POLATRAK®

CORROSION TESTING PROBE

DEEP C METER 300™ ROV-MOUNTED CP PROBE

OPERATION MANUAL

ROV-interfaced cathodic protection monitoring system

Rated for depths up to 300 meters

Lightweight, for inspection class ROVs

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1. Overview

The Deep-C-Meter 300 is a complete ROV-interfaced cathodic protection monitoring system. The system has three basic parts: The readout unit, which is twin voltmeters housed in a (black) Delrin® pressure housing; The probe, a twin element, tip-contact CP probe (Polatrak® model ROV-II™) and the flying lead, a three-meter-long umbilical that connects the probe to the readout.

Figure 1:
Deep C Meter 300 kit components

2. Documentation

2.1. The following documents are contained in the appendix:

2.1.1. ROV II operations manual

2.1.2. Parker Seals - Parker O Lube MSDS – O-Ring Lubricant

2.1.3. Dow Corning – 4 electrical insulating compound MSDS connector sealant

PLEASE CONTACT YOUR DEEPWATER REPRESENTATIVE FOR ANY QUESTIONS OR ISSUES REGARDING THIS MANUAL.

3 Health and safety

It is the intention of Deepwater Corrosion that all test and inspection procedures are carried out in a safe manner in accordance with the Health and Safety At Work Act and any other relevant legislation. If required by the client, Deepwater personnel will attend any site safety induction courses before carrying out work on site.

4 Voltage readout unit components

The readout unit has two major sub-assemblies: The pressure housing and the mount. The voltmeter module slides into a “dovetail” joint on the mount.

Figure 2: Deep C Meter 300 readout unit

4.1 Pressure housing

4.1.1. Housing body - The pressure housing is made from a solid piece of Delrin® and is rated for 300 meters (1,000 feet) depth.

4.1.2. Lens - One end of the housing contains an acrylic lens that seals with o-rings into the pressure housing. Four stainless-steel screws keep the lens seated in the pressure housing. Access to the inside of the pressure housing is gained by pulling the lens. See maintenance and repair section for details on lens removal/replacement.

4.1.3. **Bulkhead connector -** The back end of the pressure housing is sealed with a bulkhead connector. This connector threads into the back of the pressure housing and also seals with an o-ring. It should not be necessary to remove this connector during normal maintenance. A blank (dummy) connector is provided and should be in place whenever the mating connector is removed.

4.1.4. Voltmeter module - The voltmeter module is located within the pressure housing. The voltmeter module contains two independent 3 ½ -digit LED voltmeters. Default factory range is +/- 1999 mV DC on both readouts. A 9V alkaline battery powers each of the readouts. On the face of the module is a photocell that switches each measurement circuit on when exposed to light from the ROV.

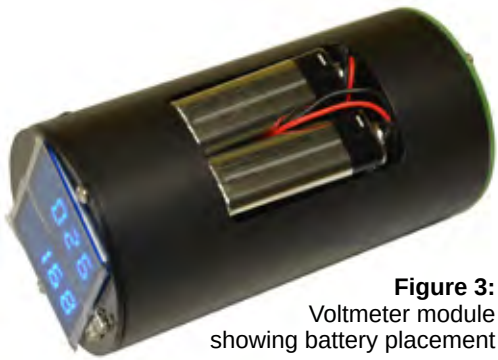


Figure 3: Voltmeter module showing battery placement

4.2. Adjustable mount

4.2.1. The adjustable mount is designed to secure the readout to the ROV frame, and provides angled adjustment to optimize camera viewing of the displays. The mount is made of Delrin® and is secured with SS bolts.

Figure 4: Adjustable meter mount

5.0 Probe unit components

5.1. Main body

5.1.1. The Deep-C-Meter 300 utilizes the popular Polatrak ROV-II tip contact probe. This probe can be used independently of the readout unit as a standard topside-wired CP probe. For reference, the entire manual for this probe is included herein or can be found separately under document number 354-MN01-ENG.

