POLATRAK®

CORROSION TESTING PROBE

EFG™ ELECTRIC FIELD GRADIENT PROBE
OPERATION MANUAL

Checks anodes for activation

Measures electric fields subsea

Compatible with Polatrak's® Deep C Meter™

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1. Overview

1.1 The EFG is an electronic field gradient (EFG) measurement device. It comprises a pair of silver/silver chloride reference electrodes separated by a known distance (13 inches).

1.2 The ideal complement to the industry-leading ROV II™ contact probe, the EFG provides a contactless method of determining anode activity and of measuring electric fields in seawater.

2. Scope

The purpose of this document is to instruct users on how to properly operate the EFG; includes general assembly and the recording and interpretation of potential readings.

3. Equipment requirements

3.1 EFG + flying lead

3.2 Spare reference electrodes

3.3 Isolation handle

3.4 Mounting blocks

3.5 Extended U-bolts

3.6 Zinc test coupon (calibration only)

3.7 Multimeter (calibration only)

3.8 Non-metallic bucket filled with seawater (calibration only)

4. Calibration instructions (See Figure 3)

CAUTION

Always inspect test leads, connectors and whips for cracks or breaks in the insulation before each use. If any defects are found, replace them immediately. Ensure that the test leads do not get wet.

When preparing to use the EFG, do the following:

4.1 Fill a non-metallic bucket or container with enough seawater or simulated seawater solution to fully immerse the EFG. Using a metallic bucket will provide erratic results. The seawater must be grease-free and the bucket should be de-greased and cleaned prior to use.

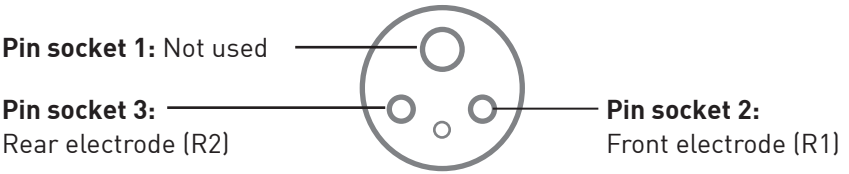
4.2 Insert the EFG into the seawater and agitate it to remove any air bubbles inside the electrode cavities. This ensures that the

reference electrodes are in contact with seawater.

4.3 Allow the EFG to soak for up to one hour to allow the electrodes to fully wet and reach equilibrium (usually not required if the probe has been used recently).

4.4 With the multimeter in its lowest voltage range (typically 200mV), measure the potential between pin 2 and pin 3 (the two small pins) of the EFG's tail connector (see Fig. 1 below).

Figure 1 - SEA CON® RMG-3MP connector pin diagram



4.5 A reading of 0 mV +/- 10 mV is acceptable if the value is stable. If the reading is very large, for instance, 300 mV, then one electrode has failed. Locate the failed electrode by testing against a third, unused electrode and replace it. Smaller values (1-10 mV can be used as an offset.

4.6 Online calibration (EFG-far reading)

4.6.1 To check the calibration of the EFG during subsea operation, move the EFG away from any metallic structures and active electric fields.

4.6.2 The reading should drop to 0 mV (+/- 10mV).

4.6.3 A reading exceeding +/- 10 mV indicates that a significant electric current is passing through the seawater. To test this, orient the EFG II in various orthogonal (right-angle) directions. The field should be higher in one axis.

4.6.4 If the field does not exhibit the above behavior, move

farther away from any nearby structures and try again. If the field does not drop off, or is the same in all directions, it is possible that a reference electrode has failed / is failing or that there is a fault in the ROV. Return to the surface to troubleshoot.

5. Measurement

5.1 Mount the EFG™ above the ROV II™ on the T-Handle assembly using the provided spacer blocks, isolation plate and extended U-bolts. Ensure that the assembly forward of the shock absorber is rigid.

5.2 Connect the EFG™ flying lead to the probe and Deep C Meter™ bulkhead connector.

5.3 The EFG™ reading will be displayed on the third line of the Deep C Meter™ digital readout and transmitted via RS-232 as the third data point in the data stream. Deepwater's "Logger" and "RUSS" software will handle this automatically. Units of the reading are mV, corresponding to potential drop induced by electric current passing by the probe.

