

**BUCKLEYS**  
**BATHYCORROMETER®**  
**INSTRUCTION**  
**MANUAL**

**READ THIS MANUAL BEFORE USING THE EQUIPMENT.**

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## **1.0 Unpacking**

1. Check that the following are in the case:-

- Bathycorrometer unit, White with Red nose cone.
- Charger, oblong box with a lead coming out of each end.
- 6 Stainless Steel pointed Probe Tips.
- A spanner to fit the Probe Tips.
- A 5 pinned rubber Plug with White Locking Ring.
- A small tube of Silicone Grease.
- This Instruction Manual

If any of these are missing, contact your supplier immediately.

2. Keep the packaging in case the unit needs to be sent back for repair in the future, or needs to be stored.

## **2.0 General Description**

The Bathycorrometer® (BCM) is an underwater corrosion volt meter, powered by a rechargeable battery. This current model has been developed from the original model and on the very successful Bathycorrometer® MkV. The unit is fitted with a 3½ digit high impedance (10 megohms) LCD Volt Meter which is backlit for operation in murky conditions. The unit can read voltages as low as 0.001V up to 1.999V D.C.. The corrosion potential is detected by a Silver/Silver Chloride (Ag/AgCl) reference electrode of extremely robust and proven construction, mounted in the protective nose cone and sited only 5cm from the probe tip.

### **2.1 Probe Tips**

Six standard probe tips are supplied with the instrument. They are provided with a standard point, suitable for use on steel work with coatings of either paint or tape etc., as used on steel piles, under sea pipelines and through thicker coatings, marine growth and the like.

The probe tip is fitted to the front of the instrument by screwing it onto the stainless steel stud and tightened with the spanner provided. A definite bottoming should be felt when the probe has been screwed fully home. Silicone grease smeared on the outside of the probe will assist fitting through the “O” ring seal.

### **2.2 Blanking Plug**

The unit is switched ON by using the 5 pinned Blanking Plug provided. This should be disconnected when the instrument is out of the water in order to conserve battery life. Silicone grease smeared on the plug will greatly facilitate its insertion. The plug is NOT underwater pluggable and must be inserted before the instrument is immersed, otherwise spurious readings and damage to the socket will occur.

### 2.3 Battery

The unit is powered by a re-chargeable Nickel Metal Hydride battery. Under normal usage, a fully charged battery will provide over 50 hours of operation. Low battery voltage is indicated by a battery symbol appearing at the top left hand side of the LCD display. Because the battery is Nickel Metal Hydride it has the advantage of no memory effect and can be topped up charged unlike the older Nickel Cadmium type.

The BCM should only be charged using the charger supplied. Use of the incorrect charger could lead to damage to the electronics which would not be covered by the warranty.

### 3.0 Technical Data

#### 3.1 BCM UNIT

Operating depth to Display	Up to 300m (Pressure tested to 600psi 42bar)
Accuracy	3½ digit LCD backlit 0.001 to 1.999V DC
Input impedance	0.05% typical ( $\pm 1$ count)
Operating temperature range	>10MW
Temperature stability	0 to 30°C
Storage temperature range	$\pm 100$ ppm/°C
Operating time on full charge	0 to 50°C
Reference electrode	50hr +
Accuracy Ag/AgCl	Silver/Silver Chloride (Ag/AgCl)
Temperature coefficient	+5mV ( $\pm 5$ mV)
Effective Life	0.2mV °C
Contact with structure	1 to 2 years if looked after
Output input socket for	Hardened, Stainless Steel probe
Weight in air	Charging, reference test, remote readout and on off switching
Weight in water	2.5Kg
Instrument size	0.85Kg negative buoyancy
Carrying case size	100mm diameter x 275mm long
	450mm x 340mm x 220mm

#### 3.2 BCM Charger

Supply Voltage:-	110V to 240V A.C. 45-55 Hz
Input Power :-	3.5 VA maximum
Output voltage :-	10.5V D.C. open circuit.
Output Current :-	30mA $\pm$ 2mA
Charging indicator :-	Green LED