5.1.2. The probe unit includes the nose cone that houses the contact tip, the main body section, the tail unit (which houses the reference electrode female plugs and the connection cable with strain relief, the reference electrode elements, the tee handle mount for manipulator mounting and the flying lead connection back to the readout unit.

5.2. Nose cone

5.2.1. The nose cone assembly is screwed into the main body section. The cone houses the replaceable contact tip and also has the female connector that attaches to the male pin on the extension cable from the tail unit. Tips are made from stainless steel plated with nickel; the nose cone is fabricated from a rugged thermoplastic.

5.3. Main body section

5.3.1. The body section, made from a rugged thermoplastic, protects the reference electrode elements and is designed to fit the tee handle mount for convenient manipulator mounting.

Figure 5: ROV-II corrosion probe

holes in the side allow the body to become free-flooding and were specifically engineered to allow for accurate potential measurements.

CAUTION

Do not cover or modify these or add additional holes in the body.

5.4. Tail unit

5.4.1. The tail unit attaches to the main body section with two (2) stainless steel cap screws. The connection cable passes through this unit and is strain-relieved with a spiral strain-relief fitting. The tail unit includes one male connector for the contact tip and two female connectors for each of the reference electrodes.

5.5. Reference electrode elements

5.5.1. Two plug-in sintered silver/silver chloride elements are included; electrode elements are accurate to ± 5 mV. See the operations and maintenance section for instructions on electrode replacement.

CAUTION

Never handle electrode elements with bare hands or expose elements to any liquid other than water; permanent damage may result.

5.6. ROV-II probe T-handle mount

5.6.1. The T-handle mount allows easy interface with most manipulator systems. The mount is made from 316 stainless steel and Delrin®.

5.7. Flying lead

5.7.1. The standard flying lead is 10 ft (3 m) long. A longer lead can be provided if it is necessary to use a rear-facing camera to look at the readout. The lead has a polyethylene abrasion-resistant sheath and has connectors on either end that mate with the bulkhead connector on the readout and the whip cable on the probe unit.

6.0 Spare parts and accessories

6.1. The Deep-C Meter is shipped in a waterproof transit case and contains the following spares and accessories. Please contact your Polatrak representative to order additional spares if required.

6.1.1. Zinc calibration block (1)

6.1.2. Contact tips

6.1.3. Lens retaining screws (4)

6.1.4. O-ring lube (1)

6.1.5. Silicone connector lube (1)

6.1.6. Bulkhead connector dummy plug (1)

6.1.7. Ag/AgCl electrode element

6.1.8. Lens back-up ring (2)

6.1.9. Lens O-ring (4)

7.0 Calibration

7.1. Bucket calibration procedure

7.1.1. Fill a non-metallic bucket or container with enough seawater or simulated seawater to completely submerge the probe unit.

7.1.2. Place the probe in the bucket with the tip pointing up so the body fills with seawater. The entire probe must be immersed, including the tip.

7.1.3. Clean the zinc coupon with a file or sandpaper to remove any oxide layer and place it into the bucket.

7.1.4. Wait thirty minutes for the electrode elements to reach equilibrium.

7.1.5. Stab the zinc coupon firmly onto the probe tip. (alternatively, the contact tip can be removed and the cable can be attached directly to the nose cone as indicated below)

7.1.6. The upper displays on the readout unit should read between (-) 1000 & (-) 1100 mV. Both displays should read within ± 5 mV (the decimal point is not displayed).

7.1.7. If the readings are not within this range, please see the troubleshooting section.

7.1.8. Note: If the probe has not been used in a while, it may take another 15 – 30 minutes for the electrode elements to reach equilibrium.

7.2. Underwater online calibration

7.2.1. While free-flying, both voltmeter displays are reading the potential of the tip contact. This number will vary depending on ROV speed, time of immersion and whether a protected structure has been recently stabbed. Normally, the reading will be in the (-) 200 to (-) 400 mV range, and both displays should be within ± 5 mV.

