

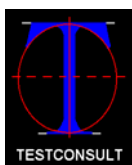
THE SYSTEM

The latest corrosion assessment tool from Testconsult is the **BGCMaP™** system. It has been designed for the Electrical Power Industry and in particular for engineers responsible for the assessment and maintenance of steel transmission towers and poles. However, it is equally at home used on any steel structure such as lighting columns.

The system uses the Linear Polarisation Resistance (LPR) technique to determine the potential for corrosion and the rate of corrosion of steel components buried below ground. It provides a rapid way of assessing the potential life of steelwork, and can help develop effective maintenance schedules.

The equipment and software is purpose designed to provide the following advantages:

- ◆ Fast and easy to use on site
- ◆ One man operation
- ◆ Robust, reliable equipment
- ◆ Accurate location using GPS technology
- ◆ User definable terms in software
- ◆ Transmission line terminology
- ◆ Data export to client database



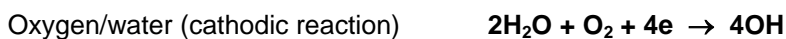
Civil Engineering Instrumentation

THE PRINCIPLE

Corrosion of a steel element embedded in the ground is a chemical reaction, whereby iron, oxygen and water react. The reaction can be characterised by the following formula:



The metallic reaction releases electrons whereas the oxygen/water part of the reaction takes in electrons.



The corrosion current is the total flow of electrons from the steel column to the soil (oxygen and water) and if it were possible to measure this current then calculation of the number of iron molecules converted to rust every year and thus the rate of corrosion would be simple and direct. However, there are many thousands of anodic and supporting cathodic sites at microscopically adjacent points on the metal surface and inserting an ammeter probe in these circuits is not possible.

However, any corroding electrode will have a potential, E_{corr} (normally measured with respect to a Copper/Copper Sulphate half cell). Over a region either side of this potential, the potential/current response of the system is approximately linear, the slope of the line being the Polarisation Resistance. Hence the name of the technique, Linear Polarisation Resistance measurement, LPR.

Polarisation Resistance, $R_p = \frac{\Delta E}{\Delta I} = \frac{B}{I_{\text{corr}}}$

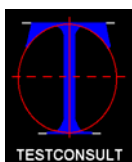
where : $B = \frac{\beta_a \cdot \beta_b}{2.3 (\beta_a + \beta_b)}$ β_a and β_b are cathodic Tafel constants

By assuming certain values, or bands for the Tafel constants, the corrosion current, I_{corr} , can be calculated and thus the corrosion rate. Alternatively, the Polarisation resistance can be used directly as a comparative value.

The corrosion current, in mA/m^2 is converted to corrosion rate in mm/year by multiplying by 0.0012.

The following table gives some typical values.

<u>Corrosion Current</u> <u>mA/m^2</u>	<u>Corrosion Rate</u> <u>mm/year</u>	<u>Classification</u>
<25	<0.03	Excellent
25 – 67	0.03 – 0.08	Very Good
67 – 108	0.08 – 0.13	Good
108 – 166	0.13 – 0.2	Moderate
166 – 208	0.2 – 0.25	Poor
>208	>0.25	Very Poor



HARDWARE SPECIFICATION

The BGCMaP™ system consists of:

- Data collection unit & carry case
- Copper/Copper Sulfate Half Cell
- Connection cables and heavy duty clips
- AC Charging Adapter - 110/240VAC
- DC Charging Cable – 12VDC
- Serial or USB download cable
- User Manual
- BGCMaP™ Analysis software



Data Collection Unit

Splash proof, ABS enclosure, 218mm x 187mm x 55mm. Unit weight 1.4Kg, Black and white LCD screen, transfective for easy daylight viewing. Back light can be used in dim conditions.

The BGCMaP is driven from a simple menu system which prompts the operator for inputs and is powered by re-chargeable batteries which give at least 8 hours continuous use. The asset nomenclature is designed for the power line industry and can be described in terms of Structure, Component, Line, Segment, Circuit and Street. The operator is also able to enter details of the Inspector, Weather and Soil conditions.

The Unit will automatically apply a current to the structure and determine ECorr. The operator can then chose the best fit line to measure Rp.