## **4.0 Operation**

### **4.1 Charger**

1. Connect a suitable main plug to the charger, the plug should be fitted with a fuse of 1Amp or 3 Amp rating. Connect the Brown wire to the Live (L) terminal and the Blue wire to the Neutral (N) terminal There is no connection to the Earth (E) terminal.
2. The BCM as supplied may not be fully charged, it is recommended that the BCM is charged for 24hours before initial use.
3. Connect the charger to the BCM. Check the orientation of the plug on the charger as it will only connect one way.
4. Connect the charger to the mains supply, the Green led light in the centre of the charger should illuminate, if not check the connection to the BCM and that the mains power is on.
5. The normal time to re-charge the battery from flat is 14 hours, but it can be left on charge for up to 48 hours without damage to the battery. The battery can be topped up after use by giving a charge of 12 minutes for each hours use.
6. There is no indication on the charger or the BCM that the battery is charged. If the charger is turned off it will not discharge the BCM.
7. When charging is complete, disconnect the charger from the mains supply and then from the BCM.

### **4.2 BCM Unit**

1. Fit a pointed probe tip to the end of the instrument using a smear of Silicone grease to help stop damage to the “O” ring seal. Use the spanner provided to make sure that the probe tip is fully home.
2. Smear the Blanking Plug Pins with some Silicone grease and insert the plug into the socket in the handle of the BCM. This switches the BCM on.
3. Screw the White Blanking Plug retaining ring into the handle to stop the Blanking Plug from being accidentally removed. NOTE:- The Blanking Plug must NOT be removed under water.
4. The unit as supplied has been fully tested and calibrated in the factory. However some drying out of the reference electrode may have occurred and it is recommended that prior to initial use the unit is soaked in Seawater for 20 to 30 minutes.
5. The BCM is now ready for use. If required the calibration can be checked, see section on Calibration.

6. To take a reading under water just push the pointed probe onto the steel structure making sure that contact is made to the steel. The corrosion potential at that point can now be seen on the display.
7. After use, wash the BCM in clean Seawater to remove any debris from inside the red nose cone, and then re-charge the unit using the charger supplied. As a guide the BCM will require 12 minutes charge for each hour of use. The BCM can be charged for periods longer than 14 hours. It is possible to charge the BCM for up to 48 hours without damage to the battery, if using the charger supplied.

## **5.0 Maintenance**

Very little maintenance is required apart from keeping the unit clean and ensuring that the holes in the red nose cone are kept clear of any obstructions such as dirt or marine growth etc.

Check the Calibration of the BCM's electronics and the reference electrode at regular intervals.

If the unit has been used in a dirty environment the red nose cone should be flushed with clean sea water to remove any contamination which would shorten the life of the reference cell.

Clean the socket in the handle of the BCM and apply a smear of Silicone grease to it and the plug to stop the contacts corroding.

Check the condition of the "O" Ring in the White Delrin Probe Cone and replace if necessary.

The battery charger must be maintained in accordance with local statutory requirements for maintenance of portable electronic equipment.

## **6.0 Replacement of the Screw in Reference Electrode**

1. Remove the Stainless Steel Probe Tip if Fitted.
2. Using a pair of grips, remove the White Delrin Probe Cone.
3. Remove the stainless steel slotted nut and washer from the Tie Rod.
4. Gently "rock" and remove the Red Nose Cone, which will expose the grey plastic Reference Electrode.
5. Carefully unscrew the Reference Electrode.
6. Ensure that there are no foreign bodies in or around the seat of the Reference Electrode and the "O" Ring around the Tie Rod.
7. Smear the "O" Ring and the thread on the new Reference Electrode with Silicone Grease.