7.2.2. If the readings are not within ± 10 mV, the probe unit is out of calibration. The survey can continue until the ROV can be brought back to the surface if both readings are recorded.

8.0 Operation

8.1. Mounting on ROV

8.1.1. Find a good location on the vehicle to mount the display unit and attach the articulated mount. Typically, the display unit should be in view at the same time as the probe unit to maximize efficiency. The lens on the unit must be camera-visible and have a light source directed at it to activate the displays. Ensure that all fasteners are tight and that all locknuts and washers are in place. Leave the lens cover in place while the unit is on deck (unless calibrating) since the displays are light-activated and battery life will be reduced.

8.1.2. Insert the probe unit into the compliant tee-handle probe mount and position in a manipulator or tool basket that is manipulator accessible.

8.1.3. We recommend tying a safety lanyard to the probe's mounting U-bolts.

8.1.4. Ensure that lock rings for the dove tails are properly mounted and secured.

8.1.5. Ensure fasteners are tight and lock nuts are in place.

8.1.6. Route the flying lead in such a way that it will not be stressed, entangled or pinched during manipulator operation.

8.1.7. Apply a small amount of the provided connector sealant to the shoulder of the flying lead connector, ensuring that no sealant is applied to the copper pin. Connect the flying lead to the probe lead and tighten the connector lock ring. Please refer to the MSDS in the appendix before handling the sealant. All appropriate Personal Protective Equipment (PPE) shall be worn, including safety glasses and gloves as a minimum.

8.1.8. Perform bucket calibration (see section 7.1)

8.1.9. Using a 7/16” wrench, ensure that the contact tip is tight on the nose cone.

8.1.10. Ensure that the tip is sharp.

8.1.11. Remove the lens cover from the instrument.

9.0 Taking CP potential readings

9.1. Stab the tip contact probe onto the point on the structure where the reading is required, when a good contact is made the reading on the displays will show a steady reading.

CAUTIONS

Avoid stabbing painted or coated surfaces whenever possible. Try to take readings on bare steel or on spots specially designated for CP measurement.

• If necessary, anodes can be stabbed. However, if possible, it is best to stab the anode band which is grounded to the structure.

• Avoid trying to stab through heavy, hard marine growth if possible.

• The probe unit should be kept out of the mud, as this may contaminate the electrodes.

• If the readings are not steady or don’t match the criteria in the table in the next section, it’s probably due to a high resistance contact. DO NOT RECORD THESE NUMBERS. Continue to stab until readings are in specification. See troubleshooting section if problems persist.

• NEVER operate the system with any of the connectors un-mated unless

the blanking plugs are installed.

10.0 Data interpretation

10.1. For carbon steel structures in seawater, the readings obtained should be within the ranges in Table 1. Exceptions may occur if the probe is stabbed onto an isolated section of a corrosion-resistant alloy (stainless steel, copper, nickel etc.). In these cases readings less negative than the indicated range may be noted. If this is the case, ensure that the readings are steady and within the ±5 mV allowable range.

Table 1 - Normal cathodic protection ranges for bare carbon steel in seawater

Range (mV)	Interpretation	Action
-500 or more positive	Error (unless unprotected)	Remake contact & verify Measure two other points around the component
-501 to -649	Isolated from cathodic protection	Remake contact & verify Record data
-650 to -799	Not cathodically protected	
-800 to -849	Marginal cathodic protection	
-850 to -1049	Cathodically protected	Record data
-1050 to -1149	Anode potential	
-1150 or more negative	Error	Remake contact & verify Measure two other points around the component

Note: For brackish or fresh water, please consult Peterson's Nomogram.

10.2. Removal from ROV

10.2.1. When equipment is removed from the ROV, wash thoroughly with fresh water and allow to dry. Soak the ROV II probe unit in fresh water for at least one hour. Replace lens cover on Deep C Meter and return to storage case provided.