5.4 To measure the field gradient at an anode, first record the "EFG far" value by positioning the probe in a space away from the anode identically to how the "online calibration check" is performed. This value will be the baseline indicating the probe measurement where no field (or background field) is detected.

5.5 Next, position the probe as close as possible to the anode. Note that the magnitude reported will vary strongly based on orientation and proximity. The best measurements are obtained by holding the probe perpendicular to the surface of interest, at as short a distance as possible; generally less than a couple inches is ideal.

5.6 Ensure that the probe is oriented the same relative to the structure for all EFG™ readings.

5.7 Record the EFG™ and ROV II™ values at each measurement point using the included software, or enter it by hand.

5.8 It is also possible to record continuous EFG™ readings to facilitate special types of surveys.

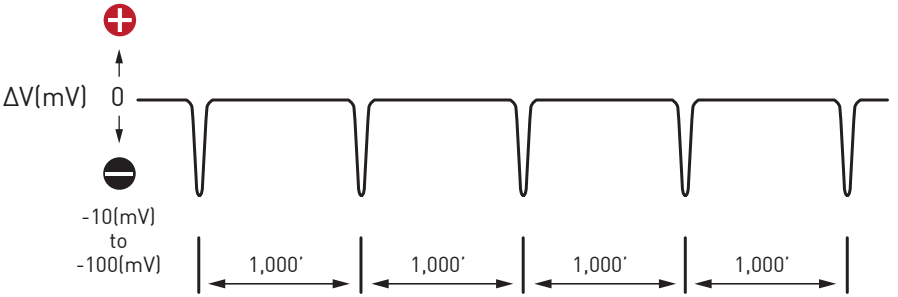
Table 1 - Interpretation of EFG™ data

ΔV	Current*	On a pipeline	On an anode	In space
=0	Negligible	Normal; current density is too low to detect	Anode is disconnected or not activated.	Normal
>0	Current is incoming	Holiday at this location drawing high CP current	Anode is not activated.	High background current, or electrodes bad
<0	Current is leaving	Holiday at this location actively corroding	Activated, functional anode	

*Readings less than 10 mV are not significant

Figure 2 - Activated anodes

On pipelines, the current density detected at an anode should far exceed the current density detected anywhere else on the pipe, including holidays.



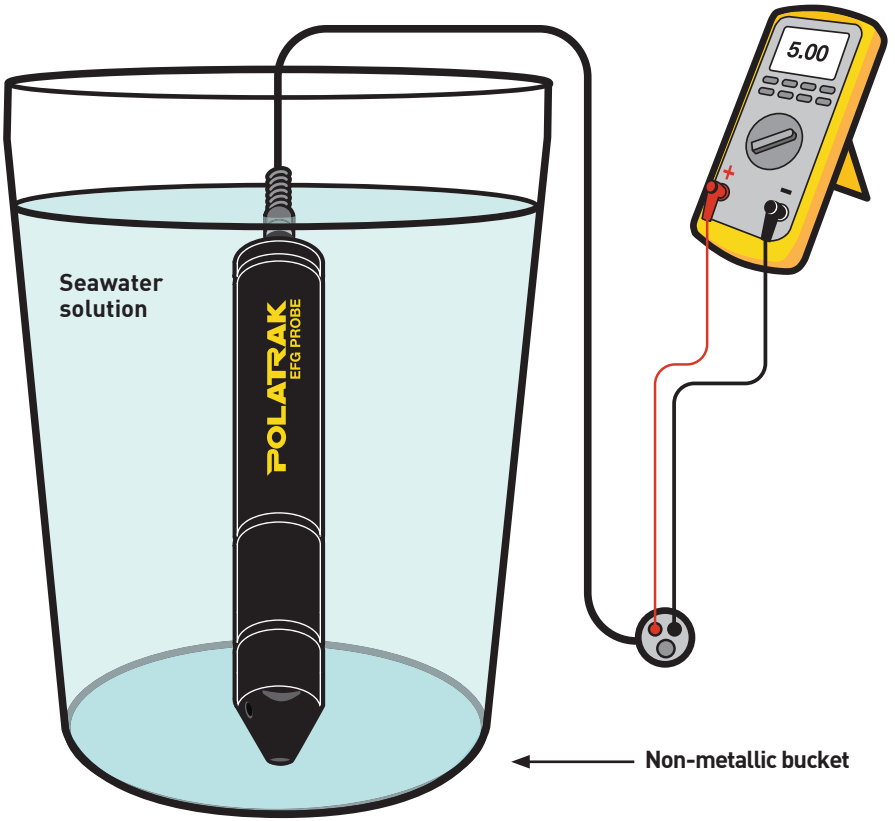
Because of this fact, holidays are not reliably detected, but anodes are easily interrogated. Typical values will range from –10 mV to –100 mV. Any value less than –10 mV should be considered insignificant.

