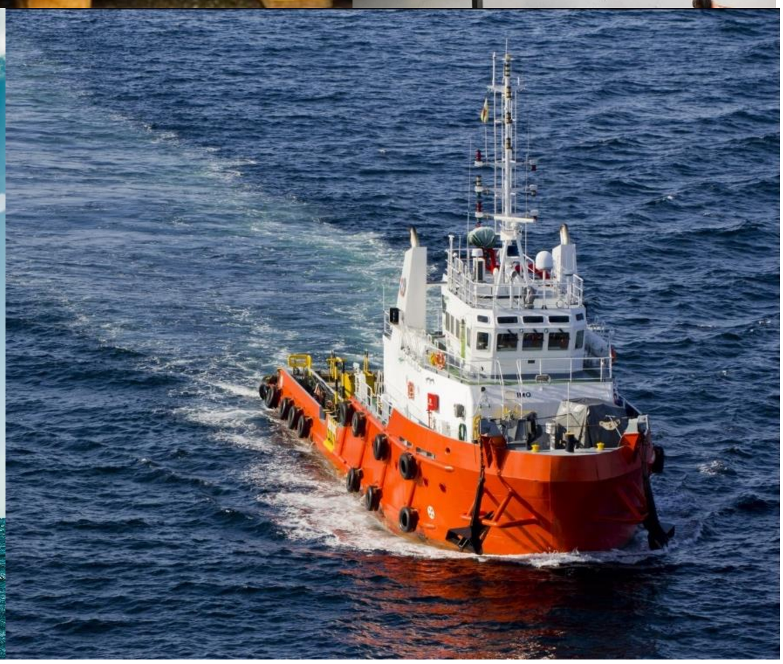
IMPRESSED CURRENT SYSTEM
(AUTO HULL SYSTEM)



AMPAK Cathodic Protection
Handelstraat 8, 4143 HT Leerdam, The Netherlands
Tel: +31345633355 – Fax: +31345633344
www.ampak.nl – info@ampak.nl

Handelstraat 8, 4143 HT Leerdam - NL
Postbus 71, 4140 AB Leerdam - NL
Internet: www.ampak.nl
E-mail: info@ampak.nl
Telefoon: +31 (0) 345 633355
Fax: +31 (0) 345 633344

1: INTRODUCTION TO CATHODIC PROTECTION

Metallic corrosion is an electro-chemical reaction in which a metal combines with a non-metal, such as oxygen to form a metal oxide or other compound. This depends upon the nature of the environment.

Different metals have different tendencies to corrode, termed ***activity*** or ***potential***. These potentials can be tabulated and form the electro-chemical series.

A more practical approach is the determination of the tendency of certain metals to corrode in certain electrolytes, like seawater. This is termed the ***galvanic series*** of which the following is an example:

If two metals are placed in an electrolyte like sea-water or damp soil and are in direct electrical contact a current will pass through the electrolyte from the more active metal to the least active metal. The least active metal does not corrode and is termed the ***cathode***. The more active metal, the ***anode***, passes into the solution and the flow of electrical current increases. This is a metal ion and electron transfer process - it ***corrodes***.

A typical simple cell as described is shown in Figure AA below:

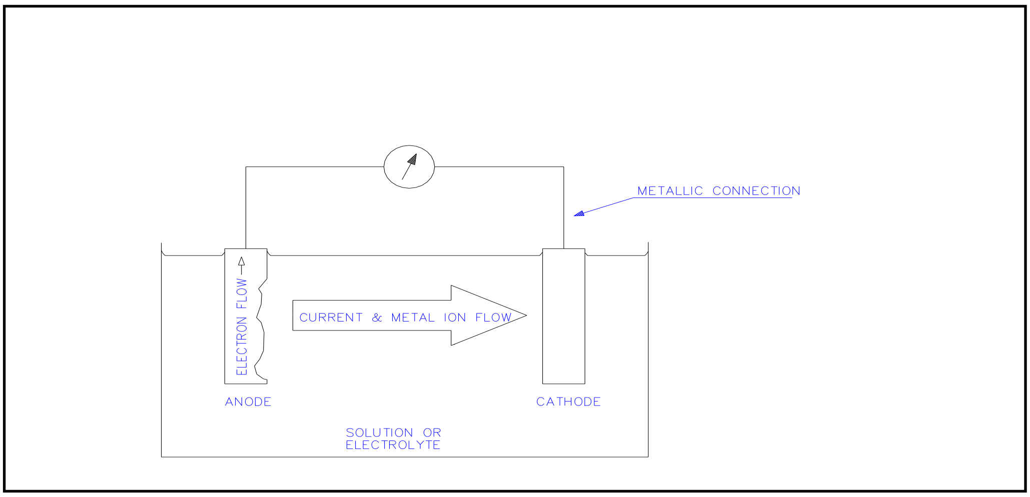


Figure AA - Simple Corrosion Cell

Handelstraat 8, 4143 HT Leerdam - NL
Postbus 71, 4140 AB Leerdam - NL
Internet: www.ampak.nl
E-mail: info@ampak.nl
Telefoon: +31 (0) 345 633355
Fax: +31 (0) 345 633344