11.0 Maintenance and repair

11.1. Overview

11.1.1. This section covers general operational maintenance. Do not attempt any tasks not described in this section as it may damage the system.

11.1.2. Please contact your Polatrak representative if you have any questions.

11.2. Tip replacement

11.2.1. Tips should be replaced once a reading can no longer be obtained. Remove the old tip with a 7/16” wrench (flats are best). Ensure that the new tip is tight.

CAUTION

The contact tip has been machined to a very sharp point to enable easier readings through coatings. This point can also easily cut or poke through human skin. Please handle with care.

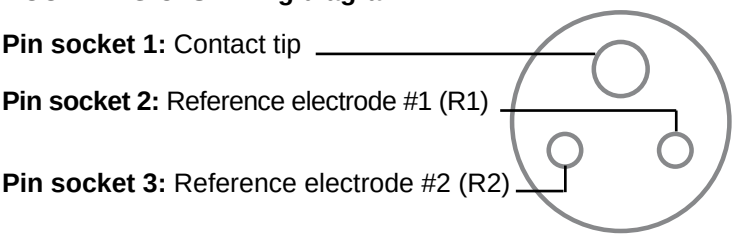
11.3. Electrode element replacement

11.3.1. Remove the probe unit from the ROV and un-mate the connector. Install the blank plug provided onto the exposed flying lead connector. Next, determine which element is bad.

11.3.2. Perform a bucket calibration described in section 7.1.

11.3.3. Using a digital voltmeter set on 2.00 VDC range, stab the large pin with the positive voltmeter lead, and pin 1 (first clockwise of large pin) with the negative lead (note reading). Then repeat, stabbing pin 2 with the negative lead, noting the reading. The faulty electrode will be the one that gives the lowest (least negative) reading.

Figure 6: SEACON RMG-3FS wiring diagram



11.3.4. Ensure that the probe is drained of seawater.

11.3.5. Take the probe unit to a clean area.

11.3.6. DO NOT handle the electrode pellet with bare hands.

11.3.7. Remove the two screws securing the tail unit and gently pull out the tail unit, exposing the electrode elements. Try to avoid un-mating the tip connector.

11.3.8. Visually inspect to ensure that the wire or element is not damaged and the connector is properly mated.

11.3.9. Remove the bad electrode and discard according to appropriate local environmental procedures.

11.3.10. Take the new electrode and carefully place a small amount of connector sealant on the shoulder being careful not to cover the copper pin. Please refer to the MSDS in appendix before handling sealant. All appropriate Personal Protective Equipment (PPE) shall be worn including safety glasses and gloves as a minimum.

11.3.11. Plug the new electrode into the connector.

11.3.12. Check that all connectors are fully mated, then carefully put the electrodes back into the housing and re-attach the tail unit and nose cone.

11.3.13. Repeat bucket calibration as described in section 7.1. (Note: A new dry reference electrode may take an additional 30 minutes to reach equilibrium)

11.3.14. NEVER immerse an electrode in water with the connector pin exposed.

11.4. Battery replacement

11.4.1. Batteries will need replacing after approximately 48-60 hours of operation or when the displays begin to fade. To replace batteries, the readout must be removed from the vehicle and taken to a clean, dry location. This is best done in a workshop.

11.4.2. Remove four (4) 10-24 stainless steel retaining screws.

11.4.3. Rotate the lens approximately 10 degrees in either

direction. This will prevent damage to the housing threads.

11.4.4. Next, screw in the four (4) ¼" – 20 stainless steel Allen screws evenly to draw lens out.

11.4.5. Carefully pull lens out by the four Allen screws.

11.4.6. Remove the four (4) ¼" – 20 stainless steel Allen screws from the lens.

11.4.7. Carefully remove the voltmeter module from the housing; there is enough slack cable to allow this. Remove and replace the two (2) PP3 9 volt batteries.