Figure 3

CELL TO CELL CALIBRATION

EFG™ PROBE CALIBRATION WIRING SCHEMATIC

Note:
Leads are interchangeable
when checking cell-to-cell.



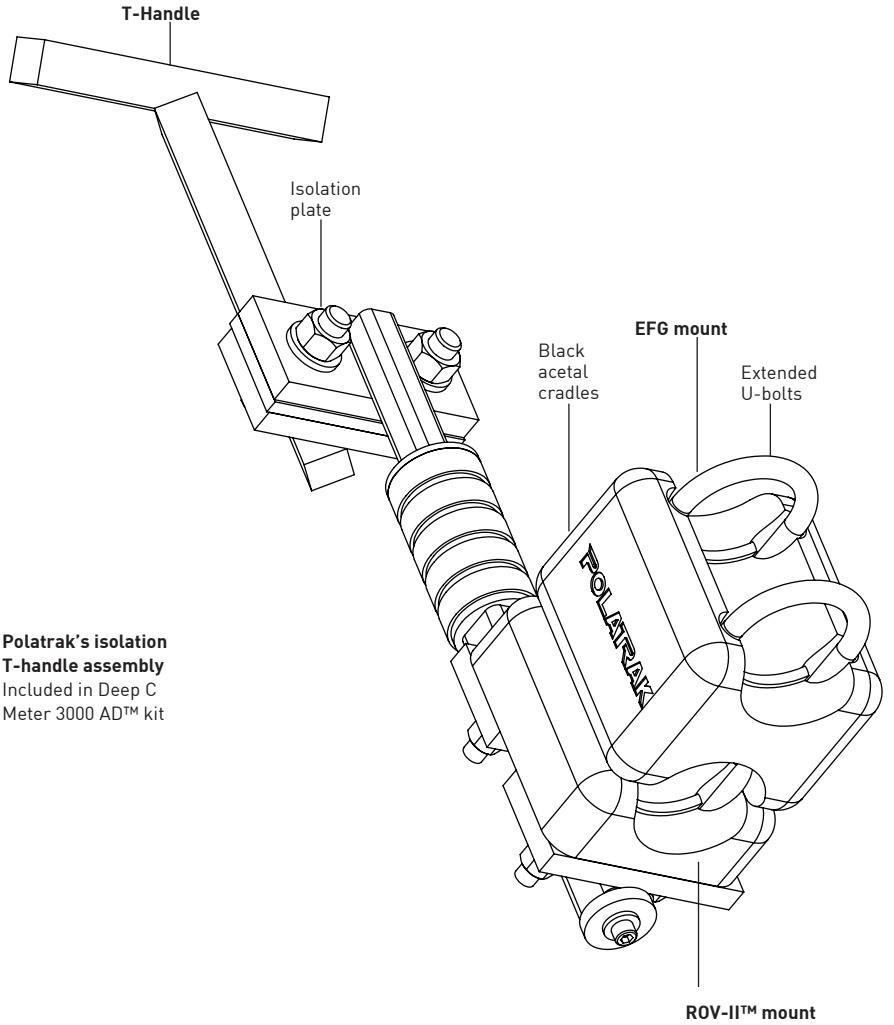
Step	+VE	—VE	DC Scale	Expected result
01	Ref 1	Ref 2	200mV	0 ±10.0 mV max

Note: To avoid damaging the cable, do not invert the EFG when placing it in the bucket.

figure 4

T-HANDLE FOR ROVs

HOLDS ROV-II™ CONTACT PROBE AND EFG™ PROBE



Polatrak's isolation T-handle assembly
Included in Deep C Meter 3000 AD™ kit