



ANALOG ULTRASOUND WATTMETER



USP-30

USER MANUAL

**BC BIOMEDICAL
USP-30 ULTRASOUND WATTMETER
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WARNING - USERS

The USP-30 is for use by skilled technical personnel only.

WARNING - USE

The USP-30 is intended for testing only and should never be used in diagnostics, treatment or any other capacity where it would come in contact with a patient.

CAUTION - MODIFICATIONS

The USP-30 is intended for use within the published specifications. Any application beyond these specifications or any unauthorized user modifications may result in hazards or improper operation.

CAUTION - SERVICE

The USP-30 is intended to be serviced only by authorized service personnel. Troubleshooting and service procedures should only be performed by qualified technical personnel.

CAUTION - INSPECTION

The USP-30 should be inspected before each use for wear and should be serviced if any parts are in question.

NOTICE – ABBREVIATIONS

C	Celsius
°	degree(s)
DUT	Device Under Test
F	Fahrenheit
g	gram(s)
kg	kilogram(s)
mm	millimeter(s)
mW	milliwatt(s)
PPM	Parts Per Million
Lbs	pounds
USA	United States of America
W	Watt(s)

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NOTICE – CONTACT INFORMATION

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**BC BIOMEDICAL
USP-30
ULTRASOUND WATTMETER**

The Model USP-30 Ultrasound Power Meter is designed to measure the ultrasonic power output of diagnostic or therapeutic transducers up to 30 watts using the radiation force balance method. The USP-30 uses a positioning clamp to hold the transducer in degassed water above a conical target. The ultrasonic energy passes through the water to reflect off the target and is then absorbed by the Neoprene rubber lining. The radiant power is directly proportional to the total downward force (weight) on the target. This force is then coupled through the target support assembly to the precision mechanical balance. The gram force is directly proportional to the ultrasound power in Watts when multiplied by a constant of 14.65. Therefore, a 2.05 gram force would be equal to 30 Watts of ultrasound radiation.

The following are highlights of the main features of the USP-30:

USP-30:

- SIMPLE OPERATION
- REQUIRES NO BATTERIES OR POWER SOURCE
- INCLUDES RUGGED CARRYING CASE
- MEASURES UP TO 30 WATTS OF ULTRASONIC POWER

TEST SETUP

Water as a Measurement Medium*

The measurements are to be performed in water because ultrasound propagation in water closely approximates that in tissues. The ultrasonic attenuation in water can be taken as a lower limit on the attenuation that will be encountered in the body. Large areas in the body can consist of low attenuating material such as urine and amniotic fluid. The use of water prevents measurements in a more highly attenuating material, such as liver equivalent gels, from representing the highest possible intensities that might be encountered in the body.

* Ultrasound propagation in water closely approximates human tissue and degassed water is the generally accepted test medium for ultrasound transducers (see AIUM/NEMA Standards Publication #UL-1-1981, SAFETY STANDARD FOR DIAGNOSTIC ULTRASOUND EQUIPMENT).

Degassed Water

Ultrasound Power measurement accuracy is affected if the water contains more than 5-10 PPM of air. To degas, boil distilled water for 30 minutes, then seal the container tightly and place it in a refrigerator. An alternate method of degassing water is to heat the water to the boiling point, then pull a vacuum on it for five to ten minutes. The degassed water storage container should be made of glass or plastic. Polystyrene containers should not be used since they allow oxygen to permeate and degrade the water quality.

Before testing, pour water into tilted test tank with minimum amount of turbulence. The test tank water surface will absorb oxygen, therefore a change of degassed water is recommended before each test. Water temperature affects accuracy, so it is

recommended to use an ambient testing temperature of 24.0 ± 3.0 °C (75.2 ± 5.4 °F). Sonic energy agitates the water surface through heating and scattering. The time duration of each test should be limited to a few minutes. Prolonged testing, particularly at higher power levels, will show visible signs of air bubbles on the transducer, target, and the absorbing rubber surface.

Transducer Wetting and Placement

To avoid introducing air into the degassed water, insert the transducer at a 45° angle, then position so it is facing the target. Verify that the transducer surface is uniformly wetted, if not, wipe the surface clean using your finger. The transducer should be pointed toward and center-positioned directly above the cone target. Small measurement variations will occur due to placement of the transducer. Try various positions above the target to minimize the magnitude of error due to positioning.

1. Place the Model USP-30 on a level and stable surface.
2. Remove the carrying case cover and lid from the test tank.
3. Remove and carefully unpack the conical target stored in the test tank. Set the target aside until the tank is filled.
4. Fill the test tank to $\frac{1}{4}$ inch (6.4 mm) below the top of the tank liner with fresh degassed water at a temperature of 24.0 ± 3.0 °C (75.2 ± 5.4 °F).
5. Immerse the conical target into the test tank at an angle to avoid any air bubbles from being trapped under the target. Shake the target gently to release any attached air bubbles. Position the cone target so that it is pointed upright in the center of the tank.

6. A triangular hanger, with its base in the horizontal position, is attached to the conical target using nylon cord. Place this triangular hanger on the upper (or lower) hook of the precision balance. Verify that the cone target is centered in the test tank and does not touch the sides of the tank.

7. Release the spring lock on the precision balance.

8. Balance the scale with the target in place and no ultrasound power applied. Each USP-30 system is setup and balanced at the factory before shipping. The weight of the conical target, when suspended in the test tank, is measured, recorded and marked on the balance. This is a “zero” or “null” reading and typically ranges between 1 and 3 grams. This weight is a constant that must be subtracted from all readings when measuring with this system. If a new target is ordered, be sure to indicate this null reading so that an equivalent target can be supplied.