The Anodic and Cathodic areas in a corrosion cell may be due to electrical contact of two dissimilar metals, termed ***galvanic corrosion*.** Large currents can occur at small anodic areas and lead to rapid corrosion. This can effect marine structures such as ships internal tanks and external hull plates, sheet steel piling in harbours and tubular structures common in jetties and drilling or production platforms.

Ampak Cathodic Protection is a system of preventing corrosion by forcing all surfaces of a structure to be cathodes by providing external anodes.

The galvanic corrosion current available from an anode to electrolyte, structure combination should be sufficient to overcome the local surface corrosion currents on the structure until no current flows from anodic areas of the structure. Hence the structure is ***entirely cathodic*** or under ***cathodic protection***.

The potential, or measure of activity, between a structure and an electrolyte when measured gives an indication of whether the structure is anodic or cathodic. For steel under normal non anaerobic conditions it can be shown that a steel to electrolyte potential more negative than 0.85 volts measured against a copper/copper sulphate electrode indicates that cathodic protection is achieved. This is equivalent to negative 0.80 volts measured against a silver/silver chloride electrode and positive 0.24 volts against a zinc electrode.

These values are further explained by Figure BB below:

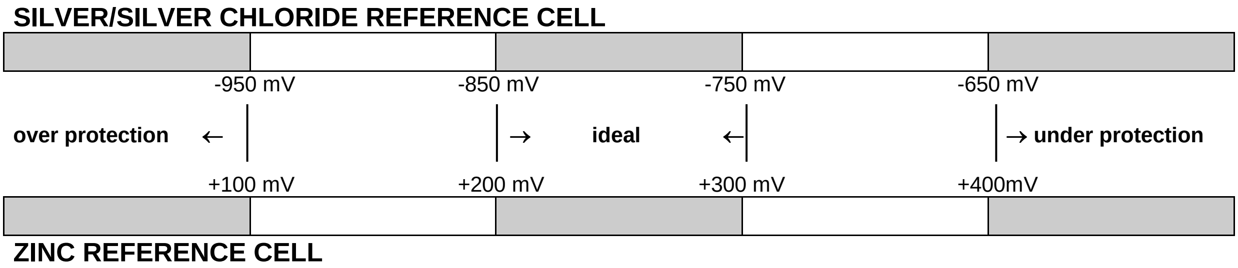


Figure BB - Comparison of Reference Electrodes

Handelstraat 8, 4143 HT Leerdam - NL
Postbus 71, 4140 AB Leerdam - NL
Internet: www.ampak.nl
E-mail: info@ampak.nl
Telefoon: +31 (0) 345 633355
Fax: +31 (0) 345 633344

2: DESCRIPTION OF IMPRESSED CURRENT SYSTEM

As previously explained a metal can be made cathodic by electrically connecting it to a more anodic material within the electrolyte. The most commonly used anodic metals are alloys of aluminium, zinc and magnesium. Anodes of these metals corrode preferentially to the structure to which they are connected. The anodes deteriorate as an essential part of their function and are therefore termed as being ***sacrificial anodes***.

Another method of making a metal cathodic is by electrically connecting it to another metallic component in the same electrolyte through a source of direct current, directing the current flow to occur off the surface of the added metallic component, ***the anode***, into the electrolyte and onto the metal, ***the cathode***.

This can easily be visualised by the extended simple cell as shown by Figure CC below:

