

LPR (LINEAR POLARISATION RESISTANCE) General Guide and AC Series Probe Information

The LPR technique allows the calculation of corrosion rate between anodic and cathodic half-cells where the connecting medium (the solution) is conductive. Measurements are made by applying a small voltage, usually between 10 and 30 millivolts, to a corroding metal electrode and measuring the resulting current flow. The ratio of voltage to current - the polarisation resistance - is inversely proportional to the corrosion rate.

APPLICATION

LPR monitoring provides an instantaneous measure of corrosion and is often used as a method for optimising corrosion inhibitor treatments. The technique is restricted to conductive solutions and the best results are obtained in highly conductive media. Data can be presented as an instantaneous corrosion rate in mils or millimetres per year.

LPR is most commonly used when fluctuating corrosion rates may be expected over relatively short intervals and where a method that averages rates over a longer period may not be sufficiently informative. For example: cooling water systems, chemical inhibition systems, wastewater treatment, oilfield water floods and chemical cleaning.

The method is not suitable for oily water or hydrocarbon applications and is subject to loss of circuit in scaling or filming environments. These can cause erroneous low corrosion rate indications. Some electrochemical expertise may be necessary to obtain best performance.

METHOD

LPR probes are configured in either 2 or 3 electrode styles. In the 2 electrode system a small polarising voltage is applied across the electrodes and the resulting current flow measured. The current flow is governed by the resistances of the two electrode/electrolyte interfaces and also by the



A flush 3 electrode LPR probe in AC mounting style.

resistance of the intervening solution. In the 2 electrode system no account is taken of solution resistance, which may or may not be of consequence.

The 3 electrode system attempts to minimise the effect of solution resistance by introducing a reference electrode adjacent to the test electrode in order to monitor potential in the solution with a view to reducing the relative contribution of the solution resistance to the series resistance path. Even so, 3 electrode systems may still contain a residual resistance that results in a lower than actual corrosion rate reading. The 3 electrode system is recommended where high corrosion rates are expected in low conductivity solutions.

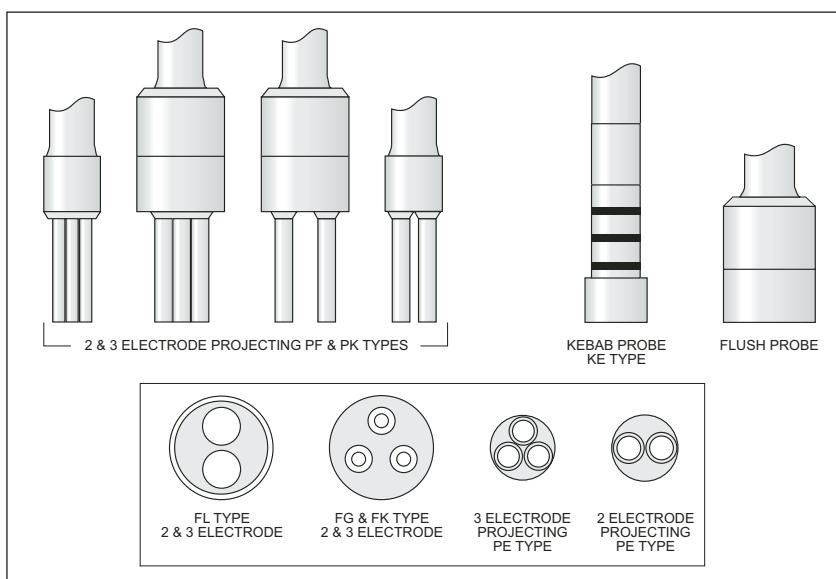
TYPICAL RESISTIVITY VALUES		
Medium	Resistivity	Conductivity
Oils/non polar organics	100 Meg ohm/cm	.01 micromho/cm
Pure distilled water	10 Meg ohm/cm	0.1 micromho/cm
Good distilled water	1 Meg ohm/cm	1.0 micromho/cm
Rain water	100k ohm/cm	10 micromho/cm
Good drinking water	10k ohm/cm	100 micromho/cm
Range if industrial cooling water	1k -100 ohm/cm	1k - 10k micromho/cm
Sea water	10 ohm/cm	10k micromho/cm

PPR SERIES PROBES

Cormon manufacture a range of specialised probes for LPR monitoring in either flush or projecting electrode form with either 2 or 3 electrodes. These are collectively known as the PPR series.

Flush electrodes are either set in epoxy resin or glass according to service. The ability of glass sealing to withstand difficult process conditions is offset by a reduction in electrode surface area.

Projecting electrode probes have threaded studs for the mounting of replaceable electrodes. Cormon standard stud is M3 (3mm), though 440 UNC is supplied on the reduced area 'R' types. Studs are usually glass sealed. Mechanically sealed studs using PTFE and Peek materials are available for extreme service applications. Projecting and flush electrodes are available in a wide range of materials.