9. To verify the scale's accuracy weigh the slotted 1-gram standard (located on the base plate below the short instruction notes) by hanging it on the upper (or lower) scale hook and re-balancing the scale. The reading should be 1.00 gram higher than the null reading.

10. When the USP-30 is not in use, store the target and hanger inside the test tank and replace the watertight lid. The lid will restrain the water during transit, reduce the absorption of air into the water, and prevent water contamination from foreign particles. If the unit will not be used for an extended period of time, it is suggested that the water be removed from the tank and replaced when use is required.

TESTING

1. Complete steps 1 through 7 in the Test Setup section above.
2. Unhook the scale spring lock from the balance arm. Note: Always replace the spring lock when the USP-30 is in transit.
3. Periodically verify the accuracy of the precision balance by finding the null (or zero) value and then weighing the 1-gram slotted standard weight by placing it on the upper (or lower) scale hook and re-balancing the scale. A 1 gram difference should be measured between this reading and the null reading.
4. To avoid introducing air into the degassed water, insert the DUT transducer at a 45° angle. Then position so it is facing the conical target $\frac{1}{8}$ to $\frac{1}{4}$ inch (3.2 to 6.4 mm) below the water level, parallel to the water surface, and directly above the center of the conical target. Check the DUT transducer surface for uniform wetting (no air pockets or bubbles should be on the surface). Wipe across the DUT transducer surface with your finger to remove any trapped air bubbles. Install the DUT transducer handle into the positioning clamp without disturbing the position.
5. With no ultrasound power applied, balance the scale (to null value), and then record this null reading (for example, 3.00 grams). For convenience, this null reading may be adjusted to an even number within the 0 to 10-gram range by using the balance compensator (a knurled nut) located at the left of the balance arm.
6. Set the DUT to the desired power and activate the DUT so that power is applied to the DUT transducer. Re-balance the scale and subtract the reading from the null reading (for example, if it now reads 3.68 grams and the null reading was 3.00 grams, the result would be 0.68 gram total force). The formula for total radiated power in Watts is equal to the total force on the precision balance (in grams) multiplied 14.65 Watts/gram. To obtain watts per square centimeter, divide the total radiated power by the effective radiating cross-sectional area of the transducer (usually, 90% to 95% of the total transducer surface area).

Reading the Main and Vernier dials: Each Incremental graduation on the Main dial has a value of 0.1 gram. The Vernier dial is above the Main dial and sub-divides the 0.1 Main dial Increment down to 0.01 Increments. To obtain total gram weight, first record the number of grams and tenths of grams indicated on the Main dial at the Zero Vernier graduation. See the illustration in Figure 1. To obtain the hundredths of grams, read the value on the Vernier scale whose increment line most closely aligns with a Main dial graduation. Add the Vernier hundredths value to the main dial grams and tenths of grams to find the total gram force. The reading shown in Figure 1 is 6.74 grams.

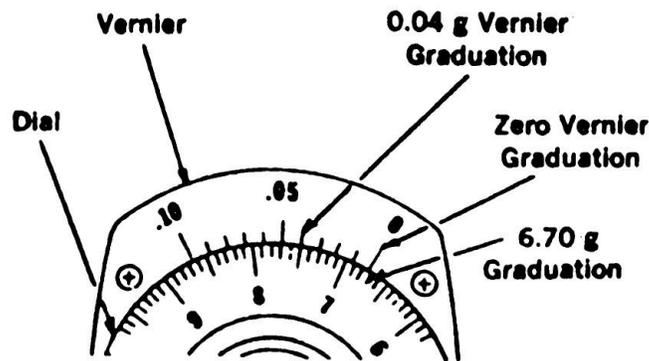


Figure 1. Typical dial reading.

7. For increased measurement accuracy, repeat the power measurement procedure a few times and take the average reading.

MANUAL REVISIONS

<u>Revision #</u>	<u>Revisions Made</u>
Rev 01	Origination
Rev 02	Misc. Edits
Rev 03	Misc. Edits, Format Updated, Pictures Updated

LIMITED WARRANTY

WARRANTY: BC GROUP INTERNATIONAL, INC. WARRANTS ITS NEW PRODUCTS TO BE FREE FROM DEFECTS IN MATERIALS AND WORKMANSHIP UNDER THE SERVICE FOR WHICH THEY ARE INTENDED. THIS WARRANTY IS EFFECTIVE FOR TWELVE MONTHS FROM THE DATE OF SHIPMENT.

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SPECIFICATIONS

ULTRASONIC POWER MEASUREMENT	
RANGE	150 mW to 30 W
RESOLUTION	$\pm 150 \text{ mW } (\pm 0.01 \text{ g})$
ACCURACY	$\pm 5\%$
TEST MEDIUM	Degassed Water @ $24.0 \pm 3.0 \text{ }^\circ\text{C}$ ($75.2 \pm 5.4 \text{ }^\circ\text{F}$).
MAXIMUM TRANSDUCER DIAMETER	4.50 Inches (114.3 mm)

PHYSICAL & ENVIRONMENTAL		
DISPLAY	Vernier Dial	
CONSTRUCTION	TANK LINING	0.5 inch (12.7 mm) thick Neoprene
	BALANCE & CARRYING CASE	Metal
SIZE	CARRYING CASE	19.00 x 17.00 x 7.00 Inches (482.6 x 431.8 x 177.8 mm) Height x Length x Width
WEIGHT	18 Lbs (8.2 kg)	
TANK CAPACITY	1350 mL	

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07/12 – Rev 03**

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