8. Screw in the new Reference Electrode until the “O” Ring just seats, then tighten half a turn and no more. Over tightening the Reference Electrode could snap the thread.
9. Replace the Red Nose Cone, ensuring that there is no debris or foreign matter around its seat, and that the cut out is positioned to accommodate the Reference Electrode.
10. Replace the stainless steel washer and slotted nut and tighten so there is no gap between the Red Nose Cone and the White Body.
11. Check the “O” rings on the inside and outside of the white Delrin Probe Cone and replace if necessary, smear the “O” rings with a little Silicone Grease, and replace the white Delrin Probe Cone onto the Tie Rod.
12. Replace the stainless steel Probe Tip, if fitted.

## **7.0 Safety**

All diving operations which involve the use of the Bathycorrometer must be carried out in accordance with the current local statutory requirements for conducting Diving Operations at Work.

## **7.1 ELECTROMAGNETIC COMPATIBILITY - EUROPEAN UNION DIRECTIVE 89/336/EEC:**

The BCM and its charger do not generate RF energy so will not interfere with other electronic equipment. The BCM is a sensitive volt meter, which when in use under water would be screened from electromagnetic interference by the sea, however when on the surface, being calibrated, interference may cause the BCM to give incorrect readings. If this is the case, investigate to see if any transmitting equipment is in operation i.e. radio telephones, radar or if any arc welding is being carried out. Also electrical storms can have an effect.

## 8.0 Calibration

There are two parts of a BCM that affect calibration. Firstly the electronics and secondly the Ag/AgCl reference Electrode.

### 8.1 Electronics Calibration Check

The Electronics in the BCM can be checked with the aid of a BCM Checker (Not Supplied), this, when connected to the BCM, produces an precision voltage of 1.990V DC which can be compared with the BCM's reading. This is just a check as the electronics are contained inside the pressure housing and cannot be adjusted without breaking the seal. Undoing the pressure housing voids the warranty. The unit should be returned to Buckleys if the reading on the BCM is more than  $\pm 10\text{mV}$  out from the 1.990V test voltage. Check that it is not the BCM Checker that is at fault first.

### 8.2 Test Procedure using screw on Calomel Reference Electrode

1. Unscrew the white Delrin Probe Cone.
2. Smear the "O" ring on the Calomel Reference Electrode with a little Silicone Grease.
3. Screw the Calomel Reference Electrode onto the threaded Tie Rod, ensuring a tight connection and correct seating of the "O" ring.
4. Fit the Blanking Plug and immerse the BCM in Seawater, ensure that the level covers the Red Nose Cone.
5. Allow the Electrode to reach a stable potential (10 to 15 minutes).
6. The voltage difference between the Calomel Electrode and the internal Silver/Silver Chloride Electrode can be read directly off the digital display on the BCM.

**Note 1:**

The values recorded for the Silver/Silver Chloride Electrode are dependent upon the Salinity and Temperature of the Seawater at the time of measurement.

**Note 2:**

The Det Norske Veritas (D.N.V.) specification "Guidelines in Potential Measurement on steel structures" gives the potential value for the Ag/AgCl Electrode as  $-4\text{mV} \pm 5\text{mV}$ . This is with the Ag/AgCl Electrode connected to the Negative terminal of the voltmeter, however in the BCM the Ag/AgCl Electrode is connected to the Positive terminal in accordance with conventional standards. To comply with the D.N.V. specification the value for the Ag/AgCl Electrode will



therefore be  $+4\text{mV} \pm 5\text{mV}$  (@  $20^\circ\text{C}$ ). Since the polarity of the reference electrode potential will be reversed.

## 9.0 Test using Zinc Test Blocks

A quick check of the operation of the BCM can be carried out using a Zinc test block. Potential measurements taken should be logged to check if any significant variation occurs. Differences in the order of 10mV or so between readings are quite possible and will mainly be caused by variations in water salinity at different locations or due to changes in water temperature. As a guide, readings taken in a 3% salt solution at ambient temperature of  $25^\circ\text{C}$  are as follows:-

Zinc (Zn) = 1.00 - 1.05V

Soak the BCM for 2 hours in a Seawater solution. The salt concentration has a great effect on the readings, so does the state of the test block. A tarnished block will give a lower reading than clean one. Do not leave the test block in the Seawater, remove after use.