Probe mounting styles vary considerably according to the type of application. The Cormon series code is linked to the mounting method; for example, the AC series is the 2" high-pressure access system style. The series code is used in the Product Code string after the PPR designation, as in "PPR AC"

SERIES	DESCRIPTION
AC	Body mounting suitable for 2" high pressure access fittings
RC	Retractable style 5/8" body for use with packing gland
FN & FB	Fixed length threaded bodies, NPT or BSP male threads
AN & AB	Adjustable length thread mounted bodies using swaged fittings NPT or BSP
LO	Laboratory style plain cylinder bodies
FL	Flange mounted probes

PROBE CONSTRUCTION

The pressure integrity and fitness for purpose of probes is a priority. Standard probe bodies are made from 316ss material and have glass sealed connectors with gold plated pins. Materials are all NACE MR-01-75 and EN10204 3.1b certified. Sealing of the probe electrodes

must be compatible with the process composition, pressure and temperature and Cormon cannot accept responsibility for probe problems arising from any incompatibility. Cormon sales can advise in this area. The sealing method is stated in the product code tables, for example, FG is a flush glass sealed probe.

Although there are some exceptions, epoxy resin probes are limited to 150°C (200°C to order) while glass variants are suitable for 260°C. Higher temperature applications usually require a mechanical construction. If in doubt, contact Cormon sales for assistance. It is important to give as much process information as possible when seeking assistance with probe selection.

ADJUSTABLE FLUSH PROBES

AC series Flush probes with a variable length are useful for obtaining an exact match with pipe wall thickness or as a spare part to cover several different locations. For 5.25" access fittings two standard lengths cover all possible pipe sizes and schedules from 3" to 20". Refer to table below to select 060 or 077 length. For longer probes use the 'Flush' calculation method and order as the shortest length allowing a maximum of 35mm extension.

NOMINAL PIPE SIZE	060 (SHORT) AF	077 (LONG) AF
3" & 4"	All Schedules	
6"	Schedule 5s to 160	Schedule XXS
8"	Schedule 5s to 120	Schedule 140 up
10"	Schedule 5s to 100	Schedule 120 up
12"	Schedule 5s to 80	Schedule 100 up
14"	Schedule 5s to 80	Schedule 100 up
16"	Schedule 5s to XS	Schedule 80 up
18"	Schedule 5s to XS	Schedule 80 up
20"	Schedule 5s to 40 + Sched. XS	Schedule 60 & 80 up

AC SERIES LENGTH CALCULATIONS

MOUNTING \hat{O}	PROBE STYLE O	FLUSH LPR	PROJECTING LPR & GALVANIC
Standard 5.25" access fitting		$W + 61$	$W + P = 61$
Flanged access fitting		$S + W - 73$	$S + W + P - 73$
P = Projection of device into pipe measured from pipe ID to tip of probe.		W = Wall thickness of pipe in mm	S = Total stand off from pipe OD to top of access fitting
NOTE: Add 25.4 mm for each inch increase in height of access fitting. Example: add 50.8 mm for a 7.25" fitting instead of a 5.25"			

PROBE WIRING

All flush and 'S' type projecting PPR series probes are wired as follows:

2 Electrode: Pins ABCD to Aux.

EF to Test

3 Electrode: Pins AB to Aux.

CD to Ref. EF to Test

All 'R' type probes are wired

2 Electrode: Pins AC to Aux. DF to Test

3 Electrode: Pins AC to Aux. E to Ref.

DF to Test

Instrument & Model No.		Standard area		Reduced area	
		Flush	Proj.	Flush	Proj.
Portable	IPR 2000	1470	147	2310	231
Data logger	DCUFMU	1.470	0.147	2.310	0.231
Recommended conversion factors for Cormon instruments and probes in industrial cooling water					

Crossover cables to other wiring configurations are available. All connectors are Mil. Spec C5015 with glass sealed gold plated pins, shroud and locator pin. An extension adapter is necessary to connect with AC series probes. Part number GEA PL 092 for portable and GEA SW 206 for permanent instrumentation.

PRODUCT CODE GUIDE

PPR					
LPR PROBE	MOUNTING	LENGTH	ELECTRODE TYPE	ELECTRODE SIZE	ELECTRODE MATERIAL
<i>To create a product code, select required option under each heading and write into boxes at top of chart</i>	Probes for 2" high pressure access system	Enter 3 digit length in millimetres <i>See data sheet for calculation method</i>	FL Flush epoxy seal FK Flush mechanical seal FG Flush glass seal AF Adjustable flush epoxy AG Adjustable flush glass	S2 2 standard electrodes S3 3 standard electrodes	A06 - Carbon steel 000 - projecting type without electrodes <i>For other options see materials list</i>
			PE Projecting glass sealed studs ø32mm PK Projecting mechanical seal studs <i>All AC series probes are 32mm diameter</i> PF Projecting glass sealed studs ø19mm	S2 2 standard electrodes S3 3 standard electrodes (M3) R2 2 reduced area electrodes R3 3 reduced area electrodes (440 UNC)	
Pressure ratings: 3600 psi standard. 6000 psi for glass sealed units if service pressure advised with order Temperature ratings: Epoxy 150°C (200°C to order), Glass 260°C For RC series product codes see CMEP021. For flange mounted probes contact Cormon sales. For all other LPR probe product codes see CMEP017					

SPARE ELECTRODES

GMA	L				
General Mechanical Accessory	Electrode set for LPR probe	S2 Standard 2 projecting electrodes with O rings S3 Standard 3 projecting electrodes with O rings R2 Reduced area style 2 electrodes R3 Reduced area style 3 electrodes	A06 Standard carbon steel <i>For other options see materials list</i>		