11.4.8. Carefully re-insert the voltmeter module and illuminate the photo cells to ensure that the displays light up.

11.4.9. The lens has two grooves: the outer groove (closest to the external, convex surface of the lens), and the inner groove (closest to the internal surface of the lens). The inner groove is designed for one round O-ring to be seated next to one backup ring (square cross-section). The outer groove contains a single round O-ring.

11.4.10. Replace all O-rings and backup rings.
NEVER REUSE O-RINGS.

11.4.11. Make sure new O-rings are properly installed and seated; confirm that the backup ring is not twisted.

11.4.12. Apply a small amount of O-Ring lubricant to the lens and the inside wall of the pressure housing, smoothing it out into a thin layer. Do not apply lubricant to the internal or external face of the lens. Please refer to the MSDS in the appendix before handling. All appropriate Personal Protective Equipment (PPE) shall be worn with eye protection and gloves as a minimum.

11.4.13. Gently push the lens in until the second ring is just above the rim of the pressure housing.

11.4.14. Use the four (4) 10-24 stainless steel retaining screws to tighten the lens down until it is properly seated against the pressure housing.

Table 2 - Troubleshooting the Deep C Meter™

Symptom	Cause	Action
Instrument will not calibrate	One electrode is bad	See section 11.3
	Zinc coupon is passive (more positive than (-)1000 mV)	Remove zinc and clean with file or sandpaper
	Readings still more positive than (-) 1000 mV	Inspect the tip wire for damage.
	Electrodes are dry	Soak for 30 minutes and retry
Both electrodes reading low	Tip wire damaged	Remove probe tail unit, unplug tip wire, remove nose cone, inspect tip wire and repair with ScotchKote® as a temporary measure. Order replacement nose cone.
Readings are not steady and continue to change	Batteries are low	Replace batteries
	Poor structure contact	Re-stab to ensure contact
One reading suddenly goes less negative	Connector is flooded	Check connectors
	Lead wire (flying lead) is nicked	Inspect and repair / replace as necessary
Displays are blank	Not enough light to photocell	Increase light intensity and re-direct to center of lens.
	Batteries are dead	Replace batteries

12.0 Troubleshooting

12.1. General

12.1.1. If the displays are not within ± 5 mV, check these:

• Repeat the bucket calibration (section 7.1). The electrode with the more positive reading is probably in error.
• Remove the reference electrode elements and replace with spares, being careful not to touch the silver/ silver chloride pellet with bare or greasy hands. See section 11.3 for details.

12.1.2. If the tip wire is damaged, a temporary soft-splice repair can be made using ScotchKote® sealant (not included)

and splicing tape. However, prolonged operation in this manner is not recommended. Order a new nose cone assembly as soon as possible.

12.1.3. After any replacement or repair, recalibrate the probe by performing a bucket test as described in section 7.1.

Table 3: List of spare parts

Part no.	Description	Required	Spares
Call	Pressure housing	1	0
Call	Meter mount	1	0
MLT0014	Lens	1	0
GSK0009	Lens O-Ring	2	4
GSK0008	Lens backup ring	1	2
FAS0104	Lens retaining screw	4	1
MFR0016	Lens cover	1	0
UWC0003	Bulkhead male connector	1	0
Call	Bulkhead O-Ring	1	0
UWC0019	Bulkhead dummy plug	1	0
MLT0026	ROV II probe nose cone	1	0
ROV0004	Contact tip	1	3
Call	Main connector	1	0
MLT0045	Replaceable Silver / Silver chloride element	2	1
MLT0010	Voltmeter module	1	0
Call	ROV II probe T-handle mount	1	0
GSK0006	Tube O-Ring lubricant	1	0
EOR0015	Tube connector sealant	1	0
Call	Zinc calibration block	1	0
358-MN02-ENG	Instruction manual	1	0
Call	Storm case	1	0
Call	Storm case O-Ring	1	0
Call	Storm case foam pack	1	0