## **10.0 Long Term Storage**

### **10.1 Laying Up**

1. Flush well in clean Seawater to remove any contamination from the Red Nose Cone and allow to dry. If salt encrustation is seen on the Red Nose Cone, remove the Ag/AgCl half cell and briefly wash in fresh water but immediately after thoroughly rinse in Salt water (3% salt solution)
2. Clean the Blanking Plug and the socket in the handle. Apply Silicone grease to the plug and fit it into the handle to get the Silicone grease into the socket. Re-apply if necessary. Then remove the Plug, re-grease ready for storage.
3. The BCM can be stored with the battery in any state of charge.
4. Place the BCM, Charger, probes, probe spanner, Silicone grease and this Instruction Manual into the carrying case.
5. Store the BCM in an ambient temperature not less than 0°C or greater than 40°C. Storage outside these temperature will destroy the LCD display.

### **10.2 Re-commissioning**

1. Remove the BCM from its case and fit the Blanking Plug. If the display comes on then charge the BCM for 14 hours. If the BCM is dead, charge for 24 hours.
2. Fit the Blanking Plug and leave the BCM working. If it is still working after 50 hours then the battery has recovered its full capacity. If it is not working then the battery is faulty and the BCM and Charger should be repaired.
3. Soak the BCM for 2 hours in a Seawater solution.
4. Carry out calibration checks, see calibration.

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## CERTIFICATE of INSPECTION and CONFORMITY

Certificate No:- \_\_\_\_\_

Order No:- \_\_\_\_\_

Date:- \_\_\_\_\_

Equipment Type:- Bathycorrometer

Serial No:- \_\_\_\_\_

Pressure Tested to 600psi 42bar on :-

Date:- \_\_\_\_\_

### Calibration:-

Test Meter:- = \_\_\_\_\_ Serial No:- = \_\_\_\_\_

Accuracy:- = \_\_\_\_\_ Date Calibrated:- = \_\_\_\_\_

Electronics Tested against Test Jig No = \_\_\_\_\_ Calibrated on :- \_\_\_\_\_

BCM Calibrated against the best of 3 No. Plastic Bodied saturated Calomel reference electrodes in a 3% Sodium Chloride (Instant Seawater) solution.

Reading on Calomel Reference Electrode 1 = \_\_\_\_\_ mV

Reading on Calomel Reference Electrode 2 = \_\_\_\_\_ mV

Reading on Calomel Reference Electrode 3 = \_\_\_\_\_ mV

### Functional Test:-

Reading on Zinc Test Block = \_\_\_\_\_ V

Tested By:- \_\_\_\_\_ *signed* \_\_\_\_\_

Zinc Test Block Reference Number = \_\_\_\_\_

Magnesium Test Block Reference Number = \_\_\_\_\_

## EC Declaration of Conformity

We: Buckleys (UVRAL) Ltd  
Beta Works  
Range Road  
Hythe  
Kent CT21 6HG  
England

as manufacturer of the apparatus listed, declare that the product:

### **Bathycorrometer**

Serial No: \_\_\_\_\_


has been manufactured in conformity with the following standards and specifications:

Safety: IEC 1010-1: 1990  
and amendments 1: 1993 and 2: 1995

EMC: EN 55081-2: 1994 Generic Emissions Standard (Industrial)  
EN 50082-2: 1995 Generic Immunity Standard (Industrial)

and therefore conforms with the requirements of Council Directive 73/23/EEC relating to safety requirements and Council Directive 89/336/EEC relating to electromagnetic compatibility.

Issued on: \_\_\_\_\_

Authorised by :  Cliff Moore  
Quality Manager