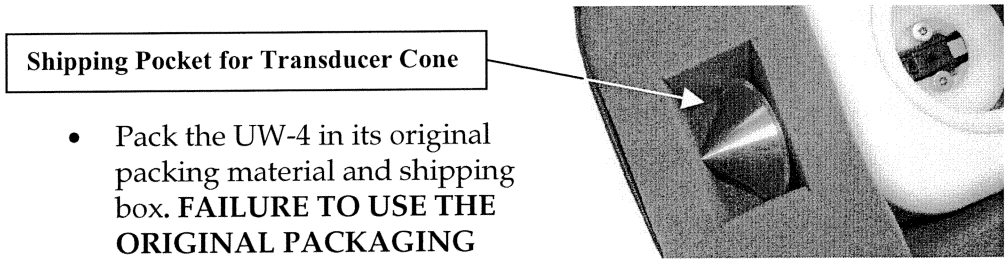


Figure 4-1

- Remove the cone from the tank.
- Place the UW-4 into the carrying bag.
- Make sure all accessories are in their individual compartments and the cover flaps are closed in the carrying bag with the exception of the Transducer Cone. **DO NOT SHIP THE UNIT WITH THE CONE IN THE TANK. PERMANENT DAMAGE MAY RESULT AND VOID THE WARRANTY!**
- Place the gray foam-padding insert around the UW-4 unit in the carrying bag.



- Place the cone in its shipping pocket. **FAILURE TO PLACE THE CONE IN ITS SHIPPING POCKET MAY RESULT IN DAMAGE TO THE CONE AND VOID THE WARRANTY!** Zip the canvas bag cover closed.

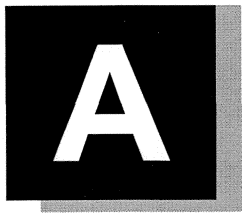


- Pack the UW-4 in its original packing material and shipping box. **FAILURE TO USE THE ORIGINAL PACKAGING MATERIAL MAY RESULT IN DAMAGE TO THE UNIT!**

Before the UW-4 is returned to Bio-Tek, make sure you have addressed each item in the following checklist:

- Obtain a **Return Authorization Number** from Bio-Tek's Service Department (800-242-4685, or FAX 802-655-3399).
- Include a statement of what is required of the Bio-Tek Service Department. State whether the unit requires calibration, cleaning, or repair.
- Include a tag that specifies the Return Authorization Number, the full model number and the serial number.
- Provide Bio-Tek with a contact name and telephone number for any questions.
- Insure the UW-4 for its full value.
- Mark the shipping box as **FRAGILE**.

Appendix A: Seiko DPU 411 Printer Configuration



The following is the proper configuration for the Seiko DPU 411 Printer to run in serial mode with the UW-4.

Settings for Switch 1 (8 Position)

The table that follows shows the correct DIP switch settings (serial) for the Seiko DPU 411 Printer when used with the UW-4. The table also shows switch settings for parallel printing.

Switch 1 Position	Function	ON	OFF	Setting for UW-4
1	Input Method	Parallel	Serial	Serial
2	CR Function	CR & LF	CR only	CR only
3	Print Mode	40 Column	80 Column	40 Column
4	Character Set	Ordinary	Special	Ordinary
5	Zero Font	0	0	ON
6-8	Int. Char. Set	See Following Table		

Switches 6-8 control the character sets for different languages. The following table shows the DIP switch settings for each.

Language	SW6	SW7	SW8
Japanese	ON	ON	ON
American	OFF	ON	ON
German	ON	OFF	ON
English	OFF	OFF	ON
French	ON	ON	OFF
Spanish	OFF	ON	OFF
Italian	ON	OFF	OFF
Swedish	OFF	OFF	OFF

Settings for Switch 2 (6 Position)

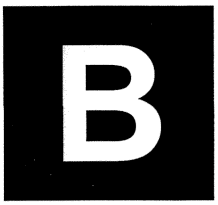
Switch 2 is used only when the Serial port is used for data transmission. The chart below lists the DIP switch settings for the Seiko DPU 411 Printer for Switch 2.

Switch 2 Position	Function	ON	OFF	Setting for UW-4
1	Data word length	8 bits	7 bits	7 bits
2	Parity use	No Parity	Parity	No Parity
3	Parity polarity	Odd	Even	Either

The chart below lists the switch settings for switches 4, 5 & 6 used for setting the Serial Port Baud rate. The UW-4 uses the setting for a baud rate of 9600 (all OFF).

Baud Rate (bps)	SW4	SW5	SW6
75	ON	ON	ON
150	ON	ON	OFF
300	ON	OFF	ON
600	ON	OFF	OFF
1200	OFF	ON	ON
2400	OFF	ON	OFF
4800	OFF	OFF	ON
9600	OFF	OFF	OFF

Appendix B: Troubleshooting Guide



Error Codes

The *UW-4* will display an error code if improper use or an abnormal condition is detected. Consult the following table for possible error codes, the probable cause, and corrective action.