The connectors are all top quality waterproof stainless design, made by lemo. Each connector has a different keyway to avoid mis-connection. The unit has a wipe clean waterproof keypad with tactile keys and full alpha-numeric functions. Data transfer is by serial port to a PC

GPS Module

The unit contains a **Trimble Lassen SQ GPS module** and integral 3.3VDC embedded antenna. Protocols are TSIP and NMEA 0183, which enables the unit to be interrogated using standard software. The accuracy of the GPS is :

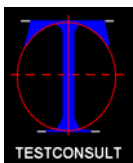
- Horizontal: <6m (50%) <9m(90%)
- Altitude: <11m(50%) <18m(90%)



Half Cell

The Copper/Copper sulfate half cell is supplied is a commercial electrode produced by Tinker & Rasor, and fitted with a porous ceramic plug. It is ready filled with Cu/CuSO₄ crystals. It will need to be filled with distilled water by the operator and it can then be refilled by the operator if required.

The complete kit is supplied in a rugged, orange case constructed of structural resin and fitted with a neoprene "O" ring. These cases are virtually indestructible and fully waterproof.





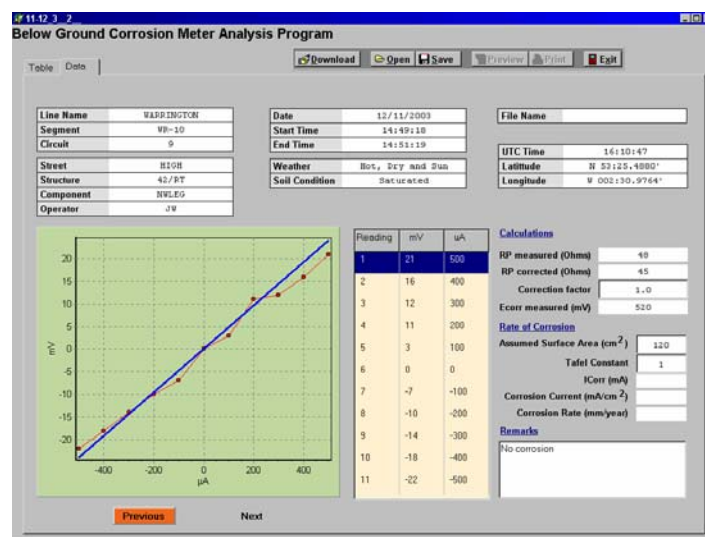
BGCMaP™ SOFTWARE AND REPORTING

The BGCMaP software operates under windows (Windows 98 or Windows XP) and follows all the usual file handling and printing protocols.

Files are downloaded from the site unit, and are automatically entered into a report table. From the table each file can be viewed independently and site data reviewed. The 'best fit' slope can be chosen to determine the Polarisation Resistance (Rp).

The software incorporates a module to enable the user to produce a pre-definable list of components, component areas and corrections factors. The user can also assign correction factors to various soil conditions and soil pH. These can be used to correct the overall Rp value if required. If Tafel constants are applied to the result, the software will automatically determine ICorr (corrosion current) and hence Corrosion Rate in mm/year. A useful tool for assessing remaining component life.

Structure	Component	Line	Soil Condition	Soil pH	Air Temp	Measured RP Ohms	Corrected RP Ohms	Ecorr mV	Icorr mA	Icorr mA/cm2	Cor Rate mm/year
OVS	PMG	1123	Moist			43		521			
3	2	9	Saturated			48		520			
3	2	9	Saturated			48		520			
565	296	24	Saturated			45		519			
565	296	24	Saturated			45		519			
565	296	24	Saturated			45		519			
DDD	PMG	1123	Moist			42		521			
DDD	PMG	1123	Moist			42		521			
DDD	PMG	1123	Moist			42		521			
LLL	MPY	1123	Moist			45		521			
LLL	MPY	1123	Moist			45		521			
LLL	MPY	1123	Moist			45		521			
OVS	PMG	1123	Moist			43		521			
3	2	9	Saturated			48		520			



The user can output all of the data in ASCII format if required. This will enable data to be interfaced with other client databases.

Reporting

Any changes made are automatically entered into the table of results. The BGCMaP then puts the results in a printable format for hard copy. The operator is able to select the number of traces viewed per page. For speed and convenience, results can also be stored and sent in electronic format to your clients, who can be then be supplied with a read only version of the BGCMaP software.

Sales Support

Testconsult offers sales support and technical assistance anywhere in the world. We can provide full training for your testing personnel in the field and advise on both the correct use of the equipment and interpretation of the results. We can also assist with independent interpretation of results obtained. Please visit our website to determine your nearest agent.