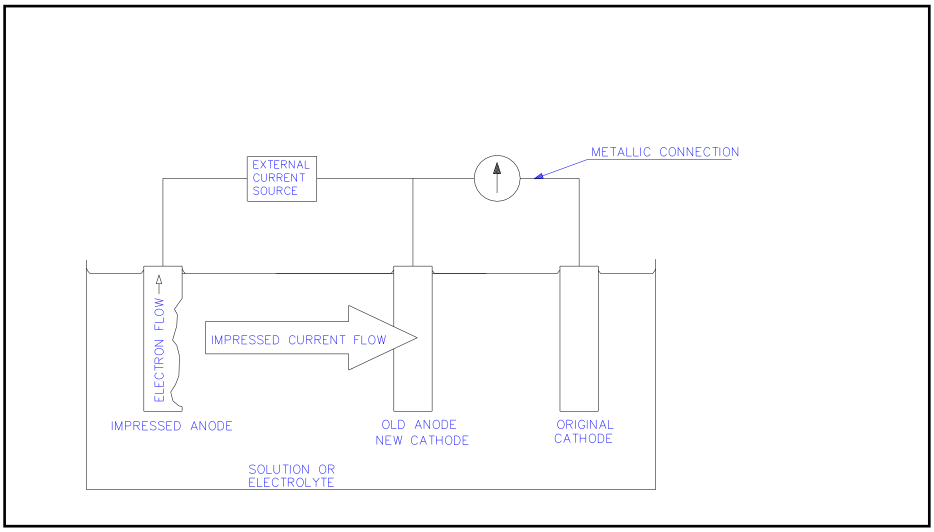


Figure CC - Cathodic Protection Applied to Corrosion Cell

As an internal current source is employed, this type of protection is termed ***IMPRESSED CURRENT CATHODIC PROTECTION*** or ***ICCP***.

This type of system requires a direct source of current usually obtained from mains powered units that contain a transformer rectifier.

Handelstraat 8, 4143 HT Leerdam - NL
Postbus 71, 4140 AB Leerdam - NL
Internet: www.ampak.nl
E-mail: info@ampak.nl
Telefoon: +31 (0) 345 633355
Fax: +31 (0) 345 633344

The impressed current anode material is ideally non-consumed by the passage of current from it into the electrolyte. In practice the materials used are a compromise between this ideal and the cost of available materials. Impressed current anodes are traditionally made from graphite, silicon iron, lead alloys, mixed metal oxide coated or platinised titanium and platinised niobium. The selection of the correct anode material is critical in the formulation of an effective and economic cathodic protection scheme.

MARINE IMPRESSED CURRENT SYSTEM:

The AMPAK Cathodic Protection ***Auto Hull*** System comprises equipment as described below.
A diagram for a typical impressed current system layout is shown by Figure.

A) **Impressed Current Anodes:**

The function of the anode is to conduct DC protective current into the seawater. ***Auto Hull*** anodes have been designed to perform this function whilst maintaining a low electrical resistance contact with the seawater. Surface linear type anodes are available with 50 to 200 Ampere ratings while recessed type anodes are available with up to 75 Ampere ratings.

All ***Auto Hull*** anodes are constructed from specialist coated titanium anode elements encapsulated in a tough, flexible, chlorine resistant plastic resin insulating carrier. They are designed to run from 12 or 24 volt systems and are less than half the size and a quarter of the weight of conventional lead silver anodes. Typical lifetimes for these anodes are in excess of 10 years.

B) **Impressed Current Reference Electrodes:**

The high purity ***Auto Hull*** Zinc reference electrodes are designed to give a stable reference against which the hull to sea potentials can be measured. The construction of the cells is similar to the anodes. A typical reference cell should be able to last up to 15 years without maintenance or replacement.

Handelstraat 8, 4143 HT Leerdam - NL
Postbus 71, 4140 AB Leerdam - NL
Internet: www.ampak.nl
E-mail: info@ampak.nl
Telefoon: +31 (0) 345 633355
Fax: +31 (0) 345 633344

The minimum number of reference cells used per power supply is one although usually two are used. Ideally a cell should be located at least 7.5 metres away from the nearest anode. In the case of a stern only installation with the anodes over 150 metres from the bows a third electrode is sometimes located in the bow area.

C) **Impressed Current Power Supply Unit:**
The ***Auto Hull*** impressed current cathodic protection power supply unit is a thyristor based unit with a state of the art control system. The units are compact and can be run from 415V 50Hz or 60Hz single or three phase supplies.

The controller is available with Analogue or Digital indicators for showing hull potentials and output readings and all other controls are easily accessed. The unit can be put into manual or automatic control at the flick of a switch.

D) **Impressed Current Bonding:**
To enable the rudder to receive impressed current protection a dedicated electrical bond in the form of flexible cable is provided. The cable is typically fixed from the rudderstock to the main ships structure. In the same way, any stabilisers may be bonded also.

To allow protection of the bare propeller and exposed shafting and to prevent spark erosion in the shaft bearings, the propeller shaft is fitted with a slip-ring assembly.

The Auto Hull Slip-Ring assembly comprises of a high content silver alloy band fixed in place with stainless steel clips and a set of high content silver graphite brushes with a holder. The brushes complete a low resistant path from the ring assembled on the shaft to earth, allowing current flow from the propeller.