ErrorCode	Description	Corrective Action
L	Indicates that an under-load is sensed. This error usually occurs when neither the cone nor the calibration weight adapter pedestal is in place on the load cell.	Replace the cone, or if calibrating, place the calibration weight adapter on the cone-mounting pin. The condition may also indicate defective electronics or load cell. If the condition cannot be cleared, return the unit to the factory for service.
H	Indicates that there may be an excessive force applied to the load cell.	Remove excessive load from the load cell immediately. If this condition occurs without any weight on the load cell, this indicates either defective electronics or a damaged load cell. Turn the unit off and back on again to see if the error clears. If the error repeats, the unit must be returned to the factory for service. If this error occurs during a calibration check with the 200-gram check weight but the unit seems to read normally without the weight on, this indicates that the unit needs to be recalibrated. The onboard processor only allows readings up to 5% over 200 grams or 210 grams. The processor will display the **H** error code for any readings above this range.
E-02	Usually the result of the unit being exposed to excessive vibration, draft, or unstable environments during calibration.	Move to a more stable work surface and/or improve environmental conditions. Before initiating the calibration process, wait until a stable zero is displayed.
E-10	Indicates that an attempt was made to zero the display with a value stored in memory. This error code will appear if the AUTO ZERO key is pressed momentarily while there is a measurement stored in memory.	The memory function is not relevant to the *UW-4*; however, memory must be cleared. Press and hold the ON button until a beep is heard, then press the ZERO/PRINT button momentarily. This action will clear memory and the display and will restore normal function.

Error Code	Description	Corrective Action
E-11	Indicates an attempt to store a measured value when the displayed value is zero. This error code will appear momentarily if the ON button is pressed after the instrument is turned on.	In its original application as a balance, a secondary function of the ON button was to add the current measurement to the value stored in memory. This is not applicable to the *UW-4* and may be ignored. Turn the *UW-4* off, then on to restore normal function.
E-54	Appears on the display when the unit is powered on if the electronics are no longer within factory-set parameters. Probable causes include: ✓ An object was dropped onto the load cell. ✓ The Wattmeter was dropped. ✓ The load cell was damaged while the cone was being removed from or placed on the cone-mounting pin.	Return the unit to the factory service center.
Δ	This symbol displayed in the upper left corner of the display indicates a serious problem. Possible causes include: ✓ Something is causing the load cell to function out of specification. ✓ Rough or improper handling of the unit. ✓ Liquids or other materials spilled onto the electronics.	Return the unit to the factory service center for evaluation and repair.

RS-232 Port

Communication failures between the *UW-4* and a printer or a PC are usually caused by the serial cable or incorrect parameter settings. Troubleshoot as follows:

1. Verify that the correct serial cable is being used. The correct cable is Bio-Tek part number 79034 or equivalent 9-pin "straight-through" male-female cable.
2. If attempting to communicate with a PC, verify that the serial cable is connected to the desired port and that the port settings are **9600, 7, N, 1.**
3. If attempting to interface with a printer, check the printer's settings. Refer to the *UW-4* Operator's Manual, Appendix A "Seiko DPU411 Printer Configuration".

Other Problems

Unit does not return to 0.0 +/- .1 watt after taking readings:

Allow at least 10 seconds for the reading to return to zero. There is a lag in the readings due to potting on the strain gauges.

There is a possibility that air bubbles have collected under the cone causing a slight change in the buoyancy. Gently spin the cone to help dislodge them and lightly tape the sides of the unit while tipping the unit on edge until all air bubbles appear to be removed.

If allowing 10 seconds more does not allow reading to return to zero then the unit and water have probably not fully temperature equalized. Thus allow the unit to sit while

turned on for at least 10 more minutes then re zero the unit and try again. Repeat the 10-minute settling time again if zero drift persists.

Readings do not stabilize and slowly decrease.

This condition usually indicates that the water has absorbed too much air and should be replaced with fresh water. When too much air is in the water, air bubbles tend to build up in the sound beam and bounce some of the sound away from the cone, thus lowering the reading.

Unit Fails to Power Up or Battery Drains Quickly.

- Verify there is a fresh 9V Battery in the Unit. If the Battery fails to hold up for approx. 10 hours operation this indicates a problem with the electronics; return the unit to Bio-Tek Instruments, Inc., for Factory Service. **Remember, when on battery power, the unit will automatically shut off after a few minutes to save battery power.**
- Use the recommended power transformer to power the unit. If the unit still fails to power up or the transformer runs hot, this indicates a problem with the electronics; Return the unit to Bio-Tek Instruments, Inc. for Factory Service.

Numbers appear to the left of the display

- Should a digit (such as 1, 5, 6, or 7) followed by a decimal point show up toward the left side of the display (possibly followed by one or two other digits followed by decimal points, you have inadvertently entered into Service Menu Codes, your unit's calibration and communications setups could be effected. **Call Bio-Tek Instruments, Inc. Service Technical Assistance Center 800-242-4685** for how to get out of the Service Menu Codes without effecting the operation of your UW-4.

UW-4